REPUBLIC OF TURKEY
PRIME MINISTRY

SOUTHEASTERN ANATOLIA PROJECT
REGIONAL DEVELOPMENT ADMINISTRATION

MANAGEMENT, OPERATION AND MAINTENANCE OF GAP IRRIGATION SYSTEMS

IDENTIFICATION REPORT

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APPENDICES

ABBREVIATIONS AND UNITS

1 Abbreviations

English	Turkish	Description
ACC	TKK	Agricultural Credit Cooperatives
AGM		Annual General Meeting
AMC		Agricultural Marketing Cooperatives
AEARP	TYUAP	Agricultural Extension and Applied Research Project
BOD		Biological Oxygen Demand
	DSİ	State Hydraulic Works General Directorate
CA		Chambers of Agriculture
CAC		Conventional Agricultural Credit
COD		
DA	DS	Demonstration Area
EC		Electro-Conductivity
EOAGM		Extra-Ordinary General Meeting
ERR	EGDH	Economic Rate of Return
FAO		Food and Agricultural Organisation of the United Nations
FRR	MGDH	Financial Rate of Return
	GAP	Southeastern Anatolia Project
GAPCACID		GAP Coordination & Advisory Council for Irrigation Development
GAP RDA		GAP Regional Development Administration
CAT		Cation Exchange Capacities
GD		General Directorate
GDPD	TÜGEM	General Directorate of Production and Development
GDARef	TRGM	General Directorate of Agricultural Reform
GDARes	TAGM	General Directorate of Agricultural Research
GDP	GSYİÜ	Gross Domestic Product
GDOS	TEDGEM	General Directorate of Organisation and Support
GDRS	KHGM	General Directorate of Rural Services
GFA	GOD	Group Formation Adviser
GFC	GOK	Group Formation Coordinator
GFO	GOÖ	Group Formation Organiser
GIS		Geographical Information System
GNP	GSMH	Gross National Product
GOT	TCH	Government of Turkey
	İBAV	Bi-monthly Training Meetings for SMS
IA		Irrigation Authority
IBRD	DB	International Bank for Reconstruction and Development (World Bank)
IC	SK	Irrigation Cooperative
ICID		International Commission on Irrigation and Drainage
ID	SB	Irrigation District
IFAD		International Fund for Agricultural Development
IG	SG	Irrigation Group (DSİ)
IIS		Institute for Irrigation Studies
ILRI		International Institute for Land Reclamation and

		Improvement
IMS		Impact Monitoring System
IRR		Internal Rate of Return
ISOB		Irrigation System Operating Body
KAP		Knowledge, Attitude and Practice
LIC		Large Irrigation Company
M&E		Monitoring and Evaluation
MARA	TKİB	Ministry of Agriculture and Rural Affairs
MIS		Management Information System
MOE		Ministry of the Environment
MOH		Ministry of Health
MOF	OB	Ministry of Forestry
MOFC	MGB	Ministry of Finance and Customs
MOM		Management, Operation and Maintenance
MOM JV		MOM Joint Venture
NSR		Night Storage Reservoirs
NWC		National Water Commission (Mexico)
O&M	İ&B	Operation and Maintenance
OFWM		On-Farm Water Management
OFWME		On-Farm Water Management Engineer
ORMVA		Offices de Mise en Valeur Agricole (Morocco)
PA	PA	Pilot Area
PDA	TİM	Provincial Directorate of Agriculture
PDRS	KHİM	Provincial Directorate of Rural Services
PDWG		Planning and Design Working Group
	PTT	Post & Telecommunications Department
RWC		Rural Water Corporation (fomerly Rural Water Commission0
SLA		Service Level Agreements
SCMC	YDYD	Secondary Canal Management Committee
SCP		Supervised Credit Programme
SIS		State Institute of Statistics
SMS	KUZ	Subject Matter Specialist
SPC		Small Private Company
SRWSC		State Rivers & Water Supply Commission (Aust)
TAWS		Terms of Agreement for Water Supply
T&V		Training and Visit System
	TCDD	State Railway System
TDP		Technical Discussion Papers
	TCZB	Agricultural Bank of Turkey
	TİGEM	General Directorate of Agricultural Enterprises
	TKV	Turkish Development Foundation
TL	TL	Turkish Lira
	TMO	Soil Products Office
	TOPRAKSU	Soil & Water Department (formerly)
TV	TV	Television
	TZDK	Agricultural Supply Association
	TZOB	The Union of Turkish Chambers of Agriculture
UNDP		United Nations Development Programme
USD		United States Dollar
VGT	KGT	Village Group Technician
WF	SD	Water Foreman

WUA	SKB	Water Users Association
WUG	SKT	Water User(s) Group
	YAYÇEP	Expanded Adult Farmer Education Programme

2 Units

(a) Length

mm	millimetre
cm	centimetre
m	metre
km	kilometre

(b) Area

km^2	square kilometre
ha	hectare
da	decare (0.1 ha)
m^2	square metre

(c) Volume

l	litre
m^3	cubic metre
$mx10^6$	million cubic metres
10^6m^3	million cubic metres
l/s	litres per second
m^3/s	cubic metres per second
m^3/sec	cubic metres per second
m^3/ha	cubic metres per hectare
l/s/ha	litres per second per hectare

(d) Weight

mg	milligram
gm	gram
kg	kilogram
t	tonne

(e) Time

s	second
h	hour
yr	year

(f) Velocity

m/day	metres/day
mm/day	millimetres per day
cm/hr	centimetres per hour
m/s	metres per second
m/sec	metres per second

(g) Money

TL	Turkish Lira
US$	United States Dollar

(h) Energy

kWh	kilowatt hour
kW	kilowatt
MW	megawatt
hp	horsepower

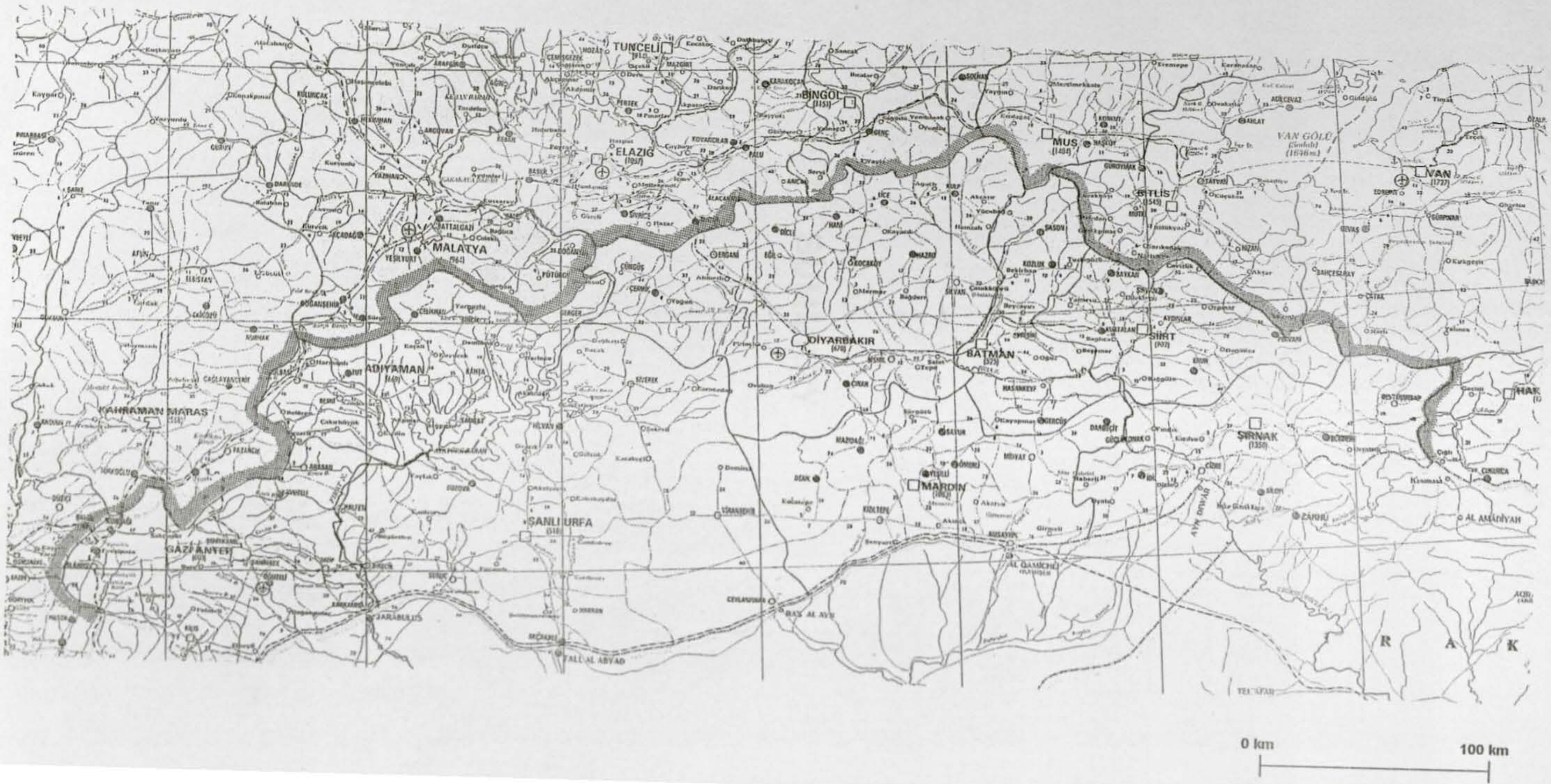
(i) Salinity

ds/m	deciSiemens per metre
mmhos/cm	millimhos per centimetre
meq/100gm	milli equivalents per 100 grams
mg/l	milligrams per litre
gm/m^3	grams per cubic metre
SAR	sodium absorption ratio

(j) Other

%	percent
^{o}	degree
^{0}C	degrees Centigrade/Celsius
m	million
b	billion
fish/ha	fish per hectare
pH	acidity/alkalinity
fish/ha	fish per hectar

GAP REGION



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SUMMARY

GAP MOM STUDY

IDENTIFICATION REPORT

SUMMARY

1 INTRODUCTION

Turkey is richly endowed with land and water resources and is a major agriculture producer with a consistent surplus in the agricultural trading sector. The climate of Turkey is extremely varied and the significant differences in agro-ecological zonation permit a wide variety of crops to be grown. Since 1980 imports of new seed varieties and emphasis on the use of agricultural inputs have led to significant increases in crop yields.

The agricultural sector is also a major provider of employment and in view of its importance to the national economy the Government has encouraged the development of irrigation projects throughout the country. A major component of the Southeastern Anatolia Project (GAP) will be the implementation of a series of large scale projects commanding some 1.7m hectares for irrigation. The development is the final stage of exploiting the water resource potential of the Euphrates and Tigris basins for both irrigation and hydro power generation.

The total GAP project is a multi-sectoral regional development plan for one of the less developed parts of Turkey embracing the sectors of agriculture, industry, transport, health and education.

2 THE GAP MOM STUDY

The GAP MOM study is concerned specifically with the development of management systems for the irrigated agriculture that will result from the GAP projects. During recent years great progress has been made under the guidance of DSİ with the planning, design and construction of major infrastructure works, such as Atatürk dam and the Şanlıurfa tunnels, as well as irrigation distribution works. Since this water is scheduled to become available in 1994, there is an urgent need to identify the most suitable management, operation and maintenance arrangements to ensure that the total resources invested in irrigation development are utilised optimally so as to:

(a) realise the full agricultural production potential of the GAP region;

(b) contribute effectively to the overall development of the region principally in terms of increased economic activity, population settlement and employment creation.

The achievement of these overall objectives is the focus of the GAP MOM study.

The Terms of Reference require the study to be undertaken in a structured sequence and programme in the following three phases:

(a) Phase 1 covers the Identification of the most appropriate model for the development of irrigated agriculture embracing all necessary technical, socio-economic, environmental, institutional, legal, organisational and management considerations.

(b) Phase 2 covers the Implementation phase of the model in a representative number of pilot areas, over a minimum period of two years, by the establishment of all necessary organisation and management units and operation and maintenance services.

(c) Phase 3 covers Monitoring and Evaluation of the organisation and management systems established in the pilot areas to determine factors contributing to success and failure, and any underlying constraints, and then to review, revise and improve the model for implementation in other areas.

This report deals with the Phase 1 studies. There is a considerable degree of interrelation between all tasks and activities and the aspects considered during model formulation include:

- Water distribution organisation and management procedures
- Institutional and organisational arrangements
- Regulatory and judicial considerations
- Sociological considerations
- Technical considerations including the assessment of water resources availability, operation of large conveyance canals and distribution systems water application methods, crop patterns and suitability, soils and topography, drainage requirements,
- Financial considerations in relation to farmers' budgets
- Economic considerations at national and regional levels.
- Environmental considerations

The core of the study is development of the MOM model and the study programme was structured so that the detailed results of these studies are taken into account in evaluating all potential models.

3 STUDY PROGRAMME

The study commenced in April 1993 and has been undertaken by an integrated team of 15 Turkish and 17 foreign consultants. The study programme has included review of existing reports and documents, meetings and discussions with government agency staff, farmers, and other organisations. Site visits have been made in the region and to view existing irrigation management arrangements in various schemes in western Turkey. Consideration of irrigation management in other countries included a study tour of the Andalusia region of Spain. A socio-economic study of the region was undertaken, including a survey of farmers in areas already irrigated or about to be irrigated, in order to ascertain perceptions and attitudes to irrigation.

The results of the studies by various specialists have been presented in a series of 22 technical discussion papers and other reports which have identified the most significant issues to be addressed in selecting the most appropriate irrigation management to suit the GAP region. These technical discussion papers are presented in accompanying volumes to this report. The consultant team has also assembled a large library of technical reference books, reports and plans together with databases of statistics and other information.

The initial findings of the study and the outline of methodology for evaluating and selecting the MOM model were presented at a Workshop conducted in Şanlıurfa in December 1993. The Workshop was attended by 86 participants from government agencies, academic institutions and other interested organisations throughout Turkey. The participants provided valuable comments on the model evaluation process which have been taken into account in compiling this report.

4 EXISTING IRRIGATED AGRICULTURE IN TURKEY

Turkey has developed its present base of irrigated agriculture very rapidly over the past 40 years and in so doing has established a valuable source of technical expertise which is applied in such large developments as GAP. In developing the GAP MOM model it is prudent to draw upon past experience by taking account of aspects which have contributed to both high and low standards of performance.

The strengths of Turkey's irrigation management include: the technical competence of DSİ in constructing and operating large dams; the experience of GDRS for smaller works; the well established and capable agricultural research institutions operated by GDRS, MARA and the universities; an established structure of farmer training and extension services within MARA which could form the basis for training in the GAP region. There are also examples of successful water user groups which are more effective than government agencies in carrying out equitable water sharing to farmers and achieving compliance with operating rules.

On the other hand some weaknesses of present arrangements include: lack of co-ordination between agencies in regard to project planning and budgeting; limited extension services available in many irrigation schemes; weaknesses in the farmer/extension/research linkage; ineffective water fee collection in DSİ projects; the crop method of water charging which encourages high water use; unsuitable irrigation methods and low water use efficiency in many schemes. DSİ also has difficulties in delivering irrigation services to farmers at the tertiary level and enforcing legal means to prevent damage to canals. There is also a need to modernise the present laws relating to surface water allocation and use and to make specific provision in the water laws for the establishment of effective water user groups.

5 IDENTIFICATION OF THE MOM MODEL

The approach which has been adopted to identify and evaluate the suitability of potential MOM management models is structured and objective and consists of the following main steps:

Step 1 Define what is meant by a MOM model and prepare a statement of the Major Objectives and the Major Criteria by which any model must be evaluated in relation to the Major Objectives.

Step 2 Identify the potential management sub-models, assess the strengths and weaknesses of each, determine the widest possible range of combinations to form a set of potential management models and define the linkages between the sub-models in terms of functions, responsibilities, lines of communication and co-ordination.

Step 3 Identify key issues, develop a comprehensive set of Key Criteria which any MOM management model must address and classify Key Criteria as either Relevant or Common.

Step 4 Evaluate the potential management models in relation to the Relevant Key Criteria selected and identify the most suitable model(s).

6 DEFINITION OF A MOM MODEL

The overall MOM Model embraces all major entities concerned with the development of irrigated agriculture in the GAP Region and can be defined in terms of four components:

(a) Structures: institutional arrangements or functions and responsibilities of each entity; organisational arrangements or lines of responsibility, communication and co-ordination between entities; management arrangements or organisational structure of each entity.

(b) Systems comprising procedures for each entity in terms of: guidelines for planning, designing, operating and maintaining the infrastructure; guidelines for promoting good on farm practices; monitoring and evaluation and feedback.

(c) Skills and Resources comprising: resources required to fulfil responsibilities and implement systems; human resource development based on training programmes.

(d) Enabling Legislation for the implementation of the institutional and management arrangements and of the systems guidelines.

The overall model must provide an institutional and organisational framework that promotes the most effective development of irrigated agriculture in the GAP Region. This goal can be expressed as three Major Objectives:

- *Maximise Net Benefits:* as measured in terms of the value of total agricultural production less costs of management, operation and maintenance.

- *Ensure sustainability:* with respect to political, environmental, financial, social and physical factors. It also relates to the institutional and legal environment and the capability to expand irrigated agriculture in a sustainable manner.

- *Implementable and Flexible:* which requires that a model must be suitable for early implementation and have inherent flexibility for development into a more effective model over time.

From these three Major Objectives a second level of more detailed Major Criteria can be derived for evaluating any model. These are summarised as follows:

Major Objective	Major Criteria
Maximise Net Benefits	• maximise water use efficiency and returns • minimise management, operation and maintenance costs
Ensure Sustainability	• political acceptability • minimise adverse environmental • promote financial viability • socially acceptable • preserve and develop physical performance • ensure institutional effectiveness
Implementable and Flexible	• allow early implementation • promote flexibility to change

7 POTENTIAL MODELS

The number of potential management models for the core water supply activity was determined by separating the total water supply into its major operating components and considering the possible management units for each one. The components and sub models so determined are as follows:

COMPONENT	POSSIBLE SUB MODEL
Headworks	DSİ
Primary Canal	DSİ Irrigation Authority Large Private Company
Secondary Canal	DSİ Irrigation District Irrigation Cooperative Large Private Company
Tertiary Canal	DSİ Irrigation Group Irrigation District Irrigation Cooperative Small Private Company Water User Group Chamber of Agriculture Large Individual Farmer

From this process a total of 13 combinations of primary, secondary and tertiary sub models were considered as being both feasible and capable of evaluation as separate potential models.

8 EVALUATION CRITERIA

From the consultancy studies some 64 Key Issues were derived which were considered as significant for the purpose of evaluating potential models. From these a reduced set of 22 Key Evaluation Criteria was developed each of which expresses a clear concept in terms of the major Objectives and Major Criteria described above. These Key Evaluation Criteria are the basic mechanism for evaluating the models and embrace a wide range of issues so that the evaluation is not distorted towards a limited number of criteria.

9 EVALUATION OF THE PREFERRED MODEL

The overall evaluation was derived as a consensus of the individual assessments of members of the consultant's team. This assessment has been supplemented by the views expressed by delegates both during the project Workshop and afterwards through the completion of questionnaires. The following key conclusions emerge from the evaluation:

(a) DSİ's key role should be to concentrate on high level sectoral allocations and resource planning at the national level. This use of the expertise of DSİ is vital to the optimum use of the nation's water resources.

(b) On a five to six year timescale, an autonomous Irrigation Authority will be the primary and secondary canal sub-model which best meets the key criteria.

(c) The large private company generally rates highly, except with regard to early implementability. This might well be the most appropriate agency in the long term at the primary and secondary levels. The divestiture of an Irrigation Authority into a self-financing private company could be feasible in the long term for the GAP region.

(d) Regardless of which agency is responsible for water supply at the primary and secondary levels, a crucial element of the overall model for GAP is that responsibility for management of the tertiary level should be by fully participatory Water User Groups.

The preferred basic model for GAP therefore comprises three principal components: a Supplier of Bulk Water, in this case DSİ; an Irrigation System Operating Body, termed an Irrigation Authority operating the primary and secondary conveyance system, and fully participatory Water User Groups at the tertiary canal level. The preferred basic model must be flexible and adaptable to the different physical and social conditions existing throughout the different projects planned for the GAP Region.

An important consideration in the development of a model comprising separate sub-models is the relationship between the sub-models. This relationship should be based on the supplier and customer concept at each interface. it implies a clear understanding of the rights and responsibilities of each party which would be expressed in a service level agreement.

Dependant upon the physical size of each irrigation scheme, four models can therefore be identified based on the preferred basic model. In relation to distribution infrastructure, these are shown as follows:

Preferred Model	Irrigation Infrastructure					Size/Comment
	Source Works	Primary System	Secondary System	Tertiary System	On-Farm	
A	{DSİ}	{DSİ}	[IA]	(WUG)	F	Large Scale schemes
B	{DSİ}	[IA]	[IA]	WUG)	F	Medium Scale schemes
C	{DSİ}	(WUG)	(WUG)	(WUG)	F	Small Scale schemes (≤500ha)

IA - Irrigation Authority; WUG-Water User Group; F-Farmer

10 FINANCIAL AND ECONOMIC ANALYSES

The projected costs for management operation and maintenance under different models have been estimated and the financial implications analysed. The results indicate that there would be major savings to Government resulting from the recommended model. The greatest part of these savings is attributed to the formation of WUGs to manage tertiary systems as indicated in the following table:

Item	Cost Saving %	Cost transferred to WUG %	Total Saving to Govt as % of Present (DSİ) Model
WUGs taking tertiaries	20	25	45
IA taking primary/secondaries	14	0	14
WUGs taking primary/secondaries	1	1	1
Total	35	26	60

Economic analyses have also been carried out which indicate increased returns on capital investment through adoption of the model. This increase is partly due to reduced O&M costs but mainly due to higher agricultural yields resulting from improved management and higher irrigation efficiency.

11 THE MOM MODEL

The recommended MOM model consists of three principal elements, namely the Supplier of Bulk Water (DSİ), an Irrigation System Operating Body (Irrigation Authority) and farmer generated Water User Groups. The model also provides for strengthened co-ordination links between these core bodies and all support agencies, including the private sector and other interests not formally involved at present. The overall Institutional framework is shown in the attached Figure.

Management of the major water sources and provision of water supply in bulk at supply points into the various irrigation systems are the primary responsibilities of the Supplier of Bulk Water. DSİ already undertakes these and is recommended to continue this role which would be enhanced without the additional responsibilities of water conveyance and local distribution. It could then focus its activities on the integrated planning of water resource development and management on the broad scale taking into account national policy objectives and international obligations. It would cover aspects such as water quantity and quality, drainage and salinity control strategies, flood control and environmental considerations. DSİ would also have direct responsibility for management of the major headworks storages, pumping stations and river regulating weirs. These large engineering structures demand the continued attention of skilled operators, backed by technical expertise, to ensure that they provide the required levels of service under all operating conditions

The proposed Irrigation Authority (IA) would take over functions at present carried out by DSİ. The IA should own, manage, operate and maintain the primary and secondary delivery system, buying water in bulk from DSİ and selling it to Water User Groups (WUGs). The IA will be a Government agency and should be established within the Ministry of Public Works and Settlements although outside the existing departmental structure of DSİ. It is an essential that the IA be set up under a charter which requires it to operate on a commercial, fully accountable basis with its own management and finances. This would establish it from the outset as a relatively autonomous body focussed specifically on delivery of irrigation services to a defined customer group. It would also facilitate the possible transition of the IA to a private sector body in the future.

The creation of WUGs is the recommended sub model for the Farmer Groups core component of the model. It would be the responsibility of a WUG to undertake the total management function for irrigation services at the tertiary level. This component of the model will be put in place immediately in proposed Pilot Areas so that the development process can be tested for wider application throughout the region.

WUGs will be organised so that they reflect the wishes and needs of members for efficient irrigation methods and profitable agricultural production. The farmers must first agree upon a constitution and a set of working rules and regulations. By producing its own constitution each WUG will be able to reflect the differing needs of the community. The minimum conditions applying for every WUG are that:

- it has legal status to enable it to own assets, open a bank account and have recourse to the legal system if required;

- it is managed by a committee, elected regularly by all the members and accountable to them;

- financial accounts of the WUG are audited annually.

The necessary legal status can be provided by establishing WUGs as village co-operatives.

Coordination and communication between the IA and WUGs would be facilitated by a Secondary Canal Management Committee (SCMC) representing a group of WUGs on the same secondary canal system.

The GAP Co-ordination and Advisory Committee on Irrigation Development (GAPCACID) would be the key coordinating body bringing together the main organisations involved in irrigation development in the region. This committee would play a major role in providing advice and guidance to the GAP Administration in the formulation of regional policy and co-ordinating the activities of departments and organisations. In particular it will provide a formal channel through which farmers' concerns and ideas can be directed to the GAP Administration so that irrigation development is planned taking into account the wishes of farmers in the planning and design phases of future projects.

GAPCACID would comprise representatives from the following:

- Secondary Canal Management Committees representing WUGs
- Irrigation Authority
- Supplier of Bulk Water (DSİ)
- Regional Directorates of DSİ, MARA and other Regional Directorates and research bodies
- Private sector bodies.
- Provincial Governors or their representatives.
- Universities

The existing Provincial Co-ordinating Committees of each province provide an important communication link between many Government agencies including those which have only an indirect relationship to irrigated agriculture. While the primary co-ordination role for organisations directly concerned with irrigated agriculture would be with GAPCACID, there is a need to ensure that the programmes of all other agencies are planned with an understanding of the irrigation development programme. This is particularly important in respect of Government agencies responsible for services such as transport, health and education, which will face increased demands on their services as irrigation development proceeds. The Provincial Co-ordinating Committees will play an important role in co-ordinating the general activities of all public agencies, which is complementary to that of GAPCACID.

Co-ordination arrangements between agencies involved during the implementation phase in the Pilot Areas, would be provided through a Planning and Design Working Group (PDWG). This group should consist of staff from GAP RDA, the GAP MOM study team, DSİ, GDRS, and provincial extension services departments. This is a means to utilise all expertise and knowledge within the various organisations involved in irrigation development in the region.

12 SELECTION OF PILOT AREAS

The philosophy of the GAP MOM study is that the recommended models will be tested and evaluated by implementation in selected Pilot Areas. For the Study to be effective and successful in meeting its objectives implementation within the Pilot Areas must also be successful.

Investigations to identify suitable Pilot Areas have centred on 6 possible locations. One location is within the Urfa command system of the Harran Plain, which will receive the first supplies from Atatürk dam, and the remainder are at five existing irrigation schemes. Three pilot areas in the Urfa system have been selected. Four possible pilot areas have been identified in existing schemes from which three will be selected. The areas selected are as follows:

Name	Province	Gross Area (ha)	Demonstration. Area (ha)
Devegeçidi	Diyarbakır	6900	2460
Hancağiz	Gaziantep	6250	6250
Ceylanpinar	Şanlıurfa	9000	180
Harran 'A'	Şanlıurfa	43040	4500
Harran 'B & C'	Şanlıurfa	43040	3000
Harran 'D'	Şanlıurfa	43040	2500
Keysun	Adıyaman	1950	1950

The Keysun scheme is included as an alternative to be selected if any of the other possible areas are not available.

13 FORMATION OF WATER USER GROUPS

Implementation of the model will be progressive over several years. The initial stages will focus on the establishment of Water User Groups in representative Pilot Areas in order to develop the process of group formation and test the effectiveness of the model under field conditions before it is adopted for wider implementation. Trials of a number of water saving measures and improved irrigation and drainage techniques will also be undertaken as part of the Pilot Area Development. This will commence in 1994.

Those aspects of the management model, such as the creation of a new Irrigation Authority, which require new legislation will take time to be implemented. Other important factors affecting implementation include establishing and improving co-ordination arrangements, resourcing the new organisations, training of agency staff and farmers, developing administrative procedures and suitable transitional arrangements for the proposed Irrigation Authority.

One of the important initial steps to implement the model is to commence the process of forming Water User Groups to take responsibility for the tertiary level irrigation works. The principle underlying the introduction of WUGs is that they should be developed as farmer generated organisations as distinct from farmers participating in groups designed by someone else. This implies that there should be a bottom up approach with guidance and encourage but little external direction.

The formation of WUGs will be assisted by placing trained organisers within the farming communities to stimulate farmers to believe that group formation is desirable. They will then lead farmers through the processes of group formation including development of working rules for effective group management and operation. It is proposed that the group formation process will begin in selected Pilot Areas with the appointment of Group Formation officers (GFOs) who are not part of any existing Government department. At a later stage, after the process has been tested, the responsibility for the group formation process will need to be institutionalised and MARA appears to be the appropriate body to assume this role. MARA would be invited to assist with the monitoring of the group formation process in the Pilot Areas.

Preparation of Group Formation Organisers will require a considerable training input and ongoing co-ordinated support will be required from existing institutions and the consultants. Up to 8 GFOs will be recruited who will be supervised by a Group Formation Co-ordinator with support and training assistance from a Group Co-ordination Adviser. The GFOs will receive initial induction training supplemented by regular follow up sessions.

14 WATER MANAGEMENT IN PILOT AREAS

Investigation of the proposed Pilot Areas has identified a number major constraints which must be rectified if the model trials are to be successful. These are the need for rehabilitation of existing infrastructure in the existing schemes, particularly Devegeçidi and Hancağiz, completion of supply and on-farm works in Urfa-Harran, the general lack of adequate water flow measurement facilities and relatively low standards of farm water application designs and practices.

The efficient use of irrigation water and the effective drainage at the farm level are an essential part of good irrigation practices and important elements in the strategy of water saving for the region. An integral part of the operation of the proposed Pilot Areas is for farmers to be trained in the use of improved farming or agricultural practices that will lead to improved water use efficiency. Some of these measures are relatively simple and can be implemented quickly by the farmers themselves. Others will require modifications to infrastructure and will take some time to introduce.

The measures proposed for improving water management are all aimed at promoting water savings and are summarised as follows:

- Water Demand measures covering the concepts of crop water requirements, water budgets and irrigation scheduling
- Water Distribution improvements such as simple flow measurement, modified canalet offtakes, construction of night storage reservoirs
- Water Management on the Farm, including improved header ditches furrow equipment, portable flow measurement equipment, multiple small syphons lay flat tubing and gated piping for surface irrigation as well as sprinkler and drip irrigation systems.
- Drainage Measures including improved land grading and preparation, drainage outlets and re-use of drainage water.

14 ESTABLISHMENT OF IRRIGATION REGIONS AND IRRIGATION ZONES

It is proposed that he region be delineated into Irrigation Regions and Irrigation Zones to facilitate management and administration.

It is recommended that the whole GAP region be considered as three regions, based on river basins and major water systems, for the purpose of overall water resource and irrigation planning. The proposed regions correspond generally to DSİ Regional Directorate boundaries with the recommendation that the existing DSİ boundaries be amended to transfer Mardin province from Region 10 to Region 15. This would ensure that all the major water supply systems to be supplied from Atatürk dam via the Şanlıurfa tunnels are within the same region.

50 Irrigation Zones have been tentatively identified. These would form the basis of administration units for day to day management at the local level. These have been delineated having regard to location of water sources, irrigation system layout, area, administrative boundaries, community infrastructure and services and social homogeneity. The tentative zone boundaries need to be reviewed at the time when new projects are being brought into operation to ensure that they still provide an appropriate basis for management.

16 LEGAL ASPECTS

Use of existing legislation to the maximum extent will allow implementation of the model to proceed without delay, particularly the development of WUGs which it is considered can be established under the existing village cooperatives law. However new legislative provisions will be required to establish the proposed Irrigation Authority as an independent public agency, institutionalise co-ordination arrangements and strengthen certain areas of water law.

Amendment of the DSİ establishment law is also required to enable it to transfer ownership of canals and related works to Water User Groups and an Irrigation Authority. New or amended legislation is necessary to provide for full cost recovery and strengthened revenue collection procedures by all agencies.

The process of drafting such new legislation should be initiated at an early date to allow adequate time for consultation with all interested organisations prior to the formal parliamentary processes.

A number of shortcomings in existing water laws have been identified in the study which apply generally to irrigation and water management throughout the country. Possible amendments to overcome these shortcomings have been proposed already by DSİ. Although these amendments are not essential to the immediate implementation of the GAP MOM model, it is highly desirable that the law be improved in these matters for effective overall water management. These suggested amendments include: the rationalisation of water rights for the extraction and use of surface water resources to ensure integrated management on a whole basin approach; promulgation of Regulations provided for under Article 641 of the Civil Code covering the general use of public waters; clarification of the water rights of individual farmers.

17 MONITORING AND EVALUATION

A Monitoring and Evaluation (M&E) process will be undertaken in the study with the following key objectives:

- To monitor the progress of the implementation of the pilot studies, evaluating the key constraints and identifying suitable measures to overcome these constraints

- To evaluate the performance of the MOM model developed and its applicability to the GAP region as a whole

The lessons learnt during the development of an effective M&E system in the pilot study areas will form the basis of the M&E approach which can be applied to the GAP region. The study involves several agencies in a complex task, so the monitoring of their activities will play an important role in ensuring the project achieves its objectives.

The M&E system will have two main components, a Management Information System (MIS) and an Impact Monitoring System (IMS).

The MIS will monitor the progress of implementation of the planned activities of the study, and should provide management with the information required to: oversee progress, ensure that planned inputs are available, that work schedules are achieved and targeted outputs obtained; and identify problems at an early stage and take steps to resolve them.

The IMS will be conducted by carrying out field surveys each year to collect impact evaluation information from farmers and WUGs. Field work should be undertaken in October, followed by data entry and verification, and initial analysis and tabulation. Annual evaluations are scheduled for February 1995 and 1996. A Project evaluation is expected in December 1996, which will be based on the progress made, and data available at that date.

18 MANUALS

To assist staff and farmers involved with the introduction of the model in Pilot Areas and related training programmes, a series of manuals will be compiled by the consultants covering management, operation and maintenance and other specialist subjects. Separate versions of these manuals will be produced, where appropriate, to cover the requirements different agencies and Water User Groups.

The MOM manuals will contain, in addition to procedures and instructions relating to specific tasks and activities, an outline of principles and policies underlying the development of the MOM model. The general headings of the main sections of the these manuals are: organisation and management, system operation arrangements and maintenance procedures

A M&E manual will be prepared describing the system outlined above. This will be undertaken as a joint exercise with the Monitoring Officer appointed by the GAP RDA. A survey design for the impact monitoring surveys will be prepared and field tested, and a data entry system, tabulation layout and report outline prepared.

A manual of cropping techniques will also be produced based on the results of agricultural research on field crops being carried out on various field crops by several institutions in the region. This manual will assist extension specialists to prepare training material.

Following investigations into improved on-farm water management, a set of guidelines for irrigation scheduling will be prepared for use by farmers and extension staff. These will be prepared for the range of crops, soil conditions and irrigation methods used throughout the region.

The MOM, M&E and cropping technique manuals should be completed in May 1994.

19 TRAINING

Training on various aspects of implementing the MOM Model is proposed for four categories of participants: management, operating and maintenance staff, farmers and trainers. In 1994 training courses are recommended for 17 groups in 1994, amounting to about 270 persons. An intensive programme is necessary, to ensure that the training matches the proposed timescale for the Pilot Areas. Details are set out in the consultant's report **Proposals for Training.**

It is proposed that the training programme be coordinated and managed by GAP RDA, to ensure control and long-term sustainability. The Training Coordinator recently appointed by GAP RDA should manage the implementation and evaluation of the training programme with the support and assistance of the consultant.

A Training Coordination Committee should also be formed, chaired by the Training Coordinator, with representatives from all the Government agencies involved, and the consultants, to advise and assist GAP RDA in all aspects of the training programme.

20 TRANSITIONAL ARRANGEMENTS

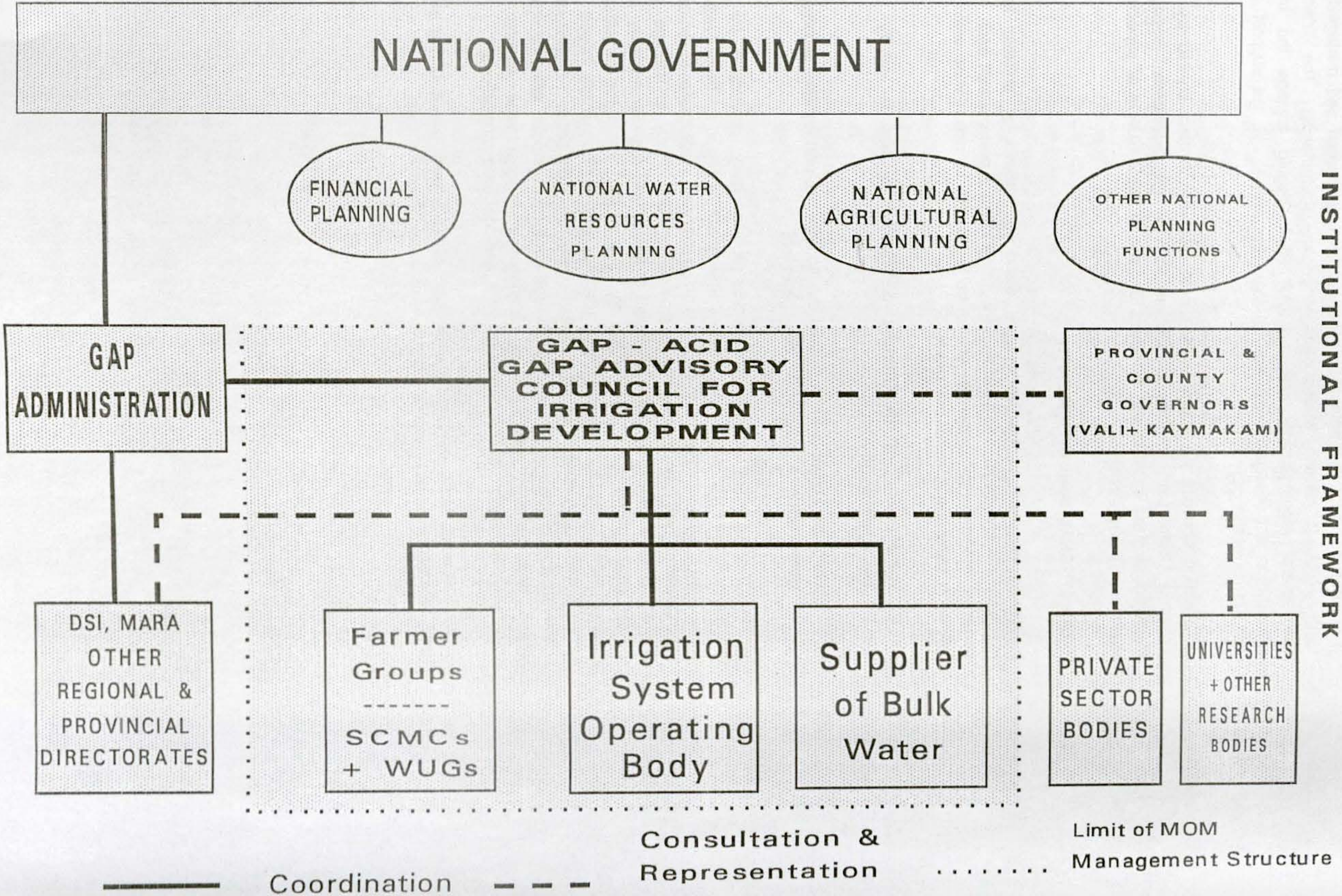
Following adoption of the model the steps for developing suitable legal mechanisms can begin and planning should be on the premise that each new scheme brought into operation should be operated in accordance with the following main principles of the model:

- management of the tertiary distribution system be wholly the responsibility of WUGs

- water be supplied in bulk from the source via primary and secondary canals under a level of service agreement.

In the interim period before it becomes economically practicable for an Irrigation Authority to begin operation as a separate entity it will be necessary for DSİ to manage the primary and secondary canals. Appropriate transitional arrangements will be developed to provide for DSİ firstly to manage the primary and secondary systems on behalf of the future Irrigation Authority and then transfer them to it. The matters to be provided for in the transitional arrangements include organisational structure and staffing levels based on future needs, funding arrangements, revenue collection procedures, administrative procedures, plant, vehicle and equipment stocks, office facilities, liaison arrangements with WUGs, timetable for progressive transfer of activities, staff, assets and facilities to the IA and staff communications.

A small working group, of about five persons, should be convened during early 1995 to commence development of the transitional arrangements.



THE MOM MODEL INSTITUTIONAL FRAMEWORK

SECTION A

BACKGROUND

SECTION A - BACKGROUND

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SECTION A - BACKGROUND

1 INTRODUCTION

1.1 The GAP Project

1.1.1 The National Context

Turkey is a unitary parliamentary republic and the only state in the Muslim world in which secularism forms part of the constitution. The President is elected by parliament, rather than by voters, for a seven year term under an electoral law which divides the country into 107 multi-member constituencies with parliamentary seats distributed by proportional representation. The administrative system of Turkey is highly centralised with local authorities in the 76 provinces having limited functions principally relating to health, education, security and provincial directorates.

Turkey has experienced steady population growth since the 1920s. The most recent census, conducted in 1990, put the population at some 56.5 million, indicating an overall growth rate over the previous five years of 2.17% which is high in European terms. In general family sizes are decreasing in western Turkey and the towns, while in the Southeastern Anatolia area family sizes are much larger. This region has the highest population growth rate in the country as shown in the following Table.

Table A 1.1
Area and Population

Region	Total Area km^2	Population 000s	Population Density per km^2	Annual Increase 1985/90 %
Mediterranean/ Southern Coast	59395	5444	92	3.14
West Anatolia	77031	3865	51	1.76
East Anatolia	176311	6867	39	1.24
Southeastern Anatolia	39749	2700	68	3.63
Central Anatolia	236347	13096	55	1.43
Black Sea Coast	81295	6827	84	0.53
Marmara & Aegean	85370	11693	137	3.48
Thrace	23862	5975	250	3.21
TOTAL/AVERAGE	779360	56473	72	2.17

The larger cities are growing by 4-5% per year because of migration from the countryside to the towns. Once overwhelmingly rural, about 59% of the almost entirely Muslim population now live in urban areas with a consequent shift in culture and politics from those of a rural to an urban based society. Primary education is universal with 6.8 million pupils in 1988/89 and corresponding secondary school and university populations of 3.55 million and 0.56 million respectively.

In 1980 fixed exchange rates were abandoned and the Turkish lira depreciated rapidly. From 1990 banks have been free to determine their own foreign exchange rates independent of the Central Bank. The basis of Turkey's modern economic development was laid down by Kemal Ataturk but it was not until the 1960s that a co-ordinated industrialisation programme was implemented under which import substitution policies formed the basic framework of the five year development plans until the end of the 1970s. Turkey's foreign balance deteriorated in the 1970s as the import needs of the rapid industrialisation initiative outstripped the growth in exports resulting in high levels of foreign borrowing requiring intervention by the IMF and foreign creditors. This intervention led to strict monetary policies being adopted which hit investment and private consumption very hard. During 1981-87 economic growth was strong though inflation remained at over 30% increasing to 75% in 1988 at about which level it remains today. Exports increased rapidly in the mid 1980s but then decreased and, although industrial output has expanded significantly, this has made only a modest contribution to employment creation.

Since the beginning of the 1960s significant changes have taken place in Turkey's national economy with the proportion of GDP from agriculture, including forestry and fishing, falling from 42% to 18% in 1990 and with an accompanying rise in contribution from the industrial sector from 16% to 29%. Internationally agricultural goods comprised 76% of total exports in 1965 and this fell to 18% in 1990. The export of manufactured goods has nearly doubled since 1981, although many of these goods depend on the processing of agricultural raw materials such as cotton textiles or manufactured food products. The shifts in sectoral contribution to GDP are shown below.

Sector	1960	1970	1980	1990
Agriculture	42	31	23	18
Industry	16	19	25	29
Construction	6	8	5	4
Services	36	42	47	49

Despite the widespread industrial base almost half the population earn their living from agriculture. The Turkish authorities face considerable difficulties in creating sufficient employment opportunities for the rapidly growing population. This is compounded by the progressive population shift from rural to urban areas and is further complicated by the large number of informal workers in the agricultural sector. The official overall unemployment level was put at 8.3% in October 1991 although the actual figure is estimated to be considerably higher (OECD 1993).

1.1.2 The Agricultural Sector

Turkey is richly endowed with land and water resources and is a major agriculture producer with a consistent surplus in the agricultural trading sector. Since 1980 imports of new seed varieties and emphasis on the use of agricultural inputs have led to significant increases in the yields of a number of crops. Tractors are numerous and widely used although in many areas manual labour is still common. Labour productivity in the sector is low compared with European standards although this does allow the agricultural sector to be a major provider of employment.

The climate of Turkey is extremely varied and the significant differences in agro-ecological zonation permit a wide variety of crops to be grown. Hence triple cropping is possible in the Mediterranean environment of the fertile valleys of the Aegean, while predominantly cereals are produced in the central Anatolian plain and the north east and tobacco, fruits, vegetables and nuts in the more temperate areas. Of Turkey's total area of 77.9m hectares, the annual cropped area comprised some 24.0m hectares (31%) in 1991 with perennial crops including vineyards, orchards and olive groves adding a further 3.7m hectares (5%). Cereals, in particular wheat, dominate production while other major produce in terms of tonnage include sugar beet, potatoes and grapes (SIS, 1991).

The land tenure system varies widely throughout the country with basically three types of ownership excluding state owned land. In village areas land is shared out between community members on a smallholder basis such as in western and central Anatolia, while in eastern Turkey there are many large estates owned by absentee landlords who may control many villages and employ local peasantry as sharecroppers. In the Çukurova plain around Adana and in parts of the Aegean coastal region there are large commercial farms while State Farms, such as at Ceylanpinar in southeastern Anatolia, are scattered throughout the country and have been used to pioneer new techniques in agriculture in particular certified seed production.

Agricultural credit is made available to farmers through the country's largest bank, the Ziraat Bankasi (Agricultural Bank), which offers money to farmers at subsidised interest rates as well as longer term money for investment projects. Agricultural Credit Cooperatives also provide loans for the purchase of inputs and extend credit from their own resources and from the Agricultural Bank. It is estimated that about one third of farm credit comes through non-institutional sources.

In terms of foreign trade, since 1984 Turkey has liberalised its policy on food imports. Whereas it is accustomed to running a surplus on the agricultural balance of payments, the rise of a large and more prosperous urban population will diversify the pattern of trading. In terms of domestic markets, while much produce is exchanged freely in local markets, the state companies such as TMO (Soil Products Office) control much marketing activity despite there often being direct competition from private companies. Tea and tobacco are now part of the open market and there are support prices for major agricultural commodities which are fixed annually by Government.

The Government has encouraged the development of irrigation projects throughout the country. A major component of the Southeastern Anatolia Project (GAP), in conjunction with the exploitation of water resources for hydro electric power generation, will be the implementation of a series of large scale projects commanding some 1.7m hectares for irrigation.

1.1.3 The Southeastern Anatolia Project

The GAP project is a multi-sectoral regional development plan for one of the least developed parts of Turkey. It is based upon a Master Plan prepared for the region in 1989 embracing the sectors of agriculture, industry, transport, health and education. It is the largest and most comprehensive project in Turkey and includes the eight provinces of Adiyaman, Diyarbakır, Gaziantep, Mardin, Siirt, Şanlıurfa, Şirnak and Batman covering some 74,000 km^2 in the southeastern part of the country bordering Syria and Iraq and occupying nearly 10% of the land area with a population of 5.2 million.

The project will be the final stage of exploiting the water resource potential of the Euphrates and Tigris basins for both irrigation and hydro power generation. This development commenced in 1962 with construction of Keban dam on the upper Euphrates. At that time planners at the General Directorate of State Hydraulic Works (DSİ), who were only considering power and irrigation development, initiated a long term scheme to implement 13 major projects. It was later recognised that the potential social and economic impacts on the area would be so great that a more comprehensive and integrated plan for development was required and hence the GAP project was formulated. With the publication of the GAP Master Plan in 1989 the region was classified into four principal zones in terms of infrastructure development and land suitability. These were:

(a) Areas with high accessibility to urban services and high land capability. These areas are Diyarbakır-Batman, greater Şanlıurfa and Cizre-Silopi. In these areas intensive and commercialised agriculture is envisaged in conjunction with agro-industrial development.

(b) Areas with high accessibility to urban services but with low land capability. These are the Gaziantep and Siirt areas in which development on a range of industries for the former and the livestock industry for the latter.

(c) Areas with low accessibility to urban services but with high land capability. In these areas, which are remote from urban areas, priority will be given to increasing agricultural production with measures to address marketing, agricultural inputs, extension services and infrastructure development including roads.

(d) Areas with low accessibility to urban areas and with low land suitability. These areas will have low priority for development unless there is potential for mineral resources or tourism development.

A further two zones were identified which exhibited a mixture of characteristics of zones (a) and (b) these being Adiyaman and Mardin-Kiziltepe areas. From this broad screening process six areas were identified with high potential for development, these being Diyarbakır-Batman, Greater Şanlıurfa, Gaziantep gateway, Siirt, Adiyaman and Mardin Frontier areas. For these areas a range of integrated development issues are intended which, in relation specifically to water resources exploitation and impact on agriculture, can be summarised as follows:

(a) Diyarbakır-Batman: irrigation, hydro-power and road development together with infrastructure for grain storage and agricultural inputs distribution.

(b) Greater Şanlıurfa: irrigation development, infrastructure for grain storage and inputs distribution together with creation of agro-industry.

(c) Gaziantep Gateway: irrigation and road development.

(d) Siirt: irrigation, hydro-power and road development together with afforestation and erosion control and creation of agro-industry.

(e) Adiyaman: irrigation and road development.

(f) Mardin Frontier: irrigation, road and dam construction together with development of marketing channels and agricultural inputs distribution.

All GAP developments are based on the original projects identified by DSİ and encompass construction of 22 major dams and 19 hydropower stations. The latter will have a total installed capacity of 7,500 MW producing an estimated 27,000KWh of energy amounting to about half the production in the country representing roughly 25% of total economically viable hydro power potential. The stored water will irrigate 1.7m hectares representing nearly a quarter of all Turkey's irrigable land and increase the irrigated area of the GAP region from 3% to 53% of total arable land. The total investment cost is estimated at US$29b (1992 prices) and the projected benefits are expected to increase national income by 12%, provide self sufficiency in food for 80m people and create an extra 3.3m jobs nationwide.

The irrigation schemes have been selected and prioritised for implementation according to a target investment per hectare and the energy projects according to a specified target rate of return on capital investment. The development is being undertaken in several stages with the highest priority projects currently under construction scheduled for completion by 1997, the remaining priority irrigation and power projects by 2005 and all other works after that date. The two largest dams, Karakaya and Atatürk on the Euphrates, are now completed and producing commercial electricity. The installed hydroelectric power capacity at these two dams totals 4,200MW or 56% of the planned total of the GAP developments. The 26km long Şanlıurfa tunnels are scheduled for completion during 1994 and will convey water from Atatürk dam to command nearly 500,000 hectares of land for irrigation in the Şanlıurfa-Harran and Mardin-Ceylanpinar plains.

The GAP MOM study is concerned specifically with the development of irrigated agriculture that will result from the GAP projects. Many interrelated projects are planned within the framework of the 13 original DSİ projects requiring the conjunctive use of surface water resources for irrigation and power generation. Additionally the conjunctive use of surface water and groundwater resources is planned for some areas such as the Harran and Ceylanpinar plains. Three of the original 13 DSİ major projects comprise hydro power development only. Of the remaining 10 projects, five lie in each of the Euphrates and the Tigris basins and comprise a total of 26 major irrigation schemes (or units), 16 in the Euphrates and 10 in the Tigris. In summary these major projects are as follows:

Euphrates Basin

(a) The Lower Euphrates Project

This comprises five irrigation schemes located to the south and east of the Atatürk reservoir, namely:

- Urfa-Harran plain gravity (142,000ha).
- Mardin-Ceylanpinar gravity (186,000ha).
- Mardin-Ceylanpinar pumped (149,000ha).
- Siverek-Hilvan pumped (160,000ha).
- Bozova pumped (70,000ha).

These schemes will be supplied from the Atatürk reservoir, the first three via the Şanlıurfa tunnels and the other two by pumping through other tunnels.

(b) The Suruç-Baziki Project

Water will be taken from the south of Atatürk reservoir via the Yaşlica tunnel to irrigate 146,500 ha by both pumping and gravity.

(c) The Adiyaman-Kahta Project

This comprises five irrigation schemes located to the north of Atatürk reservoir, namely:

- Camgazi: 6,500ha from the Camgazi dam.
- Gomikan: 7,750ha from the Gomikan dam.
- Kocali: 22,000ha from the Kocali dam.
- Büyükçay: 12,500ha from the Büyükçay dam.
- Pumped irrigation from Atatürk reservoir, 29,500ha.

(d) The Adiyaman-Göksu-Araban Project

From the Çataltepe dam an area of 71,500ha is to be irrigated to the west of Atatürk dam.

(e) The Gaziantep Project

This comprises four irrigation schemes to the south and east of Gaziantep namely:

- Hancağiz: 7,500ha from the Hancağiz dam.
- Kayacik: 14,000ha from the Kayacik dam.
- Kemlin: 2,000ha from the Kemlin dam.
- Birecik: 66,000ha by pumping from Birecik dam on the Euphrates.

Many of these schemes are divided into sub schemes and further details of these, together with several other independent schemes, are given in Table A1.2. The location and current status of each scheme are shown on Figure A1.1.

Tigris Basin

(a) The Tigris-Kralkizi Project

This comprises two schemes to the west and north west of Diyarbakır supplied from the Tigris and Kralkizi dams:

- The Tigris right bank gravity scheme of 52,000ha.
- The Tigris right bank pumped scheme of 74,000ha.

(b) The Batman Project

This comprises three schemes in the vicinity of Batman irrigated from the Batman dam, namely:

- The Batman left bank gravity scheme of 9,500ha.
- The Batman left bank pumped scheme of 9,500ha.
- The Batman right bank gravity scheme of 19,000ha.

(c) The Batman-Siivan Project

This large area between Silvan and Diyarbakır will be supplied by the Kayser and Silvan dams and comprises two schemes namely:

- The Tigris left bank gravity scheme of 200,000ha.

- The Tigris left bank pumped scheme of 57,000ha.

(d) The Garzan Project

The Garzan scheme to the east of Batman will comprise 60,000ha supplied from the Garzan dam.

(f) The Cizre Project

This comprises two schemes in the south eastern part of the region namely:

- The Nusaybin-Cizre-Idil scheme of 89,000ha supplied from the Cizre dam.

- The Silopi Plain scheme of 32,000ha.

Further details of these schemes and their component sub schemes, together with several small independent schemes, are shown in Table A1.3. The location and current status of each scheme are also shown on Figure A1.1.

TABLE A.1.2 : EUPHRATES PROJECTS

NO	SUB-PROJECT NAME	AREA (ha)	SOURCE	TYPE OF IRRIGATION	CURRENT STATUS	COMPLETION DATE
A-	LOWER EUPHRATES PROJECTS					
	A1- Urfa-Harran Project					
1	Urfa II. Section	35192	Atatürk Dam	canalet	construction	1995
2	Urfa II. Section	18900	Atatürk Dam	canalet	construction	1996
3	Harran II. Section	28683	Atatürk Dam	canalet	construction	1997
4	Harran III. Section	22861	Atatürk Dam	canalet	construction	1995
5	Harran IV. Section	23738	Atatürk Dam	canalet	construction	1995
6	Harran V. Section	22045	Atatürk Dam	canalet	construction	1995
7	Akçakale Groundwater Irr.	15000	Groundwater	classic	operation	
	A2- Mardin-Ceylanpınar Project					
1	Existing Groundwater Irr.	19650	groundwater	sprinkler	operation	
2	Planned Groundwater Irr.	111939	groundwater	sprinkler	planned	
3	I. Stage Gravity	15376	Atatürk dam	california	planned	
4	II. Stage Gravity	29390	Atatürk dam	sprinkler	planned	
5	III. Stage Gravity	65539	Atatürk dam	sprinkler	planned	
6	Viranşehir I Pumped	23952	Atatürk dam	sprinkler	planned	
7	Viranşehir II Pumped	13784	Atatürk dam	sprinkler	planned	
8	Mardin Storage I Pumped	18599	Atatürk dam	sprinkler	planned	
9	Mardin Storage II Pumped	34786	Atatürk dam	sprinkler	planned	
10	Mardin Storage III Pumped	27786	Atatürk dam	sprinkler	planned	
	A3- Bozova Project					
1	Kabahaydar Irrigation	16908	Atatürk Dam	classic	planning	
2	Ovacık Irrigation	12956	Atatürk Dam	classic	planning	
3	Akziyaret Irrigation	21331	Atatürk Dam	classic	planning	
4	Gölcük Irrigation	18507	Atatürk Dam	classic	planning	
	A4- Siverek-Hilvan Project					
1	Siverek-Hilvan Pumped Irrigation	237365	Atatürk Dam	canalet	planning	
2	Dumluca	1860	Dumluca Dam	canalet	construction	1993
3	Hacıhıdır	2080	Hacıhıdır Dam	canalet	construction	1994
B-	SURUÇ-BAZIKI PROJECT					
1	Baziki Gravity Irrigation	8737	Atatürk Dam	sprinkler	final design	
2	Baziki Pumped Irrigation	16915	Atatürk Dam	sprinkler	final design	
3	Suruç Irrigation	93754	Atatürk Dam	classic	planning	
4	Suruç Groundwater Scheme	7000	Groundwater	classic	operation	
C-	ADIYAMAN-KAHTA PROJECT					
1	Irrigation from Atatürk Dam Reservoir					
	-Birgeni Pumped Irr.	184	Atatürk Dam	canalet	planning	
	-Mağara Pumped Irr.	5436	Atatürk Dam	canalet	planning	
	-Haceri Pumped Irr.	2531	Atatürk Dam	canalet	planning	
	-Mamai Pumped Irr.	5214	Atatürk Dam	canalet	planning	
	-Bebek-I Pumped Irr.	5662	Atatürk Dam	canalet	planning	
	-Aslanoğlu Pumped Irr.	8408	Atatürk Dam	canalet	planning	
	-Ancuz	1157	Atatürk Dam	canalet	planning	
	-Çakmak	129	Atatürk Dam	canalet	planning	
	-Şengültepe	878	Atatürk Dam	canalet		
2	Gömikan Dam	7762	Gömükan Dam	canalet		
3	Çamgazi Dam Pump & Gravity	6121	Çamgazi Dam	canalet	construction	1994
4	Koçali Dam	21605	Koçali Dam	canalet		
5	Büyükçay Dam	12322	Büyükçay Dam	canalet		

TABLE A.1.2 : EUPHRATES PROJECTS (Continued)

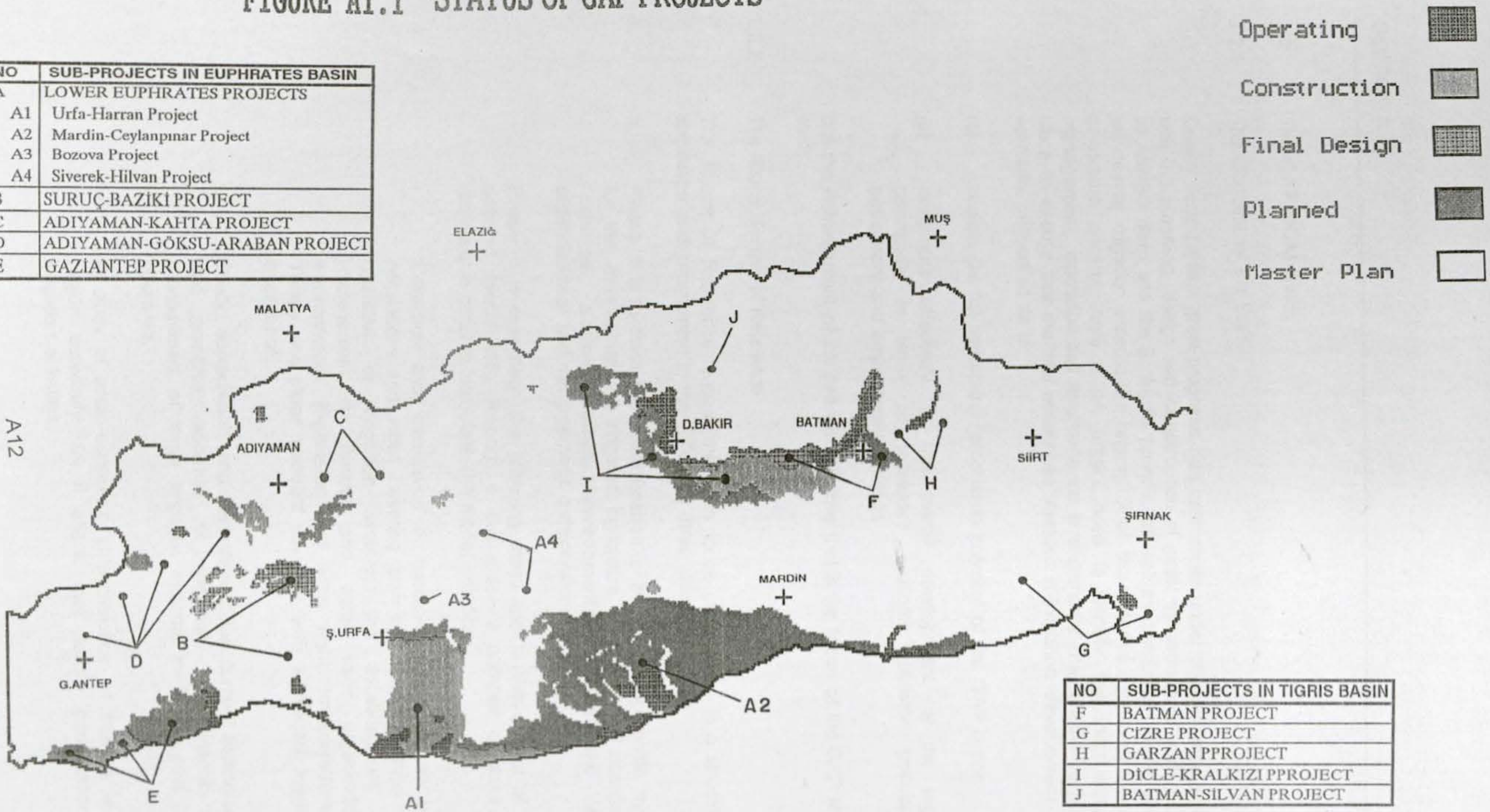
NO	SUB-PROJECT NAME	AREA (ha)	SOURCE	TYPE OF IRRIGATION	CURRENT STATUS	COMPLETION DATE
D-	ADIYAMAN-GÖKSU-ARABAN PROJECT					
1	Gölbaşı Plain Gravity Irrigation	2665	Aksu Creek	canalet	planning	
2	Gölbaşı Plain Pumped Irrigation	3329	Çataltepe	canalet	planning	
3	Besni-Kızılin	8893	Çataltepe	canalet	planning	
4	Besni-Keysun	12029	Çataltepe	canalet	planning	
5	Araban	20947	Harmancık+Ardıl	canalet	planning	
6	Pazarcık	5943	Harmancık	canalet	planning	
7	Yavuzeli	12731	Harmancık	canalet	planning	
8	İncesu Gravity Irrigation	3773	Harmancık	canalet	planning	
9	İncesu Pumped Irrigation	2003	Harmancık	canalet	planning	
10	Besni	2820	Besni dam	canalet	planning	
11	Keysun	1950	Groundwater	classic	operation	
12	Ardıl	3535	Ardıl Dam	classic	planning	
13	Harnncık	2298	Harmancık Dam	classic	planning	
E-	GAZİANTEP PROJECT					
1	Hancağız Dam(part of Hancağız)	7300	Hancağız Dam	canalet	operation	
2	Kayacık Dam(part of Akçakoyunlu)	13680	Kayacık Dam	california	construction	
3	Kemlin Dam (part of Elbeyli)	1969	Kemlin Dam	canalet	planning	
4	Seve Dam	1400	Seve Dam	canalet	planning	
5	Pumped from Birecik Dam	66007				
	Hancağız	10736	Birecik Dam	canalet	planning	
	Barak	11419	Birecik Dam	canalet	planning	
	Gevence	13524	Birecik Dam	canalet	planning	
	İkizce	11043	Birecik Dam	canalet	planning	
	Akçakoyunlu	8973	Birecik Dam	canalet	planning	
	Doğanpınar	18711	Birecik Dam	canalet	planning	
	Elbeyli	7112	Birecik Dam	canalet	planning	
	Karacaören	2704	Birecik Dam	canalet	planning	
	Kilis	4734	Birecik Dam	canalet	planning	
F-	INDIVIDUAL PROJECTS					
1	Çalikhan Irrigation	1043	Recep Creek	classic	operation	

TABLE A 1.3 : TIGRIS PROJECTS

NO	SUB-PROJECT NAME	AREA (ha)	SOURCE	TYPE OF IRRIGATION	CURRENT STATUS	COMPLETION DATE
A-	BATMAN PROJECT					
1	Batman Left Bank-Gravity	9574	Batman Dam	classic	final design	
2	Batman Left Bank-Pumping	9412	Batman Dam	classic	planning	
3	Batman Right Bank-Gravity	18758	Batman Dam	classic	final design	
4	Silvan I. and II. Section	8790	Batman Regulator	classic	operation	
B-	CİZRE PROJECT					
1	Nusaybin-Cizre-İdil (pumped)	89000	Cîzre Dam	classic	planning	
2	Silopi (pumped)	25000	Hezil Dam	classic	planning	
3	Nusaybin	8600	Çağ-Çağ spring	classic	operation	
4	Nusaybin Extention	9162	Nusaybin storage	classic	planning	
5	Nerdüş	2740	Nerdüş Creek	classic	operation	
C-	GARZAN PPROJECT					
1	Garzan	60000	Garzan Dam	classic	planning	
2	Garzan-Kozluk	3700	Kozluk Regulator	classic	operation	
D-	KRALKIZI PPROJECT					
1	Dicle Right Bank-Gravity	52033	Dicle Dam	classic	construction	1995
2	Dicle Right Bank-Pumping	74047	Dicle Dam	classic	planning	1995
3	Devegeçidi	7500	Devegeçidi Dam	canalet	operation	
4	Çınar-Göksu	3582	Çınar Dam	classic	construction	1994
E-	BATMAN-SİLVAN PROJECT					
1	Dicle Left Bank-Gravity	200000	Silvan Dam	sprinkler	planning	
2	Dicle Left Bank-Pumping	57000	Silvan Dam	sprinkler	planning	
F-	INDIVIDUAL PROJEXTS					
1	Halilan	550	Halilan Lake	classic	operation	
2	Kale	10467	Sinek Creek/Kale Dam	classic	planning	

FIGURE A1.1 STATUS OF GAP PROJECTS

NO	SUB-PROJECTS IN EUPHRATES BASIN
A	LOWER EUPHRATES PROJECTS
A1	Urfa-Harran Project
A2	Mardin-Ceylanpınar Project
A3	Bozova Project
A4	Siverek-Hilvan Project
B	SURUÇ-BAZİKİ PROJECT
C	ADIYAMAN-KAHTA PROJECT
D	ADIYAMAN-GÖKSU-ARABAN PROJECT
E	GAZİANTEP PROJECT



NO	SUB-PROJECTS IN TIGRIS BASIN
F	BATMAN PROJECT
G	CİZRE PROJECT
H	GARZAN PPROJECT
I	DİCLE-KRALKIZI PPROJECT
J	BATMAN-SİLVAN PROJECT

1.2 The GAP-MOM Study

1.2.1 The Concept of the Study

During recent years great progress has been made under the guidance of DSİ with the planning, design and construction of major infrastructure works, such as Atatürk dam and the Şanlıurfa tunnels, as well as distribution works which will deliver irrigation water to the region. Since this water is scheduled to come on-stream shortly, there is an urgent need to identify the most suitable management, operation and maintenance arrangements that should be put in place to ensure that the total resources invested in irrigation development are optimally utilised so as to:

(a) realise the full agricultural production potential of the GAP region;

(b) contribute effectively to the overall development of the region principally in terms of increased economic activity, population settlement and employment creation.

It is the achievement of this overall objective that is the focus of the GAP MOM study.

1.2.2 The Study Terms of Reference

The Terms of Reference require the study to be undertaken in a structured sequence and programme in the following three phases:

(a) Phase 1 is to cover the **Identification** of the most appropriate model for the development of irrigated agriculture embracing all necessary technical, socio-economic, environmental, institutional, legal, organisational and management considerations.

Phase 1 is essentially the planning stage and is the subject of this detailed Identification Report. In this phase a number of tasks are required in order to formulate the model including:

- Collection and evaluation of baseline data such as laws, regulations and rules covering planning, implementation and operation of irrigation systems, the establishment and management of farmer and water user organisations, environmental legislation and water right considerations in Turkey and other relevant countries with significant irrigation experience.

- Study, appreciation and evaluation of the current technologies and practices adopted for operation, maintenance and management of large irrigation systems in Turkey and other countries.

- A study of socio-economic characteristics of farmers in the region especially as it affects their future participation in irrigation activities.

- Review of designs for the GAP irrigation systems
- Identification of pilot areas in which the MOM model can be trialled and evaluated.
- Formulation of alternative MOM models and recommendations for selection.
- Development of proposals for a range of water saving measures including a programme for demonstrating these in representative field trials.

(b) Phase 2 is the **Implementation** phase of the identified model in a representative number of pilot areas, over a minimum period of two years, by the establishment of all necessary organisation and management units and operation and maintenance services.

This phase will involve application of the recommended MOM model in selected pilot areas. Tasks to be undertaken in this phase include:

- The preparation of MOM manuals
- Preparation and implementation of a training programme covering the staff of organisations involved in management, operation and maintenance of the irrigation supply system, including farmers.
- Implementation of the recommended MOM practices in the selected pilot areas.

(c) Phase 3 is the **Monitoring and Evaluation** phase of the organisation and management structures established in the pilot areas to determine factors contributing to success and failure and any underlying constraints and then to review, revise and improve the model for implementation in other areas.

In this phase the following tasks are to be undertaken:

- Establishment of the monitoring and evaluation system and preparation of relevant manuals.
- The monitoring and evaluation of the MOM activities.

The whole study is to be undertaken within a four year period with Phase 1 occupying the first year (subsequently reduced to 10 months), Phase 2 of two years and Phase 3 of three years to commence concurrently upon the conclusion of Phase 1.

1.2.3 The Structure of the Study

While the Terms of Reference designate various tasks to particular phases of the study and this differentiation is useful in developing the logic of the study, there is in fact a considerable degree of interrelation between all tasks and activities. The activities to be performed during formulation of the recommended MOM model in Phase 1 are crucial to the whole study and encompass all issues and disciplines. Particular aspects requiring detailed consideration during model formulation include

(a) Water distribution organisation and management procedures for different types of water supply systems.

(b) Institutional and organisational arrangements existing in the agricultural sector of Turkey, both public and private, including their effectiveness and suitability in the context of GAP.

(c) Regulatory and judicial considerations in relation to water supply management, water usage, land ownership and the formation of farmer organisations.

(d) Sociological considerations including social and family structures, labour patterns, farm practices, cultural preferences and differences, perceptions to irrigation farming, training requirements and the nature of suitable water user groups.

(e) Technical considerations including the utilisation of canal or pipeline systems, water application methods, crop patterns and suitability, soils and topography, drainage requirements, assessment of water resources availability and the operation of large conveyance and distribution systems.

(f) Financial considerations in relation to farmers' budgets arising from different crops, input costs including water charges, pricing and marketing policies.

(g) Economic considerations at national and regional levels.

(h) Political considerations on matters such as population stabilisation, equity and development issues.

(i) Environmental considerations in terms of minimising adverse impacts on water, soils and human health.

The core of the study is development of the MOM model and the study programme was structured so that the detailed results of all these studies is taken into account in evaluating all potential models.

1.2.4 The Study Programme

The study commenced in April 1993 and has been undertaken by an integrated team of 15 Turkish and 17 foreign consultants having a very wide range of disciplines and experience in fields such as irrigation planning, management, engineering, operation and maintenance, agronomy, legal, farmer extension and organisation, sociology, economics, data management, environment and training activities.

The study team is arranged into a long term core team, consisting of a team manager, deputy team manager and seven other long term consultants, and visiting specialists who typically spend one to three months at the project site. The on-site team is supported by headquarters facilities of the respective partners and a six person Panel of Experts, all of whom are internationally recognised in their fields of irrigation expertise and who are active members of the International Commission on Irrigation and Drainage.

The majority of the study has been undertaken at the project office in Şanlıurfa and included visits to various institutions and project sites in the region. The study process undertaken in Phase 1 has included:

(a) Study and review of existing reports, documents, plans and data relating to water resources and agriculture.

(b) Meetings and discussions with staff from GAP RDA, DSİ, GDRS, MARA, farmer organisations, individual farmers and other persons and organisations having some involvement with irrigated agriculture.

(c) An in-country study tour to 12 existing irrigation projects in western Turkey to examine a range of different organisational and operational models.

(d) Consideration of organisational models for irrigation in other countries including a study tour to the Andalusia region of Spain in company with representatives of GAP RDA and other government departments.

(e) Undertaking a socio-economic study of the region including a survey of farmers in selected villages where irrigation is already practised or is likely to be introduced in the near future. This survey was designed to understand more clearly the rural community's perception to irrigation, development and change, personal needs and likely problems. The survey also provided information on existing social structures and attitudes to participating in irrigation management at the local level.

The results of the studies by various specialists have been presented in a series of 22 technical discussion papers which have identified the most important issues to be addressed in deciding the most appropriate MOM model to suit the requirements of the GAP region. These technical discussion papers are presented in accompanying volumes to this report.

The initial findings of the study and the outline of methodology for evaluating and selecting the MOM model was presented to a Workshop conducted in

Şanlıurfa in December 1993. The Workshop was attended by 86 participants from government agencies, academic institutions and other interested organisations from throughout Turkey and they were presented with the initial study findings in terms of objectives, issues and potential models. The participants gathered into six discussion groups for detailed consideration of the issues raised by the consultants. The Workshop process was adopted as an appropriate means of consultation of the complex issues with a widely representative range of expertise prior to making firm recommendations. Some valuable feedback comments were received at the Workshop and these have been taken into account in preparing this report.

The main activities undertaken in each phase of the study are shown on a time based chart in Figure A1.2

1.3 Study Documentation, References and Acknowledgments

1.3.1 Study Library

The study team has assembled an extensive library of textbooks, reports and other documents related to irrigation development and related institutional, management and technical subjects from Turkey and many other countries. The library is located in the project office and contains some 750 items. In order to assist users to readily identify and access the available material all documents are catalogued in a data base which contains details such as title, author's name, subject heading, language (Turkish or English) and short description of the subject material.

1.3.2 Databases and Software

The following software has been used during the course of the study and is stored on the PCs in the project office in Şanliurfa:

- CROPWAT4, a program developed by FAO, has been used in conjunction with climatic and crop data for estimation of the crop water requirements of all the irrigation projects in the Euphrates and Tigris basins. This program uses the Penman-Monteith method of computation of evapotranspiration.

- SPSS (Statistical Package for Social Sciences) software was used for the statistical analysis of data collected during the socio-economic survey.

- IDRISI, a Geographical Information System (GIS) package developed by Clark University in the USA, was used to assist the selection of Pilot Areas and the identification of possible Irrigation Administration Zones.

- ONDA, one of the Halcrow developed HYDRA suite of hydraulic modelling programs, was used for the hydrodynamic simulation of open channel flow in the Urfa-Harran and Çinar-Göksu irrigation schemes.

GAP MOM STUDY ACTIVITY PROGRAMME

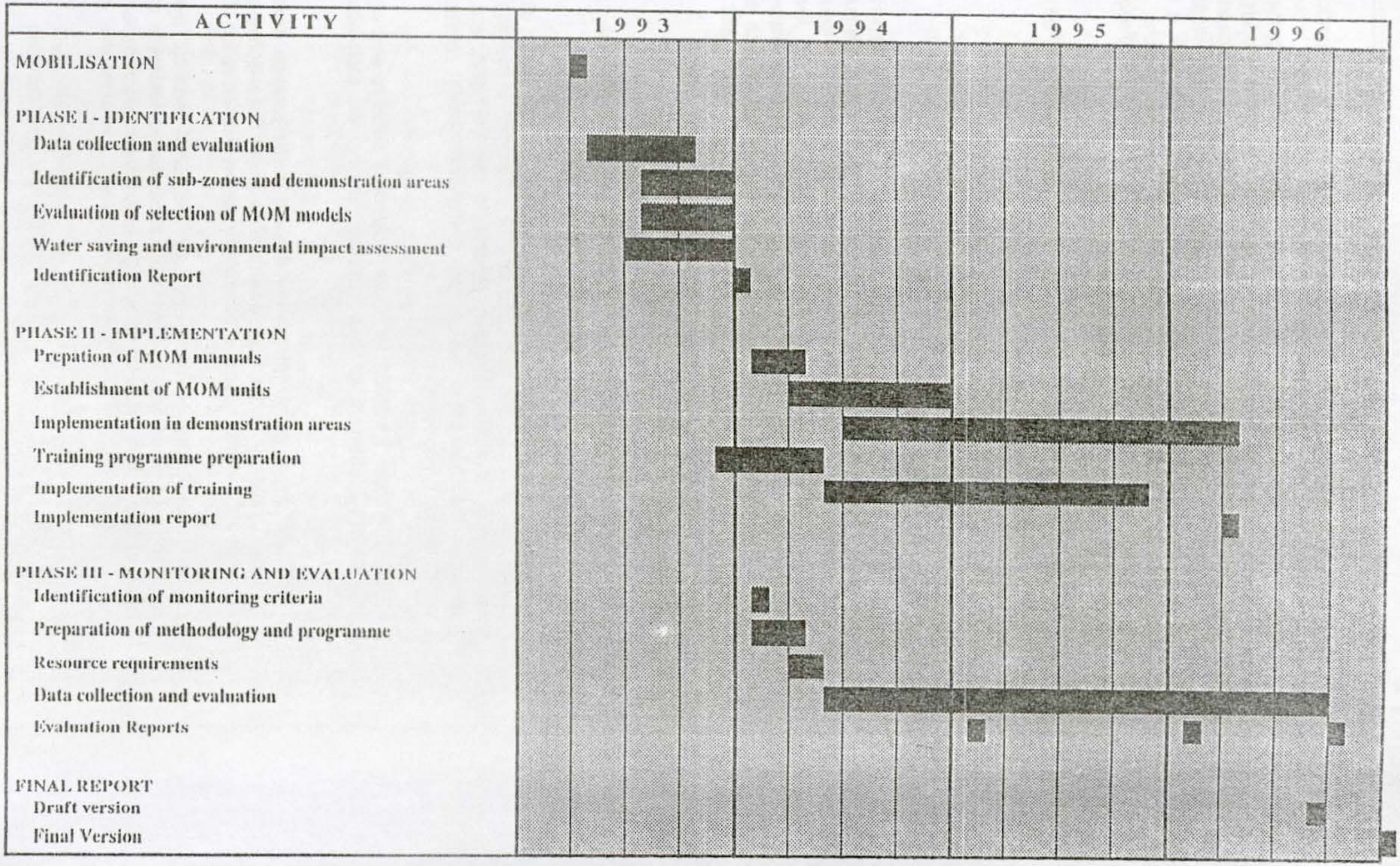


FIGURE A1.2

A Fortran coded program was developed during the study for water resource modelling of the Euphrates and Tigris basins. Multivariate stochastic flow models were constructed for both basins which allow generated cross-correlated flow sequences to be routed through the reservoirs under given demands and operational strategies. Output from the models includes the probability of meeting any fraction of the irrigation demand, probability distribution of power output and the frequency and magnitude of spill under chosen reservoir operational rules.

Other proprietary software used during the course of the study has included:

- DBASE IV for the library database which categorises all textbooks, reports and other data collected during the course of the study;
- WORDPERFECT word processing package for report production;
- HARVARD GRAPHICS for graphics and schematic diagrams; and
- QUATTRO PRO for production of tables and spreadsheets.
- LOTUS 1-2-3 for production of tables and spreadsheets.

1.3.3 Study reports

A total of 22 technical discussion papers have been prepared by study team members reporting on various aspects of the phase 1 studies. The major issues and findings of these papers have been drawn upon in developing the key criteria to be taken into account and applied in the selection MOM models.

The titles of each technical paper are listed in Table A.1.4 and the full texts of each paper are appended in the accompanying volumes to this report. The contents of these volumes are grouped according to general subject matter under the following headings:

- Institutional
- Farmer Support
- Environmental
- Socio-economic
- Irrigation & Drainage
- Water Resources

TABLE A1.4

LIST OF TECHNICAL DISCUSSION PAPERS ISSUED

NO	TITLE	DATE ISSUED
1	Water Charges and Revenue Collection	16 July 1993
2	Agronomic Factors	16 July 1993
3	Assessment of Current Irrigation Projects in Turkey	17 July 1993
4	Review of the Scope for Environmental Studies	27 July 1993
5	Assessment of Potential Impacts upon Ecology	31 July 1993
6	Institutional Framework	31 July 1993
7	Legislation Relevant to Irrigation Development	31 July 1993
8	Impact Monitoring System - Proposed Approach and Implementation	02 August 1993
9	Farmer Support Services	05 August 1993
10	Hydraulic Modelling	07 August 1993
11	Drainage Requirements	07 August 1993
12	Hydrology and Water Resources Modelling	12 August 1993
13	Study Tour of Irrigation Projects in Spain	18 August 1993
14	Planning the Training Programme	24 August 1993
15	Credit and Marketing	24 August 1993
16	Review of Groundwater Resources in the Harran and Ceylanpinar Plains	05 November 1993
17	Environmental Health	24 November 1993
18	Soil Conservation and Water Quality	17 December 1993
19	Socio-economic Studies	17 December 1993
20	Assessment of Current Engineering Designs and Practice	March 1994
21	Potential Environmental Impact of Large Scale Irrigation Development in the GAP Region	March 1994
22	Hydraulic Modelling of Distribution Systems	March 1994

1.3.4 Acknowledgments

The members of the consultant's team have held numerous meetings, discussions and site inspections in the GAP region project area and elsewhere in Turkey during the course of the study. The assistance of staff of the following organisations, at headquarters, regional and provincial directorates and field levels as appropriate, is acknowledged:

Southeastern Anatolia Regional Development Administration
General Directorate of State Hydraulic Works
Ministry of Agriculture and Rural Affairs
State Planning Organisation
General Directorate of Rural Services
Ministry of Environment
Ministry of Health
Çukurova University
Dicle University
Harran University
Middle East Technical University
Union of Turkish Chambers of Agriculture
Akdeniz Irrigation District
Korkuteli Irrigation District
Bozan Irrigation Co-operative
Erzin Irrigation Co-operative

2 DESCRIPTION OF STUDY AREA

2.1 Location

The GAP region is located in the south eastern part of Turkey eastward of the Mediterranean north of the border with Syria and Iraq. The region consists of the provinces of Gaziantep, Adıyaman, Şanlıurfa, Diyarbakır, Mardin, Batman, Siirt and Şırnak. The region covers a total area of 73,863 sq km or 9.5% of the total area of Turkey.

2.2 Topography and Soils

2.2.1 Topography

The GAP Region is encircled to the west, north and east by the southern ranges of the Eastern Taurus Mountains. These rise to over 2,500m within the GAP Region and are most extensive to the east in Siirt and Sirnak. The topography of the region can be subdivided into two main units, the uplands and the plains.

The uplands extend southwards from the Eastern Taurus Mountains. They consist of high, deeply incised mountains around the perimeter of the region; mountain blocks within the region such as Karacadağ (an extinct lava volcano) and Mardin Mountains which separate the Euphrates and Tigris valleys; dissected plains, hill country and lava uplands; and small areas of plains. The latter include areas with relatively low slopes such as Siverek-Hilvan area, and the plains along the Tigris especially north west of Diyarbakır.

The plains occur to the south of the region and extend beyond the international border further south through Syria and Iraq to the Persian Gulf along the Euphrates and Tigris valleys. The largest plains are, from west to east, Suruç, Urfa-Harran, Mardin-Ceylanpınar and Nusaybin-Cizre. Separating the plains are areas of hill country such as Bozova uplift to the west and north of the Urfa-Harran plain and the Tek Tek mountains to the east.

A slope distribution map is included as Figure A2.1.

2.2.2 Soils

The two main soil types of the region are the calcareous brown (mainly in low lying areas) and basaltic soils. Other soil types occur to a lesser extent such as non-calcareous brown, brown forest soils and young alluviums and colluviums.

FIGURE A2.1 SLOPE DISTRIBUTION MAP

The soils are mainly clay loams, fine silty clays and clays. They tend to be slightly alkaline with low levels of phosphorus and organic matter. Permeabilities are relatively high. The soils are not normally saline, although saline soils do occur in some locations.

The soils of the region were classified into eight capability classes in which Classes I to III are suitable for irrigation, but Class IV is only suitable for irrigating certain crops.

Taking the first three classes together Şanlıurfa has 38.1% of land suitable for irrigation, followed by Diyarbakır (22.6%), Mardin (17.9%), Gaziantep (11.4%), Adıyaman (5.9%) and Siirt (4.2%).

Stoniness is a major problem in the region particularly in the area of Karacadağ between Şanlıurfa and Diyarbakır and in Mardin. Erosion by running water is also a serious problem.

2.3 Climate and Agricultural Practices

2.3.1 Climate

The climate of the region is characterised by dry, hot summers and mild to cold but wet winters.

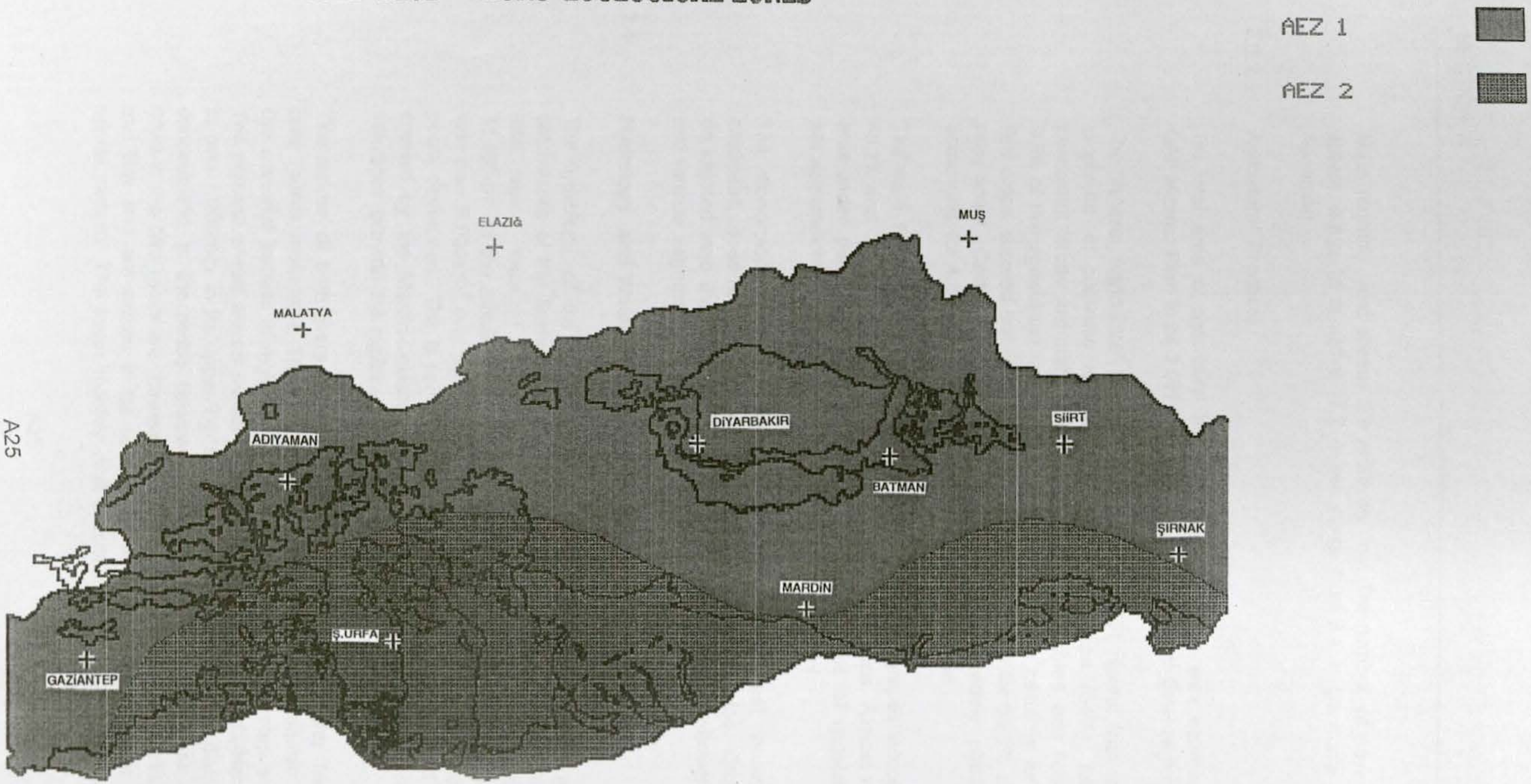
Mean annual rainfall decreases along a north to south transect from over 1200mm in Lice and Sason to 311mm in Akçakale just north of the Syrian border. Mean monthly rainfall is very low between June and September and reaches a maximum in December and January throughout the region. There is a high degree of inter-annual and intra-annual variability.

The region may be considered as two agro-ecological zones as shown on Figure A2.2. Monthly temperatures of the southern locations are 2 to 3°C higher than the northern locations. The average maximum and minimum January and July temperatures for each location are given below:

Location	January Min. °C	July Min °C	January Max °C	July Max °C
South	1.6	22.4	10.0	39.3
North	-0.9	22.0	6.2	36.0

Mean annual potential evapotranspiration rates vary from 1164mm in the north to 1257mm in the south with the highest monthly means occurring in July of 211mm and 224mm respectively.

FIGURE A2.2 AGRO-ECOLOGICAL ZONES



Mean monthly wind speeds are relatively low. The number of days with wind speeds equal to or above 17.2 m/sec range from 3.4 in Şanlıurfa to 16.4 in Adıyaman.

2.3.2 Agricultural Practices

The total area of agricultural land in the GAP Region was estimated in the GAP Master Plan to be 3,081,170ha or 42.2% of the total GAP region.

The General Agricultural Census, undertaken in 1991, found that the greater proportion of cultivated land was sown for field crops (84%), followed by permanent crops and orchards (13%), and then vegetables and flowers (3%). 9.5% of the agricultural land was irrigated. The cropping patterns for the main field crops showed that wheat, barley and lentils account for 86.3% of the total area sown. Cotton and chickpea are the next most widely planted crops accounting for 4.6% and 4.4% respectively of the total area.

The main fruit crops in the region are pistachios and grapes accounting for 45.2% and 35.7% respectively of the area under fruit crops. Almost half of the area under pistachios is in Gaziantep. The largest areas of vegetable crops are watermelons, melons, tomatoes, peppers and eggplant.

The economically important crops of the region are wheat, barley, lentils, chickpeas, sesame, pistachio, vines, sunflower and watermelon. Crops grown on irrigated land include wheat, barley, cotton, maize, lentil, sunflower, melons and various vegetables.

2.4 Hydrology and Water Resources

The hydrology of the GAP Region is almost entirely contained within the catchments of the Euphrates and Tigris Rivers. Runoff from 39,000km^2, of the total region area of 74,000km^2, drains to the Euphrates. 88%, nearly 31,000km^2 of the remaining area drains to the Tigris leaving a residual area of less than 5,000km^2 over the greater part of which the surface drainage is very poorly developed. This is particularly so of the Urfa-Harran plain and the area covered by the Mardin-Ceylanpinar scheme. The Euphrates, Tigris and their tributaries provide the exploitable regional water resource.

The regime of both rivers is dominated by the snow melt in the Taurus and ante Taurus mountains. There is therefore no meaningful relationship between the seasonal pattern of regional rainfall and flow in the Euphrates and Tigris. The regional mean annual rainfall varies from 300mm in the Urfa-Harran plain to over 1,000mm in the upper Tigris catchment and its seasonal distribution is concentrated in the period between October and early April. Peak seasonal flows in the two rivers are, however, confined to a shorter later period in April and May and are related to the seasonal rise in temperature rather than the rainfall pattern. The mean monthly and annual flows from both catchments at the Syrian border are given in the following Table.

TABLE A2.1

MEAN ANNUAL AND MONTHLY FLOWS OF THE EUPHRATES AND TIGRIS AT THE SYRIAN BORDER (Million of Cubic Metres)

MONTH	EUPHRATES AT KARKAMIS/SYRIAN BORDER Catchment Area 102,600km^2	TIGRIS AT CIZRE/SYRIAN BORDER Catchment Area 38,300km^2
October	1,088	357
November	1,310	660
December	1,590	1,080
January	1,920	1,140
February	1,820	1,430
March	3,700	2,610
April	6,910	3,710
May	6,250	3,260
June	2,840	1,630
July	1,350	520
August	1,060	380
September	357	400
	30,600	17,160

The water resources available for development in the Euphrates and Tigris basins is, however, subject to internationally acceptable flows at the border. Hydropower and irrigation are by far the principal forms of resource exploitation, although many of the planned schemes have a water supply component. The available active storage and level of water utilisation at the final stage of GAP development are shown in the following table.

TABLE A2.2

SITE	MEAN ANNUAL FLOW $(mx10^6)$	UPSTREAM ACTIVE STORAGE $(mx10^6)$	WATER UTILISATION $(mx10^6)$
EUPHRATES:			
Keban	20,500	16,800	0
Karakaya	23,700	22,386	0
Atatürk	26,800	42,300	11,903
Birecik	30,600	43,700	14,160
Syrian Border	30,600	43,850	14,160
TIGRIS:			
Cizre/Syrian Border	17,160	16,950	11,523

The locations of the existing and planned storages are shown in Figure A2.3.

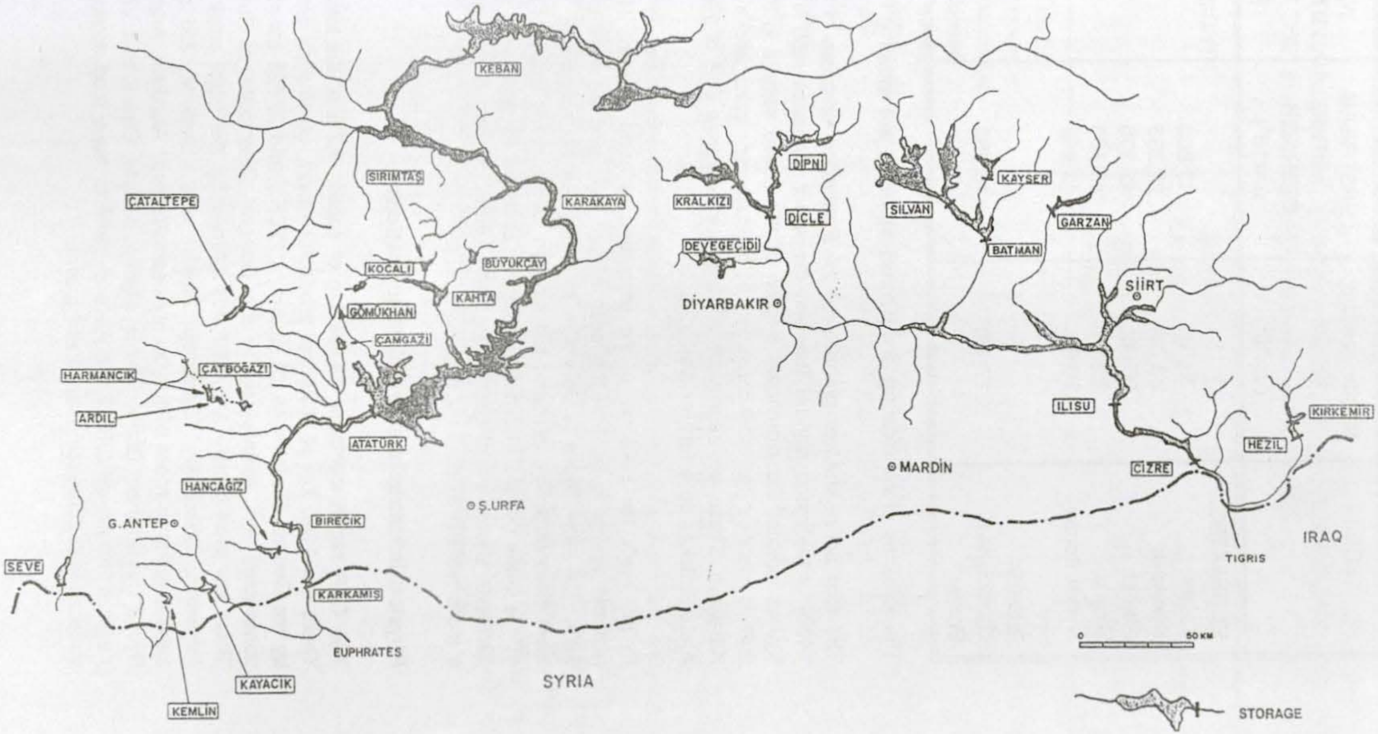
The total active storage planned for the Euphrates upstream of the border is 143% of the mean annual flow and the water utilisation ratio is 32%. These figures indicate the significant fraction of the active storage in the Euphrates that is planned for non-consumptive hydropower, principally in Keban and Karakaya. These two reservoirs will together comprise 51% of the storage and Atatürk makes up a further 44%.

In the Tigris the balance of the resources is quite different. Here the total planned storage is 99% of the mean annual flow, and the water utilisation ratio 68%. The latter figure is very high and may not be sustainable. However the level of consumptive demand is a function of the many facets of irrigation and of the crops grown. Alternative cropping patterns to those used to derive the demands shown would reduce the water utilisation rate in the Tigris system to a more realistic 37%.

2.5 Physical Infrastructure and Communications

The GAP region contains 29,968 km of roads, 9.7% of the total for Turkey. There are 4,345 km of state and provincial roads, constructed and maintained by the General Directorate of Highways (TCK), and 25,623 km of rural roads, constructed and maintained by the General Directorate of Rural Services. There are good quality asphalt roads connecting the major provincial centres, Adiyaman, Diyarbakir, Gaziantep, Mardin and Sanliurfa, and second class asphalt roads to most of the county headquarters, Akçakale, Araban, Batman, Bismil, Ceylanpinar, Cizre, Gercuş, Mardin, Midyat, Ömerli, Siirt, ViranŞehir and Yavuzeli. Nearly all (98%) villages and hamlets have road access, commonly surfaced with compacted sand and gravel.

FIGURE A2.3 The Location of the Storages in the GAP Region.



There are two main railways, totalling 805 km of single track line, operated as part of the State Railway system (TCDD). One line runs along the southern border of the region, passing through Gaziantep and providing connections to northern Syria and north west Iraq. The second links Malatya, Diyarbakir and Siirt. Adiyaman, Mardin, Sanliurfa and Siirt are not directly served by the railway.

There are airports at Batman, Diyarbakir, Gaziantep and Sanliurfa. There are daily scheduled services from Diyarbakir and Gaziantep to Ankara and Istanbul, and several flights a week from Batman and Sanliurfa to Ankara.

Modern telephone services are provided by the General Directorate of PTT, with good local, national and international connections. Telephone services are available in all villages, and a high proportion of farming households have connections.

Postal services are also operated by PTT, with a total of 4,280 postal service units in the GAP region.

State and private radio and TV services are available throughout the region, and the majority of households own receivers.

2.6 Human Resources

The 1990 Population Census recorded 5.2 million people in the GAP region, 9.3% of the population of Turkey. The population of the GAP region increased by 86% from 2.8 million in 1970, a growth rate of about 2.9% per year, and in 1970 was 8.0% of the Turkish population. Diyarbakir, Gaziantep and Sanliurfa contain 63% of the GAP region population, and 40% live in urban settlements of over 50,000. Urban growth rates were 6.2% and rural growth rates were 1.2% per year in 1985 to 1990.

The cultural origins of the population are diverse, including Kurds, Arabs, Turks, and small numbers of Turkomen and Assyrians. Kurdish speakers are the largest group in all provinces except Gaziantep, where Turkish speakers predominate.

The population age structure is very young, with 47% under 15 years, 40% between 15 and 44 and 13% over 44 in 1990. Males account for 51% of the total.

In 1990 60% of the population over six years in the GAP region were literate, which is low for Turkey, but has been improving. Female literacy is 45% and male literacy is 76%.

The 1990 Population Census recorded agriculture is the main employment for males (38%) and females (40%). Labour and artisanal activities employed 27% of males and 18% were unemployed. Agricultural employment varies over the region, with a low of 25% in Gaziantep and a high of 52% in Sanliurfa.

There is emigration from the region, mainly to adjoining provinces, and to the major urban centres and coastal towns. Emigration rates have been reducing. Seasonal migration is common, both for urban (construction) jobs and seasonal agricultural work.

2.7 Institutional Infrastructure

The existing institutions relevant to irrigation in the GAP region are listed below. More specific descriptions of their roles are given in Chapter 4 of this Section and also in Discussion Papers Nos 3, 6 and 9 (Halcrow 1993).

2.7.1 Southeastern Anatolia Project Regional Development Administration (GAP RDA)

GAP RDA's primary role, in irrigated agriculture, is the coordination of the planning and implementation of work programmes by all governmental agencies operating within the region. GAP RDA has its headquarters in Ankara and field operations are managed from the Regional Directorate in Şanlıurfa.

2.7.2 Ministry of Agriculture and Rural Affairs (MARA)

The units of MARA that have direct relevance to the GAP Region are as follows:

(a) General Directorate of Organisation and Support (GDOS)

The Training and Extension departments of GDOS are involved with the GAP-MOM project and its implementation. GDOS has headquarters in Ankara and its field activities are organised at provincial, county and village group levels.

(b) General Directorate of Production and Development (GDPD)

GDPD is responsible for implementing agricultural production through programmes of plant production, livestock development, fishery development, integrated rural development projects and technical cooperation. It is organised in a similar manner to GDOS.

(c) General Directorate of Agricultural Reform (GDARef)

GDARef conducts investigations and surveys to determine the priority of areas to be considered for land reform implementation. GDARef is responsible for managing State owned land and expropriated private land and for carrying out land consolidation in designated implementation areas. GDARef has its headquarters in Ankara and a regional directorate based in Sanliurfa.

(d) General Directorate of Agricultural Research (GDARes)

GDARes administers four research institutes in the GAP Region. These are the Field Crops Research Institute in Akçakale-Şanlıurfa, Southeast Anatolia Agricultural Research Institute in Diyarbakır, Southeast Anatolia Regional Plant Protection Institute in Diyarbakır and Pistachio Research Institute in Gaziantep.

(e) Agricultural Supply Institution of Turkey (TZDK)

This organisation is responsible from the production manufacturing and procurement of all kinds of equipment, machinery, vehicles, pesticides, chemicals, fertilisers and seeds.

2.7.3 Ministry of Forestry (OB)

The Ministry of Forestry has only limited activities in the GAP Region. Gaziantep is the leading province in forest land with 44,370ha, Diyarbakır has only 16,721ha and Adıyaman 11,639ha. The remaining provinces have no natural forest land according to studies by the Ministry of Forestry.

2.7.4 General Directorate of State Hydraulic Works (DSİ)

DSİ is responsible for planning, designing, constructing, operating and maintenance of dams, pumping stations and canals for large scale irrigation systems including all the major infrastructure of the GAP irrigation systems. DSİ has its headquarters in Ankara and Regional Directorates in the GAP area at Diyarbakır, Şanlıurfa, Kahramanmaraş and the Atatürk Dam.

2.7.5 General Directorate of Rural Services (GDRS)

GDRS is responsible for planning, construction and operation of small scale irrigation schemes, preparing and carrying out on-farm development works, in both its own and DSİ schemes, development and efficient use of land and water resources. GDRS also operates 11 agricultural research institutes including one in Şanlıurfa. GDRS has headquarters in Ankara and its field operations in the GAP area are managed by Regional Directorates at Şanlıurfa and Diyarbakır and a Directorate in each province.

2.7.6 Agricultural Bank of Turkey (TCZB)

TCZB is the largest bank of Turkey both in terms of paid-up capital and in the number of branches. It is the main institution for providing agricultural credit.

2.7.7 Ministry of Finance and Customs (MOFC)

The role in respect to irrigation of the Ministry of Finance and Customs is limited to the collection of charges levied on farmers for water supplied by DSİ.

2.7.8 The Union of Turkish Chambers of Agriculture (TZOB)

All of the agriculturally strong counties of Turkey have a Chamber of Agriculture. It is compulsory for every farmer to be a registered member of the Chamber established in his county. Within the GAP Region there are established chambers in most counties except within the provinces of Şırnak and Siirt.

2.7.9 Universities and Other Research Institutes

A number of universities carry out agricultural research activities and a leading example is Çukurova University based in Adana. The GAP RDA in 1989 commissioned this university to establish a research facility at Koruklu, south of Şanlıurfa, to undertake research specifically for the GAP Region. The University of Harran, in Şanlıurfa, is also supported by the GAP RDA to carry out research activities on crops grown in the region.

2.7.10 Existing Water User / Farmer Organisations

There are three main types of water user groups operating in existing irrigation schemes in other parts of Turkey. These are: irrigation groups, irrigation districts and irrigation co-operatives and are described in 4.3. However within the GAP region there are very few water user organisations, the only ones known to be functioning being three irrigation groups in DSİ projects at Hancağiz (two groups) and Ceylanpinar (one group).

2.8 Socio-economic Conditions

Social organisation is similar across the GAP region, with traditional tribal structures developed for nomadic lifestyles giving way to village structures to accommodate settled farming. Tribal leaders have retained power and influence through ownership of large farms and involvement in local or national politics. Landlords are an important feature of rural society and are found in about half of the villages.

Villages are generally small, 86% have less than 1000 inhabitants, and 56% less than 500, and control between 500 and 3000 ha of land. Agriculture is the major economic activity, providing 70% of employment. Most households have both dryland crop enterprises and livestock. Landless households are common and these usually undertake sharecropping with landowners, who often reside outside the village. Land renting is also found, but is less common.

2.9 Existing Irrigation Development

In Turkey, DSİ and GDRS are the two governmental organisations which are responsible for planning, designing, constructing, managing and financing irrigation and drainage systems separately or jointly. In general, small groundwater irrigation projects implemented jointly by these two organisations are transferred to irrigation cooperatives for their operation and management. GDRS develops small scale irrigation projects with water supply capacity of up to 500 l/s DSİ is responsible from the development, construction, operation and maintenance of irrigation and drainage networks of larger water resources (over 500 l/s water supply).

To date, DSİ and GDRS have developed 70,364ha of irrigation which is currently operational in the region. The irrigation projects constructed, operated and maintained by DSİ are shown below:

Project	Province	Commenced Operation	Area(ha)
Devegeçidi	Diyarbakır	1972	6,900
Batman	Diyarbakır	1972	7,590
Gözegöl	Diyarbakır	1963-1980	1,000
Halilan	Diyarbakır	1982	550
Kırkat	Batman	1986	350
Hanok	Mardin	1971	250
Nusaybin	Mardin	1958	6,900
Akçakale*	Şanlıurfa	1977	14,200
Ceylanpinar*	Şanlıurfa	1978	9,000
Keysun	Adıyaman	1985	1,950
Hancağiz	Ğaziantep	1989	6,250
Total			54,940

* Akçakale and Ceylanpinar are supplied from groundwater and the remainder from surface sources.

DSİ and GDRS have jointly constructed small scale irrigation projects having an irrigation area of 15,424 ha and these schemes have been transferred to local organisations or farmers.

3 STUDY RATIONALE AND OBJECTIVES OF THE MOM MODEL

3.1 The Need for a MOM Model

Irrigated agriculture is the foundation for sustained development of the GAP region. If it fails to perform up to expectation, this will seriously weaken the economic base of the region and threaten the sustainability of the rapid development that is now taking place.

The country has already invested in infrastructure for some 4 million hectares in the country as a whole and is currently engaged in another massive drive to bring a further 1.7 million hectares under irrigation in Southeastern Anatolia. The operation and maintenance of the existing irrigation systems is already placing a severe strain on DSİ and the national resources. The additional demands of the newly developed areas will become an excessive burden. The consequence will inevitably be that limited resources are required to be spread over a wider area, with a consequent fall in the standard of system management, operation and maintenance and the quality of technical support provided to the farmers. This in turn will result in falling levels of service, reduced efficiency of water use and lower crop production. As the farmer's ability to pay for the services reduces, so the quality of the services falls further and the downward spiral continues. This can be reversed only by means of fundamental changes in the institutional structure, aimed at ensuring that the farmers' management ability is fully utilised and resources as a whole are used most effectively in order to maximise water use efficiency and crop production.

The situation in Southeastern Anatolia is exacerbated by a general shortage of water in relation to the area of irrigable land available. At the same time many existing schemes suffer from high water losses in the distribution systems, much of which can be attributed to insufficient resources being available for maintenance. At the farm level, irrigation use is in many cases not as efficient as it could be due to sub-optimal investment in land preparation at the implementation stage and only very limited availability of technical advice for the farmers on efficient irrigation methods. Such inefficient use of a scarce resource is not only contrary to the primary objective of maximising agricultural production in an equitable manner but will also lead in time to degradation of the land resources. Most of these difficulties arise from constraints inherent in the present institutional framework and can be affectively addressed only through a basic reform of the structure.

The completion of the Atatürk dam and the imminent completion of the Şanlıurfa tunnels, which will convey 328 m^3/s of high quality water to the fertile Harran plains, means that there will be a rapid increase in the area under irrigation over the next ten years. The need for identifying the most appropriate MOM model for irrigated agriculture in the region in advance of this quantum growth is recognised by all concerned agencies. However, this large scale development can tend to mask the fact that of the 1.7 million ha of planned irrigation, some 480,000ha will comprise schemes and sub schemes of less than 20,000ha. Of these approximately 11% percent of the area will be in schemes of less than 10,000 ha. In this category, 11 schemes serving 55,000ha are already commissioned. The need for an appropriate MOM model applies as much to these medium and small schemes as to the large schemes. Moreover the benefits can be realised more rapidly.

3.2 Overall Institutional Framework

Figure A3.1 illustrates the current institutional framework, with DSİ playing the central role of planner, designer, implementer and operator of irrigation schemes larger in area than about 1,000 ha. Smaller schemes are the responsibility of the GDRS. Prior to the creation of the GAP Administration, government agencies tended to function independently with little effective coordination of their activities in the field, although a forum for coordination does exist in the form of the Provincial Coordination Committees chaired by the respective Governors. More recently the GAP Administration has been given the task of coordinating all development activities in the region and this has had some beneficial effects in relation to agricultural research and non farming activities. However, in relation to irrigation development, the general philosophy remains typically one of top down management with a low level of farmer participation at the planning and design stage and limited sense of accountability within the government agencies (although many of the professional and technical staff show a high level of dedication individually). A sense of "ownership" of the irrigation system amongst farmers is generally lacking with consequent little motivation to look after the infrastructure and a general culture of short-term interests predominating.

The perception of delegates attending the Workshop in Sanliurfa on 7-8 December was that there was lack of coordination between the Universities and other agencies engaged in research and perhaps more seriously, there was only a weak linkage with the farmers' actual requirements. Furthermore the mechanisms for the transfer of the results of the research to the farmer were at present inefficient. One suggestion was that a single body should be made responsible for coordinating all research and training and this matter should be addressed positively.

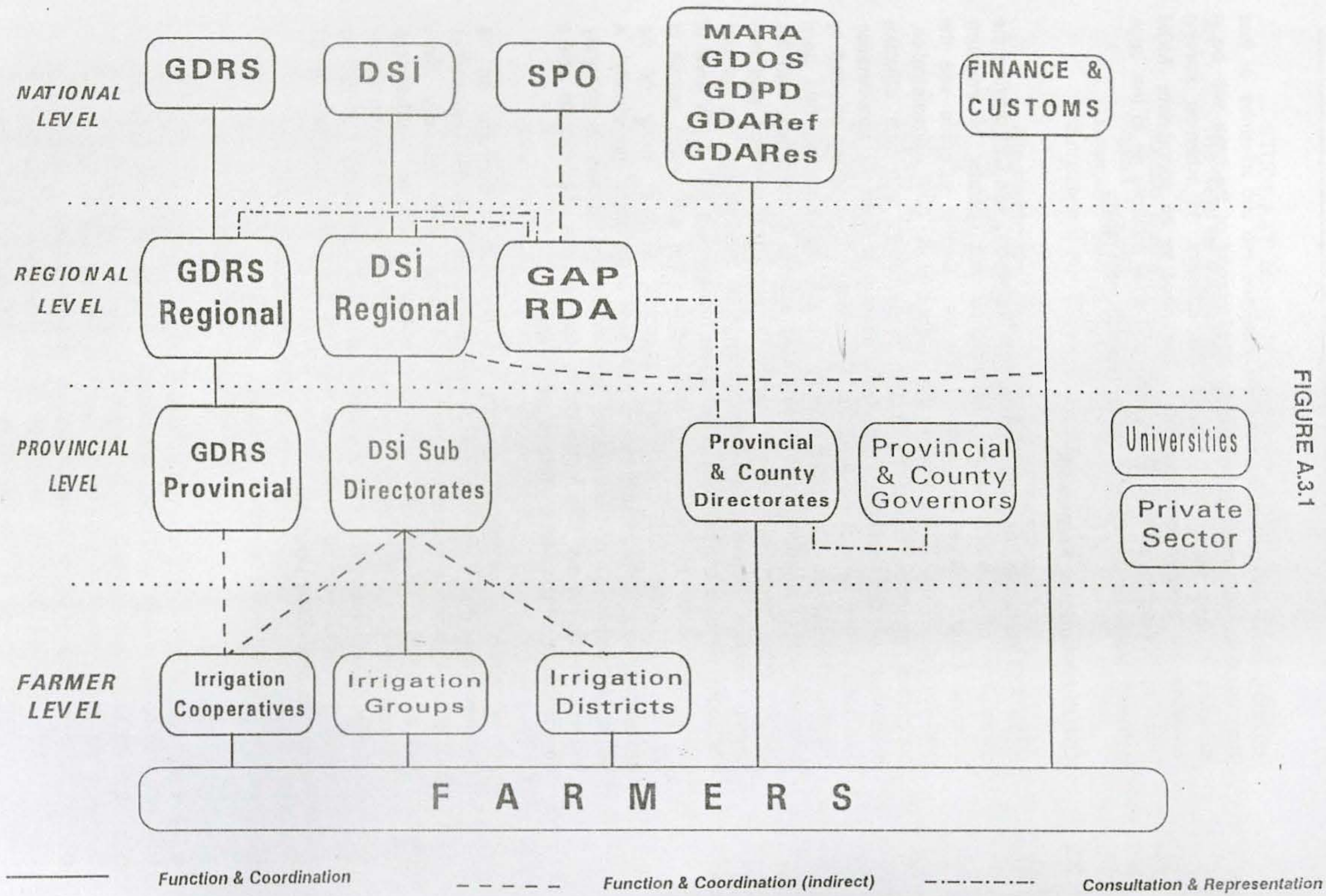

GDRS
DSİ
SPO
MARA
GDOS
GDPD
GDARef
GDARes
FINANCE &
CUSTOMS
NATIONAL LEVEL
REGIONAL LEVEL
GDRS Regional
DSİ Regional
GAP RDA
PROVINCIAL LEVEL
GDRS Provincial
DSİ Sub Directorates
Provincial & County Directorates
Provincial & County Governors
Universities
Private Sector
FARMER LEVEL
Irrigation Cooperatives
Irrigation Groups
Irrigation Districts
F A R M E R S
Function & Coordination
Function & Coordination (indirect)
Consultation & Representation

FIGURE A.3.1

These communication difficulties have a negative impact on farmers' confidence in the quality of service that the government agencies can supply. The situation is further exacerbated by the arrangements for the collection of water charges; although DSİ is responsible for operation and maintenance of the infrastructure of the larger schemes, the responsibility for collection of water charges is vested in the Ministry of Finance. The farmers' perception is that there is no direct link between these two activities and thus there is little or no social pressure on defaulters to pay their charges. Moreover the extended lines of responsibility within the government mean that legal sanctions are in practice seldom applied. The result is that cost recovery rates are typically as low as 10 percent which is in marked contrast to those situations where farmer groups set and collect contributions for tertiary, and in some cases secondary, level operation and maintenance, where cost recovery rates are typically very high.

The ideal institutional framework will thus be one that;

- develops a sense of ownership amongst the farmers,
- encourages them to utilise their management talents to their own and the nation's advantage, while providing them with the information, skills and support that they require in order to maximise their productivity.

Within this framework there must be a management structure that:

- assigns clearly defined responsibilities to different entities, and individuals within those entities,
- ensures that there is minimal overlap and that the capacity to undertake those responsibilities is in place and continuously maintained or improved.
- provides at the same time clear descriptions of the interfaces between these core entities and other regional and national bodies and establishes arrangements to facilitate communication, coordination and accountability between them.

Finally, the legal provisions that will enable the framework to be established and to function must be identified and amendments to the existing legislation implemented and new legislation promulgated.

The following section describes the concept of the MOM model in more detail.

3.3 Definition of the MOM Model

3.3.1 The Scope of the Overall MOM Model

The model description needs to cover the following aspects:

- The Institutional Arrangements which describe the major organisational entities, their form (e.g government department, authority, cooperative etc) and their functions, responsibilities and interdependencies.
- The Organisational Arrangements describing the lines of communication, coordination, accountability and responsibility between the entities.
- The Management Arrangements which describe the organisational structures of the key entities, the systems and procedures that they will follow and the resources and skills that are required.
- Guidelines for planning, designing, operating and maintaining the physical infrastructure.
- Guidelines for good on-farm practices.
- Guidelines for manpower resource development (e.g training programmes, training materials etc).
- Performance Monitoring and Evaluation System with arrangements for the feedback of the evaluation in the form of modifications to the guidelines and management arrangements.
- Description of the enabling legislation required for the implementation of the institutional and management arrangements and for implementation and enforcement of the guidelines.

All these aspects are addressed in later parts of this report.

3.3.2 The MOM Management Model

The MOM Management Model is a description of how the management of operation and maintenance of irrigated agriculture systems may best be organised for the particular conditions pertaining to the GAP region. This continuous process is distinct from the time bound events such as the planning and design of irrigation and drainage systems, which though very important to the efficient operation of the systems, have a finite life and do not have to be sustained beyond the implementation period. As such this continuous management process, or MOM Management Model, is the core activity which must be properly established and efficiently sustained if the objectives of the GAP MOM study are to be fully realised.

In institutional terms, the scope of the MOM Management Model may be defined as shown on Figure A3.2 The primary element of the model consists of three principal components (also referred to as levels or layers): the Farmer Groups, the Irrigation System Operating Body and the Supplier of Bulk Water, each with its distinct function and organisational characteristics.

It is the selection of the most appropriate and effective institutional form for each of these core components that is critical and which has therefore been the focus of the model selection process.

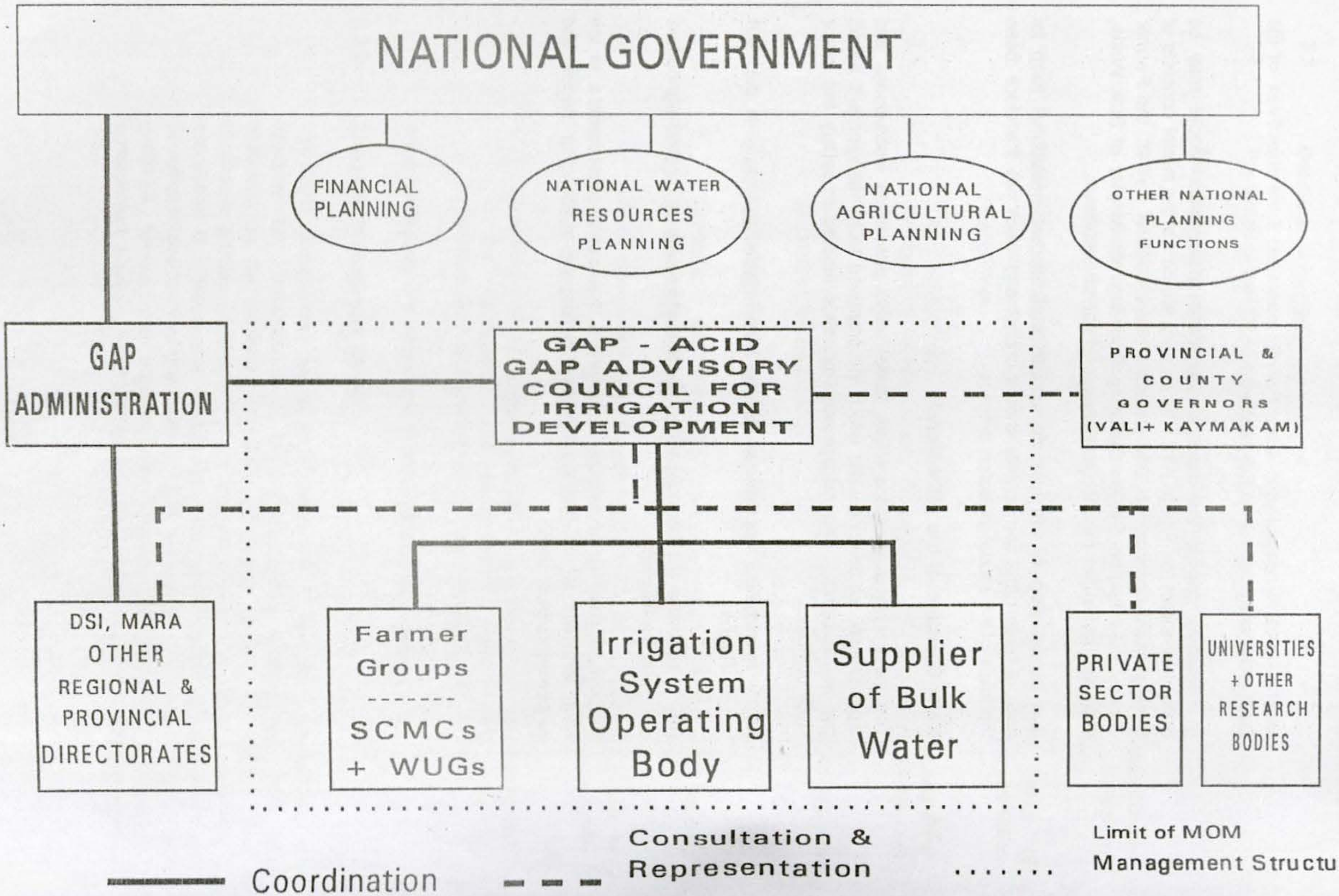
3.4 Major Objective of the MOM Model

The major objective of the MOM Model is to provide an institutional and organisational framework within which the proposed MOM management model can be replicated. The management model is required to satisfy the major study objectives:

(a) to maximise net benefits derived from irrigated agriculture in the GAP Region

(b) to ensure the financial and physical sustainability of irrigated agriculture in the Region;

Moreover it must be a management system that can be implemented in the short term and which has the flexibility to respond to changing needs and requirements over time.


NATIONAL GOVERNMENT
FINANCIAL PLANNING
NATIONAL WATER RESOURCES PLANNING
NATIONAL AGRICULTURAL PLANNING
OTHER NATIONAL PLANNING FUNCTIONS
GAP ADMINISTRATION
GAP - ACID
GAP ADVISORY COUNCIL FOR IRRIGATION DEVELOPMENT
PROVINCIAL & COUNTY GOVERNORS (VALI+ KAYMAKAM)
DSI, MARA
OTHER REGIONAL & PROVINCIAL DIRECTORATES
Farmer Groups

SCMCs + WUGs
Irrigation System Operating Body
Supplier of Bulk Water
PRIVATE SECTOR BODIES
UNIVERSITIES + OTHER RESEARCH BODIES
Coordination
Consultation & Representation
Limit of MOM Management Structure

FIGURE A.3.2

3.5 Fundamental Requirements

The model that is to meet the stated objectives has to satisfy a number of fundamental requirements. It has to provide:

(a) **optimal returns to land and water** - in this region water is the scarcer resource and in order to maximise benefits it will be necessary to optimise the returns achieved per unit of water; the land is effectively a non-renewable resource of great value whose productive capability must be carefully safeguarded for future generations;

(b) **overall financial sustainability** - irrigation is dependent on well maintained and operated infrastructure; unless irrigated agriculture produces sufficient financial surplus so that an adequate proportion can be directed to this operation and maintenance the system efficiency will deteriorate, productivity will fall and a downward spiral of degeneration will result. The surplus should also be sufficient to permit investment in research and improvements to farming practices so that productivity is not only maintained but improved and the quality of life for those resident in the area is enhanced;

(c) **protection of national interests and resources** - if the development of the region is to be sustained then it must be carried out in a manner that is compatible with the preservation of the national resources, both in terms of quantity and quality, and that does not conflict with national interests; the model must contain provision for assessing and monitoring such impacts and for planning and managing measures for mitigating negative trends;

(d) **social harmony** - the objectives of maximising production and ensuring sustainability can only be realised in an environment of social harmony;

(e) **equitable allocation of water at all times and particularly in times of scarcity** - equitable allocation of water is not only in the interests of social harmony but it is closely linked to the improvement of water use efficiency which is in turn a prerequisite for the maximisation of returns and financial and physical sustainability;

(f) **optimal mobilisation of the total manpower resources of the Region in terms of skills, experience, enterprise and labour** - this has to be an objective of any management system seeking to maximise net returns; manpower resources are as essential for production as water and land and a goal of good management is to make best use of all available resources;

(g) **the capacity to develop skills and capability to meet the growing demands of the Region as development takes place** - skills have to be taught and capability developed through practical experience; institutions, specially trained persons and teaching aids are needed for this purpose and specific provision has to be made for these; such training must be recognised and implemented as a continuous process and not a solitary event linked with the initial establishment of the model;

(h) **flexibility so that the systems may respond to change** - development is a dynamic process and the management system must be flexible enough to respond to the changing needs and requirements and to be able to absorb and benefit from improved technology and knowledge.

Above all else the Model must be implementable under the actual conditions pertaining to the region in relation to the institutional, legal, cultural and physical characteristics and constraints.

Finally, for the management system to be organisationally functional and efficient in meeting the targets that have been set, it must consist of certain physical attributes and exhibit some well known but elusive characteristics. These are described below.

3.6 Essential Characteristics

The management of irrigated agriculture is a commercial enterprise that shares much in common with any business. Resources have to be procured and managed, investment in infrastructure made, quality assured and output marketed. Any efficient and successful business organisation must have structure, systems and skills. The management structure defines functions, assigns responsibilities and lines of communication. Without structure there can be no accountability, redundancy of activity is endemic and motivation is low.

The systems describe the day to day processes that have to be followed in order to achieve the objectives of the business; they may take the form of written procedures, manuals and protocols. It is becoming increasingly common to formalise these into a quality assurance system with the basic operating philosophy and policies set out in the Quality Manual. Routine audits ensure that procedures are being correctly followed and that modifications are introduced to reflect changing requirements. In the context of the GAP MOM model the systems may be seen to include the legal provisions and such aspects as the policy for setting water and drainage charges.

Skills required to operate the business are the third essential ingredient; these may be partially bought in and enhanced through training. If the business is concerned with creating a product that has to be marketed, as is the case with irrigated agriculture, then research and development has to be added as a fourth prerequisite for success.

These three elements alone will create a functional entity but, in order that the business be performed efficiently, it is necessary that the human resources employed are developed and mobilised to the full. Training will improve technical and managerial skills and can be effective in encouraging persons to recognise the advantages of teamwork. It is equally important that the organisational structure is designed in order to facilitate those attributes which maximise the effectiveness of any group endeavour: motivation, accountability, communication and coordination. Implicit is that levels of responsibility have been clearly defined so that all functions are fully covered without redundancy and duplication.

Another principle that is rapidly gaining ground in many countries, particularly with respect to service organisations, is that of the supplier/customer relationship. The concept aims to establish a strong relationship between the supplier of a service and the end-user or customer in order that the level of service provided meets the actual demands in a cost-effective manner. Although the supplier may be in possession of a higher level of knowledge about the service that he is supplying, the principle that the supplier knows best is rarely found to be true in practice. It is not uncommon for service organisations to provide an unnecessarily high level of service in one area and below standard in other areas; this is inefficient for both supplier and customer. The best combination is usually one of cooperation in which the customer defines his requirements and the supplier then offers the best service that is practicable in order to satisfy those requirements. In the particular business of the supply of water, which is to some extent unpredictable due to the stochastic nature of the primary supply, the level of service will define the target pattern of delivery and set out the degree of uncertainty involved and the response to shortfalls in the supply. The customer and the supplier are encouraged to cooperate in order to minimise the adverse impact of such periods of difficulty. This is a more flexible and effective approach than the more legalistic alternative of a formal supply contract, which encourages an adversarial relationship and time and resources spent unnecessarily, and unproductively, on legal procedures. Recourse to legal sanctions should be seen as the final fall-back position when all other means of reaching a mutually acceptable outcome have been exhausted.

Accountability and motivation together form a powerful force for the realisation of the full potential from human resources. Accountability may take numerous forms from the legal to social but the principle of incentive to perform to expectation or to fulfil a prescribed function is common to all. Some form of sanction in the event of failure to perform is implicit and this may take the form of peer pressure or a more formal action. Motivation is a more positive concept and arises from either pecuniary incentive or a sense of ownership and common cause. Participation in decision making can often contribute to motivation.

Communication and coordination are perhaps the most essential requirements for any effective organised activity. The two are distinct activities but coordination without communication is not feasible, while communication without coordination is ineffective. Horizontal communication, between entities at the same institutional level is the most important with regard to coordination but vertical communication, between the end-user and the primary supplier or between the system manager and the producer is essential for the efficient matching of demand and supply and ensuring that research and development is properly addressing the actual requirements. Vertical communication is also important for fostering a sense of participation, ownership and common purpose, which in turn is a strong contributor to motivation and cooperative action. Failure to realise effective vertical communication may be seen as a major contributor in many examples worldwide of development that has failed to come up to expectation; often attributable to weaknesses in the planning and design of the system that could have been avoided if more effective channels for communication had been in place.

The model to be selected for replication in the GAP region should incorporate these essential characteristics in addition to satisfying the fundamental requirements that were described earlier.

Other essentials for the implementation of the model are the skills and resources required or the facilities for generating those skills, which in itself will require physical, financial and trained manpower resources .

3.7 Enabling Environment

At the institutional level, the legal framework is akin to the systems that are an essential element of an organisation. It establishes the basis for existence and describes the functions and responsibilities of public organisations and, through rules and regulations, sets standards to be met and limits on the behaviour and actions of both public and private sector entities and individuals. In addition, it provides guidelines for resolving disputes and provides sanctions that can be applied in order to promote compliance with the rules and regulations.

Any new organisational and management model must therefore be consistent with the legal framework. If the legal framework is inadequate suitable amendments to the legislation, perhaps involving new legislation where unavoidable, must be implemented. In the interests of early implementation of the model, the need for such changes should be minimised but not at the expense of selecting the best long term model. In practice the major constraint is likely to be the political acceptability of changes in the law and it is this that will be a key factor shaping the model.

4 EXISTING MOM PRACTICES IN TURKEY

4.1 The Institutional Framework

Irrigated agriculture in Turkey involves a range of organisations at central, provincial, municipal and village administration levels as well as farmer organisations and various private sector bodies. In this section the roles of the main organisations are outlined together with descriptions of typical management practices. Some comments are made on the relationship between the different organisations and the strengths and weaknesses of the existing practices.

Detailed accounts of the activities of most of these organisations is given in Technical Discussion Papers Nos 3 and 6 (Halcrow 1993). The roles of each are summarised in the following sections.

4.2 The Roles of Existing Institutions

4.2.1 Southeastern Anatolia Project Regional Development Administration

The Southeastern Anatolia Project Regional Development Administration (GAP RDA) was formed in 1989 as an autonomous body from within the State Planning Organisation (SPO), which is the responsible agency for preparation of Five Year Development Plans and related Annual Programs. The GAP region covers the eight provinces of Gaziantep, Şanlıurfa, Adıyaman, Diyarbakır, Siirt, Mardin, Batman and Şırnak. The primary role of GAP RDA is the co-ordination of the planning and implementation of work programs by all governmental agencies operating within the region. However, the GAP Administration's co-ordination responsibility does not extend to intervention during the implementation phase to modify the work programmes of other agencies.

In relation to irrigation development, GAP RDA co-ordinates the activities of the water, rural services, agricultural and research agencies described in this section. It is understood that the role of GAP RDA in relation to agencies which are subject to Provincial Administrative Law is to be strengthened (GAP, 1993).

4.2.2 Ministry of Agriculture and Rural Affairs

The Ministry of Agriculture and Rural Affairs (MARA) has a number of General Directorates and units responsible for various activities in relation to primary production and agriculture throughout Turkey. MARA and its General Directorates have their headquarters in Ankara and field activities are organised at provincial, county and village levels. The provincial and county directorates come under the Provincial Administration Law which influences programme priorities. The units of MARA of direct relevance to the GAP region are as follows:

(a) General Directorate of Organisation and Support

Two of the seven departments of the General Directorate of Organisation and Support (GDOS) are involved with the GAP MOM project and its implementation. These are the Training and Handcrafts Department and the Extension Department.

The Training and Handcrafts Department is responsible for the organisation of in-service (on-the-job) training of MARA staff and also assists the Extension Department with farmer training.

The Extension Department is responsible for extension services which are carried out through the respective provincial directorates and county and village administrations. The Department also conducts skills analyses and in service training for its extension staff.

Extension services in the region are supported by a major project known as the Applied Research and Extension Project (TYUAP) which is funded by the World Bank and IFAD and includes the GAP region. TYUAP Phase I, implemented from 1984 to 1990, covered 18 provinces, with a budget of US$205 million for infrastructure and services. Three provinces of the GAP region: Diyarbakır, Mardin and Şanlıurfa were covered by this phase.

TYUAP Phase II runs from 1990 to 1997 with a budget of US$113.5 million and the scope has been extended to cover the remaining GAP provinces of Gaziantep, Batman, Adiyaman, Siirt and Şirnak. TYUAP, therefore, covers all those areas where GAP MOM Pilot Areas will be located.

In summary the aims and objectives of TYUAP are to: increase agricultural production; provide additional on farm employment: provide employment in agro-industries created: introduce new crop and animal husbandry technologies: provide a model for extension to other provinces.

TYUAP supports provincial and county extension departments by strengthening research and training and the provision of technical information from local and overseas institutes. Farmer contact by the extension services is focused on the Village Group Technician (VGT), who is in turn supported by Subject Matter Specialists (SMS) at county and provincial level. Immediate supervision of VGTs is undertaken by the County Directors and the Extension Supervisors. Extension personnel practise the Training and Visit (T&V) system of extension, which forms a three-way linkage between research institutes, extension and farmers. The work programmes are intended to accommodate all of the T&V components through leader/contact farmers or farmer groups.

Leader/contact farmers are expected to pass information to other farmers in their village.

VGTs receive monthly refresher training from SMSs while the latter receive specialist training every two months under the "Consultation, Knowledge Give and Take" system (İBAV). This training is undertaken by the staff of the South East Anatolia Research Institute and other researchers in order to keep informed about current research programmes, conclusions and recommendations. During this training programme feedback from farmers is intended to be relayed via VGTs to SMSs and to the relevant research staff.

(b) General Directorate of Production and Development

The General Directorate of Production and Development (GDPD) is responsible for implementing agricultural production through programs of plant production, livestock development, fishery development, integrated rural development projects and technical co-operation. Some activities of an extension nature are also carried out by GDPD for various projects. GDPD is a possible source of trainers to be used as subject specialists in various training programmes and is also able to design various integrated projects and programs for on-farm systems.

GDPD is organised in a similar manner to GDOS with a central headquarters in Ankara and field operations organised at provincial, county and village levels. Subject matter specialist staff of GDPD are appointed according to the agricultural requirements of particular areas.

(c) General Directorate of Agricultural Reform

The General Directorate of Agricultural Reform (GDARef) was established in 1985 to implement the Agricultural Reform Act Concerning Land Arrangement in Irrigation Areas (1984). GDARef conducts investigations and surveys to determine the priority of areas to be considered for land reform implementation. Once such a land reform area has been identified and accepted, GDARef is responsible for managing State owned land and private land expropriated in designated implementation areas and for carrying out programmes of land consolidation in these implementation areas, including allocation of land to beneficiary farmers. It also provides equipment, support and training for land allocated farmers. While promoting efficient land use and increased agricultural production, GDARef consolidates land into more economic units.

The GAP Region is one of the implementation areas under this Act and the process of land reform and consolidation is a very important component of the new irrigation developments.

GDARef is organised with a headquarters in Ankara and seven regional directorates one of which is located in Şanlıurfa.

(d) General Directorate of Agricultural Research

The General Directorate of Agricultural Research (GDARes) is responsible for the administration of some 52 agricultural research institutes and experimental stations throughout Turkey. The individual research institutes and stations vary in discipline, staffing, facilities and size according to the crop/livestock requirements of their locality.

Four of these research facilities are in the GAP region. These are Field Crops Research Institute at Akçakale-Şanlıurfa, Southeast Anatolia Agricultural Research Institute at Diyarbakır, Southeast Anatolia Regional Plant Protection Research Institute at Diyarbakır, and Pistachio Research Institute at Gaziantep.

Apart from their applied research activities the staff of these institutes are experienced in a number of disciplines and are a valuable resource as trainers of extension workers and farmers.

(e) Agricultural Supply Institution of Turkey

The Agricultural Supply Institution of Turkey (TZDK) was established in 1944. It is under the jurisdiction of the Ministry of Agriculture and provides the technical production inputs of Turkey's agriculture. It undertakes the following tasks in accordance with the policies set by MARA:

- Production and manufacture of equipment, machinery, vehicles, pesticides, related chemicals and fertilisers and to procure seeds from local and foreign markets for sale either by cash or on credit paid in instalments.

- Establishment and operation of agricultural, industrial, commercial institutions or enter capital equity and business partnerships with other institutions in these fields.

- Operation of repair shops.

- Processing and sale of material which is left over from production and manufacturing.

The Agricultural Supply Institution has 25 Regional Directorates and 356 Section Directorates throughout Turkey. The Section Directorates are mainly located in the agriculturally important counties of Turkey. It also has seven Agricultural Machinery Operating Enterprises, an Agricultural Machinery

Research Institute and an Agricultural Implements and Machinery Manufacturing Plant manufacturing tractors and implements.

The Institution distributes local and imported fertilisers, agricultural chemicals, seed and agricultural machinery and equipment through its widely dispersed Section Directorates. It is the main source supplier of such material for the Agricultural Credit Cooperatives. It also acts as a price regulating outlet for such supplies.

4.2.3 Ministry of Forestry

The Ministry of Forestry has four main service units, these being the General Directorates of: Afforestation and Erosion Control; National Parks and Game Wildlife; Forest and Village Relationships; and Forestry.

The Ministry of Forestry conducts its activities in Turkey through 19 Regional Directorates of Forestry. Within the GAP region Gaziantep is the leading province in forest land with 44,370ha (5.8% of its total land). Diyarbakır, including Şırnak and Batman, has 16,721ha, and Adıyaman has 11,639ha. Siirt, Mardin and Şanlıurfa have no natural forest land, according to the Provincial Land Use Studies conducted by the General Directorate of Rural Services.

The demand projections for wood products in Turkey by the year 2000, is expected to reach 10 million cubic metres, out of which 6 million cubic metres will be for poplar. The fast growing characteristics of poplar species, their varieties, cultivars and hybrids make them very competitive trees to be grown economically on irrigated land, especially when intercropped with annual or perennial forage crops during the years of initial plantation. The Regional Directorate of Forestry at Şanlıurfa is the main focus for forestry activities in the GAP region. It has established a poplar plantation trial in Şanlıurfa which will be closely observed and the economics tested, to identify if poplar production can compete with other agricultural commodities, especially under a double cropping system.

4.2.4 General Directorate of State Hydraulic Works

The General Directorate of State Hydraulic Works (DSİ) is within the Ministry of Public Works and Settlements and is responsible for planning, designing, constructing, operating and maintenance of dams, pumping stations and canals for the larger scale irrigation systems, defined as those with supply capacity greater than 500 l/s DSİ also has responsibility for planning, designing and implementing works for hydroelectricity, flood control, swamp reclamation, river training and water supply to cities over 100,000 population. DSİ is one of the major investing agencies of National Budget funds in Turkey.

DSİ also can make arrangements for the operation of schemes which will be transferred to other authorities after construction. The establishment law of DSİ provides a broad basis for it to transfer irrigation O&M and on-farm development activities to individuals, companies, associations, groups, municipalities, villages, districts and co-operatives. To date such transfers of DSİ works have been limited to the irrigation groups, irrigation districts and co-operatives described in 4.3 below.

DSİ has its headquarters in Ankara and field operations are managed from 25 regional directorates covering the whole of Turkey. The GAP irrigation region extends over the three DSİ regional directorates of Diyarbakır (Region X), Şanlıurfa (Region XV) and Kahramanmaraş (Region XX). In addition DSİ Region XVI manages the Atatürk Dam and Hydroelectric Power Station.

Being organised on a regional basis, DSİ is able to operate in a fairly autonomous manner and is not subject to the requirements of the Provincial Administration Law.

4.2.5 General Directorate of Rural Services

The General Directorate of Rural Services (GDRS) was established in 1985 by incorporating the Soil Conservation and Irrigation Organisation (TOPRAKSU), the Rural Settlement Organisation and the Rural Roads, Water and Electricity Organisation into one organisation as one of the six general directorates of the Ministry of Agriculture and Rural Affairs. In July 1993 GDRS was separated from MARA and attached to the Prime Ministry. It is likely to form the base for a new ministry although this has not been finalised.

GDRS is responsible for:

- Planning, construction and operation of smaller scale irrigation schemes (less than 500 l/s supply capacity);
- Preparing and carrying out on-farm works, in its own and DSİ schemes, including supply and drainage works, quaternary canals, land levelling, land consolidation, sub-surface drainage, infrastructure improvements, etc;
- Establishment of organisations to undertake activities for the benefit of land protection, land rehabilitation and irrigation;
- Construction of rural and forestry roads;
- Development and efficient use of land and water resources by farmers including related research, surveys and other services;
- Provision of settlement services;

- Preparation of plans and construction of domestic water supply, electricity and sewage facilities for villages and settlements;
- Preparing and implementing agricultural projects on State owned land;
- Promotion of the utilisation of agricultural lands;
- Reclamation of saline, acidified and alkaline lands;
- Construction of buildings, workshops, laboratories, research stations and other facilities for the above responsibilities.

GDRS also operates 11 research institutes including one at Şanlıurfa.

GDRS has headquarters in Ankara and its field operations are managed at both regional and provincial levels with 19 regional directorates and a provincial directorate in all 76 provinces.

4.2.6 Agricultural Bank of Turkey

The Agricultural Bank of Turkey (TCZB), established in 1864, is set up as a State Economic Enterprise and operated as such under the Prime Ministry. It is the largest bank of Turkey both in terms of paid up capital and in the number of its branches, with over 1000 in Turkey and in various major cities of the world.

TCZB is recognised as the main institution for agricultural credit in Turkey. However, it is estimated that in general only two thirds of all the agricultural credit is institutionalised credit. Very limited information is available about the remaining one third which is from non-institutional sources with very high interest rates. Although the main channel for institutional credit is the TCZB, in recent years credit funds have also started to flow through other institutions such as the Meat and Fish Institution, the Milk Industry Institution, the Agricultural Supply Institution, the Sugar Factories Corporation and the State Monopolies.

TCZB has three major channels of credit available to farmers. These are its own local branch offices, the Agricultural Credit Cooperatives (ACC) and the Agricultural Marketing Cooperatives (AMC). Agricultural credit is mainly processed in two thirds of the 1000 local branch offices of TCZB. The remaining branches are in large cities and their main activities are commercial ones like any other bank.

Throughout the country, TCZB offers two types of loan schemes. The Conventional Agricultural Credit (CAC) includes operational and investment loans for a variety of purposes. However CAC reaches only about 700,000 farmers and the same farmers who have proved to be reliable in repayment continue to receive this short term credit. Since land mortgage is generally a prerequisite, more than 3.1 million farmers are not eligible for these credits due to lack of proper land title.

The Supervised Credit Program (SCP) is a development oriented scheme of considerably less magnitude than the CAC. TCZB is also involved in other credit projects, directed towards individual farmers, but these are usually limited to certain areas or limited in scope.

The funding of credit operations of Agricultural Credit Cooperatives comes from the TCZB. The main objective of ACC is to supply its 1.3 million members with operational credit.

The Agricultural Marketing Cooperatives have about 0.5 million members who receive credit as only a supplementary service generally given as short term development credits. The main task of AMCs is to market the produce of their members particularly to the export markets. Some 90% of the funds loaned to AMC by the TCZB, is used to finance the marketing operations.

TCZB has been giving special emphasis on the development of GAP, and has been working on different models to be implemented for the credit allocation system. The establishment law of TCZB specifically stresses that it should favour small farmers. However the bank generally prefers medium or large farmers, due to the difficulties faced in collecting the repayment.

4.2.7 Ministry of Finance and Customs

The direct role in respect to irrigation of the Ministry of Finance and Customs (MOFC) is limited to the collection of charges levied on farmers for water supplied by DSİ. The amount of water charges is calculated by DSİ for each farmer while the rendering of accounts and collection of money due is carried out by MOFC officers, who are usually based in the DSİ regional offices.

4.2.8 The Union of Turkish Chambers of Agriculture

There is a Chamber of Agriculture in most of the counties of Turkey that are strong in agriculture. The local chambers are linked by a Union of Turkish Chambers of Agriculture (TZOB) which is located in Ankara.

It is compulsory for every farmer to be a registered member of the Chamber established in his county. Each Chamber is governed by a general assembly and a Council elected by the members. The Ankara based Union has a general assembly formed from delegates elected by each province. The Union is effective in policy development related to agricultural issues in Turkey and is usually invited to attend all decision generating meetings.

Within the GAP Region there are established Chambers in most counties except within the Provinces of Şırnak and Siirt. These bodies are an important and influential means of consultation to assist development of joint policies related to the implementation of the GAP irrigation systems.

4.2.9 Universities and Other Research Institutes

A number of universities carry out agricultural research activities. One of the major ones in relation to irrigated agriculture is Çukurova University based at Adana. The GAP Administration in 1989 has commissioned this university to establish a research facility at Koruklu, south of Şanlıurfa, to undertake research specifically for the GAP region. Research conducted for over four years has started to yield particular information for the species and varieties to be grown under irrigated conditions.

The University of Harran, at Şanlıurfa, is also supported by the GAP Administration to carry out research activities on crops grown in the Harran Plain.

4.3 Existing Water User/Farmer Organisations

4.3.1 Introduction

There are three main types of formal water user groups operating in existing irrigation schemes. These are irrigation groups, irrigation districts and irrigation cooperatives and they have been formed to undertake operation and management of schemes designed and implemented by DSİ and/or GDRS. Both DSİ and ĞDRS are empowered to transfer such responsibility to local management control provided that there is some form of corporate body available to undertake it. Other bodies undertaking such functions include municipalities, village administrations and universities although these are not specifically formed as user groups.

In recent years DSİ has been endeavouring to transfer a number of its smaller schemes to one of the various forms of local management control. Up to 1993 some 192 such transfers had been finalised including 17 to irrigation districts, 71 to municipalities, 99 to village administrations, two to universities and five to irrigation co-operatives. Similarly since GDRS has no specific organisational arrangements or funding for O&M of the irrigation systems it constructs, in recent years it has transferred a large number of such schemes to local management most commonly irrigation co-operatives.

The role and activities of the irrigation groups, irrigation districts and irrigation cooperatives are outlined below. The legal basis for their establishment is discussed further in Chapter 5.

4.3.2 Irrigation Groups

Irrigation groups are established in DSİ managed schemes to take responsibility for water allocation to individual farmers and to perform simple maintenance. Groups can be organised on a single village basis under administration of the village headman, (the "muhtar") or an elected group leader. There are currently 987 irrigation groups carrying out O&M in 600,000ha of existing projects.

The major activity of a group is to perform the allocation of water flows within the tertiary distribution canals to individual farmers. The group employs one or more ditchtenders who collect details of water requirements or water orders from each individual farmer, calculate the total flow need for the tertiary system and liaise with the DSİ canal operation staff to provide this flow into the part of the canal system under group control. The group ditchtender then allocates and supervises distribution of the available flow to each farmer.

The groups also carry out collectively some of the simple maintenance tasks to the canal system such as weed and silt removal. The amount of maintenance performed is limited to tasks requiring use of manual labour or normal farm equipment. Larger tasks such as replacing damaged canalets or major structure repairs are carried out by DSİ.

DSİ allows the groups to collect an amount between 12% and 25% of the annual water charge and use it to cover the cost of their services. Collection rates of the group's proportion of the charge is usually high, as much as 100%, even in schemes where the collection of the DSİ share is low.

During the course of the study the consultants have met with representatives of several groups and discussed their activities. It is apparent that the effectiveness of any group depends very much on the motivation and leadership qualities of the group leader. Some groups indicated a willingness to undertake a greater degree of local control although they are constrained in this to the extent that DSİ still owns the assets and makes all major decisions in regard to policy or system development.

While the performance of groups is variable they usually provide more effective interaction with individual farmers than is possible in the schemes where there are no groups.

4.3.3 Irrigation Districts

DSİ has the authority to transfer full responsibility for management, operation and maintenance of its canal distribution systems to other bodies having corporate status. One such body developed over the past 20 years is the "irrigation district" having a wider scope of activity and greater autonomy than the irrigation groups. Irrigation districts are formed under the legal basis of the

Municipality Law No 1580 of 1930, Village Law No 442 of 1922 or Farmer Properties Law No 4081 of 1941.

The irrigation district so established is managed by a local executive committee elected by the farmers. It employs its own staff who generally undertake the whole range of water supply operation and most maintenance tasks required for the canal system under its control. The district boundaries usually comprise a discrete canal system so the works often include primary and secondary canals in addition to tertiaries.

The irrigation district executive prepares its own budget and sets water charges although these are subject to DSİ approval. It also has the right to collect water charges, impose fines and make contracts to perform necessary works. DSİ still has management control of any dams and river diversion works serving the district. DSİ also retains ownership of the assets although the district is required to repay original investment cost of these assets over a 25 to 30 year period.

There are 17 irrigation districts the largest being Korkuteli of 5,000ha. This form of management has been reasonably effective for schemes up to the size of Korkuteli.

4.3.4 Irrigation Co-operatives

Formation of an "irrigation co-operative," usually before commencement of a scheme, provides a greater measure of local control than for irrigation groups or irrigation districts. The capital works are generally constructed by DSİ and/or GDRS. The co-operatives are required to repay original investment costs incurred by DSİ and following completion of repayment they become owners of the works. Farmers have not so far been required to repay investment cost made by GDRS although it is understood that there is a policy decision to do so in the future. Co-operatives are well suited to groundwater or smaller scale surface supply schemes up to a few hundred hectares in size.

Irrigation co-operatives are established under the general Co-operatives Act, No 1163, for which the Ministry of Agriculture and Rural Affairs (MARA) has recently issued a new draft standard instrument of incorporation This defines their purpose as the acquisition, operation and maintenance of agricultural irrigation systems built or to be built by the State.

A co-operative is governed by a committee elected by the members who usually consist of all those farmers served from the scheme. The executive employs such staff and carries out all necessary O&M tasks necessary to meet its responsibilities as set out in its articles of incorporation. The co-operatives enjoy a much greater degree of autonomy in matters such as setting and collecting water charges and managing their routine O&M activities than either the irrigation groups or irrigation districts described above.

Irrigation co-operatives are in fact the most numerous formal irrigation body in Turkey with 13,880 constituted throughout the country managing a total area of some 1,118,000ha mostly in small schemes. 903 of these co-operatives, with an irrigation area of 245,320ha, are for groundwater schemes developed jointly by DSİ and GDRS.

4.4 The Role of the Private Sector

4.4.1 General

The role of the Union of Turkish Chambers of Agriculture has been described in 4.2.8. There are also a number of other private sector bodies involved in agriculture in the region as indicated below. These have mainly been established to meet the requirements of dryland agriculture and it can be expected that with the expansion of irrigation there will be a corresponding increase in the number and range of private sector organisations to meet the specific technical, agronomic and marketing needs of irrigated agriculture.

4.4.2 Input Suppliers

(a) Fertiliser Suppliers: These companies sell their products through agents in all provinces and counties.

(b) Irrigation equipment: Items such as sprinkler and drip systems, syphons etc are sold through agencies in most provinces who also provide some training for farmers in the use of their equipment.

(c) Tractors and harvesters: There are agents for major brands in most provinces.

(d) Farm equipment (plough, disc harrow, drill etc): These are produced by relatively small manufacturers throughout Turkey, with the most developed industry being in western Turkey. The farm equipment industry in Gaziantep is in the development phase and it can be expected that it will also expand in provinces such as Şanlıurfa, Diyarbakır and Mardin.

(e) Chemicals (pesticides, herbicides and fungicides): The products of national and international companies are sold through agencies in each province which may also be agencies for seed supply companies.

(f) Seeds: Various seed suppliers market their products through agencies at province level. The agencies also provide an extension service for the products.

4.4.3 Commercial Traders

Various traders purchase produce direct from farmers to sell to agro-industry or other buyers. These bodies also include wholesale merchants who purchase farm produce and sell to markets and retail outlets. In other cases individual farmers bring their own produce, such as perishable foodstuffs, direct to markets.

4.4.4 Agro-industry

At present there are some flour mills and oil processing plants in provinces and at some county levels. It is expected that the variety of such industry will be enlarged into areas such as tomato paste, jams etc with increase in the range of irrigated crops.

4.5 Typical MOM Practices in Turkey

4.5.1 Introduction

DSİ and GDRS are the main agencies involved in planning and implementation of new irrigation projects in Turkey. DSİ is responsible for developing the medium and large projects with water supply capacity of above 500 l/s, which equates roughly to an irrigated area greater than 500ha. GDRS is responsible for smaller projects and also prepares designs for and implements on-farm irrigation and drainage works both in its own and DSİ projects Some projects, such as those involving supply from groundwater, are developed jointly by DSİ and GDRS.

DSİ assumes the responsibility for the operation and maintenance of headworks, primary, secondary and tertiary canals in most of the projects it has constructed. Responsibility for the training of farmers in water handling and irrigation application techniques is carried out by the Extension Services Department of GDOS.

By comparison with DSİ, GDRS has no ongoing role or funding to manage the O&M of schemes it initiates and consequently these are transferred to some form of local management control upon completion. Many of these are transferred to the irrigation cooperatives described in 4.3.4 while others are transferred to municipalities or other village groups.

4.5.2 Operation in DSİ Managed Projects

As at 1993 DSİ had under its direct management control a total of 218 irrigation projects with a total command area of some 1.3 million hectares of which the actual irrigated area was 890,000 hectares. The great majority of these schemes are supplied by gravity from large dams or river diversion weirs with distribution to farms via lined "classic" canals or above ground concrete flumes known as canalets for which DSİ has well established operating procedures. Supply to individual farms is generally by syphon tube from canalets or through a slide gate where it is taken from a canal.

In all the large gravity irrigation projects, water application to crops is generally by surface flooding methods using furrow or basin systems. Water for each application is ordered one or two days in advance by farmers, with DSİ staff aggregating orders for tertiary and secondary canals to determine the total required releases from storage and flows at each canal offtake. There are some flumes and weirs for flow measurement in the larger canals although the more common measurement of canal flow is by staff gauge in a uniform section for which a rating table is available. Measurement at canal offtakes is also possible using single or double orifice doors. In practice it is understood that relatively few routine flow measurements are made and operating staff tend to adjust canal flows according to their past experience. No attempt is made to measure volumes of water supplied to individual farms, although it is possible to obtain an approximation of flow rates for distribution purposes from the number of syphons employed or measurement of gate openings.

Within the tertiary supply systems, DSİ has been encouraging the formation of irrigation groups, described in 4.3.2 above, to undertake some of the O&M activity on its behalf. These groups now cover about 50% by area of DSİ schemes and generally play the major role in managing the water distribution allocation and distribution to individual farms.

The majority of higher value horticultural crops are still irrigated by basin or furrow methods. A change to more efficient application methods is now occurring in some areas. For example, in the Seyhan project about 10% of horticulture is now irrigated by sprinkler and drip methods, nearly all the drip systems coming in the past two years. With increasing areas of greenhouse production of vegetables and fruit, this trend to drip systems is likely to continue. By contrast the large areas of horticulture at Manisa and Menemen are all still irrigated by furrow and basin.

In systems where there are periodic water shortages, especially at times of peak demand it is common to introduce some form of ration or rostering. Details of how the rosters operate vary according to crop type and other local factors which are determined in conjunction with irrigation groups where they exist.

In schemes where water supplies are usually adequate, it is common practice for irrigation to cease overnight with excess flows being discharged to outfalls or ponded in low lying lands. This is a major contributor to excessive water use and low overall efficiency. It has become a long established custom in many areas and is a very difficult practice to overcome once it becomes entrenched.

Irrigation efficiencies, calculated as the theoretical crop water requirement for the planted area expressed as a percentage of water released into the distribution system, range from 30% to 50%. Irrigation ratios, defined as the area actually irrigated expressed as a percentage of total command area, averages 67% over all DSİ projects and varies from as low as 1% up to 100%. In most cases these ratios generally fall well below the expectations of scheme proponents.

Cropping and planting patterns are determined solely by the individual farmer. In areas where a single crop dominates this can lead to water shortages during peak demand. At Devegecidi and Hancağiz in the GAP region, cotton now represents over 90% of the irrigated crop and the theoretical peak July water requirement is much greater than the main canal capacity, leading to water rationing and a significant decrease in crop yields.

Similar water distribution procedures usually apply in projects supplied by pumping, both from surface and underground supplies. However the arrangements are often simpler and more project specific than for the larger and more complex gravity systems. Pumps deliver water either into a tertiary canal system or to a pressurised pipe system. Water ordering procedures commonly require one day notice. As the cost of energy for pumping is a very significant item, up to 70% of total O & M costs, managers are conscious of the high cost of operating and maintaining pumping equipment and the operating rules reflect this fact. In the bore supplied areas water is often delivered from a single pump to individual farmers in rotation based on the time of usage. This is a logical and reasonably equitable allocation basis in such cases where the operating rules are best determined according to the circumstances of each particular scheme.

4.5.3 Operation of Other Projects

The general operating procedures in the smaller projects managed by irrigation district, irrigation co-operatives or other bodies are usually similar to those in the DSİ projects, although often less formalised and designed to suit the particular system characteristics and farming needs. In several projects managed by irrigation co-operatives where supply is drawn from groundwater, quite specific rules have been devised to optimise pump use and minimise costs. Supply is delivered to individual farmers on a timed rotation basis with the time of supply used to calculate payment.

4.5.4 Maintenance

(a) DSİ Projects

Maintenance works on the primary and secondary canals is carried out by DSİ for which it uses its own direct labour force and has a large pool of service vehicles, mechanical plant and equipment. The main maintenance activities include removal of weeds and silt from canal waterways, repairs to canal linings and structural repairs to canal regulators, bridges and canalets. Routine maintenance of tertiary canals and canalets such as desilting, weed control and other minor works is performed by irrigation groups where they exist. Larger works, such as repairing broken canalets, are usually performed by DSİ. Where there are no irrigation groups DSİ has the responsibility for maintenance although this may have lower priority than for maintenance of the primary and secondary systems.

(b) Other Projects

Most of the smaller organisations do not have a permanent workforce or a large equipment pool for maintenance activities. Such works, if of a minor or routine nature, are usually performed by temporary workers or labour contributed by the farmers. More complex maintenance works requiring higher levels of skills or large resources of labour and equipment require the use of contractors or another large organisation. In this regard DSİ carries out some more complex maintenance works such as bore repairs and rehabilitation on a contract basis for co-operatives.

4.5.5 Water Charges

In projects directly managed by DSİ water charges are calculated each year to recover the majority of the previous year's operation and maintenance cost, without inflation adjustment, plus a small component of past investment cost in some schemes. The schemes are divided into five groups, three for gravity supplies and two for pumped supplies according to relative income levels of the groups and a tariff schedule is set for each group on a charge per area for each crop grown. The DSİ schedule of water charges for 1993 is shown in Table A4.1. Typical 1993 water charges were: cereals 18,000TL/da, sugar beet and cotton 45,000TL/da and citrus 90,000TL/da. In the pumped schemes water charges are higher, often about double the charge for a comparable crop in a gravity district. Various discounts and rebates are available; for example, for multiple cropping in a season, application by drip or sprinkler and also if serious crop loss occurs. Where an irrigation group is established to carry out some operation and maintenance, a discount of around 12% is made by DSİ which can be increased up to 25% in special cases. The irrigation groups then have the right to charge and collect this corresponding amount directly from the farmers.

TABLE A.4.1: 1993 OPERATION, MAINTENANCE AND ANNUAL INVESTMENT WATER PRICE TARIFFS

IRRIGATION AND RECLAMATION PROJECTS WHERE OPERATION AND MAINTENANCE COSTS ARE COLLECTED

IRRIGATION PROJECTS

GROUP 1.	Ayrancı,Eleşkirt,Kars,Akyaka,Göynük,Karakoçan,Van,Erciş,Muradiye,Karasu,Arıncık,Malazgirt, Bulanık,Ahlat,Yıldızırmağı,Gemerek,Maksutlu,Yapıaltın,Suşehri,Karaçomak,Germeçtepe,Gökçeada.
GROUP 2.	Bursa,Demirtaş,M. Kemalpaşa,İzmit,Akalan,Hasanağa,Akpınar,Eskişehir,Sarıcakaya,Çifteler, İnönü,Ömerköy,Pamukova,Kütahya,Yaralı,Seyitgazi,Söğüt,Tavşanlı,Çavdarhisan,Çumra,May, Sille,Gebere,Atlantı,İvriz,Gevrekli,Uluırmak,Altınapa,Gödet,Mürted,Bolu,Düzce,Köprüköy, Asartepe,Çorum,Alaca,Kızılgeçit,Tokat,Erbaa,Niksar,Amasya,Suluova,Uluköy,Yerkozlu,Zile, Ortaköy,Artova,Çitli,Erzincan,Iğdır,Kuzova,Malatya,Yazıhan,Akçadağ,Doğanşehir,Erkenek, Polat,Gayt,Suçatı,Devegeçidi,Gözegel,Halilan,Hanok,Batman,Kırkat,Nusaybin,Süloğlu, Altınyazı-Karasaz,değirmenci,Kocadere,Keşan,Kayalıköy,Hayrabolu,Güneşkaya,Sarımsaklı, Zamantı,Ağcaşar,Kovalı,Çoğun,Kültepe,Bozkır,Fehimli,Yahyasaray,Boğazova,Karataş,Belenli Karamanlı,Yalvaç,Yılanlı,Seyitler,Selevir,Karakuyu,Çıldırım,Yenişarbademli,Göksun,Keysun, Hancağız,Kınık,Çelikhan,Işıklı,Irgıllı,Kelekçi,Balıkesir,Halkapınar,Karakol,Karacaören, Alidemirci,Bigadiç,Sındırgı,İbirler,Savaştepe,Çanakkale,Ezine,Koyunyeri,Fındıklı,Değirmenli, Kocabey,Apagut.
GROUP 3.	Bergama,Menemen,Manisa,Saruhanlı,Turgutlu,Adala,Alaşehir,Sarıgöl,Seyhan,Ceyhan,Haruniye, Yuvarlaklı,Kesiksuyu,Kozan,Berdan,Silifke,Anamur,Kırıkhan,Varsak,Aksu,Köprüçay,Manavgat, Alara,Alanya,K.Maraş,Andırın,Topçam,Söke,Akçay,Nazilli,Sarayköy,Çürüksu,Fethiye,Kestap
GROUP 4.	Bursa YAS,Orhangazi,Keramet,Boyalıcı,İznik,Karacabey,Ulubat,Çifteler,Sarıcakaya,Kütahya, Karaağaç,Pamukova,Ömerköy,Tavşanlı,Alakova,Ilgın,Köprüköy,Kalecik,Gökçeören,Asartepe,Bolu, Kumbaba,Tokat,Erbaa,Amasya,Suluova,Yerkozlu,Erzincan,Uluova,Malatya,Eyüpbağları, Palu-Kovancılar,Kirişhane,Küplü,Karasaz,Sarımsaklı,Taşhan,Sarıhıdır,Elmalı-Kışla,Mursal, Akçakale,Ceylanpınar,Atabey,Barla,Yılanlı,Senirkent,Gelendost,Hoyran,Karataş,Selevir, Karakuyu,Çıldırım,Boğazova,Yenişarbademli,Kalealtı,Topçam,Aydın,Karaçomak,Balıkesir,Bigadiç, Sındırgı,Savaştepe,Çanakkale.
GROUP 5. (Pompaj)	Menemen,Turgutlu,Alaşehir,Seyhan,Misis,Haruniye,Berdan,Mersin Bahçeleri,Erdemli, Silifke, Aydıncık,Samandağ,Varsak,Köprüçay,Bucak,Manavgat,Alara,Sağrın,Karabük,Alanya

RECLAMATION PROJECTS

GROUP 6.	Marmaracık,İznik,Civaşir,Eleman,Gebekilise,Lütfiye-Sarısu,Satılmış,İhsaniye,Sığırcık-Buzluca, Yenidoğan,Tespihli-Rüstemler,Karakamış-Akçınar,Ahmediye-Cobran,Açakamış, Çarksu-Memba,Demirbey-İcbariye,Gökçeören,Simav,Kurşunlu,Aynaz,Amik Ovagelemiş,Kestel,Emen,Sağlık Ovası,Ekinambarı,Kumkale.

IRRIGATION AND RECLAMATION PROJECTS WHERE ANNUAL INVESTMENT COSTS ARE COLLECTED

GROUP 7.	May,Sille,Ortaköy,Kars,Gözegöl,Halilan,Zamantı,Muradiye,Karasu,Malazgirt,Bulanık,Ahlat, Yıldızırmağı,Gemerek,Maksutlu.
GROUP 8.	Eskişehir,İnönü,Yaralı,Kütahya,Çumra,Atlantı,Mürted,Köprüköy,Erzincan,Iğdır,Kuzova, Karakoçan,Malatya,Göynük,Batman,Çoğun,Kültepe,Bozkır,Kanlıdere,Van,Erçiş,Arıncık, Yalvaç,Selevir,Çıldırım,Işıklı,Karaçomak,Balıkesir.
GROUP 9.	Bursa,M. Kemalpaşa,Ulubat,Karamet,İvriz,Kalecik,Gökçeören,Asartepe,Bolu,Düzce,Çorum, Kumbaba,Kızılgeçit,Erbaa,Amasya,Uluköy,Süloğlu,Değirmenci,Altınyazı-Karasaz,Keşan, Kocadere,Macidiye,Atabey,Boğazova,Senirkent,Gelendost,Karataş,Çanakkale.
GROUP 10.	Menemen,Alaşehir,Ceyhan,Kesiksuyu,Misis,Berdan,Mersin Bahçeleri,Aydıncık,Kırıkhan,Aksu, Manavgat (P),Söke,Nazilli,Sarayköy,Fethiye.
GROUP 11.	İznik.

TABLE A.4.1 : 1993 OPERATION, MAINTENANCE AND ANNUAL INVESTMENT WATER PRICE TARIFFS. (Continued)

NO	CROPS	OPERATION & MAINTENANCE COSTS (TL/da)						ANNUAL INVESTMENT COSTS (TL/da)				
		IRRIGATION					RECLAMATION	IRRIGATION				RECLAMATION
		GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8	GROUP 9	GROUP 10	GROUP 5
1	Cereal	9000	13000	18000	32000	41000	3300	300	450	600	750	200
2	Pulses	21000	26000	34000	58000	73000	3300	300	450	600	750	200
3	Melons	19000	24000	30000	53000	66000	3300	300	450	600	750	200
4	Sugarbeet	28000	36000	45000	79000	97000	3300	300	450	600	750	200
5	Cotton	28000	36000	45000	79000	97000	3300	300	450	600	750	200
6	Tobacco	26000	34000	41000	73000	92000	3300	300	450	600	750	200
7	Anise	26000	34000	41000	73000	92000	3300	300	450	600	750	200
8	Groundnut	28000	36000	45000	79000	97000	3300	300	450	600	750	200
9	Sunflower	17000	21000	26000	45000	56000	3300	300	450	600	750	200
10	Opium	17000	23000	28000	47000	60000	3300	300	450	600	750	200
11	Flower Garden	39000	51000	62000	109000	137000	3300	300	450	600	750	200
12	Flax, hemp, Jute	15000	19000	24000	41000	53000	3300	300	450	600	750	200
13	Sesame	17000	21000	26000	45000	56000	3300	300	450	600	750	200
14	Corn	15000	19000	24000	41000	53000	3300	300	450	600	750	200
15	Rice, Sugarcane	73000	90000	112000	199000	247000	3300	300	450	600	750	200
16	Nursery	11000	15000	19000	32000	41000	3300	300	450	600	750	200
17	Fig	26000	34000	41000	73000	92000	3300	300	450	600	750	200
18	Grape	17000	23000	28000	47000	60000	3300	300	450	600	750	200
19	Olives	17000	21000	26000	45000	56000	3300	300	450	600	750	200
20	Orchards	41000	51000	64000	111000	139000	3300	300	450	600	750	200
21	Strawberry	36000	43000	54000	96000	120000	3300	300	450	600	750	200
22	Citrus	58000	71000	90000	156000	195000	3300	300	450	600	750	200
23	Banana	96000	120000	150000	262000	330000	3300	300	450	600	750	200
24	Vegetables	38000	47000	60000	103000	129000	3300	300	450	600	750	200
25	Potatoes	23000	30000	38000	64000	79000	3300	300	450	600	750	200
26	Onion, Garlic	21000	26000	32000	56000	71000	3300	300	450	600	750	200
27	Fodder	15000	19000	23000	39000	51000	3300	300	450	600	750	200
28	Poplar, Eucalyptus, Forest	23000	30000	38000	64000	79000	3300	300	450	600	750	200
29	Out of season Irrigation	9000	11000	15000	26000	32000	-	300	450	600	750	-
30	Pasture	4000	6000	8000	13000	15000	-	300	450	600	750	-
31	Mills	1462000	1462000	1462000	-	-	-	-	-	-	-	-
32	Brick Plants	1096000	1096000	1096000	1705000	1705000	-	-	-	-	-	-
33	m3 water price (TL/m3)	37	47	58	105	129	-	-	-	-	-	-

In DSİ projects the overall level of water charge collection, as a percentage of the total amount due, has been below 50% in recent years amounting to only 32.4% in 1991 and 33.2% in 1992 (DSİ 1993). Actual collection rates vary from near full collection in Eskisehir Region, 88% at Aksu, and 60% at Soke to low figures of around 20% or less in other areas. By comparison near 100% collection rates are claimed by many irrigation groups for their share of the DSİ charge.

In the irrigation district schemes, described in 4.3.3, the management board establishes an annual O & M budget and sets annual water charges to recover this cost, plus any past investment cost. DSİ must approve the estimates and proposed charges which cannot be higher than in a comparable DSİ scheme. Irrigation co-operatives are free to set their own level and basis of water charges which must be adequate to cover all their costs. Many co-operatives involve groundwater supply for which electricity and pump maintenance are significant costs. Typical of these are systems where supply is given to each farmer on a time basis. At these schemes a separate charge per pumping hour is set for each pump and charged to farmers according to recorded pumping times which is a logical and equitable basis. Actual collection rate of water charges is very high in most co-operative and district schemes.

The problem of low collection rates has also been raised by the World Bank in a recent review of irrigation in Turkey (World Bank 1992). The Bank suggests that the responsibility for expenditure and revenue collection should not be split between DSİ and MOFC as at present.

The reasons for the differences in collection rates between DSİ schemes and those managed by local bodies can be attributed to a number of factors. The importance placed by farmers on the level of service is one consideration but possibly of greater significance is the manner of follow up action and likelihood of sanctions for non payment. In the co-operatives and districts there is a direct link between charge and service, the local manager can readily contact anyone in arrears and usually comes to a satisfactory arrangement taking account of any mitigating factors. Continued non payment is relatively rare and can usually be handled effectively, for example, by refusing supply.

In summary, the low collection of DSİ charges can be attributed to:

(a) The lack of any direct link between income received and O&M expenditure. This is illustrated by the fact that MOFC has responsibility for collection and its level of performance does not reflect on DSİ activity levels.

(b) Follow up action for arrears is at the discretion of individual officers and there are no effective sanctions applied either to those who do not pay or those who do not collect. Follow up action is usually ineffective and even made difficult for those who wish to pay.

(c) The low penalty interest charge of 10% applying to late payments is seen as a disincentive to pay in a period of high inflation.

(d) The perception that the Government does not require water charges to be collected.

4.6 Strengths and Weaknesses of Existing MOM Practices

4.6.1 Introduction

The nature of the overall management systems for irrigation in Turkey is one of the major influences in determining how effective the systems perform in meeting the objectives of maximising agricultural production while ensuring long term sustainability of both water resources and farm production systems. The following list of perceived strengths and weaknesses covers both operational and institutional aspects of the existing MOM systems.

The study team has adopted the process of a strengths and weaknesses assessment of the many factors for which judgments can only be made on a subjective basis. Turkey has developed its present base of irrigated agriculture very rapidly over the past 40 years and in so doing has established a valuable source of technical expertise which is already being applied in such large developments as GAP. On the other hand it is prudent to learn from past experience of those matters which have contributed to low standards of performance and take account of them in the GAP model.

4.6.2 Strengths

(a) DSİ undertakes a major role in developing large scale irrigation schemes and has the technical competence and resources to construct and operate the large dams and canals.

(b) GDRS also has extensive experience in the construction of smaller scale irrigation schemes and on farm works including drainage works.

(c) The various agricultural research institutions operated by GDRS, MARA and the universities have extensive experience and capability. There is a limited degree of co-ordination of research activity within the GAP region which needs to be enhanced. The research conducted so far by these institutions has yielded useful results which must be passed on to the private and/or public sector plant propagation institutions in order to meet the demand for needed seed and plant material.

(d) There is an established structure of farmer training and extension services within MARA which focuses primarily on agronomic inputs and needs. This system could form the basis for training in the GAP projects provided it is resourced accordingly and subject matter is expanded to include irrigation technology and practices.

(e) Local user based groups are generally more effective than government agencies in carrying out equitable water sharing to individual farmers, achieving compliance with operating rules, collecting water fees and enforcing sanctions if required.

(f) There are three main types of farmer organisations involved in the larger schemes - irrigation co-operatives, irrigation districts and irrigation groups - which operate with varying degrees of effectiveness. The irrigation co-operatives and irrigation districts may be good models for application in the GAP projects.

4.6.3 Weaknesses

(a) There is a lack of co-ordination between the large agencies in regard to project planning and budgeting which is determined mainly according to the priorities of individual departments. In part, it also reflects the strength and political influence of the individual agencies.

(b) In the case of organisations such as GDOS and GDPD, which operate through provincial and county directorates, programme priorities may be significantly influenced by provincial and county governors rather than the needs of a particular project.

(c) Extension services available in many irrigation schemes are limited due to inadequate resourcing. They tend to be slanted towards rainfed farming and crop husbandry and provide insufficient information on irrigation technology and techniques. As with many government extension services they also tend to be reactive instead of being pro-active.

(d) Weaknesses also occur where the farmer/extension/research linkage is not functioning properly. The flow of information between all three groups is vital to a dynamic agriculture, to enable agricultural technology to occur and for research to respond rapidly to farmers' problems.

(e) Once GDRS has completed an irrigation project by contracting out the infrastructure works, it does not provide any further follow-up, nor does it inform the GDOS to programme its extension activities to transfer the new technology needed by the farmer.

(f) MOFC is relatively ineffective in collecting water charges from farmers under the existing arrangements. This is brought about by the lack of any responsibility link between provision of service and payment together with ineffective collection procedures.

(g) Although DSİ is a capable manager and operator of dams and large canals, it is less effective in delivering irrigation services to individual farmers.

(h) There is an urgent need to review and modernise the present laws relating to surface water allocation and use. In particular the rights of the State to develop water resources for the overall national benefit needs to be ensured. There is also a need for overall co-ordination of water allocation and protection of the rights of users on a whole catchment basis. This is discussed further in Chapter 5.

(i) The existing water laws do not provide specifically for the establishment of effective water user groups. In the absence of such provisions reliance is made on other laws, such as an old municipalities law, to establish locally managed water user bodies.

(k) The almost universal use of the crop/area method of charging for water encourages high rates of irrigation water use, there being no incentives for water economy.

(l) Unauthorised interference and damage to canal structures is common on DSİ schemes and existing legal procedures are largely ineffective to overcome such problems.

(m) GDRS does not become involved in on-farm water management activities. As a result unsuitable irrigation methods and low water efficiency is seen in many projects.

5 EXISTING REGULATIONS AND LEGAL FRAMEWORK IN TURKEY

5.1 Planning, Design, Financing and Construction of Hydraulic Works

Law No 6200, which came into effect in 1954, established DSİ as the primary body for management and utilisation of surface and underground water resources in Turkey. Article 2 of this law provides specifically that DSİ is to be in full charge of and responsible for economic and profitable use of water sources. Article 2(b) of the Act empowers DSİ to build irrigation facilities and to make maps and plans showing land within irrigation areas and if necessary to carry out cadastral surveys of these lands.

Funding of the construction of irrigation works by DSİ is provided through the national budget as part of the DSİ annual investment programme. Law 6200 requires that the investment cost of works built by DSİ, with the exception of flood protection and access works, be repaid by the benefiting farmers. The annual schedule of water charges levied in DSİ irrigation projects includes a component to cover this investment cost. In the case of schemes in which O&M responsibility is transferred to organisations such as irrigation districts or co-operatives, repayment of the original investment cost is recovered over a 25 or 30 year period. In reality this repayment is a token gesture as the amount to be repaid is the actual original cash cost without any adjustment being made for inflation or interest charges.

Law No 3202 of 1985 established the General Directorate of Rural Services (GDRS) and empowered it to carry out a range of irrigation related services. The main thrust of GDRS activities is directed to on-farm works such as land levelling, lateral canals, irrigation layouts and drainage systems. However it is also authorised under this law to construct irrigation systems requiring a flow rate of up to 500l/s and in accordance with this provision GDRS has implemented many small scale irrigation schemes of up to about 500ha size.

The funding of GDRS irrigation works is also provided through the national budget. However in contrast to the DSİ schemes there is no requirement for the investment cost of GDRS irrigation schemes to be repaid by the benefiting farmers.

Law No 167 of 1960 regulates underground water resources in Turkey and confirms that DSİ is the responsible authority for management and development of groundwater. Any person or organisation wishing to extract and use groundwater must obtain DSİ approval.

5.2 Operation and Maintenance of Hydraulic Works

Article 2(g) of Law 6200 authorises DSİ to carry out management, operation, maintenance and repair works to the irrigation works it has constructed. In accordance with this provision DSİ now manages 218 irrigation projects throughout Turkey having a total command area of some 1.3m hectares. In about half the area under its control DSİ has now formed irrigation groups which carry out water distribution operation and some maintenance of the tertiary canal systems.

DSİ is also empowered under Article 2(k) of Law 6200 to transfer irrigation works it has constructed to a range of other organisations which have corporate status under public law or the Civil Code. The bodies to which transfers can be made are as follows:

(a) Village corporate body: Where the irrigation facilities are available to only one village they may be transferred to that village by decision of the village headman or "muhtar".

(b) Municipality: Where irrigation facilities are within a municipal boundary they may be transferred to that municipality by decision of the municipal council.

(c) Union (Irrigation District): Where irrigation works serve several villages and municipal bodies they may be transferred to a "union" formed by the corporate bodies. In this report this union is referred to as an "irrigation district" to distinguish it from other bodies known as unions.

(d) Where several villages or municipalities benefit from various separate units which are part of a larger system, individual units may be transferred to the appropriate local administrations.

(e) Transfer to other State Organisations, Public Service Corporations, Companies, Societies or private persons may be permitted subject to special protocols approved by the Director General of DSİ.

(f) Co-operatives: Transfers may be made to irrigation co-operatives having specific provision in their constitution for irrigation O&M.

The legal basis for forming an irrigation district, described in 4.3.3, is under the Municipality Law No 1580 of 1930, Village Law No 442 of 1922 or Farmer Properties Law No 4081 of 1941.

GDRS has power under Law No 3202 to operate those irrigation schemes which it is authorised to build. It is also authorised to constitute unions, partnerships and other corporate bodies to which it can transfer the management, operation and maintenance of its works.

Irrigation co-operatives, described in 4.3.4, are established under the general Co-operatives Act, Law No 1163, for which the Ministry of Agriculture and

Rural Affairs (MARA) has recently issued a new draft standard instrument of incorporation which defines their purpose as follows:

> " To set or acquire existing land grading, field lateral, field trough, drainage and similar agricultural irrigation facilities aimed at agricultural use of water obtained from irrigation systems built or to be built by the State; to operate the same or cause the same to be operated, to maintain the same or cause the same to be maintained."

Projects constructed by both DSİ and GDRS can be transferred to irrigation co-operatives.

5.3 Water Charges, Collection and Fines

Water Charges for DSİ irrigation projects are set annually to recover an amount of money approximating the level of the previous year's O&M costs, plus a component to cover past investment, without any adjustment for inflation. The basis of calculating the water charge is set out in Law No 6200. The charge is an annual one based on the area irrigated for the season and the particular crop grown. The charges are set out in a schedule of tariffs as shown in Table A 4.1 which is the 1993 schedule. The schemes are divided into five groups, three for gravity supplied schemes and two for pumped schemes, according to the relative income levels of the regions. The scale of charges is proposed by DSİ and approved by the Council of Ministers.

The details of area and crop irrigated as recorded by DSİ at the conclusion of the previous irrigation season are used to calculate the amount of water charge payable by each farmer. After a period of public display and comment in each village the draft payment schedule is certified by the appropriate village muhtar when it becomes the official amount payable by each farmer.

Revenue collection is the responsibility of the Ministry of Finance and Customs (MOFC) members of whose staff are assigned to each DSİ regional directorate office for this purpose. The method of collection is generally by personal contact by the MOFC staff to every farmer. Payment is required in two equal instalments at the end of February and April. Law 6200, Article 32, provides for a once only fine of 10% for late payment. All money collected, including fines, passes to MOFC and DSİ plays no part in the collection and follow up process.

Repayment of the investment component in respect of DSİ assets is required after a "grace" period of five to ten years following which farmers have a further 30 to 40 years to repay the debt without interest.The 1993 amounts for repayment of the investment component ranged from 300 to 750TL/da which are based on a 1984 calculation without any adjustment for inflation in the subsequent years.

While there is currently no repayment by farmers of GDRS investment expenditure, by decision of the council of ministers in 1986 provision was made for such repayment in respect of on-farm and reclamation works. However due to the long period of grace allowed, over 20 years, this has not been implemented.

In projects managed locally each irrigation co-operative or district sets its own schedule of water charges on a basis which it selects as most appropriate to its circumstances to cover its total operation and maintenance costs for the **current** year. In the case of irrigation districts the annual cost estimates and schedule of water charges has to be endorsed by DSİ. The crop/area method of charging is commonly used. Collection rates are reported as generally high in this type of locally managed schemes. In the case of the Akdeniz Irrigation District the fine imposed for late payment of water charges is 7% per month on the amount outstanding.

5.4 Drainage Charges

In DSİ managed irrigation projects the cost of operating and maintaining drainage facilities is met from within the total O&M budget. No separate costing is generally performed for the O&M costs directly attributable to drainage works. There is no provision in Law No 6200 to impose a separate charge to cover drainage services. Consequently DSİ drainage facilities, where they exist, are considered as part of the total irrigation service and the charge for this service is included in the total water charge.

As far as is known there is no separate charge for the provision of drainage services anywhere in Turkey.

5.5 Water Rights

The situation regarding water rights for surface waters in Turkey is complicated due to the number of agencies involved and the proliferation of laws, regulations and administrative rules which have arisen, often to address immediate problems with the use of water resources in a particular location. Despite various legislative attempts to rationalise and modernise the overall use and management of water numerous decisions of the courts on disputed matters have tended to uphold long established practices and rights to water use. In particular the rights conferred on individuals to the use of public waters due to the traditional concept of "usufruct" is still applied by the courts and in fact enshrined by specific laws enacted since the birth of the Turkish Republic.

Article 641 of the Civil Code provides generally that the Government has the right to use public waters. It also envisages enactment of special statutes to cover general use of these waters and to date no regulations setting out specific rules covering the whole of public domain waters have been made. In the absence of definite rules it is to be expected that the courts would apply traditional legal principles even though they may not be compatible with modern technical and economic requirements.

The establishment Law No 6200 for DSİ clearly provides for that organisation to have overall responsibility for management and utilisation of all water resources in Turkey. However neither DSİ or any other agency has the overall authority to allocate use of water resources for a particular purpose or project. As a result there is a somewhat fragmented approach to allocation and use of water. For example GDRS has the authority under its establishment law No 3202 to develop irrigation projects with up to 500l/sec flow capacity, with the implication that it can extract this amount of water from the supply source. There is a protocol requiring consultation between GDRS and DSİ in the planning of new projects but in practice this does not always occur with the result that there are a number of river systems where water resources have been overcommitted due to separate development of different projects. The need for overall co-ordination and prioritisation of water use on all streams becomes more urgent as resources become fully developed.

The question of water rights of individual farmers in irrigation projects is not specifically covered by legislation or rules. The general practice in DSİ projects is that any farmer who can obtain access to a canal may extract water from it even if his land was not originally planned to be commanded from it. In the absence of specific rules, it is left to local managers to allocate water in as equitable a manner as possible.

The difficulties inherent in the incomplete and fragmented approaches to the laws concerning surface waters have been recognised for many years, but to date it has not been possible to enact appropriate and comprehensive legislation to meet the requirements of modern development.

The position in regard to underground waters is more definite than for surface water. Law Nos 167 and 178 of 1960 amended the Civil Code to ensure that underground water was public property.This was assisted by the fact that traditional and Islamic law had not envisaged private rights to this water, as distinct from the situation with surface water. The relevant provision of Law 178 reads:

> "Underground waters are, in general, waters of public usufruct. The ownership of a land does not entail ownership of water beneath it. The form and extent of utilisation of underground waters by landowners shall be determined by special statutes."

There is one inconsistency in relation to spring water which is not included as part of underground water under Law No 167. As a result spring water remains the property of the owner of the land where it occurs even though it is part of the same hydrologic cycle as underground water.

5.6 Environmental Protection

Article 56 of the national Constitution of 1982 refers to the environment in the following terms:

> "All people have the right of living in a balanced and healthy environment. Development of environment, preservation of environmental health and prevention of environmental pollution are the obligations of the State and the citizens."

The Constitution also contains several other references to environmental matters, including the protection of shores and river beds, productive land use, protection of farm lands, forests and historical and cultural wealths.

The Environment Law No 2872 of 1983 covers matters such as preservation and amelioration of the environment, optimum utilisation and protection of land and water resources, prevention of water pollution, preservation of flora, fauna, natural and historic riches of the country. It is of interest that this Act states as a principle that protection of the environment should not impede development.

Other general principles laid down by this Act include:

- Protection of the environment and prevention of pollution are obligations of both private persons and corporations.

- Health of humans and other living things is to be taken into account in adopting protection measures for the environment.

- Organisations authorised to make decisions on land and resource utilisation shall exercise care to achieve balance between environmental protection and development using the best suited technology.

- The "polluter pays" principle applies to expenditure associated with remedying pollution problems.

Law No 2872 prohibits direct and indirect acts of pollution and requires those responsible for such actions to take remedial measures. It also requires environmental impact assessment reports to be prepared for proposed industrial plants. The operations of companies which cause pollution and fail to take preventative measures may be temporarily or permanently stopped by order of a territorial governor.

A Water Pollution Control Regulation was published in 1988 to set out more specific legal and technical aspects relating to rules governing pollution of surface and sub surface water. Subsequently several further communiques have been issued to give effect to specific administrative and technical procedures arising out of these regulations.

The Aquatic Products Law No 1380 of 1971, while not directly concerned with matters of water supply and irrigation, also sets rules prohibiting discharge of noxious substances into inland and coastal waters with the intention of fishing and other water based industries.

6 MOM MODELS IN USE IN OTHER COUNTRIES

6.1 Introduction

The nature of the management models for irrigation can take many forms according to the legal, political, economic and physical situation of the particular country or region. These arrangements frequently change over time as irrigated agriculture moves beyond the development phase, new technologies are introduced, farmers seek increased income and national economic and political priorities are changed.

In this section examples are given of management arrangements applying in several countries. These can be regarded as typical for each country although they are not the only models applying in those countries. Comments are offered on the effectiveness of these examples and their relevance to the GAP development.

6.2 Australia, State of Victoria

The major irrigation areas in Australia are in the Murray Darling River Basin where construction of large scale irrigation works commenced in Victoria in the late nineteenth century. Irrigation management has passed through the following phases:

(a) Up to 1905

Originally it had been intended that all the irrigation systems would be self financing and locally managed. Accordingly the Government formed 80 local "irrigation trusts" or companies for this purpose. However within a few years nearly all the trusts became bankrupt due to poor management and a lack of storage dams for severe drought periods and the Government needed to rescue them.

(b) 1906 to 1984

In 1906 the Government established a single State owned agency, the State Rivers and Water Supply Commission (SRWSC), to take over all the existing trust works. The SRWSC continued expanding the irrigation areas until the present area of over 550,000 ha was reached in 1970. The SRWSC also constructed many large dams which were then recognised as being essential for large scale irrigation projects under the extremely dry Australian conditions.

All the capital costs of dams and irrigation canals built by the SRWSC were paid by the Government. The farmers were required to pay water charges, based usually on a volumetric charge requiring flow measurement device to every farm. For many years the Government provided a subsidy to cover part

of the O&M costs. The SRWSC operated a form of water user groups, called advisory boards, which provided useful operational advice to local managers but had no executive power.
The SRWSC was managed by a board of three full time government officers who were usually engineers or agriculturalists. All major decisions on policy, investment and operations were taken centrally in the Melbourne headquarters.

By the 1970s the outlook for irrigation had changed as the development phase had ended and agriculture became less significant in national economic priorities. The Government wanted to reduce the budgetary cost of irrigation, encourage high value crops and introduce "user pays" systems for irrigation and all other public utilities.

(c) 1984 to date

The SRWSC was replaced in 1984 by the Rural Water Commission (RWC) which remained a Government budget agency but with a charter to operate in a more commercial manner and recover full O&M costs and loan interest charges from customers although some overhead costs were subsidised. The composition of the RWC board was increased to eight persons, three government officials and the remainder part-time appointees experienced in farming, business, finance and environmental aspects.

The RWC became the Rural Water Corporation in 1992 which is outside the Government budget and must meet the full cost of all irrigation operations through water charges to its customers without any subsidy. There are now boards of directors at two levels. The central office board is responsible for major policy issues, financial performance of the total business and only those operational matters which involve more than one region or adjoining states. There is a management board at the five regional centres responsible for all local policy and operational decisions, works priorities and setting water charge levels. Advisory committees continue to provide advice to the regional boards on local operations. RWC operates the supply system to most farms although individual supply systems and business units can be sold to users or private companies.

During 1994 the five RWC regional boards are becoming independent irrigation authorities. The Government intends that it will retain ownership of the dams and responsibility for water resource management.

The restructuring of the RWC was part of a comprehensive review of all water authorities in the State which commenced in 1980. All existing water laws, some almost 100 years old were reviewed as part of this process and replaced by the Water Act 1989 (Victoria, 1989). The new Act includes provisions covering the control and use of both surface water and groundwater, the respective rights and duties of the State, water authorities and users and the arrangements for reorganising the RWC as described above. The Act requires all water authorities to operate on a strictly commercial basis rather than as a department or arm of government.

The situation in other Australian States is similar to that in Victoria. All the large irrigation systems were built and managed by Government agencies for many years. Governments are now removing themselves from a direct operating role in irrigation while retaining the responsibility for overall water resource management and large dams. In the State of New South Wales, which has about 50% of the irrigation in Australia, the process of privatising Government managed irrigation schemes has begun.

6.3 France, Canal De Provence Authority

The Canal De Provence Authority is one of a number of private water companies granted concessions by the Government of France to develop, operate and manage water systems (Porcheron, 1988). The Canal De Provence was granted a 75 year concession in 1963 to take over an old open canal system supplied from the River Verden in the Provence region of Southern France. The conditions of the concession require the company to establish new facilities and operate them to supply an area of 100,000 ha of rural lands and village communities.

The company is developing a comprehensive network of main canal, reservoirs, pumping stations and pipelines supplying pressurised water to 22,000 customers when completed. The company has a written contract with each landholder specifying the volume or flow rate which is to be supplied, effectively a form of individual water right. Water supplies are metered to each landholder and water charges set according to actual water consumption. The company has a government authorised bulk water entitlement from its main water source.

The water supply system is equipped with modern automatic regulating and control facilities enabling an on demand pressurised supply to be provided. The company operates in a similar manner to any other private commercial organisation. While it operates without any commercial opposition it is necessary for it to have high standards for technical performance and customer satisfaction to ensure its long term future.

This project represents a most advanced stage of irrigation technology and management with government involvement reduced to one of authorising use of the water resource and general monitoring of the company's performance. There is no government funding involved and this arrangement saved a large expenditure of government funds which would have been required to rehabilitate the old scheme under the previous arrangements before the company was formed. It is the logical outcome for a project which is initiated with high levels of government assistance but is no longer required when farmer incomes reach the stage where it can be operated as a commercial enterprise.

6.4 Indonesia, West Java

West Java has a history of irrigated agriculture dating to the mid nineteenth century. Since the 1960s Indonesia has had a major programme of irrigation expansion and rehabilitation of older schemes to provide sufficient rice and other food for its rapidly increasing population. The design and construction of large schemes is undertaken by the national water department with O&M being the responsibility of the provincial level water resources service. Medium and small scale irrigation schemes were usually developed by the provincial water resources service which retains management responsibility for medium sized schemes and transferred the smaller ones to village control (up to about 500ha).

There is over 1.2 million ha under irrigation in West Java of which the large Government controlled systems total about 1 million ha. The point of supply from the Government canal system is to a tertiary unit often comprising 100 or more individual farmers. Each tertiary unit employs a water distributor (ditch tender) who is responsible for supplying water to the individual farms. In the early 1970s a formal system of water user committees was introduced based on the tertiary units with officials elected by the members of the unit. The role of these committees is primarily to educate the farmers and ensure that proper agricultural and water management practices are carried out in the tertiary unit. Apart from emergency situations the water user committees do not perform any maintenance of the Government canals. Water user committees have been developed gradually and some are more effective than others as many farmers are still at subsistence level.

Other government bodies with a direct role in irrigation include departments of agriculture, village development, forestry and lands. To ensure that there is co-ordination of policy development and administration between all these bodies there are formal irrigation committees established at provincial and two municipal levels. The high level committee develops irrigation policy at the provincial level and is accountable to the provincial governor. The two lower level committees are involved with administration at scheme level on matters such as cropping patterns, operating rules for dry periods, water rotation systems and enforcement of legal provisions.

Traditionally O&M of the government systems has been funded from the government budget with no recovery through water charges. Faced with a diminishing O&M budget the Government introduced a water tax in the late 1980s based on irrigated land area.

Indonesia is a tropical country and has a range of management systems for irrigated agriculture to suit a diversity of geographical conditions, population densities and cultural differences. The other highly populated provinces have large irrigation systems managed in a similar manner to those in West Java. In other locations there are many small systems entirely locally managed without significant government involvement, such as the "Subak" system of Bali which has developed over many years to suit the cultural characteristics of the area.

6.5 Mexico

Mexico has 77 large scale irrigation districts with an area of 3.2 million hectares which were developed by government bodies and which have managed their O&M activities until recent years. These districts are responsible for about 30% of the total national agricultural production from 15% of the cultivated land. However the productivity of these districts declined significantly in the 10 years to 1989 when the infrastructure fell into disrepair as the Government had insufficient financial resources and traditional management practices were found to be ineffective. Accordingly the national government has adopted a new and ambitious policy providing for progressive transfer of responsibility for operation, maintenance and administration to the water users of each district.

A new National Water Act 1992 has been adopted which sets out clearly the rights and responsibilities of both government bodies and users, whether companies, associations or individuals (NWC, 1992). The new Act embodies the principles and sets out the legal framework for transfer of government funded irrigation projects to appropriately constituted corporate bodies of users. This Act also sets out in relatively simple terms the nature of "water right" for irrigation usage by each farmer in an irrigation district.

An irrigation management transfer program was adopted providing for transfer of at least 21 districts to user management over the five years from 1990 to 1994 (NWC, 1991). These districts comprise generally the most advanced technically and economically and represent over 250,000 farmers with an area of 2.0 million hectares being 62% of the total area in irrigation districts. These districts vary in size, several smaller ones being in the range 10,000 to 20,000 hectares while there are five districts larger than 200,000 hectares. For ease of administration the districts are subdivided into smaller units or "modules", of 5,000 to 10,000 hectares, usually based on the configuration of the secondary canal system.

The National Water Commission (NWC), a Federal Government agency has been responsible for operation and maintenance of these irrigation districts in the past. Its present roles include, inter alia, administering the Act on behalf of the Government, formulating and implementing the national water program, granting concessions and licences to users of "national waters", managing the transfer of irrigation district management to properly constituted local bodies and overseeing their subsequent operations. The NWC remains responsible for management of dams and other large main works.

There is also provision for NWC to establish and convene "basin councils", consisting of representatives of all relevant government, municipal and user interests of a hydrologic basin to formulate overall water policy and strategies for the respective basins.

The transfer process is carried out in the following two stages:

(a) **Stage 1** is the transfer of each module (secondary canal system) to a legally constituted civil association which is licensed to use a defined volume of water and operate and maintain the infrastructure supplying that module. Transfer of operation to local control is carried out progressively during which time NWC provides training of personnel hired by the civil associations. The civil associations must be administratively and financially self sufficient with fees paid by water users adequate to meet the full cost of O&M together with a contribution to cover the cost of supervision and main works O&M by NWC.

(b) **Stage 2** involves transfer of the larger scale primary level infrastructure which serves the district as a whole. All the civil associations of a district are convened as an assembly which must decide how it wishes to manage these works. There are several available options for this:

- Incorporation as a Limited Liability Public Interest Company with Variable Capital to provide the service.
- Incorporation of a Limited Liability Company as above to provide the service **and** exercise overall district coordination and control.
- Hire one or more private companies for O&M of the primary system.
- Hire NWC to continue operating the primary system on a contract basis for which costs are paid by users.

The process of transfer and subsequent performance of the local user associations is supervised and controlled closely by NWC as the agent of government. To this end NWC has adopted a well structured approach with clear guidelines, procedures and requirements to be followed by the local communities. It also stresses that the process of forming associations is to be as democratic as possible with representation to be shared among both large and small farmers (NWC, 1993).

6.6 Morocco

The Government of Morocco is giving priority to developing a number of large scale irrigation projects (20,000 ha to 250,000 ha) as a national economic objective. The policy adopted in the mid 1960s provides that the Government pays for dams, irrigation supply works and on-farm development. It also provides farmer credit, selected seeds and other farm inputs and guarantees crop prices. The farmer is required to farm in accordance with national objectives, follow scheme rules and pay appropriate taxes and water charges.

Construction and maintenance of large dams is carried out by the Ministry of Public Works. Design, construction, operation and maintenance of irrigation works, together with integration of all the productive services required by farmers, is undertaken by autonomous regional bodies within the Ministry of Agriculture known as ORMVAs. Each ORMVA has a Board of Directors comprising representatives of the Ministry of Agriculture and other ministries directly involved together with several farmer representatives.

ORMVAs receive a share of the national budget and also collect and retain water charges set to cover scheme O&M costs. The ORMVAs provide O&M services to individual farmers in most schemes although, following the formation of water user associations, these have commenced to carry out some of the O&M up to the secondary canal level. As schemes become established the ORMVAs are transferring some traditional services which are commercial in nature to the private sector.

In the Haouz project there has been a successful transfer of O&M of distribution system to a farmer managed organisation. One of the main features leading to this success is that the supply system was modernised In such a way that it accords with the traditional social system.

Further details of the management of large irrigation projects in Morocco are given in World Bank Technical Paper No 99 (ICID, 1989).

6.7 Spain

Spain has a total irrigated area of about three million hectares with some schemes having been in operation for hundreds of years. In recent times the country has faced the need to restructure its agriculture and rationalise use of water use as resources are fully exploited in some river basins. National irrigation policy is directed to ensuring the long term sustainability of existing schemes. The role of Government is now limited to overall water resource management and project co-ordination with responsibility for irrigation O&M devolved to farmer groups to the maximum extent possible.

During 1993 a study team comprising representatives of GAP RDA, other government officers and the consultants visited the Andalusia region of Spain. A full account of that visit is given in Technical Discussion Paper No 13 (Halcrow 1993) and the following is a summary of the irrigation management in Andalusia which can be taken as representative of other regions of the country.

Spain has separate governments at national and regional levels each having clearly defined powers and responsibilities in relation to water resources and irrigation management.

Overall water resource development and management is a national government responsibility carried out within each major river basin by a "hydraulic confederation" agency of the Ministry of Public Works. The responsibilities of the confederation include:

- Assessment of total water resources within the basin.

- Design, construction, operation and maintenance of storage dams and other large structures on rivers and some large canals.

- Control of water extraction and use including allocation of resources between different communities and resolving conflicts between groups.

At the regional level the Ministry of Agriculture, through its Andalusia Institute of Agrarian Reform (IARA), is responsible for initial investigations for new irrigation projects and subsequently planning, design and construction of secondary canals, drainage systems and on farm works. IARA does not have an ongoing O&M role in irrigation as the works usually pass to farmer control at an early stage. The process of land reform has been integral to new and rehabilitated irrigation schemes in recent years and IARA implements land reform as part of the irrigation design and construction process. IARA also provides some extension advice to individual farmers in the early stages of scheme development although 'ongoing farm advisory services are usually provided through the private sector.

Under the Spanish Water Law of 1985 it now is mandatory to form one or more "irrigation communities" for all public irrigation projects. The role of the communities is to take over full responsibility for operation and maintenance of irrigation supply works including pumping stations and all canals supplying a single project. Some projects have only one community while others have several organised on the basis of defined canal systems or geographical boundaries. Community size varies from a few hundred hectares with about 50 farmers up to 45,000 ha in the case of the Lower Guadalquiver project. Drainage collector systems are also managed by a community which may be the same as the irrigation supply body or a separate one covering the drainage area.

An irrigation community is governed by a management committee elected by all the farmers. The committee employs such numbers of administrative and field staff needed to perform operation and maintenance works. The community has the status of a private company in employing staff, ownership of assets, entering contracts and purchasing goods. However because of the public interest nature of its business it is not required to pay tax.

The community is required to finance its activities, including all O&M and an agreed proportion of original investment cost, through water charges. The form and amount of the water charge is decided by each community committee. Generally the gravity canal systems have no water measurement facilities to individual farms and charges are levied on a area basis. All recent schemes have been installed as pressurised pipe systems with flow meters at the supply point to each farm and in these schemes charges are levied on a volumetric usage basis. In all projects water charges are collected in full.

6.8 Vietnam

Most of Vietnam's irrigation infrastructure was destroyed in the wars from 1950 to 1975. Several new schemes have been developed in recent years. Design and construction are undertaken by the national Ministry of Water Resources. Responsibility for operation and maintenance of the distribution system is usually transferred to a government owned company responsible to the local district administration, the equivalent of a municipality. Technical support is provided by the provincial government or the Ministry of Water Resources in respect to large dams or special structures.

Most of these systems have had a fairly rigid cropping pattern for the main crop, usually rice, and landholders are expected to farm in accordance with the cropping plan adopted by the provincial agricultural department. With some relaxation of the centrally planned approach to agriculture in recent years farmers can now select their second crop. Operation of the smaller irrigation structures is often performed by staff of a village committee, which has official status and operates as a water user committee, apart from having other functions. The education level of many farmers is low and individual farmers make contact with the water company through the village committee.

Farmers are required to pay water charges to cover part of the normal O&M costs. The amount of payment is determined by the Government and is usually based on payment of a percentage of the actual main crop harvested. Farmers are also required to contribute some labour towards maintenance of the main supply system.

The Tam Phuong Water Control Project, a 7,000 ha irrigation, drainage and salinity control project in the Mekong Delta, was completed in 1990. The feature of this organisation is creation of a government owned company with responsibility for direct management of the project. This company is required to liaise closely with other government administrative and technical agencies under overall direction of the provincial administration.

6.8 United States of America, Salt River Project, Arizona

In 1902 the US Government passed legislation to allow it to loan money to landholder associations for the purpose of constructing development facilities for reclamation of lands. A group of farmers then formed an association called the Salt River Valley Water Users Association in order to qualify for a government loan to build a dam on the Salt River and works to supply farms. The dam was completed in 1911 and initially the dam and water delivery system were operated by the US Bureau of Reclamation (USBR). From commencement the project was multi purpose with income from the sale of electricity to assist repayment of loans and keep water charges low. The original loan of USD 10 million was to be repaid to the government over 44 years without interest.

In 1917 at its request the Water Users Association took over full responsibility for management of the dam and supply works from USBR. This request followed recognition by the landholders that it was in their economic interest to ensure that the project was operated correctly to meet their needs.

Under management of the Association both the water supply and electricity businesses have expanded and now support a population totalling one million people with all works and operations financed from income generated from customers. The project is now managed as two businesses, the Water Users Association and the Power District. Each has a 30 person Board of Directors elected by landholders and shareholders.

The Salt River Project is an example of a large user managed water and power authority which has been operating successfully for over 80 years. The initiative for user management came from the farmers who already had a background of working co-operatively for a common economic objective. A major factor in the project being able to operate in a self financed manner is the broad income base available through sale of both water and electricity from the earliest years.

6.10 Relevance to GAP of MOM Models in Other Countries

The social, political and economic conditions vary between all these countries and are certainly different from those in Turkey. Nevertheless there are common themes in matters such as the approaches to national development, the respective roles of government and water users, funding policies and the emerging needs of agriculture as projects become fully established. Consequently the experience of these examples, both positive and negative aspects, should be considered in developing a model to meet the particular circumstances of GAP. The significant points are as follows:

- Large scale irrigation projects in all these countries have generally been implemented by government agencies which continued to manage O&M in the early stages. It may take many years until large projects reach full development and often require continued government assistance until they become self sufficient. The most common form of assistance has been for governments to provide substantial cost subsidies by having no water charges or charges so low that they bear no relation to the actual O&M cost.

- Frequently all parties are prepared to let this situation continue until some significant change occurs in economic and political factors which require the nature of irrigation management to be questioned and changed to suit the new circumstances. The impetus for change can come from government (Australia, France, Spain, Mexico and to a lesser extent Indonesia) when it is recognised that national budgets can no longer afford to subsidise the high cost of O&M and rehabilitation of long established schemes.

- On the other hand in the example of the Salt River Project cooperation of a strong rural community was utilised to initiate the project and then manage it. The original works were constructed by the government at its cost and after only a few years the leading farmers recognised that they could derive much economic benefit by taking over full financial and management responsibility. The relatively high education levels and good economic returns from the irrigated crops contributed to this demand from the farmers.

- In most countries the role of governments in irrigation is now directed to overall water resource policy and management, including management of large dams, initial development of new projects and assistance with O&M of the distribution systems only to the stage when these can be transferred to local management.

- Formal coordination arrangements are necessary between all the main organisations, both public and private, involved in irrigated agriculture throughout the planning, design and implementation stages of all projects.

- In Mexico and Spain transfer of management responsibility from government to farmer based community groups is now a mandatory requirement. This applies from the commencement of all new projects although the application of the policy to established government schemes needs to be managed carefully. In both of these countries the government works closely with the farmers and the transfers take place progressively as the community develops its ability to manage the more complex systems. In systems which are relatively self contained it is possible for farmers to assume responsibility for all activities quickly. Government does not need to be involved in service delivery to individuals when the farmers are able to provide it adequately.

- In most countries a policy of recovery of the full cost of O&M of the irrigation distribution from water users is now implemented. Even in countries such as Indonesia and Vietnam, where many farmers are at subsistence level and traditionally there have been no water charges, farmers are now expected to contribute to a proportion of O&M cost often through indirect means such as contributing part of their crop or a certain amount of labour to scheme maintenance.

- Repayment of investment cost by farmers is a more complex matter and is handled differently in each country and between new and old schemes. Frequently an inducement for transfer of projects to local communities is for governments to write off past investment costs. Farmers in Spain are required to repay investment cost from the commencement of new schemes even if transfer of management responsibility to the farmer community has not yet occurred. In most cases governments continue to meet the investment cost of "national" works such as large dams although water users are often required to pay O&M of storages through some form of bulk water charge.

- When farmers are required to undertake greater financial responsibility, such as paying full O&M costs, they are usually willing to undertake a greater share of scheme management and operate it cost effectively.

- In almost all cases local community and farmer managed organisations are usually in a better position than government bodies to manage local water distribution to satisfy local needs, achieve compliance of farmers with operating rules and levy and collect water charges.

- There are many possible management models depending on the legal, political and social circumstances of each country and region. The extent to which management control of the distribution system can be passed to community groups depends very much on their education and economic levels. For these reasons large projects remain under government control in countries like Indonesia and Vietnam. Even in these cases the authorities are implementing policies which place increased responsibility on farmers for meeting part of O&M costs and undertaking some degree of local works.

- Open canal conveyance and distribution systems remain the major form of irrigation network in most large schemes. Increasing attention is being given to modernising these systems, such as by installing automatic or centralised control systems and long life components to improve water efficiency and at the same time reduce O&M costs.

- Where topographic conditions are suitable, pipeline distribution systems offer considerable operating and maintenance advantages over open canals of similar capacity. In most new schemes and for rehabilitation of older canals, pipelines are now commonly being installed as an alternative to canals. The operational and economic viability of pipelines as an alternative to canals or canalets should be evaluated for future projects taking into account an economic comparison of full costs over the life of the assets.

- Pipeline systems also are more suitable for the provision of water measurement facilities to individual farm outlets.

- Other aspects which require attention during the design stage are the location of canal systems in relation to villages and the desirability of undertaking land reform and consolidation and on-farm works as an integral part of the design of irrigation schemes. In Spain these were essential elements of project design and implementation.

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SECTION B

IDENTIFICATION OF MOM MODELS FOR THE GAP REGION

SECTION B - IDENTIFICATION OF MOM MODELS FOR THE GAP REGION

CONTENTS

SECTION B - IDENTIFICATION OF MOM MODELS FOR THE GAP REGION

1 IDENTIFICATION APPROACH

1.1 Concept Behind the Approach

In developing an approach to identify the most appropriate MOM model for the GAP Region, it is considered that it must have three important characteristics:

- it must be as impartial and objective as possible
- it must be structured to assist the decision making process
- it must be transparent, that is clearly and easily understood

Considering each of these characteristics in turn:

Objective: the approach must, at the start, seek to identify the widest range of possible models and to then proceed to judge these against the criteria selected for evaluation in an impartial way.

An approach must not start with a subjective selection of a model, and then attempt to show that this is supported by the evaluation criteria.

Structured: the approach must allow consideration of the many issues or areas for concern that relate to irrigation development in a step-by-step way that logically converges or leads to a conclusion about which model is best.

It must provide a framework for decision making that allows the many tangible and intangible issues involved to be managed, and a valid set of evaluation criteria to be developed rationally.

Transparent: the approach must be easily understood, so that each step can be reviewed, discussed and resolved before moving to the next step.

The approach used for the GAP MOM study includes all these characteristics, and is described in detail in the following chapters together with the results of its application.

1.2 Definition of Terminology

Before proceeding to the detailed discussion of the MOM model evaluation, it is necessary to define the terminology used in order to avoid confusion about concepts or procedures. These definitions are as follows:

1.2.1 Overall MOM Model

The Overall MOM Model was described in Section A3.3 and shown on Figure A3.2. It embraces all major entities concerned with the development of irrigated agriculture in the GAP Region. Such a model is defined by describing its four main components:

(a) Structures: that is:

- Institutional Arrangements or functions and responsibilities of each entity
- Organisational Arrangements or lines of responsibility, communication and co-ordination between entities
- Management Arrangements or organisational structure of each entity

(b) Systems: that is the systems or procedures that each entity should follow in terms of:

- Guidelines for planning, designing, operating and maintaining the infrastructure as appropriate for each entity
- Guidelines for promoting good on farm practices as appropriate for each entity
- Monitoring and evaluation and feedback system as appropriate for each entity

(c) Skills/Resources: that is:

- Resources required to fulfil responsibilities and implement systems
- Human resource development based on training programmes and materials

(d) Enabling Legislation for the implementation of the institutional and management arrangements and of the systems guidelines.

1.2.2 MOM Management Model

The MOM Management Model was also described in Section A3.3 and shown on Figure A3.2. It refers to the model for management of the operation and maintenance of the GAP irrigation schemes extending from the primary water source down to the farm level. It comprises three main components:

(a) Farmer groups

(b) Irrigation System Operating Body

(c) Supplier of Bulk Water

1.2.3 MOM Management Sub-Models

An irrigation supply system can be divided into five possible levels dependent upon the size of the system. These levels are related to the distribution infrastructure, that is:

- the source or primary works
- the main distribution system
- the secondary distribution system
- the tertiary distribution system
- the farm level

A Management Sub-Model refers to any of the management components described above (farmer, system operator or bulk supplier) who has responsibility for one (or more) of these system levels. These are described in Chapter 3 below.

1.2.4 MOM Model Major Objectives

The MOM Model Major Objectives are a statement of the most important goals of the an Overall MOM Model. That is, they are the **Major Objectives** that the Model must fulfil. These were described in Section A3.4 and are discussed in detail in Chapter 2 below.

1.2.5 Major Evaluation Criteria

The Major Evaluation Criteria come directly from the Major Objectives and are a list of the conditions that any MOM Management Model must satisfy in a positive way. They are a list of the **Major Criteria** against which each MOM Management Model must be judged or evaluated. These are discussed in Chapter 2 below.

1.2.6 Key Issues

The Key Issues are major concerns or problems relating to irrigation development in the GAP Region. They were identified during project studies, and described in a series of Technical Discussion Papers as listed in Table A1.4.

1.2.7 Key Criteria

The Key Criteria come from the Key Issues that were identified during the project studies. They are the parameters against which any MOM Management Model must be judged to see how well it satisfies the Major Objectives. The Key Criteria can be directly related to the Major Evaluation Criteria. These are discussed in Chapter 4 below.

1.2.8 Relevant Key Criteria and Common Key Criteria

The Key Criteria defined above and discussed in Chapter 4 below can be divided into two categories by asking, for each Key Criterion, the question:

"Would different MOM Management Models significantly limit the achievement of different levels of success in satisfying that particular Key Criterion?"

If the answer is judged to be yes, then that Key Criterion is classified as **relevant** to the evaluation of different MOM Management Models. All such criteria have been termed **Relevant Key Criteria**.

If the answer is judged to be no, then that Key Criterion, though highly important in itself, is **not a relevant** measure of how well one MOM Management Model rather than another will satisfy the model objectives. All such criteria are important and must be satisfied by whichever model is selected and in this sense they are classified as **Common Key Criteria** and are not used to evaluate the strengths or weaknesses of different management models. They must however be satisfactorily addressed by the management model eventually selected for implementation.

Two examples will illustrate the difference:

(a) Financial Autonomy

Do different models allow stronger or weaker links to be established between higher cost recovery and improved levels of operation and maintenance? Organisations which have responsibility for the collection of revenues, but which are concerned exclusively with the provision of operation and maintenance services, will have greater financial autonomy than organisations with wider responsibilities, especially those which are a part of a major government ministry. Financial autonomy is therefore a highly **relevant** criterion.

(b) Farmer Training

The training of farmers in new skills and technologies is of vital importance for the success of any model for irrigation development. Farmer training measures could and should be put in place whichever model is selected and hence this is a **common** criterion.

Obviously very few criteria are truly common or independent of the management model. However, as an aid to the decision making process, we must have a systematic and consistent approach that allows us to identify and concentrate on those criteria which are most important. This must be rigorously applied, bearing in mind that it is management structures that are being evaluated, otherwise the decision making process will falter under the weight of too many unequally important issues.

The categorisation of all criteria as either **relevant** or **common** is fully discussed in Chapter 4.

1.3 Structure of the Approach

A structured, objective and transparent approach has been used to identify and evaluate the suitability of potential MOM Management Models for the GAP Region. The approach is shown on Figure B1.1 and consists of four main steps:

1.3.1 Step 1

(a) Define what is meant by a MOM Model. This was described in Section A 3.1 and referred to in 1.2.1.

(b) Prepare a statement of the Major Objectives of a MOM Model. This was described in Section A 3.4 and is discussed in detail in Chapter 2.

(c) From the Major Objectives, develop a statement of the Major Criteria by which any model must be evaluated to determine how well it addresses the Major Objectives. These Major Criteria are discussed in Chapter 2.

1.3.2 Step 2

(a) Identify the widest possible range of potential Management Sub Models as defined in 1.2.3 above and discussed in Chapter 3.

(b) Assess the strengths and weaknesses of these management sub-models and determine the widest possible range of combinations of management Sub Models to form a set of potential MOM Management Models. This is discussed in Chapter 3.

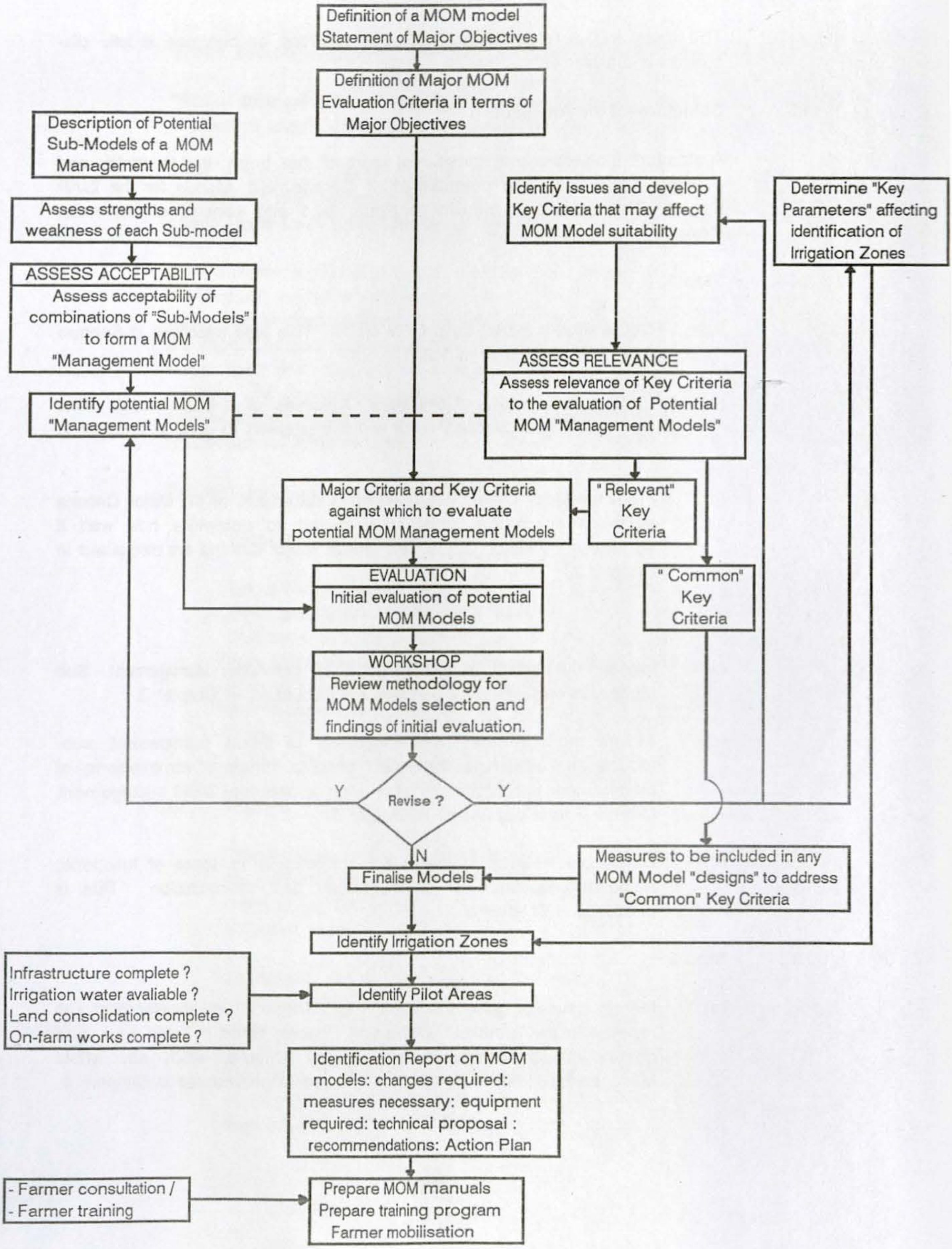
(c) Define the linkages between the sub-models in terms of functions, responsibilities, lines of communication and co-ordination. This is described in Chapter 3.

1.3.3 Step 3

(a) Identify issues or concerns about irrigated agricultural development (as reported in the Technical Discussion Papers, listed in Table A1.4, and develop a comprehensive set of Key Criteria which any MOM Management Model must address. These are discussed in Chapter 4.

FIGURE B.1.1

A STRUCTURED APPROACH TO IDENTIFY, EVALUATE AND SELECT OPTIMUM MOM MODELS TO BE IMPLEMENTED IN THE GAP REGION



(b) Classify Key Criteria as either Relevant or Common as described in 1.2.8 above and discussed in Chapter 4.

1.3.4 Step 4

(a) Evaluate the potential MOM Management Models against the Relevant Key Criteria selected and identify the most suitable model(s). This is discussed in detail in Chapter 5.

As stated previously, this approach is structured and transparent. Each stage is fully described and argued and at any point additional models or criteria can be introduced or modified and the evaluation process reconstructed. The process lends itself to the application of weightings to different criteria if necessary and a sensitivity analysis if required, as discussed in Chapter 5.

The above procedure was presented at the GAP MOM Study Workshop held in Şanlıurfa in December 1993 and issues and responses arising from that occasion are discussed in Chapter 4.

Based on the findings of the model evaluation and the views expressed by delegates at the Workshop, the final preferred model is described in detail in Chapter 6 below. This model will be implemented during the first months of 1994 in selected Pilot Areas in accordance with the Action Plan described in Section F of this report. The tasks required to implement the model will include:

- Identification and description of the institutional arrangements required to put the model in place (Section F2)
- Definition of the legislative environment to enable model implementation (Section F3)
- The establishment of Pilot Areas to test the effectiveness of the proposed model (Section F4)

These will be supported by the preparation of:

- Organisation and Management and Operation and Maintenance Manuals (Section F6)
- The preparation and implementation of an extensive training programme for managers, technicians, farmers and trainers (Section F5)
- The preparation and implementation of a comprehensive monitoring, evaluation and feedback programme (Section F7)

Finally, an overall implementation programme (Section F8) and details of the physical and financial resources required to put the model in place have been prepared (Sections F8 and F9).

2 MAJOR OBJECTIVES AND MAJOR CRITERIA FOR EVALUATING MOM MODELS

2.1 Major Objectives for Evaluating MOM Models

The Overall MOM Model must provide an institutional and organisational framework that promotes the most effective development of irrigated agriculture in the GAP Region. This goal can be expressed as three Major Objectives:

- **Maximise Net Benefits:** as measured in terms of the value of total agricultural production versus costs of management, operation and maintenance of irrigation schemes.

- **Ensure sustainability:** with respect to political, environmental, financial, social and physical factors. This also importantly relates to the institutional and legal environment to enable sustainability to be achieved, as well as the expansion of irrigated agricultural development on a sustainable basis.

- **Implementable and Flexible:** which requires that a model must be suitable for implementation in the short term and must have inherent flexibility for development into more effective models with time.

These Major Objectives are shown on Table B2.1.

2.2 Major Criteria for Evaluating MOM Models

Having defined the three Major Objectives that any MOM model must achieve, these can be described by a second level of more detailed Major Criteria against which any model must be evaluated. These are also shown on Table B2.1 which shows the relationships between objectives and criteria. These can be summarised as follows:

Objective: *Maximise Net Benefits*

The Major Criteria are:

- maximise water use efficiency and returns
- minimise management, operation and maintenance costs

Objective: *Ensure Sustainability*

The Major Criteria are:

- political acceptability
- minimise adverse environmental impacts

TABLE B.2.1

THE MAJOR OBJECTIVES OF A MOM MODEL
AND THE DERIVATION OF THE MAJOR CRITERIA FOR EVALUATING THE SUITABILITY OF A MOM MODEL

MAJOR OBJECTIVES	MAJOR EVALUATION CRITERIA	COMPONENTS
MAXIMISE NET BENEFITS	Maximise Water Use Efficiency and Returns	- Gives farmers incentive to improve efficiency - Facilitates the optimum management of water demands - Promotes concept of supplier/customer relationship - Promotes efficient supply of services to the farmer - Promotes the development of marketing and post harvest facilities
	Minimise Management, Operation and Maintenance Costs	- Promotes effective management structure through accountability at all levels - Promotes optimal mobilization of manpower resources - Places responsibilty for operation and maintenance on the user
ENSURES SUSTAINABILITY	Political Acceptability	- Safeguards national interests
	Minimise Adverse Environmental Impact	- Safeguards national resources - Minimises potential health risks - Minimises land degradation
	Promote Financial Viability	- Facilitates cost recovery - Promotes financial autonomy - Protects Government investment - Financially viable for farmers
	Socially Acceptable	- Accords with existing social structures and attitutes - Promotes equity of supply - Adaptable to existing land tenure and farm size - Allows flexibility in group formation
	Physical Performance	- Capacity to develop appropriate expertise and resources to operate and maintain - Promotes persuit of most efficient infrastructure - Promotes effective monitoring and evaluation
	Institutional Effectiveness	- Promotes maximum contribution from all agencies - Capacity to enforces legal procedures but also minimises need for formal litigation - Promotes devolvement of responsibility to farmer - Promotes communication and operational co-ordination - Allows control of water distribution and collection of water charges close to farmer - Promotes the development of the most appropriate operating rules
IMPLEMENTABLE AND FLEXIBLE	Early Implementation	- Uses existing organisational structures and legal provisions where possible - Any new legislation is likely to have political support
	Flexibility to Change	- Promotes greater farmer participation in management - Promotes adoption of new technologies

- promote financial viability
- socially acceptable
- preserve and develop physical performance
- ensure institutional effectiveness

Objective: *Implementable and Flexible*

The Major Criteria are:

- allow early implementation
- promote flexibility to change

These Major Criteria can be each be further described by a set of main components which are also shown on Table B2.1 and discussed below.

2.3 Maximise Net Benefits

2.3.1 Maximise Water Use Efficiency and Returns

A MOM model must seek to improve the effective use of water by providing farmers with incentives to be more efficient, for example by the charging for water on a volumetric basis with realistic and enforceable levels of charge. Optimum levels of management of water demands must be achieved by ensuring a flexible and rapid capability to supply water at the right time and in sufficient quantity as and when farmer demands change.

The model must promote the concept of a customer/supplier relationship at all levels with clear levels of service agreements on the part of the supplier, and clear contractual agreements to meet financial obligations on the part of the user. An efficient supply of services to farmers must be provided by all agencies concerned if farmers are to maximise their returns. Any model must additionally promote the development of marketing and post harvest facilities.

2.3.2 Minimise Management, Operation and Maintenance Costs

A model must promote effective and transparent accountability at all levels of management if MOM costs are to be minimised. This refers to the accountability between a bulk supplier and government, between an operator and farmers or farmer groups, and between farmer group management and its members.

To minimise overall costs it must also promote the optimal mobilisation of manpower resources at all levels, from the planner to the farmer. Finally it must place responsibility for operation on the user through implementation of the principle that the user pays.

2.4 Ensure Sustainability

2.4.1 Political Acceptability

Any proposed institutional framework must have political support, which is a measure of overall acceptability to the wider community. If political support is not available for the necessary institutional, legal and financial changes then the model will fail.

2.4.2 Minimise Adverse Environmental Impact

A model must in overall terms safeguard the national resources and must seek to minimise potential health risks primarily by promoting efficient water use and alternative distribution system designs that minimise the probability of creating large areas of standing water. Additionally the model should seek to minimise land degradation particularly in respect of soil salinisation and erosion.

2.4.3 Promote Financial Viability

It is critical that any model must have the institutional structure and the appropriate management systems in place to facilitate significant levels of cost recovery if irrigated agricultural development is to be placed on a sustainable, expanding basis. The recovery of costs or revenue is also closely connected with financial autonomy. The model must allow a close link between revenue collection and expenditure on operation and maintenance if financial sustainability is to be achieved.

The model must also seek to protect government investment from a national viewpoint. At the farmer end, no model will be sustainable if the measures put in place do not guarantee the farmer a profit from his investment, with a high probability of success.

2.4.4 Socially Acceptable

Any model must have several important positive social components in order to ensure sustainability. It must accord with the social attitudes and cultural structures existing in the GAP Region and must be adaptable to land tenure and family sizes.

Worldwide experience has shown the desirability of allowing farmers largely to determine their own local management arrangements which they feel suit their local needs. Any MOM model must promote this concept if sustainability is to be assured.

2.4.5 Physical Performance

Any model must encourage the development of improved skills and expertise and command additional resources so as to be able to develop operational procedures in response to the changing needs of farmers. There must be an incentive to adapt and modify infrastructure in response to changing farming practices and to maintain the infrastructure in optimum condition.

Additionally, to test organisational effectiveness, any model must promote the implementation of a formal monitoring and evaluation system to measure actual achievement against a number of quantifiable performance indicators.

2.4.6 Institutional Effectiveness

For sustainability a model must promote the effective co-ordination of activities between all agencies including public organisations, farmer and community groups, individual farmers, the private sector and university and other research institutions. Importantly it must promote devolvement of responsibility for management, operation and maintenance downwards, particularly to the farming community.

It must promote the development of the most appropriate operating rules and hence must allow the greatest possible level of flexibility of formation of organisations at the tertiary level. It must seek to create a sense of ownership on the part of the farming community, and should therefore place the responsibility for control of water distribution and the collection of water charges as close to the farmer as possible.

Finally, the institutional framework should minimise the need for formal legal recourse and encourage the resolution of disputes at the local level by community based groups where peer pressure is often a significant factor in achieving compliance.

2.5 Implementable and Flexible

2.5.1 Early Implementation

In order that any model can be implementable in the short term it should be based on existing organisational structures and legal provisions as far as possible. A fundamental requirement of any irrigation organisation is that its legal status must be clearly defined.

In the event that new legislation is required, it will be advantageous if this could be achieved by new regulations rather than the need for Parliamentary approval. In all cases, political support will be required which will be dependent on acceptability to the wider community.

2.5.2 Flexibility to Change

As a characteristic of any good model, flexibility to change is complementary to being implementable. A model must be responsive to farmer needs, advances in technology and changing demands for water and services over time.

3 POTENTIAL MOM MANAGEMENT MODELS

3.1 The Concept of Sub Models for MOM

The total water supply system to be managed for operation and maintenance can be considered in terms of its separate main components as follows:

- Headworks
- Primary Canals
- Secondary Canals
- Tertiary Canals
- On Farm (Quaternary) canals and layout.

The management and technical activities to be performed for each of these components are not identical. In devising potential MOM models it is therefore appropriate to consider the requirements of each component separately.

Headworks comprise water storages, major river regulating structures, pumping stations, boreholes and other large works. These require specialist professional and technical skills and adequate financial and physical resources to operate and maintain the large engineering works in a safe condition. In the GAP region DSİ currently has responsibility for construction and management of all major water storages and is likely to retain that responsibility in the immediate future.

Primary Canals have as their function the conveyance of water over long distances in bulk from the headworks to the secondary and distribution canal systems. These works usually comprise large canals and structures requiring availability of adequate technical skills and resources for O&M. DSİ already manages these works in nearly 200 of the largest projects throughout Turkey. Alternative management units to DSİ could be possible, such as a large irrigation authority (publicly controlled) or a large irrigation company (privately owned).

Secondary Canals have the main function to convey water in bulk between primary canals and the distribution system. In some cases secondary canals may perform both a carrier and distribution function. These works require a reasonable level of technical skills and resources and in most current schemes are managed by DSİ. However due to their smaller scale, compared with primary canals, the responsibility for management for their O&M could be extended further to larger community based organisations such as irrigation districts and irrigation cooperatives.

Tertiary Canals which distribute water to individual farms in accordance with the required crop needs. Compared with primary and secondary canals, the tertiary system comprises much smaller scale and numerous works. Routine O&M tasks are relatively simple and are within the capability of many community based groups with appropriate training.

An important feature of tertiary level management is to achieve good coordination and cooperation among all farmers so that water resources are shared equitably to meet the total needs of that community. Persons responsible for operating tertiary level canals need detailed knowledge of the local canal layout and its characteristics, local crops, farming and irrigation practices and the individual farmers. For maintenance the majority of routine tasks are also within the capability of the community using normal farm labour and equipment.

Experience in Turkey and elsewhere confirms that the O&M tasks at the tertiary level are best carried out either fully or partially by community groups. The following possible tertiary sub models are considered as possible management units for the GAP projects:

(a) Existing Organisations for Irrigation Management in Turkey

- DSİ, in conjunction with the existing irrigation groups.
- Irrigation districts.
- Irrigation cooperatives.

(b) Other Possible Organisations

- Small private company (farmer owned)
- Special purpose water user group.
- Local Chamber of Agriculture.

Where there is a single farm, such as a large company or family owned property, comprising a whole tertiary unit it also can be considered as a separate sub model.

On Farm (Quaternary) Canals and Irrigation Layout are the responsibility of individual farmers and do not need separate consideration in developing the management models.

The range of possible sub models for each level of the irrigation system is shown in Table B3.1. With the assumption that headworks remain a DSİ responsibility, the range of choices of sub models which would be combined to form the complete model is at primary, secondary and tertiary levels as described below:

TABLE B3.1

Headworks	Main Conveyors		Distribution system	On Farm System (Quaternary System)
Storages, Major Structures, Pump Stations	Primary Canal	Secondary Canal	Tertiary Canal	
(1)	(2)	(3)	(4)	(5)
DSİ	DSİ	DSİ	DSİ (Irrigation Group)	Individual Farmers
	Irrigation Authority	Irrigation District		
	Large Irrigation Company	Cooperative	Irrigation District	
		Irrigation Authority	Cooperative	
		Large Irrigation Company	Small Private Company	
			Water User Group	
			Chamber of Agriculture	
			Large Individual Farmer	

A single model comprises one sub model from columns 1,2,3 and 4.

3.2 Detailed Description of Potential Sub Models

3.2.1 Sub Model 1 Large Individual Farmer/Private Enterprise Control

The size of management unit is determined by:

- Extent of lands commonly owned or operated as a single business enterprise.
- Configuration of lands in relation to the supply system.

The internal management structure of this organisation is determined by the particular circumstances and composition of the enterprise; ie, whether it is a grouping of family members or a private company having partners, directors or shareholders with legal status. Management control is exercised by the family head person or by the manager in the case of a company and this person would be accountable for the total performance of the unit. It is most likely that the irrigation activities would be closely integrated with other farm activities and therefore a separate management structure is not required. Nevertheless within the unit it is probable that some family members, or employees as the case may be, would be assigned particular responsibilities and tasks in regard to the irrigation function.

The full cost of capital investment, operation and maintenance within the unit would be met by this organisation. Within the unit there is a maximum of flexibility to change cropping practices, irrigation methods and infrastructure in response to changing market conditions as only the needs of one enterprise have to be considered. Similarly there is the incentive and opportunity to minimise the cost of irrigation activities especially where these can be readily combined with other farming operations.

3.2.2 Sub Model 2 General Directorate of State Hydraulic Works (DSİ)

DSİ is responsible for planning, designing, constructing, operating and maintenance of dams, pumping stations and canals for the larger scale irrigation systems. It also has responsibility for works for hydroelectricity, flood control, swamp reclamation, river training and water supply to cities.

The establishment law of DSİ (Law No 6200) provides authority for all its activities. It also allows it to transfer O&M and on-farm development activities to individuals, companies, associations, groups, municipalities, villages, districts and co-operatives.

DSİ has a well established organisation structure covering management, technical, administrative and field staff to perform the O&M of the large irrigation projects under its control throughout Turkey. DSİ has regional directorates at three locations in the GAP region and already manages a number of existing irrigation schemes in the area.

Funding of DSİ's O&M activities is provided through the national budget. It also raises revenue through water charges to users of the irrigation service. However there is no direct link between revenue and expenditure on O&M and the current level of O&M is heavily subsidised.

3.2.3 Sub Model 3 Irrigation Group in DSİ Projects (Present basis)

Water User (or Irrigation) Groups are initiated by DSİ within its projects to assume responsibility for water ordering and delivery from the DSİ canal system to individual farmers. The groups also carry out simple maintenance works such as cleaning and minor repairs to tertiary and sometimes secondary canals. Their role is set out by DSİ which still retains ownership of all canal assets and closely monitors the activities of the groups.

Irrigation groups are most commonly formed on a single village basis with the muhtar in charge. In some cases groups are based on multiples of villages or on a municipality basis for larger communities. Alternatively the group may be formed on a canal system basis with a management committee elected by all farmers in the group area. While any of these arrangements are possible, it seems more practical and logical for the GAP region to establish groups on the basis of canal systems even though this may cut across established village and social boundaries. The irrigation works already planned and/or constructed in the Harran Plain involve very long and complex canal networks over which water distribution will be difficult to control unless it is canal based.

Each irrigation group can employ workers to carry out its share of the operations and is empowered to collect directly a proportion, generally 12%, of the DSİ water charge to meet its costs. There is some financial incentive for groups to achieve a high level of charge collection and to carry out works in a cost effective manner as they are permitted to retain any unused balance for village social purposes.

The existing legislation enables such groups to be formed and operate. However amendments would be desirable to widen the role of groups, make their establishment mandatory and provide for them to levy and collect the full amount of water charges from individual farmers.

The irrigation group could be introduced under existing provisions from the commencement of irrigation. This would introduce limited user management pending legal changes to enhance the role of the groups as suggested above or before moving to one of the more autonomous units described below.

3.2.4 Sub Model 4 Irrigation District Management

Formation of an "Irrigation District" is one means adopted by DSİ to transfer full responsibility for management, operation and maintenance of part of its canal system to local control. Such transfer must be initiated by a request from the local community and when authorised the District is managed by an elected board of directors which employs its own staff, allocates water, levies and recovers water charges and carries out its own O&M activities subject to overall annual approval and audit by DSİ. The works transferred to District management usually comprise a discrete canal system but not storages, major river structures or large conveyance canals which remain under full DSİ control.

Irrigation districts are fully responsible for funding their O&M activities as well as repaying original investment cost of that part of assets under their direct management. They can exercise a greater degree of autonomy than the irrigation groups while still remaining under overall DSİ control since the latter retains ownership of the assets and must approve any request for modification or rehabilitation of them.

The legal mechanism is available for an irrigation district to be established at the commencement of large scale irrigation in GAP although it might be some time before the district could operate without assistance from DSİ.

3.2.5 Sub model 5 Irrigation Co-operative

Co-operative committees have been formed in order to establish and subsequently manage many small and medium scale irrigation projects developed by GDRS and/or DSİ. These are established under the Co-operatives Law No 1163. It is mandatory for a legal co-operative to be formed, at the request of a minimum of 15 farmers, before a new scheme is undertaken.

While the co-operative form of management is usually applicable to self contained projects, such as groundwater supplies or localised surface supplies, it could be adapted for use in larger projects, such as those in the GAP region under certain circumstances. The favourable conditions for a co-operative are that there is a clear physical or geographical distinction from other units, there is a reasonably homogeneous farming and social community and that there is strong local support for it.

Co-operatives assume full responsibility for O&M of their schemes after an initial phasing in period. They are also responsible for recovery of all O&M cost through charges to scheme members. In addition they have been required to repay original investment costs, in the case of projects constructed by DSİ, although not so far for those constructed by GDRS. In the case of any co-operative formed in the GAP region, it would be logical that it repay the investment cost in respect of all works under its direct control, usually tertiary canals, together with a contribution towards primary and secondary works on the same basis as any other local management units served by the same headworks and conveyance canals.

A co-operative has the flexibility and autonomy to develop its own operating rules and policies, regulate its own affairs and make changes to meet the requirements of the majority of its members probably to a greater degree than would an irrigation district. However it might have little influence over events outside its boundaries and therefore to protect the rights of all its members there should be a firm contract covering the conditions of bulk supply to its boundary.

An irrigation co-operative could be established immediately as a private corporate body. It may require some time to become fully independent of government agency assistance for its operations.

3.2.6 Sub Model 6 Irrigation Authority

An Irrigation Agency (IA) would be a new government agency formed to take responsibility for O&M of primary and/or secondary canals, downstream of main storages and conveyance canals. It would also be responsible for O&M of drainage collection and disposal systems.

The IA would be responsible primarily for the **management, operation and maintenance** functions of the irrigation supply system and associated infrastructure. It would not have the functions of investigation, design or construction of large capital works; if these are necessary they would be performed by existing agencies, such as DSİ or GDRS, or the private sector.

The role of the IA is intended to pick up functions that are being carried out only to a limited degree in the GAP region at present. In this regard it would complement rather than duplicate the activities of organisations such as DSİ, GDRS and MARA. It would require a reasonable amount of in-house expertise and may need to draw some staff from the major agencies. However some activities could still be carried out by these agencies where they have the necessary skills and resources. In every case where activities are undertaken on behalf of the IA by another public or private body, it should be on a contract basis.

The IA would operate as an independent financial entity with all its operations, including the servicing of investment costs, funded by revenue paid by the beneficiaries of its services. It would be expected to pay a bulk supply charge to DSİ in respect to bulk water supplied from storages at its intake points. In turn it would charge a bulk supply charge to the tertiary groups at the point of supply, preferably on a volumetric basis. The IA would not be responsible for setting charges to individual farmers or collection.

If the IA is to operate as a truly self financing entity, it is important to ensure that has a wide revenue base and retains the ability to recover the total cost of all services provided. Some suggested steps to achieving this include:

- The IA should be responsible for collection and recovery action for revenue due to it. There should be power to withhold water or initiate legal action against a tertiary group which is in arrears of its bulk charge.
- If Government requires that some level of subsidy or rebate should be made to a particular group of farmers, then such subsidy should be explicit and funded by Government via the IA.
- Where there are hydroelectric generating plants located within the canal system under control of the IA, then net revenue in respect of these power plants should be credited to the IA.

New legislation, or amendment to existing legislation, would be required to establish the IA.

3.2.7 Sub Model 7 Large Irrigation Company (Commercial).

The concept of fully privatised water supply companies has been developed and implemented in a number of countries. The most widespread examples of commercial water companies are in the non irrigation sector, principally for urban and industrial supplies and waste water disposal and these are now common in Europe and USA and are being introduced in Australia.

In the agricultural water sector, there are private companies authorised to operate water supply systems in USA and France. The examples of privatised irrigation usually occur when irrigation has reached beyond the initial development phase and there is a widespread desire by customers to pay for a service provided along private business principles often to higher customer standards than in a traditional government agency. The privatisation process is also encouraged where governments decide to withdraw from all direct involvement in the delivery and funding of irrigation services and make the judgement that farmers have the financial ability to pay the full cost of a service which can be delivered more efficiently by the private sector. Water is measured at the point of supply from company to farmer and charges are usually set on the basis of actual volumes supplied.

Frequently private irrigation companies undertake only the water conveyance and delivery function, drawing a bulk supply from a storage or river offtake controlled by a government agency. In all cases responsibility for overall water resource management and allocation remains with government and the commercial company has control only of the water downstream from its authorised diversion point.

The authorisation by government for a private company to deliver a water supply service is usually in the form of a "concession" or "licence" for a specific period which may be renewed subject to past compliance with any performance standards or conditions. For the Canal De Provence Authority in France the period of the concession is 75 years although in other cases a lesser period might be appropriate. The period that a company is authorised to operate must be sufficient for it to be able to achieve full recovery of its costs and a suitable return on investment.

While the commercial companies operate generally along private enterprise principles, they are usually in a monopoly supply position without the element of direct competition. The questions of service standards, customer satisfaction and adequate communication and complaint resolution procedures between customer and service provider then become important considerations.

For the GAP region it is likely that privatisation of any large part of the delivery system would not be feasible in the near future while most schemes are still in the development phase. Nevertheless there could be both regional and national advantages in moving toward this form of management over time. One means of achieving this could be by privatisation of the Irrigation Authority described in 3.2.6 above. This might be desirable at a time when there is a demand for major rehabilitation or upgrading of the irrigation infrastructure.

The functions of this company would be as a bulk supplier similar to the IA with a greater flexibility in the performance of its activities in response to market and economic demands. The company could be expected to become entrepreneurial in its approach to rationalising its operations, seeking new customers and meeting special needs; eg, for those customer groups which wish to receive a level of service different from the general standard to other farmers.

The question of ownership of the private company would be important and there are several possibilities, namely:

- fully privately owned with shares available for purchase by any person or organisation
- limited private ownership with restricted class of shareholders such as farmers only
- some partial Government ownership in conjunction with one of the forms of private ownership outlined above.

There is broad provision in Law No 6200 for DSİ to transfer responsibility for O&M of its works to private companies having corporate status in a similar manner to the transfers made to public bodies such as irrigation district described in 3.2.4. An appropriate private company could be established under existing legislation. This however would involve a major policy decision which, no doubt, would be the subject of considerable public and political discussion.

3.2.8 Sub Model 8 Small Private Company

Formation of a private company at the tertiary canal level would be a continuation of the privatisation concept. At this level it would be appropriate for ownership to be limited to all or a majority of farmers within that tertiary unit.

Such a company would have many of the private enterprise features already described for the large company at the primary/secondary level. It would be directly owned and controlled by the beneficiaries and there would be a direct incentive to cost effective and good performance in its operations. The company would be fully self funded for both O&M and investment type works and autonomous in all its activities.

There would need to be specific provisions in the constitution of such a company to ensure that the company is not dominated by the wealthiest or most influential farmers. The interests of tenant or share farmers would need special consideration.

As with the large private company described in 3.2.9 there is sufficient legal basis to establish such companies. The concept may take some time to be accepted but could evolve from one of the other tertiary sub models if the majority of farmers are in agreement.

3.2.9 Sub Model 9 Water User Group

Formation of a special purpose Water User Group (WUG), as distinct from an existing DSİ group, would be as a farmer generated organisation. A feature of the WUG is that it would develop progressively with emphasis on setting its own rules, sanctions and conflict resolution procedures. There would be minimum outside direction apart from the clearly established rules of supply at from the bulk supply point. These rules would be need to be specified in a contract with the supply agency.

The basis of the WUG is that before a farmer can receive water, he must become a member of the Group and accept certain obligations, responsibilities and duties which he will perform collectively with his neighbours. This requirement presupposes that there is acceptance by the community of the need for local management and operation as an **equal partnership** with the water supply agency. This partnership must be recognised by the water supply agency, supported by the Government and established as a legal entity with appropriate legislative backing.

The WUG would be fully self-funded from the setting and collection of water charges. It would be autonomous in its operations subject to its bulk supply contract. It is essential that the WUG be able to develop its own rules to regulate its operations and maintenance activities, including the charging procedures for members using irrigation water.

The WUG would be managed by a small committee, elected annually by all the members. This committee would set a budget, covering anticipated income and expenditure, following which it could make decisions on engaging employees and incurring other expenses. The water foreman, in charge of water distribution, should be a paid employee. The expenditure should include allowance for payment of a bulk water charge to the secondary canal supplier. In setting water charges for members the WUG could make its own decisions on the form of tariff and collection procedures.

The committee would carry out all routine administration and operations and report annually, or more often, to all members on financial and any other important matters. Annual accounts should be subject to professional audit in accordance with legal requirements.

The WUG would have independent legal status sufficient to sue and be sued, raise money from financial institutions and operate a bank account. Subject to meeting legal requirements for its financial affairs, the WUG should be free from other bureaucratic controls. The mechanism of formation of an irrigation co-operative is one means of establishing a WUG as a legal entity although other means such as formation of a private company could also be adopted.

Briefly the main functions of a WUG are to:

- to receive bulk water supply and distribute it to individual farmers.
- to pay a bulk water charge and recover its full O&M costs through charges on members.
- to set its own rules by agreement among all the members.
- to regulate its business in accordance with those rules.
- to maintain and improve the tertiary canal system (and drainage canal if relevant).

Such self generated WUGs, as described above, might take some time to become established if they were left to evolve gradually out of one of the already established forms of tertiary sub model. However this process has the difficulty that some of the weaknesses apparent in other types of organisations could occur and so reduce the possibility of a truly self generated body becoming established.

The process could be accelerated if initial assistance was provided for establishing the Group. This could be provided by a Group Formation Organiser (GFO) who would act as a catalyst in the group formation process. This person, who should have a rural background, would require appropriate training to be able to provide information and advice to potential group members and liaise with other organisations and officials.

3.2.10 Sub Model 10 Chamber of Agriculture

The possibility of a Chamber of Agriculture CA) becoming a direct participant in irrigation management could produce benefits. It is an existing farmer organisation, well established and self funded. Many farmers could be likely to respond positively to such an organisation which they know and feel will protect their interests.

The CA should be cost effective and relatively autonomous in its operations.

Possible limitations of a CA as an irrigation management body would include the fact that it represents its own members while some farmers in the any scheme may not be members. As an organisation it is not focused on irrigation farming alone. The question of how committed it would be to the concept of full cost recovery is unknown.

As the Cas are already established as farmer controlled groups, they can be considered as a possible sub model at the tertiary level

3.3 Strengths and Weaknesses of Sub Models

All the sub models have been proposed on the premise that they have possible application to the GAP irrigation systems based on their known or likely performance. For all models it is possible to put forward a number of relative strengths and weaknesses in regard to how adequately they might meet the particular managements requirements of the GAP irrigation systems. For the models based on bodies already involved in irrigation management in Turkey, judgements can be made on these characteristics based on reports and observations studies by various authorities including the consultant's studies. For the models not already operating in Turkey similar judgements are offered where possible based on known performance in other countries with appropriate allowances for how they might be applied to the conditions in this country.

A summary of these perceived strengths and weaknesses for each sub model is given in Table B3.2 covering matters such as management structure, legal basis, flexibility, autonomy, cost effectiveness and degree of farmer involvement.

3.4 Determination of Potential MOM Models from Sub Models

The next major step of the MOM model selection process is to determine which of the many potential models are feasible and should be taken through to the detailed evaluation process. In this section the feasible models to be taken forward to the next stage of evaluation are identified.

The sub models have been described in terms of whether they would be appropriate to manage at the levels of primary, secondary, tertiary canal levels.

The management emphasis at the primary and secondary canal system levels is directed towards the organisation of technical skills and resources to undertake the operation of large works. It is possible to have various combinations of sub models between primary and secondary levels. However as the nature of activities to be undertaken is similar, it would seem desirable and logical for the same organisation to operate at these levels in most cases.

At the tertiary level, however, the thrust of management effort is directed to meeting local water requirements based on farmer needs. The nature of the management functions is significantly different from the other levels. Most of the suggested tertiary sub models could probably be combined with the primary/secondary sub models. The process therefore is to select the primary/ secondary sub models first and then the appropriate tertiary sub model. There are some tertiary sub models (DSİ irrigation groups and Irrigation Districts) which are derived from DSİ operation of existing systems. For possible models in which DSİ is not involved at the primary and/or secondary level then these particular sub models should not be considered as they do not relate to the other primary and secondary sub models.

TABLE B3.2
SUMMARY OF STRENGTHS AND WEAKNESSES OF SUB MODELS

Model	Extent	Strength	Potential Weakness
1 Large Individual Farm, (Private Enterprise Control)	Tertiary canal	Simple management structure. Maximum flexibility. Good integration of irrigation & other farming activities. Cost effective, ie. low cost. Achieves full cost recovery. Can implement immediately.	Applies only in some specific and limited circumstances.
2 DSİ	Primary, secondary, tertiary canals	Legal basis is clear. Organisation is already well established in region. Well resourced to manage large engineering works and activities. Has undertaken implementation of all engineering works for GAP irrigation. Relatively autonomous for routine operations.	Delivery of irrigation services to individual farmers is ineffective without irrigation group or other tertiary level organisation. Cost effectiveness doubtful. Achieves limited cost recovery. Organisation structure relatively inflexible. Limited coordination with other agencies. No participation in farmer training or on farm activities.
3 Irrigation Group (DSİ model as at present)	Tertiary canal	Can provide reasonable O&M at tertiary level. Can achieve good response & compliance from farmers. Reasonably cost effective. Basis already exists and can be implemented in new schemes immediately. Provides a focus for negotiating with adjoining groups for joint use of canal resources.	Legal status is tied to DSİ. Does not own or control assets. Scope of activity limited. No autonomy Level of group performance varies according to ability of leader. Difficult for group structure to reflect both social and system characteristics. No provision for repayment of investment cost or DSİ share of O&M. Formation of groups is optional.
4 Irrigation District	Secondary, tertiary canals	High level of farmer participation in scheme management. High level of cost recovery for both investment and O&M. Closer identification of farmers with scheme "ownership" (cf DSİ Schemes). Autonomous for routine administration. Cost effective. Some internal flexibility. Can be implemented immediately (but only where a municipality exists).	Scope restricted by present limitation of municipal law. Would need change of law to broaden scope. DSİ retains legal ownership of assets and overall financial control. Common community basis limits maximum size of unit. New district requires some government assistance in early stages of development.

Model	Extent	Strength	Potential Weakness
5 Irrigation Co-operative	Secondary, tertiary canals	High level of farmer participation. Full recovery of investment and O&M costs. Cost effective. Identification of farmers with scheme "ownership". Internal flexibility. Autonomous. Can be implemented immediately.	Effectiveness often limited to self contained schemes. Probably less effective where community is not homogeneous. New co-operative may require government assistance for a period before operations are fully autonomous.
6 Irrigation Authority	Primary, secondary canals	Special purpose authority designed for requirements of GAP region. Organisation focussed on irrigation management. High cost recovery. Cost effective if properly resourced. Reasonably autonomous. Cuts across existing institutional constraints.	New organisation and concept requiring new legislation. May meet barriers from existing institutions. Probably requires 5 to 7 years to become fully established
7 Large Private Company	Primary, secondary canals	Special purpose organisation. Cost effective. Full cost recovery. Services closely related to market and economic demands. Greater scope for flexibility in planning, policy development, financial management and operations (cf government agencies) Potential for farmer ownership in the company.	New concept requiring legislation and public/political acceptance. Scope limited while projects are still at the development stage. Requires care to ensure economic management is related to service delivery. Social objections.
8 Small Private Company	Tertiary canal	Special purpose organisation owned by the farmers. Cost effective. Full cost recovery. Direct incentive to high performance. Autonomous for most activities. Flexible to meet local economic and market demands.	New concept requiring public/political acceptance. Wealthy or influential farmers may dominate activities. Difficult to represent tenant farmers. Social objections.

Model	Extent	Strength	Potential Weakness
9 Water User Group	Tertiary canal	Completely farmer organised for participation and control. Each group designed for local conditions. Full O&M cost recovery by farmers. Recovery of investment cost, in longer term, is possible. Cost effective. Farmers "craft" own rules and regulations within conditions of overall supply system. Sanctions enforced locally. High level of compliance and group performance expected due to farmer commitment and direct participation. Fully autonomous for normal operations eg water allocation, fee setting and collection. Can be established under existing co-operative law if this is acceptable to members	May require long lead time for satisfactory establishment. Group area may not coincide with social (village) boundaries. May require new legislation or regulation (unless established as a co-operative). Requires "catalyst" or leaders to initiate. May not be acceptable to all farmers. Relies on community solidarity and commitment. Possible political interference. Influential farmers may dominate. Little cohesion between adjoining groups.
10 Chamber of Agriculture	Tertiary canal	Farmer organised within existing structure with wide membership. Has established legal basis. Acceptable to most farmers. Relatively autonomous. Financially independent and can be cost effective.	May not accept or pursue full cost recovery. May not be representative of all irrigation farmers. Not focussed specifically on irrigation issues. Limited scope for Government direction. May conflict with other irrigation groups.

It can be seen from the 10 sub models depicted in Table B3.1 there is a theoretical total of 105 possible combinations which might form a complete MOM Management Model. Evaluation of so many models would be a substantial task. However when the various sub models are seen in relation to each other, it is evident that many of the theoretical combinations would be neither feasible nor practical for effective management. On the other hand there are some natural combinations of sub models.

The means adopted to reduce the possible combinations to a manageable number for further evaluation is to examine in turn the possible combinations with each of the three sub models proposed at primary canal level (DSİ, Irrigation Authority and Large Private Company). The possible combinations are shown in Tables B3.3, B3.4 and B3.5 respectively.

Seven possible sub models were identified at the tertiary level. In reality there is relatively little discernible difference between some sub models at the tertiary level. This could lead to the conclusion that the selected model could comprise a combination of several tertiary sub models, which could be reasonable to reflect different circumstances, social structures, etc across the same project area. As the characteristics of several are close, for the purpose of model evaluation these have been grouped so that there are only three sub models at tertiary level. As a result of this process the likely combinations of sub models to be evaluated has been reduced to 13. These are shown in Table B3.6

TABLE B3.3

SUMMARY OF POTENTIAL SUB MODELS

Likely or Feasible combinations where DSİ manages Primary Canal

Headworks	Main Conveyors		Distribution system	On Farm System (Quaternary System)
Storages, Major Structures, Pump Stations	Primary Canal	Secondary Canal	Tertiary Canal	
(1)	(2)	(3)	(4)	(5)
DSİ	DSİ	DSİ	DSİ (Irrigation Group)	Individual Farmers
	Irrigation Authority	Irrigation District		
	Large Irrigation Company	Cooperative	Irrigation District	
		Irrigation Authority	Cooperative	
		Large Irrigation Company	Small Private Company	
			Water User Group	
			Chamber of Agriculture	
			Large Individual Farmer	

A single MOM model comprises one sub model from columns 1,2,3 and 4.

Likely Combinations:

DSİ	/	DSİ	/A {IG, ID, CA}
DSİ	/	DSİ	/B {COOP, SPC}
DSİ	/	DSİ	/C {WUG, FARMER}
DSİ	/	ID	/ID
DSİ	/	COOP	/COOP

TABLE B3.4.

SUMMARY OF POTENTIAL SUB MODELS

Likely combinations where Irrigation Authority manages Primary Canal

Headworks	Main Conveyors		Distribution system	On Farm System (Quaternary System)
Storages, Major Structures, Pump Stations	Primary Canal	Secondary Canal	Tertiary Canal	
(1)	(2)	(3)	(4)	(5)
DSİ	DSİ	DSİ	DSİ (Irrigation Group)	Individual Farmers
	Irrigation Authority	Irrigation District		
	Large Irrigation Company	Cooperative	Irrigation District	
		Irrigation Authority	Cooperative	
		Large Irrigation Company	Small Private Company	
			Water User Group	
			Chamber of Agriculture	
			Large Individual Farmer	

A single MOM model comprises one sub model from columns 1,2,3 and 4.

Likely combinations: IA / IA / A { CA }

IA / IA / B {COOP, SPC }

IA / IA / C {WUG, FARMER }

IA / COOP / COOP

TABLE B3.5

SUMMARY OF POTENTIAL SUB MODELS

Likely combinations where Large Irrigation Company manages Primary Canal

Headworks	Main Conveyors		Distribution system	On Farm System (Quaternary System)
Storages, Major Structures, Pump Stations	Primary Canal	Secondary Canal	Tertiary Canal	
(1)	(2)	(3)	(4)	(5)
DSİ	DSİ	DSİ	DSİ (Irrigation Group)	Individual Farmers
	Irrigation Authority	Irrigation District		
	Large Irrigation Company	Cooperative	Irrigation District	
		Irrigation Authority	Cooperative	
		Large Irrigation Company	Small Private Company	
			Water User Group	
			Chamber of Agriculture	
			Large Individual Farmer	

A single MOM model comprises one sub model from columns 1,2,3 and 4.

Likely combinations: LIC / LIC / A { CA }

LIC / LIC / B { COOP, SPC }

LIC / LIC / C { WUG, FARMER }

LIC / COOP / COOP

TABLE B3.6

SUB MODEL COMBINATIONS

No	Head works	Primary	Secondary	Tertiary
1	DSİ	DSİ	DSİ	Irrigation Group Irrigation District Chamber of Agric.
2	DSİ	DSİ	DSİ	Cooperative Small Private Co.
3	DSİ	DSİ	DSİ	Farmer Water User Group
4	DSİ	DSİ	Irrigation District	Irrigation District
5	DSİ	DSİ	Cooperative	Cooperative
6	DSİ	Irrigation Auth-ority	Irrigation Authority	Chamber of Agric.
7	DSİ	Irrigation Auth-ority	Irrigation Authority	Cooperative Small Private Co.
8	DSİ	Irrigation Auth-ority	Irrigation Authority	Farmer Water User Group
9	DSİ	Irrigation Auth-ority	Cooperative	Cooperative
10	DSİ	Large Irrigation Co.	Large Irrigation Co.	Chamber of Agric
11	DSİ	Large Irrigation Co.	Large Irrigation Co.	Cooperative Small Private Co.
12	DSİ	Large Irrigation Co.	Large Irrigation Co.	Farmer Water User Group
13	DSİ	Large Irrigation Co.	Cooperative	Cooperative

3.5 Relationships between Sub Models within a Model

An important consideration in the development of a MOM model comprising sub models which are separate organisations is the matter of the relationship at the interface between sub models. It is highly desirable that the concept of "supplier" and "customer" be recognised as applying at each interface. This implies a understanding and acceptance of rights and responsibilities at each level. It also needs clear lines of communication and accountability between each unit. These should be expressed in a form of "level of service agreement" so that each party is clear as to its responsibilities and accountabilities and what is expected of the other. This agreement should be concise and cover matters such as:

- **Supply Conditions** in terms of volume, flow rates, ordering arrangements, times of availability, procedures in the event of water shortage or surplus etc.
- **Basis of Charge** including tariff schedules, method of assessment and payment arrangements.
- **Communication and Reporting Procedures** to include formal and informal contact arrangements, reporting periods and times, nature of reports and information to be communicated.
- **Emergency Arrangements** to cover unforeseen events.
- **Guarantee of Supply** provisions including liability, funding flow implications, possible sanctions or compensation if service is unavailable.
- **Procedure for Changes** to the provisions of the agreement on the request of either party. It is likely that circumstances will change over time as both the supply and agricultural systems become more fully developed and there should be a means of regularly reviewing such agreements.
- **Procedures for Dispute Resolution** between the parties including the means of appointing an independent person or body to arbitrate on such matters.

4 KEY CRITERIA FOR THE EVALUATION OF MOM MODELS

4.1 Introduction

In Chapter 1 the overall concept adopted to evaluate different MOM models was described and terminology defined. The concept was then explained further in Chapter 2 and the relationship defined between a set of Major Objectives for a MOM model and the Major Criteria which need to be addressed by any MOM model.

As a result of the various specialist studies carried out in the GAP MOM study many issues were identified and expressed as Key Criteria. In total 64 such Key Criteria were identified and these are described in 4.3.

These Key Criteria were then assessed and divided into two categories:

- Relevant Key Criteria which should be used to evaluate MOM models
- Common Key Criteria which any MOM model must address

In total 37 Relevant Key Criteria were identified. These are indicated in 4.3 and fully discussed in 4.4. The remaining 27 were classified as Common Key Criteria. These are also indicated in 4.3 and fully discussed in 4.5.

These 37 Relevant Key Criteria, arising from studies in different disciplines, were then reviewed. Some specialists had identified broadly similar issues and there was a degree of similarity and overlap between certain criteria. Therefore they were rationalised and reduced to a total of 22 Key Evaluation Criteria which represent the full range of criteria for evaluating the MOM models. This process of rationalisation is described further in 4.6.

The final list of 22 Key Evaluation Criteria is carried forward to Chapter 5 where the process of model evaluation is described.

4.2 Issues and Responses Arising from Study Workshop

4.2.1 Introduction

A significant contribution to identification of the main issues to be taken into account in developing the MOM model was provided by participants to a two day Workshop conducted in Şanlıurfa in December 1993. The Workshop was attended by 86 participants from government agencies, academic institutions and other interested organisations who were presented with the consultant's initial findings in terms of objectives, issues and potential models.

The participants were then formed into discussion groups for detailed study of particular matters raised by the consultant. These discussions were carried out in three working sessions during which each group considered a separate topic. In some cases the same topic, or different aspects of it, were considered by more than one group. At the end of each discussion period the group leader reported the major findings in plenary session to all participants. The main points raised by the groups are summarised below under their broad topic headings. The comments and matters raised during the Workshop have been taken into account in the formulation of this report.

4.2.2 Farmer Participation in Irrigation Management

(a) Motivation can be increased by more dissemination of information.

(b) Actual ownership of infrastructure should be passed to users as soon as the law allows.

(c) Participation to be encouraged from the beginning and to be sustained.

4.2.3 Farmer Training

(a) The objective of farmer training is seen as being: to increase productivity through better water utilisation, plant protection and land utilisation.

(b) The training process should be to identify the requirements and skill gaps and then train to meet these specific needs.

(c) There needs to be a dynamic relationship between research and training which may be fostered through a central institution responsible for co-ordinating both functions.

(d) Information dissemination is important and organisational arrangements to achieve this need to be strengthened.

(e) Training should cover the full range of skills and knowledge required for agricultural production and system O&M as well as technological issues.

(f) Farmers' organisations should become more directly involved in extension activities.

(g) Literacy needs to be improved particularly among women.

(h) Training should start as soon as possible utilising existing capability to the fullest.

(i) Training is a continuous process not simply "one off".

(j) A central training co-ordination institution should be considered.

(k) Initial concentration should be on trainers and lead farmers.

(l) Demonstrations in pilot areas are important. The areas must reflect the full range of conditions in the GAP area.

4.2.4 Water Charging Policy and Practice

(a) The objectives of water charging policy should be to encourage water use efficiency and cost recovery. Incentives should be available to encourage good practice.

(b) The principle needs to be explained to farmers that water charges are related to the cost of providing the service rather than sale of the actual water. Users should be fully informed of the components of the charges.

(c) The recovery of investment cost should be made at the time it is incurred and not devalued by inflation.

(d) The point of contact for collection of water charges from users should be the water user group leader.

(e) Drainage charges should be included as part of water charge. Charges should be set on an individual scheme basis.

(f) Sanctions should be available. Fines should be applied for late payment.

(g) At least part of the water charge should be paid before the start of the irrigation season.

(h) A volumetric basis of charging is preferred but it must be practicable.

4.2.5 Monitoring and Evaluation

(a) Items to be monitored and evaluated should include: levels of service and observance of the obligations of both parties (supplier and customer); physical performance in relation to objectives; quality and quantity of resources; social, cultural and economic trends.

(b) Monitoring and evaluation should be implemented by an impartial organisation.

(c) Financing of monitoring and evaluation from a central government source is preferred.

(d) Supplier and user should also monitor their own performance.

4.2.6 Legal Provisions

(a) Existing laws should be used to the best effect possible.

(b) Where existing laws require amendment this should be carried out for early implementation.

(c) The longer term goal is to have well drafted, practicable and implementable new laws.

(d) Legal sanctions are required and loopholes should be plugged.

(e) Legal provisions are required to cover the needs of monitoring and evaluation.

4.2.7 Water Measurement

(a) Flow measurement should be implemented at all levels from source to point of use with particular emphasis at the latter.

(b) The means of measurement will vary with the method of water application. For pressurised water it is straight forward while surface irrigation it may be more difficult.

(c) Measurement of return flows to drains should be considered.

(d) Water measurement should be included in the training programme for farmers in the pilot areas.

4.2.8 Maximising System Efficiency

(a) Government plant and equipment should be transferred to the private sector (contractors) to improve utilisation rates.

(b) The introduction of more efficient distribution systems, such as low pressure buried pipes, needs promotion where it is technically feasible and acceptable to farmers.

4.2.9 Compatibility of Infrastructure with Social Structure

(a) Surveys should be undertaken to ensure social factors are considered at the planning and design stage even if it entails an additional cost.

(b) Farmers generally prefer land consolidation but the time required for implementation can be a constraint.

(c) The Heritage Law sometimes leads to land fragmentation, small holding sizes and inefficient production. The legal minimum holding sizes should be reviewed. On the other hand, land fragmentation may also occur due to farmer preference.

4.2.10 Distribution System Design to be Based on Operating Rules

(a) Studies need to be undertaken at the start of scheme planning to determine realistic irrigation requirements and scheduling.

(b) Provision for water measurement should be included.

(c) Improved co-ordination is required between users, government agencies and scheme designers.

(d) Irrigation system design should be as simple as practicable while providing the necessary degree of control.

4.3 Key Criteria Developed from Issues Identified During the Study

A comprehensive list of 64 **Key Criteria** has been prepared directly from the consultant's technical discussion papers and various related studies and these are listed in Table B4.1. An indicative assessment of whether each Key Criterion is **Common** (C) or **Relevant** (R) to model selection is shown in the right hand column of this table. In 1.2.8 the concepts of "Common" and "Relevant" criteria are explained with respect to the model selection process. In summary 27 of the Key Criteria are assessed as "Common" and 37 as "Relevant". The rationale for this assessment is discussed in detail for each criterion in 4.4 and 4.5.

TABLE B4.1
ASSESSMENT OF KEY CRITERIA AS COMMON OR RELEVANT

No	CRITERION	RELEVANCE TO MODEL SELECTION *
	FINANCIAL AND ECONOMIC CRITERIA	
1	Value of agricultural benefits is maximised	R
2	Cost of management, operation and maintenance is minimised	R
3	Financial autonomy is provided.	R
4	Government investment is protected.	R
5	Farmers are able to pay water charges after paying the cost of inputs.	C
6	O&M cost can be fully recovered.	R
7	Contributions to investment cost can be collected in the long term	R
8	Water can be charged for on a volumetric basis.	R
9	Credit is available for farmers	C
10	Farmers can market their production	C
	AGRONOMIC CRITERIA	
11	Model allows flexibility in development of cropping patterns.	C
12	Agricultural research can be farmer oriented and respond rapidly to needs.	C
	TECHNICAL CRITERIA	
13	System operation must be compatible with design.	C
14	Maintenance can be performed to acceptable standard at all levels.	R
15	Canal and drainage designs are adequate for service delivery.	C
16	Sufficient technical expertise is available at each level relative to system complexity	R
17	System infrastructure is flexible to permit variable water demands.	C
18	Water flow measurement facilities are available and appropriate.	C
19	System design is appropriate for soil characteristics and topography.	C
20	Design minimises need for land consolidation.	C

SECTION B

No	CRITERION	RELEVANCE TO MODEL SELECTION *
	WATER RESOURCE AVAILABILITY CRITERIA	
21	Demand can be managed to optimise available water resources.	R
22	Method of water application is efficient.	C
23	Water delivery system is efficient and can be operated effectively.	C
24	Water measurement can be implemented.	R
25	Re-use of water can be managed as part of total resources.	C
	LEGAL CRITERIA	
26	Existing legislation and procedures are suitable.	R
27	Ease of introduction of new enabling legislation.	R
28	Legal status of water user groups, however constituted, is clearly established.	C
29	The need for legal recourse is minimised.	R
30	Water rights of project are secure.	C
31	Water rights of farmers are clear	C
32	Legal procedures, including penalties and sanctions, can be enforced.	R
33	Land tenure rights of farmers are clear.	C
	POLITICAL CRITERIA	
34	Political support is likely for structure and financial implications.	R

No	CRITERION	RELEVANCE TO MODEL SELECTION *
	INSTITUTIONAL CRITERIA	
35	Existing institutional structures are adequate or require minimum change.	C
36	Objectives and responsibilities of each management level are clear	C
37	Management skills are available and adequate at each level.	R
38	Communication processes between different levels are clearly established.	R
39	Coordination between different agencies can be achieved readily.	R
40	Management structures are sufficiently flexible to respond to farmer demand.	R
41	Management structures can respond to technological change.	R
42	Farmer training and extension requirements can be met.	C
43	Management structure promotes farmer group autonomy and devolvement of responsibility.	R
44	Management structure allows enforcement of appropriate legal sanctions.	R
45	Management structure allows flexibility for formation of farmer groups.	R
46	Management structure promotes accountability at each management level.	R
47	The management structure allows water distribution and collection of charges to occur close to the farmer level.	R
48	The management structure promotes equitable water distribution.	R
49	The management structure promotes the concept of supplier/customer relationship at all levels.	R
50	The management organisation accommodates monitoring and evaluation of performance.	R
	ENVIRONMENTAL CRITERIA	
51	Adverse effects on human health are minimised.	R
52	Adverse effects leading to land degradation are minimised.	R
53	Adverse ecological effects are minimised	C
54	Adverse effects on hydrology are minimised	C
55	Safety risks to life and property are minimised	C

No	CRITERION	RELEVANCE TO MODEL SELECTION *
	SOCIOLOGICAL CRITERIA	
56	Management structure is compatible with land tenure particularly for tenants and share farmers.	R
57	Tertiary management organisations are compatible with social structures.	R
58	Community has positive attitude to development and change.	C
59	Management structures are socially acceptable.	R
	FARMER INVOLVEMENT CRITERIA	
60	Farmer participation is maximised consistent with capability.	R
61	Availability and suitability of key or leader farmers.	C
62	Farmers have sufficient information of irrigation methods and technology.	C
63	Farmers are trained and have the capacity to respond to new techniques.	C
64	Farmers are willing to accept the structure and obligations. Factors include: (a) Understanding of farmer role. (b) Willingness to participate in self generated WUGs and comply with rules. (c) Willingness to pay water charges. (d) Willingness to maintain tertiary system, (e) Willingness to be trained. (f) Farmer confidence in the economic benefit of the structure. (g) Feeling of ownership of their system.	R

* R = Relevant Criterion, C = Common Criterion

4.4 Key Criteria Relevant to MOM Management Model Evaluation

In this section the 37 Key Criteria identified as **relevant** to model selection are discussed individually together with the rationale for classifying them as relevant.

Some of these criteria in fact overlap with each other, or at least express a common principle. Accordingly after the detailed discussion of each one they will be combined into 22 concise statements which become the **Key Evaluation Criteria** to be carried forward for application in Chapter 8. The number of each criterion corresponds to its number in Table B4.1

Financial and Economic Criteria

No 1 *Value of agricultural benefits is maximised.*

From both economic and financial viewpoints it is important to maximise the benefits arising from any project. Although the MOM project is immediately concerned with improving management and O&M, the end objective is to increase the value of agricultural production from irrigation projects in the GAP region. Long term agricultural productivity will be the single most important measure of success or failure of the irrigation schemes.

Relevance: Given that agricultural production will be sensitive to operation and maintenance within the irrigation systems, and that the standard of this could well vary between alternative management models, the benefit to agricultural production is clearly a **relevant** criterion for comparing MOM models. On the other hand although it is possibly one of the most important single key criteria, a case could be made for ignoring it in model comparison. This is because it will only be a reflection of lower level criteria, notably efficiency of water use and system performance, which have to be included as relevant issues. Hence it is suggested that agricultural productivity should not be considered as a primary evaluation criterion. However it is vital that all lower level criteria on which production benefit is dependant are included in the final analysis.

No 2 *Cost of management, operation and maintenance is minimised.*

The alternative MOM models, with potentially different management structures, levels of devolvement and resource requirements, could have significantly different resource requirements. The greater the extent to which the O&M tasks can be passed to the beneficiaries, the lower will be the cost, since they will, inter alia, use labour more effectively and will not incur unnecessary overheads. Hence the lowest cost model will be that which is

- as "lean" as possible consistent with having the ability to perform its responsibilities effectively, and

- devolves responsibilities to lower levels to the maximum extent consistent with capabilities at those levels.

Relevance: It is clear that in comparing any alternatives which have the same end objective, the costs engendered by these alternatives are **relevant** to the selection process. However it is shown elsewhere that while cost minimisation is relevant to choosing the appropriate MOM model, it is not sufficiently important to be rated as a primary evaluation criterion. Essentially this is because although the potential for cost differences between the different models is significant when examining MOM costs in isolation, it is not that significant in comparison with potential benefits.

No 3 *Financial autonomy is provided.*

Financial autonomy of the institutions involved in irrigation operation is a pre-requisite for improved performance. At present there is no direct linkage in DSİ schemes between higher levels of cost recovery and improved operation and maintenance, since water charges are absorbed in general revenues. Under current arrangements, if revenues were to increase dramatically, there is no assurance of any additional O&M funding. It is important to provide linkages between the money which an agency spends and performance, and between revenues collected and service provided.

Studies in a wide range of countries by organisations such as IBRD, Asian Development Bank and the International Irrigation Management Institute have found that, where the irrigation agency collects the fees and is able to use them for O&M, the standard and level of O&M improves. Financial autonomy increases the possibility for progressive reduction of government subsidy for operation and maintenance. The alternative is that the operation and maintenance continues to be dependent upon budget allocations related more to political considerations rather than to fee collection and operational performance.

Financial autonomy is a key factor in improved management and operation and maintenance in the GAP region. If the irrigation agency is run on business lines, whether or not it is a commercial organisation, in that its budgets depend upon the collection of water charges, it will have to give full and active consideration to what its customers need. Its customers (farmers and farmer groups)) should then be able to make a connection between paying for services and the quality of service.

Relevance: Given that the degree of financial autonomy possible will depend upon the type of institution selected, it is an extremely **relevant** criterion in selecting the appropriate MOM model. This is one of the most important criteria against which MOM models should be judged.

No 4 *Government investment is protected.*

A problem in many existing irrigation schemes is that for many years insufficient resources have been allocated to maintenance. This has led to either a reduction in efficiency and benefits, and or to the need to undertake expensive major rehabilitation. Past government investments have thus not been protected. It is highly desirable that this experience is not repeated in the GAP region.

Relevance: Given that the maintenance performance of alternative management models is likely to vary, the need to protect government capital investments is highly **relevant** to the choice of model. However it is considered that this criterion should not assume primary evaluation criterion status because it is dependant upon technical and financial criteria to be used in the final evaluation. Hence protection of investment will be taken fully into account.

No 6 *Operation and maintenance cost can be fully recovered.*

The full recovery of operation and maintenance cost is important for achieving financial sustainability of operation and maintenance of the irrigation schemes. National financial considerations require that the subsidy from government be reduced and preferably eliminated over time. If operation and maintenance costs are not recovered, the probability that scheme maintenance will fall below the required standards increases significantly.

Relevance: The management structure is likely to affect the extent to which operation and maintenance costs can be recovered. Hence this is a **relevant** issue in deciding which model to recommend.

No 7 *Contributions to investment cost can be recovered in the long term.*

The extent to which capital cost investments should be recovered is not certain. If all costs are recovered in real terms, the resulting water charges would severely test the affordability criterion. If the present policy of recovering costs over a long period continues, based on the original historic costs, the revenue obtained would be extremely small. Furthermore the recovery of capital costs is less important than the recovery of operation and maintenance costs. Nevertheless in principle it is desirable to recover a proportion of the investment costs from the beneficiaries.

Relevance: The management structure is likely to affect the extent to which investment costs can be recovered and the matter is **relevant** to model selection. However it is not proposed as a primary evaluation criterion since it is less important than recovering O&M costs and the recovery of O&M cost criterion embraces any capital cost recovery criterion.

No 8 *Water can be charged on a volumetric basis.*

This is a highly desirable requirement for successful irrigation in the GAP region in the long term. It is necessary to satisfy both equity and efficiency criteria. The water resources of the region are not unlimited and it is vital that their use is optimised in order to maximise total benefits. Charging related to a volumetric basis is the main means of providing farmers with an appropriate incentive to minimise unnecessary watering. Volumetric charging does not necessarily depend upon direct physical measurement; for example, the timing of a known flow rate may suffice. However whether water is measured directly or indirectly, measurement and billing require certain levels of competence and management action.

Relevance: Given that the ability to introduce and enforce volumetric measurement could well vary between models, it is a **relevant** criterion for model assessment.

Technical Criteria

No 14 *Maintenance can be performed to an acceptable standard at all levels.*

The supply of large quantities of water from source to farm involves various engineering works ranging from large dams, canals and tunnels to medium and small canals, pipelines and associated control structures. These works utilise materials of different strength and durability and all require maintenance to ensure that the specified performance is achieved throughout their life.

The detailed activities for maintenance depends on many factors including age, physical condition and nature of the particular works. A well planned maintenance programme comprises activities which can be classified as:

- **Essential** which must be carried out immediately to provide service.
- **Routine** consisting of minor repairs and canal cleaning which restores full performance at moderate cost before there is serious loss of performance.
- **Cyclic** which are carried out at periodic intervals often related to seasonal conditions or life expectancy of protective materials.

How well a maintenance programme is carried out has a large influence on the long term viability of the system infrastructure. However maintenance is also a large annual cost and it is the one major item which is often deferred, for a short period at least, in favour of operation and other relatively fixed costs.

Performance of an acceptable standard of maintenance therefore requires considerable levels of skills, resources and funding. The irrigation agency often may decide whether to carry out additional maintenance or take the risk of failure or service deficiency if maintenance is not done.

Relevance: In view of the importance of maintenance to long term viability and the fact that different management models could result in different approaches to maintenance, this criterion is very **relevant** to model selection.

No 16 *Sufficient technical expertise is available at each level relative to system complexity.*

The three major components of the irrigation supply system to which sub models are related are primary, secondary and tertiary canal systems. These consist of engineering structures of varying levels of complexity requiring particular skills among the management, supervisory and operating staff.

For the primary and secondary canals there is a need for particular skills and training in hydraulic principles and water management related to the conveyance of large water quantities over long distances. For the tertiary system the canal operational activities are much simpler and there is considerable emphasis on personal communication skills between operator and farmers together with a need for knowledge of local canal layouts and farming practices.

The possible MOM models comprise various combinations of sub models. Some of the sub models would be relatively large, well staffed and resourced organisations, while others would be smaller community-based organisations having low staff numbers sufficient for only relatively simple operations.

Relevance: As the satisfactory operation of the supply system is an essential feature of any acceptable model and there is the likelihood of different levels of technical expertise in each potential model, this is a **relevant** criterion for model selection.

Water Resource Availability Criteria

No 21 *Demand can be managed to optimise available water resources.*

Making the most effective use of available water will be of crucial importance to the long term success of irrigation development in GAP. Although possibly not evident in the early years when water supply will be plentiful, the effective use of water resources will directly affect the amount of agricultural production possible in the long term. More effective use will mean larger areas can be irrigated a higher level of agricultural production. This will increase the likelihood that development will be financially and socially sustainable and therefore successful.

Given that more efficient use of water resources will lead to increased agricultural production, the level of agricultural production achieved in the GAP Region will be sensitive to the effectiveness of the management and operation of the distribution systems. The optimum balance between water used and crops produced also requires effective husbandry at farmer level.

Relevance: Assuming farmers are educated and are therefore aware of the most effective watering schedules for different crops, the most efficient or optimum use of water will occur under a management system that allows, as far as possible, freedom for farmers to obtain water at the optimum time for crop requirements. A management model that can respond to varying demands and operate the distribution system with minimum wastage will allow optimum use of water resources. This is therefore a highly **relevant** criterion.

No 24 *Water measurement can be implemented.*

Accurate water measurement allows good monitoring and evaluation of water distribution use and efficiency. It creates improved operational control and provides a means of volumetric charging.

Relevance: Whether or not water measurement can be implemented has technical, institutional and social implications:

- **Technical:** water measurement structures can be included in any system; this is solely a matter of design, and in this respect is a neutral issue.

- **Institutional:** any management organisation will fully utilise measurement facilities if there is incentive to do so. If the organisation is financially dependent on revenue based on the quantity of water supplied, then there is an incentive to implement and improve water measurement. This would also improve system control and reduce water losses. In this respect, this is a relevant issue.

- **Social:** at the tertiary level, the intention for any type of management unit would be to promote equitable water charging, whether by water measurement or other means. This would not be affected by the type of farmer group constituted and is therefore neutral.

The efficient use of water based on good water measurement arising from financial incentives for management to improve distribution control is vital and overall this is a **relevant** criterion.

Legal Criteria

No 26 *Existing legislation and procedures are suitable.*

A fundamental requirement for establishment of an irrigation organisation which is to operate as an autonomous business entity is that its legal status can be clearly defined. This is necessary for all types and sizes of sub models covering public and private organisations and the community based groups.

Those sub models which are based on existing organisations in Turkey are established under existing legal frameworks. While such legislation does provide a basis for additional similar organisations to be constituted, there is a need for additional and amending legislation to clarify and strengthen certain procedures. In the case of Irrigation Districts formed to take over management of former DSİ irrigation systems, these are established under a municipalities law dating back to 1930 which was clearly never intended for this purpose and limits their scope of operation.

Other sub models involve organisations which are not currently involved in irrigation management in Turkey and may require new legislation or amendments to existing laws to accommodate them.

Relevance: The availability of enabling legislation is a **relevant** criterion in the selection of MOM models as the legal requirements may differ between the potential sub models.

No 27 *Ease of introduction of new enabling legislation.*

As indicated in Criterion No 26, it is possible that new legislation might be required in order to establish the recommended MOM model. A number of amendments to existing legislation have also been suggested to strengthen the activities of existing water authorities and these changes could be necessary or desirable whichever MOM model is selected. An important factor would be whether enabling legislation could be enacted within an acceptable time.

Relevance: The particular legislation and the nature and extent of amendment that might be required is different for each sub model. If a preferred model requires extensive new legislation, then the practicability and ease with which such legislation might be provided is a **relevant** issue in the selection process. If some of the required legal provisions can be achieved by new regulations which do not need Parliamentary approval then this might be achieved without undue delay or difficulty.

No 29 *The need for legal recourse is minimised.*

Legal recourse refers to the process of initiating some form of legal action to resolve a dispute. Often it causes antagonism between the parties involved. For an irrigation agency reasons for legal recourse may arise in order to recover outstanding water charges or penalise persons who steal water or damage canal works.

For any offences which are contrary to rules and laws of the irrigation system, it is important that the responsible management agency is prepared to take appropriate action to rectify the situation if it can find the wrongdoer. This is important so as not to penalise the majority of farmers who obey the rules. Experience in Turkey and elsewhere suggests that in many cases such matters can often be effectively resolved and appropriate sanctions applied at the local level by community based groups without the need for formal legal action in a court. Peer pressure is a significant factor in achieving compliance within a local community.

On the other hand, larger organisations usually do not have the same opportunity to apply informal measures and must resort to formal legal processes in order to prosecute offenders. This is usually a slow and costly process.

Relevance: This matter could have different effects in each of the various sub models and is therefore considered a **relevant** criterion in the MOM model selection process.

No 32 *Legal procedures, including penalties and sanctions, can be enforced.*

It is important in the successful introduction and ongoing management of an irrigation system that the necessary rules regulating both agency and farmer operations are put in place. Most desirably these rules should be prepared by, or in close conjunction with, the farmers and be accepted by them.

For management units formed on community based groups, the development of such rules can be a relatively straightforward exercise. The fact that the farmers are directly involved in such rule formation should lead to a high level of observance. Application of penalties or sanctions, where needed, can be achieved easily with general community acceptance.

In the case of large scale works and where a large organisation, government or private, is involved, the process of rules and procedures is much more formal. Achieving compliance with such laws by staff at the local level may be difficult and recourse to formal legal action may be the course adopted by such organisations.

Relevance: The means of legal enforcement could vary between the different sub models and therefore is a **relevant** criterion in the process of model selection.

Political Criteria

No 34 *Political support is likely for structure and financial implications.*

The development of management models for GAP involves consideration of a range of economic, agronomic, technical, legal, sociological and other factors. Matters such as financial autonomy, devolution of power from centralised to local control, full cost recovery and introduction of the private sector into irrigation management inevitably bring a political context into the selection and evaluation process. It is crucial that there is the political commitment to the recommended management structure in order to achieve the long term economic benefits which are expected to follow adoption of a selected model.

This may involve introduction of some measures which are a departure from traditional practices, such as greater farmer involvement or new financial arrangements.

Relevance: Political support for the particular institutional structure is a measure of its overall acceptability to the wider community. In a practical sense political support will be essential if legislative changes are required to implement a particular model. As the different models and sub models display a range of factors which have political implications this is regarded as a very **relevant** criterion in the model selection process.

Institutional Criteria

No 37 *Management skills are available and adequate at every level.*

The realisation of the full agricultural potential of irrigation systems in the GAP region will be dependent upon the operational performance of the irrigation institutions involved. This in turn will largely depend upon the numbers and competence of the staff employed by those agencies. The desirable levels of management and operation and maintenance can only be achieved if sufficient competent managerial and technical staff are available at every level of the model.

Relevance: The ability of alternative institutions to attract and retain staff of the necessary calibre may vary. This will depend upon their ability to provide a professionally satisfying environment and to offer terms of employment which are financially attractive, compared with the alternatives facing potential recruits. Since this ability will fundamentally affect operational performance, it is a **relevant** criterion for model selection.

No 38 *Communication processes between different levels are clearly established.*

Given that there will be more than one institution involved in every model, it is important that at every interface an appropriate relationship is established between the two parties. Communication processes are an important element, since inadequate or slow communication would inevitably lead to a reduction in operational efficiencies. It is particularly important that the communication between the user groups and their supplier of water is soundly established. Any shortcomings would reduce the confidence of the farmers in their supplier and affect future cooperation.

Relevance: Since the communication processes could well depend upon the type of management structure, this is a **relevant** criterion.

No 39 *Coordination between different agencies can be achieved readily.*

Management of the total irrigation system is an interactive process with an need for coordinated activities between all public organisations, farmer and community groups, individual farmers and the private sector. Lack of coordination between government agencies has been identified as a problem in the management of existing irrigation systems in Turkey.

The need for coordination of activities such as water supply, agricultural development, training, extension services, land layout and consolidation must be taken into account in the development of GAP irrigation management arrangements. This should be addressed at each level of the management structures, covering matters of policy development, implementation of supply and on-farm works, training, research and advice to farmers.

Relevance: There are possibilities for differing approaches to coordination between the various sub models and therefore this is a **relevant** criterion in the selection of the most appropriate model.

No 40 *Management structures are sufficiently flexible to respond to farmer demand.*

The agency which supplies water to user groups must also be able to respond rapidly to the local group needs whether for advice, maintenance support, or water provision. Failure to do so would have implications for cooperation and agricultural production.

Relevance: The ability of staff to respond to farmer demands will depend upon the management structure of the MOM model. Hence this is a **relevant** criterion.

No 41 *Management structures can respond to technological change.*

The management structures initially introduced for GAP will be focused on the needs of developing irrigated agriculture in areas previously devoted mainly to dryland farming. Many of the farmers, as well as staff of the irrigation supply agencies, may have had little or no previous experience of irrigation.

The level of technology applying in the supply systems and on-farm during the early years will be geared predominantly to the requirements of flood irrigation application to field crops. The management structures should reflect these requirements.

As the irrigation development becomes more fully established, and farmers gain experience and confidence in their ability to generate additional income, it is likely that market and economic conditions may lead to production of higher value crops. This in turn could result in introduction of higher level technologies to improve water application efficiency and meet varying water requirements of specialised crops.

Relevance: Management structures must be adaptable to meet such changes in response to farmer needs. The different management structures under consideration have the potential for varying degrees and rates of response. This criterion is therefore **relevant** in the selection process of the model.

No 43 *Management structure promotes farmer group autonomy and devolvement of responsibility.*

At the local level a considerable degree of group autonomy is desirable whereby the farmers' views and preferences on all aspects of water management, operation, maintenance and division of the cost between members, should be respected. This should be limited only where farmer actions impinge upon other groups or on the environment. This will contribute to maximising the participation of the beneficiaries which is a pre-requisite for long term irrigation success. The corresponding requirement is that the overall management structure of the model promotes rather than hinders user group autonomy. This requires that the bulk supplier agency views devolvement of responsibility to local groups positively, and does not try to undermine the irrigators' authority over their local system or to dictate to the users, other than to enforce contracts with those groups.

Relevance: The potential for any model to support community and farmer involvement, with the resultant enthusiasm for participation in maintenance and high cost recovery is important in model selection. The extent to which alternative management models are likely to succeed in targeting the farmer will, in part, be a question of philosophy. A free enterprise organisation may better appreciate that farmer behaviour is the key to success than civil service or engineering dominated organisations. Hence this is a **relevant** criterion since the latter type of institutions may not the most appropriate organisations for dealing directly with user groups. A new institution which is designed to be "user friendly" is more likely to have the flexibility to focus on farmer requirements and support devolvement. With a greater degree of independence from government for organisations operating at the higher levels of the system it may be easier for them to create the conditions for local group autonomy and minimise interference in local group management.

No 44 *Management structure allows enforcement of appropriate legal sanctions.*

While local groups will be allowed reasonable autonomy, it is important that the supplier is able to enforce sanctions whenever a group fails to meet its obligations. Given the time delay between inadequate maintenance and its full effects becoming apparent, it is possible that some farmers could neglect their maintenance responsibilities, unless some form of sanctions is built into the system and rigorously enforced. If sanctions cannot be effectively enforced, the whole basis of contractual arrangements on which any sound model should be founded would collapse. The immediate effect would be financial, but in the longer term maintenance would deteriorate.

Within the tertiary level system greater levels of adherence to such obligations are most likely to be achieved where there is a community based group responsible for developing the local rules and enforcing them.

Relevance: While the ability of the management structure to enforce sanctions will in part depend upon factors outside its control, both the will and ability to enforce unpopular measures are likely to differ between institutions. Hence this criterion is highly **relevant.**

No 45 *Management structure allows flexibility for formation of appropriate farmer groups.*

It is desirable that the farmers themselves should largely decide upon the local management arrangements which they feel suit their particular needs. The logical conclusion is that at the tertiary level, the appropriate solution will be a mix of a number of the alternative arrangements. Hence it is important that the management structure is sufficiently flexible that it is able to accommodate this requirement.

Relevance: While all management structures will contain a degree of flexibility, this requirement means that the necessary level of flexibility will be higher than is often built into irrigation operation, and is a **relevant** criterion.

No 46 *Management structure promotes accountability at each management level.*

Accountability of all elements of the management structure is vital for long term success. The key elements include:

- **the major institutions to Government:** whatever the level of autonomy enjoyed by these institutions, they are, to a greater or lesser degree, still responsible to government. Even if a private company is involved it would still have to abide, and been seen to abide, by certain regulations.
- **the supplier agency to the farmers**: this element is absent today in the existing GAP irrigation schemes.
- **user group management to members:** the absence of accountability would encourage inefficiency and inequity.

Relevance: Given the influence of accountability on efficiency, and the probability that accountability will partly depend upon the particular management structure selected, this is a **relevant** criterion.

No 47 *Management structure allows water distribution and collection of charges to occur close to the farmer level.*

A pre-requisite of irrigation success is that farmers identify with the systems and not only are, but feel, involved. The closer to the farmer level that water distribution and water charge collection occur, the more likely farmers are to feel that they are full participants.

Relevance: Since the distance which these activities take place from the farmer will be related to the selected model, this is a **relevant** criterion. However given that distance is integrally related to the level of devolvement, this criterion is also closely related to Criterion No 43.

No 48 *The management structure promotes equitable water distribution.*

Equitable water distribution refers to the sharing or allocation of available water resources among all farmers within a supply system in accordance with their legal or established right to that water.

This issue is seen as one that mainly concerns the distribution or tertiary part of the system and in particular how it is managed and operated. Factors that bear directly on the attainment of equity include:

- the existence of system rules which are known clearly by both farmers and operators
- the adherence to those rules in actual water supply operation
- confidence by farmers that the system operators are applying the rules fairly without undue favour or penalty to individuals.

Relevance: This is an important criterion which is **relevant** in the selection process at the tertiary level where the different sub models may have varying capacity to achieve equity.

No 49 *The management structure promotes the concept of supplier/customer relationship at all levels.*

A basic requirement of all the MOM models should be that at each interface between two organisations, where one is receiving water from the other, the recipient should be considered as a "customer" of the one supplying the water. This should apply throughout the system, both where a large institution such an irrigation agency is supplied by DSİ and at the other end of the system where water is being supplied to a small group of farmers.

Both parties in the customer/supplier relationship should know in advance what to expect of the other, and what is expected by the other of itself. Hence firm contractual arrangements between the supplier and users are required. All customers should be able to expect a defined level of service. Hence the supplier would have to guarantee certain deliveries, at a certain rate and possibly provide compensation if it failed to meet its contractual obligations. The agreement might also cover the provision of additional supplies, if and when they are available, possibly at a different rate. The rules governing the service would have to be spelled out clearly: for example, on how the supplier would ration water to its various customers when it is unable to meet all the demands placed upon it. The contractual obligations on the user groups would centre on meeting their financial obligation to pay the water charges and could also cover their maintenance obligations.

The contract could indicate the nature of sanctions that might be applied for non performance. A customer/supplier relationship at the point of water passing to tertiary groups complements farmer group autonomy. If this approach is adopted and is successful, great progress will have been achieved towards sustainability. If the approach is not successful, the monitoring and evaluation system should be used to investigate the reasons and propose appropriate modifications.

Relevance: While it is probable that all the existing or proposed agencies should be able to enter successfully into supplier/customer relationships, particularly at the higher levels of the system, there could be differences in the manner in which they treat farmers groups as customers. An authority or company could be specifically tailored to this function. Hence this criterion is **relevant** for MOM model selection.

No 50 *The management organisation accommodates monitoring and evaluation of performance.*

In order to test the effectiveness of any organisation in carrying out its functions, it is necessary to have some form of monitoring and evaluation system. This is highly desirable in order for the organisation to be properly accountable for its actions.

For large organisations it is usual to have a formal Monitoring and Evaluation (M&E) system which measures actual achievement against a number of quantifiable performance indicators expressed in terms of key objectives. For smaller organisations the system may be simpler but should follow the same principles as for large agencies.

Relevance: This is a requirement that applies to all models and sub models. However the extent to which each can accommodate M&E varies, particularly between existing and proposed organisations, and therefore this criterion is **relevant** for the purpose of model selection.

Environmental Criteria

No 51 *Adverse effects on human health are minimised.*

Irrigation can exacerbate health problems due principally to diseases associated with water-borne vectors, sanitation and drinking water supply. Malaria is the most serious water-borne disease which is likely to occur in the GAP region. The form of malaria most likely to occur is not a fatal variety but causes illness, loss of employment and places a strain on the social and health care services. Reasons for malaria outbreaks in irrigated areas include:

- the creation of habitats suitable for mosquitoes usually resulting from poor operation and maintenance, such as: drainage ditches full of water due to high groundwater and weeds; pools of water from tertiary canal leakages and siphons in fields; borrow pits; roadside ditches

- migrant workers pitching camp or sleeping outside close to the fields and hence close to the mosquitoes

- overuse of chemicals leading to mosquitoes developing resistance.

The control of mosquito breeding sites is the main mechanism for reducing the risk of malaria. This should be done by avoiding the creation of standing water and requires good drainage, regular weed clearance, rapid repairs of leakages, and adopting irrigation methods which do not result in standing water such as sprinklers or drip irrigation.

Schistosomiasis infection is also possible because the snails that transmit the disease are already found in Ceylanpinar. The snails would be able to breed in drainage channels. At present schistosomiasis is not a problem.

Diarrhoeal diseases are common in the GAP Region and associated with unwholesome water and sanitation problems. This problem could worsen if, for example:

- people take water from the canals or drainage ditches (especially migrant workers who do not have access to proper water supply)

- the groundwater drinking water supply is contaminated by return flow off the agricultural fields.

Many of these issues can be resolved by technical, social, institutional (health care services) and infrastructural development. The characteristics which would favour a particular MOM model from the health viewpoint include mechanisms to that ensure regular and efficient maintenance is performed and mechanisms to prevent overuse of water. Technical measures to reduce breeding sites include mechanisms to prevent standing water, such as sprinkler and drip application, drainage provision, and mechanisms to avoid overproduction of crops with high water use.

Relevance: In terms of MOM models the most important criterion is the need to restrict the habitats for disease vectors as this is tied very closely to having a management structure in which water use efficiency and maintenance are stringently applied. The capacity for achieving these can vary between the models and therefore this is **relevant** to model selection.

No 52 *Adverse effects leading to land degradation are minimised.*

Agricultural development is dependant upon making the most of the natural resources available. One important resource is the soil. The productivity of the soil can be affected by:

- its removal by erosive forces
- agricultural practices destroying its structure
- addition of pollutants effecting its properties
- poor management of other inputs (eg water quality) required to sustain crop growth

The occurrence of any one or combination of the above factors will lead to land degradation.

Relevance: The farmers are directly responsible for managing the soil and this is a common factor to any model. However their attitude to how they manage the soil is dictated by the MOM hierarchy above them. Also the interests and responsibilities of the MOM model selected will influence the inputs the management agencies put into:

- land preparation to reduce the soil erosion potential
- matching the irrigation system to the land conditions
- maintaining a good quality of water supply
- supplying water as and when required by the farmers
- sub-surface drainage to reduce water table levels

The matter of land degradation is therefore one which is a **relevant** criterion in the selection of a MOM model.

Sociological Criteria

No 56 *Management structure is compatible with land tenure particularly for tenants and share farmers.*

There is a large number of landless farmers in the GAP region, up to 42% in the areas studied in the socio-economic survey based on 1991 Agricultural Survey figures. There are also areas where there is ambiguity in land titles, where there is no clear title or where no cadastral surveys are available.

Many lands are legally owned by absentee landholders and are farmed, legally or not, by itinerant workers, tenants or sharefarmers. Obviously the preponderance of different classes of tenure among farmers will have a significant effect on attitudes to capital investment, formation of groups and the long term management of particular schemes.

Relevance: This issue is of particular importance in the development of management at the tertiary level and, due to the different degrees and nature of farmer involvement in the various sub models, this criterion is **relevant** to the process of model selection.

No 57 *Tertiary management organisations are compatible with social structures.*

The socio-economic survey indicates that the only major linkage of the farming communities is within their own village and there are generally no other organised groupings. In most cases the community is focused on the village headman as leader and spokesman.

The large scale irrigation canal systems that have already been designed and/or installed in the Urfa-Harran area encompass many villages and thereby cut across the only established social groupings. This is going to be a very important issue in developing coordinated management of water conveyance and distribution over such a wide area.

Relevance: This is a key criterion in developing appropriate and workable management arrangements and, as the potential sub models indicate different possible structures at the village level, this criterion is regarded as very **relevant** in model selection.

No 59 *Management structures are socially acceptable.*

This issue is very similar to Criterion No 57 above and the same comments apply.

Relevance: This criterion is very **relevant** to the model selection process as the various sub models offer structures which vary in their effect on social structures and therefore acceptability.

Farmer Involvement Criteria

No 60 *Farmer participation is maximised consistent with capability.*

The farmer at grass roots level is the key to success of the irrigation programme and he must feature at the centre of all activities as the end purchaser of water for irrigation purposes for crop production.

Farmers will participate in the irrigation programme if they perceive that it will produce financial and economic benefits. Their successful participation will also depend on capability in being able to carry out the necessary irrigation-related works, operations, and husbandry at farm operation level. The level of capability will vary from farmer to farmer, and some will be highly proficient and others less so. The level of this capability will not directly affect the way in which the irrigation programme will operate, but it will affect the level of farm productivity and subsequent profit, and overall prosperity of the region.

It will be necessary to raise the capability level of farmers in irrigation agronomy and operation, and this will be carried out in a number of ways mentioned above. In addition farmers will also learn from experienced irrigation practitioners in the area and from lead farmers.

The overall success of the irrigation programme will depend upon maximum farmer participation, to ensure full use of water supply consistent with assured delivery. Full farmer participation will also reduce the overhead costs per farmer if full participation is achieved, thus spreading the cost more evenly among the community of irrigators.

Relevance: The extent of direct farmer participation can vary between the potential sub models and models and therefore this issue is very **relevant** to the selection process.

No 64 *Farmers are willing to accept the structure and obligations.*

The success or otherwise of the MOM model depends on the willingness or otherwise of the farmer to respond positively to the developments proposed. Unless there is acceptance by the farmer community of the need for a role in management and organisation at the local level, whichever MOM model is adopted is likely to fail. The farmers' participation in the process must be seen as a partnership in which they carry out certain responsibilities and duties as **equal partners** with the water supply agency. This partnership must be recognised by the water supply agency, supported by the Government, and be backed up by the necessary legal safeguards to ensure that it is a recognised entity.

Some particular aspects of farmer willingness are discussed as follows:

- *Understanding of farmer role*

  If farmers are to play a part in the process they must understand what is required of them, their responsibilities, duties, and the obligations of the water supply agency in delivering the water to the distribution point where the user group takes over its role.

- *Willingness to participate in self-generated WUGs and comply with rules*

  One of the potential sub models is a Water User Group (WUG) self generated by the farmers. A feature of this model is that if farmers wish to receive water, they must belong to a WUG. Those who do not participate will not be able to irrigate their land. In becoming members of a group they must be willing to pay the required water charges and carry out the necessary maintenance of the tertiary structures. In addition, each farmer will have a say in the devising of the rules and regulations that will govern the operation of the WUG. Such rules should reflect the needs of the members in being able to control the use of water, regulate the actions of members and set water charges.

- *Willingness to pay water charges*

  The basic premise of all the models is that fair water charges must be borne by the end user. If the farmer is willing to pay the price for water to irrigate his land, increase his production, and thus increase his profitability, then the overall objective of the MOM model will be met in that sufficient funds will be raised to cover operation and maintenance costs of the system.

- *Willingness to maintain tertiary system*

  In several of the tertiary sub models, the farming community would effectively become the owner of the tertiary system of water distribution. In other models the farmers would also be expected to maintain tertiary canals even if they do not legally own them. It is highly desirable that the group realises that it is in its own interests to carry out the necessary maintenance works.

- *Willingness to be trained*

  The introduction of any new system requires that the people concerned understand how it has to be operated. This requires a training input to ensure that the members understand the technical aspects of operating a water supply system, together with the agronomic factors involved in growing irrigated crops. They also need assistance in forming the appropriate sub model. Farmers must, therefore, be willing to receive instruction in these areas. The extent of training required will vary according to the farmers' knowledge and experience and the extent to which they are involved in system O&M.

- *Farmer confidence in the economic benefit of the structure*

  Farmers must feel that their involvement in the scheme will produce benefits ultimately. If such confidence is lacking it will be difficult to persuade them to participate fully. An understanding of the many factors involved in the process of group formation, the level of the farmer's involvement, his feeling of belonging to the group and being committed to its complete success are all necessary components of confidence building. Within any group, the farmer must feel that he is in command of the situation jointly with his neighbours, and that orders from above are not going to render local control inoperative, especially where farmers are investing personal and financial capital in the eventual success of the scheme.

- *Feeling of ownership of the system*

It is desirable for farmers to understand that the tertiary system belongs to them and it requires care and attention. This ensures that damage is minimised, is repaired quickly when it occurs and that those damaging the system are made responsible for the repairs. In this way, every member of the group has an interest in making sure that each portion of the system is operational and that if any part fails it will reduce the supply of water and deprive some members of irrigation water. Each member is effectively a monitor of the system and of each other member's behaviour.

Relevance: The question of farmer willingness and acceptance of the proposed management structure is a most important part of the whole irrigation process, and seeks to address the weaknesses of present system of irrigation management. This criterion is therefore very **relevant** to the model selection process as many factors in the different sub models are likely to provoke different reactions from the farmer viewpoint.

4.5 Key Criteria Common to any MOM Management Model

In this section each key criterion identified as Common to the model evaluation process is discussed and the rationale for this assessment is explained.

Financial and Economic Criteria

No 5 *Farmers are able to pay water charges after paying the cost of inputs*

It is important that farmers can afford to pay the water charges after meeting their other production costs for two reasons. Firstly one of the key objectives of irrigation development in the GAP region is to benefit the farmers in the region. If too high a proportion of their increased production is levied as water rates, this objective will not be met. Secondly a high level of farmer cooperation for the project is a pre-condition for project success. If they are not able to retain the major part of the benefits, their enthusiasm for the project will diminish.

Relevance: While water charge affordability is a key issue in planning the MOM project it is not directly relevant to the choice of MOM model, since it is a consideration which is common to all alternatives. It is therefore classed as **common.**

No 9 *Credit is available for farmers*

It is desirable that farmers are able to take maximum advantage of the opportunities offered by irrigation water and to do this they need sufficient seasonal capital to purchase the desirable level of inputs, and in some cases longer term capital for on-farm investments.

Relevance: While this is an important issue when considering irrigation development in the region, it has less relevance in determining the appropriate MOM model. The effect is similar whichever model is being considered and it is therefore classified as **common.**

No 10 *Farmers can market their production*

It is important that farmers are able to sell their production at a reasonable price. Given the identified constraints in market infrastructure in the region, this means that they will only be able to grow very limited areas of some potentially profitable crops in the immediate future. If this constraint is to be overcome, marketing investments will be required.

Relevance: Since this is an issue which is similar under all models, and does not impinge upon model choice, it is classified as **common** in the context of model selection.

Agronomic Criteria

No 11 *Model allows flexibility in development of cropping patterns*

Several different cropping patterns have been identified in the previous studies. There are five cropping patterns suggested or projected for the region in order to provide the most efficient use of water technically and economically. One crop pattern was suggested in the GAP Master Plan and the other four are projections for the years 1995, 2000, 2005 and 2010 stated in the "Agricultural Marketing and Crop Pattern" study.

These are projections however, and it does not necessarily mean that any one of them will be the actual pattern, but they do show that there must be a balance among the crops to achieve the most efficient use of water. Whichever model is selected, application and development of cropping patterns must involve farmer training, extension and establishment of strong links between the research and extension organisations.

Relevance: The selection of a model would not affect the application and development of cropping patterns in the region and this is therefore **common** to all models.

No 12 *Agricultural research can be farmer oriented and respond quickly to needs*

The farmer, as the key factor of the success of an irrigation design, must have the necessary information on irrigation and agronomy. This information must be created by agricultural research and go to farmers via extension. Similarly, the problems of the farmers must go to research to be solved and then the findings communicated by extension. In order to establish this two way process, agricultural research must be farmer oriented and respond rapidly to needs.

The establishment of a farmer oriented approach in agricultural research could be achieved by the establishment of strong links between research and the extension. The development of a system of extension and research which is farmer driven, rather than State or institutionally driven, through the means of private commercialised advisers and consultants to farmers, may be a possibility over time and as irrigation farmers become more sophisticated.

Relevance: This issue is **common** in all models.

Technical Criteria

No 13 *System operation must be compatible with design.*

The irrigation supply system is designed to deliver a predetermined level of water demand through the carrier and distribution canals from water source to each farm. The management system introduced must be capable of carrying out operation of the supply system in accordance with the procedures assumed by the system designer.

Relevance: The requirement for compatibility between actual system operation and design basis is an important feature in all potential MOM models. However in the evaluation process leading to selection of a preferred model this issue is judged to be **common** as it is unlikely that there will be discernible differences between the models.

No 15 *Canal and drainage designs are adequate for service delivery*

The supply and drainage carrier systems, together with their associated on farm works, are designed to meet an assumed level of service. The technical adequacy of the infrastructure designs is an important factor in the achievement of the planned level of agricultural production.

Relevance: Adequate design is a basic requirement of the irrigation infrastructure regardless of the management model which is adopted. This factor is not a variable one as far as the different models are concerned and therefore it is judged to be **common**.

No 17 *System infrastructure is flexible to permit variable water demands*

It is desirable that the irrigation supply systems be flexible to be able to react to meet changing conditions from those assumed by the system designer. Such changes can arise due to a variety of economic, technical, physical and social causes during the life of the project.

Relevance: The need for flexibility in the technical sense is a **common** issue as far as the selection of MOM models is concerned as the requirement applies equally to all models. However the matter of management flexibility, which would accommodate the implementation of technical flexibility, is relevant in model selection and is covered by another criterion.

No 18 *Water flow measurement facilities are available and appropriate.*

This criterion embodies the concept that maximum water use efficiency, in this case having the facilities available to measure and monitor water distribution and use, can assist maximising water use efficiency and hence agricultural production.

Relevance: This matter is highly important but not relevant to the decision between one management model and another. The fundamental question is whether or not the incentives exist for the management organisation to use the measurement facilities provided, and this is covered under another criterion. As a common issue, it is vital that appropriate flow measurement facilities are incorporated in any model design.

No 19 *System design is appropriate to soil characteristics and topography.*

The method of irrigation application should be adapted to the land and soil conditions. Irrigation design should therefore take into account matters such as:

- soil infiltration rates
- soil texture which affects channel flow rates and potential for erosion
- soil depth which affects the amount of land grading possible
- general topography which affects choice between surface, overhead or drip irrigation
- degree of land slope which affects alignment of irrigation furrows, length of border strip etc.

If the design of the irrigation system is appropriate to these conditions then:

- efficiency of water use will be possible
- maintenance of the system will be improved
- management of field irrigation will be easier

Relevance: Irrespective of which MOM model is selected, the design decision on the method of irrigation most appropriate for a particular project area will have already been taken. If the design is compatible with the soil and topographic conditions, then there is more flexibility to make adjustments during the operation of the project to adapt to changing conditions. This is **common** irrespective of which MOM model is used.

The benefits to be realised from proper project design will be to the direct advantage of the farmers. As the farmers are directly responsible for managing the field irrigation then this is also **common** to any model.

No 20 *Design minimises need for land consolidation*

At present the normal practice in the implementation of a new irrigation project is to reallocate land among the farmers so as to fit in with the irrigation system layout. Knowledge of the farm ownership boundaries by the design team before the designs are finalised would enable the canal and drain alignments to be positioned wherever practicable along existing property boundaries. This could minimise the number of boundary changes required and make land consolidation easier where it is still necessary. This would also reduce possible conflicts between farmers and help them maintain a good disposition towards the new irrigation system management. However in some circumstances it could make the design process more complex and increase the distribution system costs.

Liaison is required between the irrigation management agency, system designers and GDARef which is responsible for land consolidation within the project areas. Parcellation maps should be obtained for all areas before designs are finalised.

Relevance: The benefits to be derived from land consolidation will be applicable to all MOM models. The decision on how to fit the irrigation infrastructure into the existing farmer boundary network would normally be taken before a MOM model is selected. This issue is therefore **common** to all models.

Water Resource Availability Criteria

No 22 *Method of water application is efficient*

As with the matter of optimum management of water resources, the efficient use of water at the field level will allow larger areas of land to be irrigated thereby promoting greater agricultural production. Additionally, more efficient application of water will minimise potentially adverse environmental impacts such as soil salinisation and the spread of human health problems.

Relevance: It could be argued that promoting higher water use efficiency at the field level will be most effectively encouraged by the implementation of realistic water charges accompanied by an effective collection mechanism. Although water charging policy and procedures are certainly linked to the type of model selected, any model must promote, through an appropriate and effective extension service, the education of farmers in efficient water management practices. This criterion is therefore judged to be a **common** one in terms of model selection.

No 23 *Water delivery system is efficient and can be operated effectively*

A delivery system is deemed to be efficient if it:

- is based on the best possible design to minimise seepage and evaporation losses
- has the hydraulic capacity to deliver water in response to demand
- can be operated effectively with appropriate storage and control structures provided so that spillage and rejection losses are minimised.

An efficient system should result in the minimisation of water losses, and hence maximisation of water for irrigation of land under command and therefore agricultural production.

Relevance: Although in part related to the operation and management of the system, efficiency is fundamentally a technical issue requiring that, for any system, the design must accord with the planned method of operation. This is a common criterion to all models.

No 25 *Re-use of water can be managed as part of total resources*

This issue again embodies the concept that maximising water use efficiency leads to maximum agricultural production. Whether or not excess irrigation water can physically be re-used is directly related to the foresight of the designer and the infrastructure provided to allow this to be achieved.

Relevance: Whether or not any organisation will seek to manage a system so as to maximise water re-use depends upon incentive. At times of water shortage, DSİ has historically constructed new works to capture drainage water for re-use. In times of plenty, it is not certain that any one type of organisation would manage re-use of water any better than another. This is therefore judged to be a **common** criterion. What is certain is that provision for re-use should be incorporated in system design with clear operational policies and guidelines for its use.

Legal Criteria

No 28 *Legal status of water user groups, however constituted, is clearly established*

The potential MOM sub models under consideration comprise a number of groups whose membership would be based on the fact that they consist of all farmers in a defined area of the water supply system. Effective management at the local level of such groups is largely dependent on community commitment and interaction between all the farmers concerned on matters such as water allocation, canal cleaning, setting and collection of water charges, dispute resolution and application of penalties and sanctions.

While water user groups can and do perform many activities in a relatively informal manner, their operations and autonomy are severely limited if they do not have a defined and clearly established legal basis. This is vital if such a group is to have full autonomy and control over infrastructure and property. The DSİ irrigation groups and irrigation districts are examples of existing bodies whose operational scope is restricted by the limitations of their legal status.

Relevance: The requirement to have a clearly established legal basis for any group applies equally to all sub models and is therefore a **common** criterion .

No 30 *Water rights of project are secure*

Secure water rights for each irrigation agency involved is fundamental to the long term sustainability of any irrigation project. This right is not in doubt at present in the GAP region but may become important in future years as full development occurs and additional water demands are placed on the main river systems.

Relevance: This fundamental right to clearly defined water rights applies equally to all potential sub models and therefore this is a **common** criterion for the purpose of selecting MOM models.

No 31 *Water rights of farmers are clear*

The right to water of each farmer within an irrigation project, and the conditions under which he may exercise to use that right, are important in achieving acceptance and understanding by the community. The details and nature of the farmer's right may differ in each project and desirably it should be clearly defined by the tertiary level agency in a form that is understandable to each farmer.

Relevance: This is an matter which applies equally to every project and for whichever management model is involved. Therefore this issue is regarded as

common to the model selection process.

No 33 *Land tenure rights of farmers are clear*

Farmers who will be operating in the GAP region comprise landowners, tenants, share farmers and employees. The nature of their land tenure is a matter that is significant in determining their attitude to irrigation management and the acceptance of operating rules, water charges and infrastructure maintenance.

Relevance: This is a factor that needs to be taken into account by irrigation organisations, particularly at the tertiary level, in developing their operating rules and arrangements. However the issue is equally significant for all potential models and is therefore regarded as **common** for selection of the model.

Institutional Criteria

No 35 *Existing institutional structures are adequate or require minimum change*

The range of potential sub models and models under consideration includes some which would involve organisations already in existence which could operate under their present arrangements or with minimum change. Other models propose organisations, that would be new in Turkey, with a more radical approach to irrigation management than has traditionally been practiced.

Relevance: The possibility of introducing a MOM model requiring little variation of existing institutional arrangements may have some attraction, at least in the short term. However if applied as one of the main evaluation criteria this issue would limit the range of management options and reduce the likelihood of achieving the medium and long term economic benefits of the GAP irrigation projects. This issue is therefore considered as **common** to the process of selecting MOM models.

No 36 *Objectives and responsibilities of each management level are clear and unambiguous*

It is a major requirement of good management for any business or organisation that every management level has clearly stated objectives and responsibilities which are derived from those of the total organisation. This is important to ensure accountability, utilise resources efficiently and avoid both duplication or omission of key activities.

This matter becomes even more critical in a situation where there is the possibility of multiple organisations involved in a total management structure as could occur with a MOM model comprising a combination of sub models.

Relevance: This is a key issue in development of the total management process and applies equally to all models. Therefore it is classified as a **common** criterion in respect of model selection.

No 42 *Farmer training and extension requirements can be met*

Agricultural extension input is provided by the MARA GDOS Provincial Directorate of Agriculture in Şanlıurfa and other provinces with county offices throughout the provinces. The present system is described in Technical Discussion Paper No. 9 (Halcrow 1993). Some improvements are necessary if GDOS is to play a full and active part in the development of irrigated agriculture in the provinces. This will include the need for a greater input in irrigation agronomy advice to farmers through extension staff and a greater concentration of such staff in the proposed Pilot Areas and the first irrigation areas which are irrigated from the newly constructed GAP projects. Farmer training through upgraded extension is an activity of the GAP MOM study during the Implementation phase.

Relevance: Whilst farmer training and extension to farmers are essential inputs for successful farmer participation in irrigation programmes, the provision or not of these inputs will not affect the selection of a management model. It is therefore regarded as a **common** criterion.

Environmental Criteria

No 53 *Adverse ecological effects are minimised*

The natural vegetation of the GAP region, where it still exists, is a woody steppe in the wetter areas and desert steppe in the semi-arid and arid regions. Much of the area has already been converted to agriculture. Where dryland farming includes a fallow and in areas which are grazed a pseudo-steppe vegetation results. There are endemic and endangered species living in the region although their geographical distribution is not known, making it impossible to assess the impact of individual schemes. Some of the endemic species include the wild forms of many cultivated plants. These are of potential importance for genetic research. There are no areas which are protected for their ecology although some locations have been suggested.

Relevance: Widespread irrigation may potentially result in the loss of habitats of ecological conservation value, extinction of rare species, a reduction of bio-diversity, and changes in the species richness and abundance of flora and fauna. It may also lead to the prevalence of new pests or crop diseases or the improvement of some existing agricultural problems. These will occur regardless of the management structure adopted because they are related to the conversion of semi-natural habitats to intensive farming habitats with wetter summer conditions. Possible ecological effects are therefore regarded as a **common** criterion for model selection as they apply equally to all models.

No 54 *Adverse effects on hydrology are minimised*

Irrigation development is primarily concerned with the use of water in the most economical way to enable profitable agricultural production. By abstracting water for irrigation purposes from a particular water source there should be an awareness of the needs of other users who may rely on the same water source. The resultant change in the river flow regimes or groundwater levels could have adverse impacts on downstream users and the environment..

Agencies responsible for management of irrigation projects need to be aware of the need to return excess water quickly to the river or make it available for groundwater recharge. This entails maintaining an efficient drainage system to collect and then transport the drainage water. Reuse of water will reduce the demands made on the primary water source and this has been covered in another criterion.

Relevance: Irrespective of which MOM model is selected, the decision on where, how and when water will be extracted from a particular water source will have already been taken. This decision should also have taken into account all other demands from the same water source and the ensuing environmental implications. This matter is therefore regarded as **common** in the model selection process as it applies equally for all models.

However the choice of MOM model could have implications on how efficiently the water is used. This would affect the amount of additional water available to downstream users or will help to reduce the depletion of groundwater resources. The environmental impact of this aspect would be minimal compared with the effects from the original demands made on the water resource.

No 55 *Safety risks to life and property are minimised*

The main safety issue is the risk of drowning by adults, children, livestock and other animals in the conveyance system. It is understood that drowning in irrigation canals is a cause of a number of deaths throughout the country every year. The primary and secondary canals are deep (in excess of 3 metres for the former and 2 metres for the latter) and would be carrying relatively fast flowing water. Under these conditions it would be impossible for people to stand up in the canals. They would also be unable to find a hand hold along the canals which have a smooth cross section. Livestock would also be unable to climb out of the canals. Any loss of life is unacceptable. Loss of livestock is also undesirable because it is unnecessary, represents loss of income and may cause damage to the structures. For these reasons it is necessary to consider safety hazards in the design of the irrigation system. The tertiary canal system in the Urfa-Harran area is mainly on pedestals (canalets) and so should not present a safety hazard by drowning.

Relevance: Safety is a fundamental issue in canal design which is dealt with by minimising the risk of people and livestock falling in and providing a means of escape if they do so. The type of irrigation management structure would not affect the level of risk and this is a **common** criterion for MOM model selection.

Sociological Criteria

No 58 *Community has positive attitude to development and change*

The attitude of the farming community towards management and organisation of new irrigation development will be influenced by various factors including their knowledge, if any, of irrigation practices and their perceptions and expectations of what benefit they will derive from it.

The results of the socio-economic survey indicate positive thinking among the farmers surveyed towards a number of issues which would tend to favour the successful introduction of large scale irrigation. In particular there has been good support for direct farmer involvement in scheme operation and maintenance and acceptance of the need for fair and reasonable levels of water charges to be paid by all farmers. The subject of land consolidation, while only experienced by a minority of those surveyed, also indicated positive attitudes to the need for this activity as part of the development process.

On the other hand the survey also indicated a number of factors and attitudes that could be negative towards success of the projects. The lack of formal village organisations and low level of experience in crafting organisations could cause difficulties in development of water user groups where there is little social cohesion.

Relevance: The attitude of the farming community is an important issue for the successful introduction of large scale irrigation in GAP. Each project and even each village will require to be considered individually as to the particular attitudes towards development. This is therefore very important in the implementation of a MOM model. However these considerations apply to all potential models and this is therefore regarded as **common** in the model selection process.

Farmer Involvement Criteria

No 61 *Availability and suitability of key or leader farmers*

It is desirable that key farmers and leader farmers are available, especially for the operation of the TYUAP supported training and visit extension system. It is hoped and expected that there will be at least one person in this category within every community that will receive irrigation. Such persons would act as leaders and encourage the less able and less informed to benefit from irrigated agriculture. The transfer of knowledge and the setting of example by these people will be of key importance in the rapid acceptance by other farmers of new technology.

Relevance: The presence or not of leader farmers will not affect the selection of a MOM model. This criterion is therefore **common** for model selection purposes.

No 62 *Farmers have sufficient information of irrigation methods and technology*

This matter is linked to the subject of farmer training and extension and the availability of key or leader farmers. It is desirable for farmers to be sufficiently informed of methods and technology. The extension and training input, plus information received from other sources, will assist the farmer and help to upgrade his knowledge of irrigation technology.

Relevance: These matters will be important regardless of the MOM model chosen. This criterion is therefore **common** as it applies to all models and will not affect the model selection.

No 63 *Farmers are trained and have the capacity to respond to new techniques*

As discussed above it is planned that farmers will be trained and will have the capacity to respond to new techniques. However, there will be factors other than training which affect the farmer's ability to respond to new techniques. These include the availability of credit, availability of supplies and equipment, availability of labour, availability of water, ability to sell the crop or commodity produced, together with a responsive extension and research network giving advice and support.

Relevance: While all the above factors will be crucial in the production process overall they do not affect the selection of the MOM model and as such this criterion is **common** to all.

4.6 Key Evaluation Criteria

The 37 Relevant Key Criteria described in detail in 4.4 form the basic mechanism for evaluating the models. As indicated previously these criteria were drawn from the detailed studies of all the consultant's specialists covering a range of disciplines and there are similarities between the ideas expressed in a number of these 37 criteria. For example there are 13 under the Institutional category and 7 under the Financial and Economic while only two each are in the categories of Technical, Water Resource Availability, Environmental and Sociological. The final model evaluation and selection must be based on the widest range of criteria thus ensuring that the process it is not distorted or biased towards one or two groups of criteria. Accordingly the list of 37 Relevant Key Criteria has been reviewed and rationalised resulting in a total of

22 Key Evaluation Criteria which are clear statements expressing the evaluation concepts without duplication. Because of the many ideas emanating from the studies this rationalisation process has in a number of cases required separate but related ideas to be combined into a single Key Evaluation Criterion.

Table B4.2 lists the 22 Key Evaluation Criteria and shows their relationship to the Major Evaluation Criteria. Details of their application in the evaluation process are given in Chapter 5.

TABLE B4.2
RELATIONSHIP BETWEEN MAJOR EVALUATION CRITERIA
and
KEY EVALUATION CRITERIA

MAJOR EVALUATION CRITERIA	KEY EVALUATION CRITERIA	
Maximise Water Use Efficiency	1	A water charging structure that promotes water use efficiency, such as volumetric charging, can be implemented.
	2	Demand can managed to optimise use of total resources.
	3	The concept of supplier and customer and the enforcement of sanctions is promoted at all levels.
	4	Efficient provision of the total set of services required by the farmer, including inputs and marketing,is promoted.
Minimise Management, Operation and Maintenance Cost	5	Optimal mobilisation and development of management skills is promoted at all levels.
	6	Two-way accountability at all levels is promoted.
Minimise Adverse Environmental Impacts	7	Adverse effects on human health are minimised.
	8	Adverse effects leading to water quality degradation are minimised.
Promote Financial Viability	9	Financial autonomy is promoted.
	10	Operation and maintenance cost can be fully recovered together with contributions to investment cost in the longer term.
	11	Government investment is protected.

MAJOR EVALUATION CRITERIA	KEY EVALUATION CRITERIA	
Social Acceptability	12	Suitability of local management to different farm sizes and tenure arrangements.
	13	Equitable water distribution and farmer acceptability are promoted.
	14	Flexibility for formation of farmer groups is allowed.
	15	Structures are socially compatible and acceptable.
Physical Performance	16	Capacity to mobilise and develop, in a suitable timeframe, sufficient skill and resources so that operation and maintenance are performed efficiently at all levels.
Ensures Institutional Effectiveness	17	Performance can be monitored and evaluated at all levels and acted upon.
	18	Horizontal and vertical communication and coordination processes can be established and maintained in and between agencies.
	19	Legal procedures can be enforced, including appropriate sanctions and penalties as a last resort, although informal controls are encouraged.
	20	Maximum devolvement of responsibility and farmer participation in management, operation and maintenance is encouraged by allowing control of water distribution and collection of charges close to the farmers.
Allows Early Implementation	21	Existing legislation and procedures are suitable or, where additional provisions are required, political support for such measures can be expected.
Promotes Flexibility to Change	22	Management structure is responsive to farmer needs, technological advances and changing demands for water and other services over time.

5 EVALUATION OF ALTERNATIVE MOM MANAGEMENT MODELS

5.1 Introduction

The evaluation of alternative management models has been based on an assessment of how well each of the alternative models addresses the 22 Key Evaluation Criteria. It is the fourth and final step in the process aimed at determining the most suitable model for operating and maintaining irrigation schemes in the GAP Region in a structured and unbiased way.

The models are evaluated against the Key Evaluation Criteria and a judgement made as to whether a particular model is positive, neutral or negative against every criterion in turn. These judgements are presented by means of a colour coding system in which green represents positive, yellow neutral and red negative. In this system some intangible factors involve subjective judgement, whilst tangible factors can be more directly or numerically assessed as demonstrated in the Technical Discussion Papers. This is an inescapable factor in any decision making process where both tangible and intangible criteria are involved. To be comprehensive both types of criteria must be considered; indeed if the process does not allow this, then evaluation cannot proceed.

The visual approach used is particularly powerful in that it allows those involved in the decision making process to appreciate more easily the results of their decisions about many interrelated criteria. The pattern is displayed in its entirety and readily allows comparison of model against model, and the identification of particularly sensitive criteria.

As an approach it has been used previously in other countries for similar multi-criteria studies to the satisfaction of those involved in the decision making process. Finally, its strength also lies in allowing participation in evaluation by experts from a wide range of disciplines. This has been adopted for the GAP MOM study where many team members have prepared their individual assessments. These have been amalgamated to produce a consensus view as shown on Table B5.1. For each model the table shows the response to each criterion as being positive (green colour), neutral (yellow colour) or negative (red colour). The rationale for these judgements is set out in detail for each criterion in 5.2.

The envisaged timescale for the judging of alternative models was five to seven years since any changes will require time to become fully operational.

TABLE B5.1 : INITIAL EVALUATION OF MOM MODELS

OBJECTIVE	MAXIMISE NET BENEFITS						ENSURE SUSTAINABILITY														IMPLEMENTABLE		
MAJOR CRITERIA	MAXIMISE WATER USE EFFICIENCY				MINIMISE MOM COS		MIN. ADVERSE ENVIR. EFFECT		FINANCIAL VIABILITY			SOCIAL ACCEPTABILITY				INSTIT. EFFECTIVENESS PHYSICAL PERFORMANC					EARLY IMPL.	FLEXI-BILITY	OVERAL ASSESS
KEY CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
MODEL																							
DSI/DSI/DSI/-IG/ID/CA						+	−	−	−	−				−			−		−	+	+	−	
DSI/DSI/DSI/-COOP/SP				+					−								−				+	−	
DSI/DSI/DSI/-F/WUG							+	+	−			+	+	+	+		−					−	
DSI/DSI/-ID									−								−				+		
DSI/DSI/-COOP				+					−								−				+		
DSI/IA/IA/-CA	+	+	+		+	+	+	+	+	+	+							+	+				
DSI/IA/IA/-COOP/SPC	+	+	+	+	+	+	+	+	+	+	+							+	+	+		+	
DSI/IA/IA/-F/WUG	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+		+	+	+		+	
DSI/IA/-COOP	+	+		+	+	+	+	+	+	+	+							+				+	
DSI/LIC/LIC/-CA	+	+	+		+	+	+	+	+	+	+						−	+	+		−		
DSI/LIC/LIC/-COOP/SP	+	+	+	+	+	+	+	+	+	+	+						−	+	+	+	−	+	
DSI/LIC/LIC/-F/WUG	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	+	−	+	
DSI/LIC/-COOP	+	+		+	+	+	+	+	+	+	+						−	+	+		−	+	

+ : Positive (blank) : Neutral − : Negative

5.2 Evaluation of Alternative Models

The final step of the MOM model selection process is to evaluate each of the alternative MOM management models described in 3.4 in terms of the 22 Key Evaluation Criteria described in 4.6.

The 22 Key Evaluation Criteria basically divide into the following two types:

- those which affect the selection of the primary/secondary sub-model
- those which affect choice of the tertiary sub-model.

While a few criteria are identified as being relevant for both choices, most fall into one category or the other. Hence in considering the alternative models each criterion should be identified initially as either affecting the primary/secondary sub-models, the tertiary sub-models, or both. Subsequently the focus is then directed to the appropriate level of sub-models. The main arguments affecting the judgements for the respective models against each individual criterion are discussed below.

In Table B4.2 each of the 22 Key Evaluation Criteria discussed below are shown linked to the next higher level of 8 Major Criteria, which are themselves referenced to the three MOM Major Objectives of:

- Maximising Net Benefits
- Ensuring Sustainability
- Implementable and Flexible.

The structure of the following sections follows this format.

5.2.1 Maximise Net Benefits

(a) Maximise Water Use Efficiency

Criterion No 1 *A water charging structure that promotes water use efficiency, such as volumetric charging, can be implemented*

This is mainly a primary/secondary sub-model criterion. It is not easy to distinguish between the different sub-models as to the technical ability to measure and charge for water on a volumetric or on some other proxy basis. However charging to promote efficiency, for example by volume, may also require communicative and other skills which DSİ does not generally possess. New organisations should be better equipped than DSİ in this regard since they should be specifically designed to take such requirements into account. Furthermore their whole philosophy will be in line with charging to promote efficiency.

This criterion does not significantly affect the tertiary level sub-model choice, in the medium term, since measurement is likely to end at the tertiary off-takes.

Criterion No 2 *Demand can be managed to optimise use of total water resources*

This criterion, which is particularly relevant in times of scarcity, is basically a high level issue. It overlaps with criteria discussed below covering the effectiveness of operation and maintenance, and flexibility and ability to respond to farmer needs. Hence an irrigation authority and an irrigation company would be ranked ahead of DSİ on this criterion. However this criterion represents a crucial issue which relates to the management of the total water resources in the interests of all users from power generation to recreation. This is an area where DSİ's strength lies, and therefore DSİ's high level role and overall responsibility for the management of the total resource base to meet a whole range of water use demands is not currently under debate. It can be argued that given this high level role, it is appropriate for DSİ to restrict its role, within the irrigation sub-sector, to responsibility for the headworks and major carriers, and to be released from its role as the main irrigation water conveyor agency in the MOM model. If it ceases to be the direct supplier to individual schemes it will be in a better position to make balanced high level allocation decisions.

At the other end of the scale, the managing of demand to optimise the use of water may require alterations to farmers' preferred cropping patterns involving the reduction of the area of crops which have high demands, particularly during the peak summer months. Here an authority or a company would be preferable to DSİ since the requirements are related to criteria discussed below, such as Criterion No 8 relating to communication and coordination.

Criterion No 3 *The concept of supplier and customer and the enforcement of sanctions is promoted at all levels*

This is solely a primary/secondary level issue. If the tertiary organisation requires water, it will have to act as a willing customer, whatever sub-model it represents. The extent to which any primary level management structure fulfils this requirement is related to its commercial orientation. Hence a large private company comes out top of any evaluation, while DSİ would only receive a moderate mark. The extent to which an irrigation authority would act commercially would largely depend upon its philosophy, but it should be possible to build in a commercial outlook into its enabling legislation. Hence it should rate just below a large company.

Criterion No 4 *Efficient provision of the total set of services required by the farmer, including inputs and marketing is promoted*

This criterion can relate to all levels of the model. Within the context of the higher levels of the models currently under consideration, it depends upon the extent to which DSİ, an authority, or a large irrigation company becomes involved in the provision of services. DSİ is less likely than the authority to become involved in this exercise. However it is considered unlikely that either the authority or company should be heavily involved in service provision. In all models the main function of the primary supplier will be to coordinate with existing agricultural service providers, both governmental and private. Hence direct service provision is largely neutral. Co-ordination is covered by Criterion No 18. At the lower level, the main factor which could affect model marking is whether or not co-operatives are involved. If well managed, adequately resourced co-operatives are involved, this should allow the models which include co-operatives to score highly.

(b) Minimise Management, Operation and Maintenance Cost

Criterion No 5 *Optimal mobilisation and development of management skills is promoted at all levels*

While this issue is relevant at all levels, its main importance relates to the primary/secondary level. At the tertiary level, the extent to which this criterion is likely to be fulfilled will be affected by the sub-model. However given the gradations in the marking system, these cannot be shown in the diagram, since they are less important than the differences between the top level sub-models. The key factor for the higher level agencies will be their ability to attract the right calibre management personnel and to develop their skills. Hence institutions which are able to reward staff who perform well will find it easier to attract good staff. In addition the greater the extent that an organisation is divorced directly from government, the greater its concern with maximising the output from staff members. This is demonstrated by the difficulties faced by government organisations to take effective action against staff who do not perform well. Hence a private company is likely to put the greatest emphasis on developing the skills of its staff and has an advantage over an irrigation authority, which itself should have an advantage over DSİ.

Criterion No 6 *Two-way accountability at all levels is promoted*

This issue is relevant at both the primary/secondary and tertiary levels. In general Government departments in many countries tend to perform moderately in accountability tests. For example, while departments in general spend money on its intended purpose, there is little relevant accountability as to how efficiently it is utilised. Accountability is again related to the philosophy of an organisation: the greater the emphasis placed on results in terms of outputs, the greater the emphasis on accountability. Hence at the higher level, an authority is likely to score well, but not as highly as a private company, while both would be assessed higher than DSİ.

At the tertiary level the level of accountability will depend both on the tertiary organisation and on the local power structure. Whatever tertiary organisation is formed, accountability may be limited if the management of that organisation is constrained by powerful local influence or by top-down directions. Nevertheless the type of tertiary organisation should affect the level of accountability. This will be related to the extent of democracy present in that group. Hence the individual farmer and Water User Group should rate highly while the Irrigation Groups would rate poorly. The other organisations would be in between.

5.2.2 Ensure Sustainability

(a) Minimise Adverse Environmental Impacts

Criterion No 7 *Adverse effects on human health are minimised*

Criterion No 8 *Adverse leading to water quality degradation are minimised*

These criteria are largely related to efficient high level water provision. For example if excess water is provided, it would provide a breeding ground for mosquitos. Similarly if excess water is provided it will increase problems such as salinity. However it will also concern the attitudes of the lower level organisations involved in the model. The lower the feeling of shared interest, the greater the potential problem. Hence the assessment is influenced by the water efficiency but downgrading occurs where existing irrigation groups are involved.

(b) Promote Financial Viability

Criterion No 9 *Financial autonomy is promoted*

Financial autonomy is a factor which will apply mainly to the selection of the organisation to operate the primary and secondary systems. Given that DSİ is part of a major government ministry, the potential for financial autonomy is limited. Even if the present system is changed so that revenue collected can be made available directly for O&M, little real autonomy could be expected. Firstly, since DSİ is responsible for many areas and irrigation, O&M is a minor part of its overall financial budget, autonomy would be an unrealistic aim. Secondly, in the event that it did achieve some form of autonomy, its structure and philosophy suggest that financial shortfalls would lead to the wrong form of cost saving in that maintenance would be reduced.

Financial autonomy could be built into the establishment rules of an irrigation authority. Furthermore assuming that it is not responsible for major new works, irrigation O&M would form the major part of its remit, so that funding would not be lost in other activities. Assuming that it is a quasi governmental organisation, it may have some difficulty in areas such as staff motivation and discipline. This could be overcome by employing a significant part of its labour force on a short term contract basis with appropriate financial compensation in the terms of employment. A commercial organisation would meet financial autonomy criteria by definition.

Hence all models having DSİ at the primary and secondary levels rate relatively poorly against this criterion, while those including an irrigation authority rate higher, but not quite as well as those involving a large company.

Criterion No 10 *Operation and maintenance cost can be fully recovered together with contributions to investment costs in the long run*

This is mainly an issue affecting primary/secondary sub-models, and will depend partly upon the service provided, and hence the achievable water charges, and partly on the ability to collect effectively and enforce sanctions. Again the ability of both the irrigation authority and large company to concentrate on irrigation operation and maintenance, and their greater potential for financial autonomy, will enable them to collect a greater proportion of water charges than DSİ. There is no reason, other than inefficiency and inability to enforce sanctions, why any agency should not collect sufficient revenue to fully cover all operation and maintenance costs. The level of charge needed to meet this target can be afforded by farmers benefiting from irrigation. However on present trends, it is unlikely that DSİ could achieve this to the same extent as an authority or large company, even if the existing water charge and collection procedures are revised.

At the tertiary level, the closer to the end users that money is collected and informal sanctions imposed, the greater the degree of collection success. Hence Water User Groups and large farmer scenarios will rate highly compared with existing Irrigation Groups, with other groups in between.

Criterion No 11 *Government investment is protected*

The protection of Government's past financial investments depends largely upon the quality of maintenance. Hence this is an issue which affects both the primary/secondary and tertiary sub-models.

The level of maintenance at the higher levels will largely be a reflection of factors covered by other key criteria. However in general it is suggested that an irrigation authority or large company will provide better O&M than DSİ due to greater financial autonomy, more appropriate resourcing and higher incentives. At the tertiary level this issue will depend largely on the level of involvement of the beneficiaries. Hence the Water User Groups, individual farmers, co-operatives, small private companies and possibly irrigation districts rate above irrigation groups and Chamber of Agriculture.

(c) Social Acceptability

Criterion No 12 *Suitability of local management to different farm sizes and tenure arrangements.*

This criterion only concerns the lower levels of the model. It will be best achieved by water user groups since they will be the most flexible in accommodating local requirements. Furthermore the conflict with this criterion is likely to increase as the coverage of the local group increases. Hence the only models which rate highly are those in which the lowest level unit is based on fully participatory water user groups with their own location specific rules.

Criterion No 13 *Equitable water distribution and farmer acceptability are promoted*

If the argument is accepted that it is appropriate for the major conveyor to allow the tertiary groups to manage their own affairs, this criterion mainly concerns the tertiary level. Clearly the actions of the primary/secondary agency are important, especially when serious water constraints become evident, but the main concern is at the tertiary level. Here there may be as much variation within the different sub-models as between them, since while the democratic nature of the tertiary level organisation will be important, and here WUGs should rate highly, it will also depend upon local personalities.

Acceptability to farmers is mainly a tertiary level issue. The obvious answer to achieve acceptability is to leave the choice to the farmers themselves. This implies that the most desirable model will involve a mix of tertiary level organisations at different locations. Nevertheless water user groups should rate highly since by definition they are based on farmers determining their own rules for their specific situation. Existing irrigation groups would rate relatively poorly since the extent of farmer involvement in decision making is very limited.

Criterion No 14 *Flexibility for formation of farmer groups is allowed*

At the tertiary level, if the main determinant should be the wish of the "customers", it would be appropriate for there to be a mix of models at this level. Where an irrigation district or cooperative is responsible at the secondary level, then that organisation might also operate at the tertiary level. Hence DSİ may tend to be rated low on this criterion since it is likely to be the least flexible of the main suppliers. This criterion is partially neutral at the tertiary level if farmers are able to choose any of the tertiary sub-models. However if an irrigation district or cooperative at the secondary level does dictate the type of tertiary level organisation, those models would also be rated low on this criterion.

Criterion No 15 *Structures are socially compatible and acceptable*

This criterion relates primarily to the lower levels of the system. A basic requirement of any management arrangement for irrigation schemes to be socially acceptable is that farmer participation is maximised in all aspects of planning and operation. While a number of the low level sub-models cater for farmer participation, only water user groups, as defined by the project, will maximise this participation.

(d) Physical Performance

Criterion No 16 *Capacity to mobilise and develop in a suitable timeframe, sufficient skills and resources so that operation and maintenance are performed efficiently at all levels*

This criterion is relevant at all levels. While tertiary level maintenance should be better in those sub models where farmer participation is maximised, in general the comments under Criterion No 5 apply.

(e) Institutional Effectiveness

Criterion No 17 *Performance can be monitored and evaluated at all levels and acted upon*

This criterion relates mainly to the primary/secondary level. There are two key factors. Firstly it tends to be easier to monitor and evaluate the performance of institutions which are not an integral part of a government ministry. Hence it should be easier to monitor and evaluate the performance of a quasi-governmental authority and a private company than that of DSİ. Secondly the irrigation operation and maintenance performance of any institution, which is specifically tailored to specialise in irrigation O&M, is easier to monitor than an organisation in which this is only one of many functions and which involves a relatively minor part of its total funding. This implies that it is more difficult to monitor and evaluate DSİ performance.

While monitoring and evaluation will be required at the tertiary level, it is difficult to judge the extent to which different sub-models are amenable to quantitative scrutiny. Hence although important it cannot be usefully incorporated into the decision making process.

Criterion No 18 *Horizontal and vertical communication and coordination processes can be established and maintained within and between agencies*

This is mainly a primary/secondary level issue. While coordination and communication within the main supplier agency may be largely neutral, communication and coordination with tertiary level organisations and agricultural organisations is likely to vary between the higher level organisations. DSİ's strength lies in its technical competence rather than in communication skills. The new organisations may be better equipped than DSİ, since their formation should take into account this requirement. Furthermore the philosophical background of DSİ in which engineering and technical skills are valued more than social skills, put it at a disadvantage compared with the authority or commercial company. There is little to choose between the last two organisations when measured against this issue.

Criterion No 19 *Legal procedures can be enforced, including appropriate sanctions and penalties as a last resort, although informal controls are encouraged*

At the higher level it is easier for non government organisations to enforce sanctions since they tend to be able to take a longer term view than government bodies. All bodies will be constrained by political considerations and will find it difficult to introduce measures which are viewed as unpopular. Government organisations, however, may find it more difficult to resist the pressures. (For example, DSİ is reluctant to cut off the supply of water to those farmers who do not pay). In addition, private organisations have a financial incentive to enforce sanctions. Hence an irrigation authority should score reasonably well, but not as highly as a commercial company, with DSİ rated lower. At the higher levels the main factor minimising litigation is certainty. If the organisation is known to be determined to enforce sanctions, the number of those challenging it would be minimised in the long run. Hence the rating is similar to that discussed above.

At the tertiary level the main way to avoid litigation is by informal measures, notably peer pressure. Hence those organisations where true farmer participation and empowerment is highest will rate most highly. Hence the Water User Group and individual farmers rate ahead of small private companies, irrigation districts and cooperatives, with the other sub-models lower.

Criterion No 20 *Maximum devolvement of responsibility and farmer participation in management, operation and maintenance is encouraged by allowing control of water distribution and collection of charges close to the farmers*

Although the effect of this issue occurs at the tertiary level, for model selection purposes it mainly relates to the primary/secondary level. The main requirement is that the main supplier is willing to accept and promote devolvement. This is largely a question of philosophy and approach. It requires a willingness to release control over decision making relating to the lower levels of a system. DSİ with its emphasis on engineering competence rather than on social skills, does not rate highly in this regard. However if an irrigation authority is established, this characteristic could be built into its rationale. A large company would also be likely to promote devolvement, as long as it was accompanied by firm contracts.

5.2.3 Implementable and Flexible

(a) Allows Early Implementation

Criterion No 21 *Existing legislation and procedures are suitable, or where additional provisions are required, political support for such measures can be expected*

This criterion affects all levels of the model. At the higher level DSİ rates above both an irrigation authority and a large private company since not only does it already exist, but it is carrying out irrigation O&M. Those models which involve DSİ together with irrigation groups, cooperatives, or irrigation districts should be implementable without any new legislation. On the other hand, if the efficiency situation is to improve, even these models may require some new legislation. Nevertheless it should be possible to implement those models which involve DSİ more quickly than those involving an authority or a private company.

Given the current moves worldwide for reducing the direct role of government in service areas of the economy, with increased support for privatisation, it is possible that the timing for the creation of a GAP irrigation authority is opportune and that political support for the necessary legislation would be forthcoming. Hence while this criterion does not directly support an irrigation authority, it does not necessarily condemn it. On the other hand it is suggested that the full privatisation of irrigation within GAP would be premature at this time. Hence a private company would rate poorly on the implementation issue.

At the tertiary level those organisations which do not yet exist, such as the fully participatory water user groups, might require new legislation, and would probably do so if they were combined with DSİ as the main supplier, so that they do not simply end up as modifications of existing irrigation groups. On the other hand if they were combined with an authority, it might be possible to include them in the enabling legislation for the authority. Hence while the tertiary organisations which already exist would be marked higher than those which do not, this issue does not rule out either of the proposed new tertiary organisations, small private companies and water user groups.

(b) Promotes Flexibility to Change

Criterion No 22 *Management structure is responsive to farmer needs, technological advances and changing demands for water and other services over time*

Under this criterion farmer needs relate to both water supply and other services and infrastructure. The criterion primarily relates to the higher level sub-model, although flexibility at the lower level will also be a modifying factor. Flexibility does not tend to be a characteristic of government organisations. DSİ reflects this in several ways and has only changed slowly over time, even when necessary change has been identified. An irrigation authority is likely to be more flexible but possibly not as flexible as a company. At the tertiary levels the responsiveness to farmer needs is closely correlated to the level of farmer participation.

5.3 The Preferred Model

5.3.1 Overall Assessment

The overall assessment has been derived as a consensus of the individual assessments of members of the consultant's team. This assessment has been supplemented by the views expressed by delegates both during the project Workshop and afterwards through the completion of questionnaires.

The result is shown colour coded in Table B5.1 from which the following key conclusions emerge:

(a) DSİ's key role should be to concentrate on high level sectoral allocations, with responsibility for resource planning at the national level. This relates directly to the skills and expertise of DSİ and is a vital role if the use of the nation's water resources is to be optimised.

(b) On a five to six year timescale, an autonomous Irrigation Authority will be the higher level sub model which best meets the key criteria. If this proposal is accepted as the medium term target for the main distributor agency, the next step will be to devise appropriate institutional transition arrangements.

(c) The large private company generally rates highly, except with regard to early implementability. This might well be the most appropriate agency in the long term at the primary and secondary levels. However, it is too soon to make a judgement, and this decision or transition or transition may be deferred for some years. However, if a privately owned (shareholder), or joint government/private share capital company is later determined to be the way forward for the GAP region, then the medium term solution is a step in this direction. The divestiture of an Authority into a self-financing private company is a worldwide trend and could be feasible in the long term for the GAP region.

(d) Regardless of whichever agency is responsible for water supply at the primary and secondary levels, a crucial element of the overall model for GAP is that responsibility for management of the lowest (or tertiary) level should be by fully participatory, Water User Groups.

5.3.2 Principal Components

The preferred basic model for GAP therefore comprises three principal components:

- a **Supplier of Bulk Water,** in this case DSİ;
- an **Irrigation System Operating Body,** termed an Irrigation Authority above;
- and **Water User Groups,** or fully participatory farmer groups.

However, the preferred basic model must be flexible and adaptable to the different physical and social conditions existing throughout the different projects planned for the GAP Region.

A review of the distribution of the size of the proposed GAP projects (see Figure B 5.1) including their phasing indicates that:

- at least **30%** are **less than** 5000ha in extent, that is, are **small** projects;
- some **90%** are **less than** 50,000ha, that is, the majority are **medium**

sized projects;

- only **10%** can be classified as large projects greater than 50,000 ha.

Many factors will dictate whether the formation of Water User Groups will be successful or unsuccessful. Important among these is the physical size of the area which directly effects management of the system. Small areas tend to result in the need for frequent adjustments to water flows, thereby causing management problems; whilst for large systems, the long travel times for water and the large numbers of control structures and user points, makes it difficult management of supply to demand.

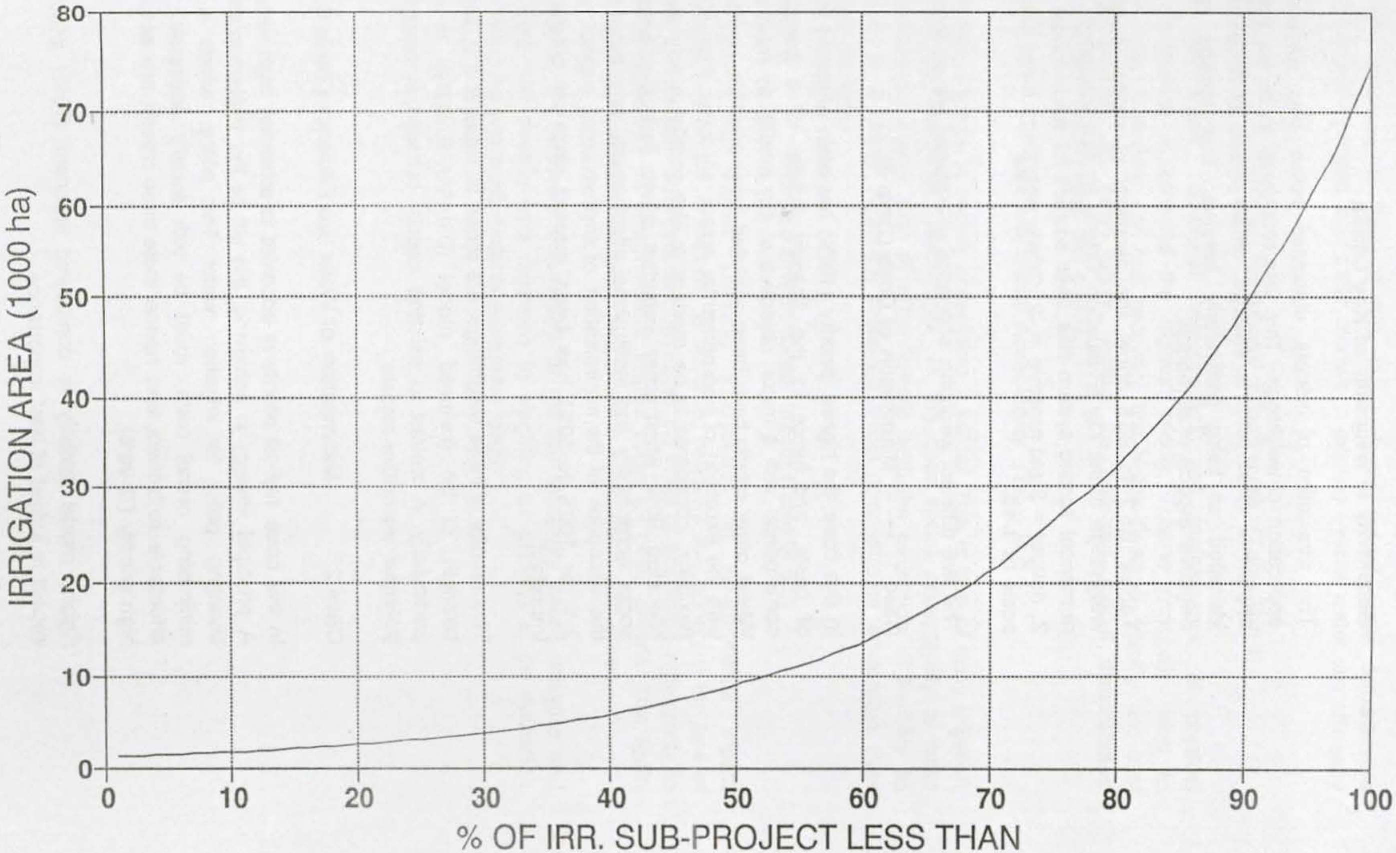
Worldwide experience has shown that water use efficiency is maximised for schemes with management units of 300-500ha in size (BOS M G, 1983). Both above and below the size, efficiencies tend to decrease. While it is a fundamental part of the GAP MOM study to establish, monitor and evaluate tertiary user groups in pilot areas, and that this will involve WUGs of different sizes, the concept of the preferred model is that the maximum WUG size should be about 500ha.

Dependant upon the physical size of each irrigation scheme, and given that the creation of an Irrigation Authority would be 5-6 years into the future, four models can therefore be identified based on the preferred basic model. In relation to distribution infrastructure, these are shown as follows:

Preferred Model	Irrigation Infrastructure					Size/Comment
	Source Works	Primary System	Secondary System	Tertiary System	On-Farm	
A	{DSİ}	{DSİ}	[IA]	(WUG)	F	Large Scale schemes
B	{DSİ}	[IA]	[IA]	WUG)	F	Medium Scale schemes
C	{DSİ}	(WUG)	(WUG)	(WUG)	F	Small Scale schemes (≤500ha)

IA - Irrigation Authority, WUG-Water User Group F-Farmer

FIGURE B5.1
GAP IRRIGATION PROJECTS
SUB-PROJECTS SIZE DISTRIBUTION



5.4 Sensitivity to Weighting of Key Criteria

The evaluation of models discussed above was undertaken without the application of weightings. This was considered to be an important part of the approach. Once patterns emerge, certain criteria or areas of concern can be identified as being particularly sensitive. This applies particularly to the negative aspects of all models.

Tables B5.2 to B5.6 show the sensitivity of model suitability to different weightings of the Key Evaluation Criteria for five scenarios. In these tables a numerical scoring system has been adopted for each model, where positive = 2, neutral = 0 and negative = -2. Criteria weightings have been expressed on a scale of 1-10.

The five different weighting scenarios investigated are as follows:

Case 1: Minimisation of Costs (Table B5.2)

In this case, the highest priority (100%) has been attached to the minimisation of costs, and hence to the financial viability of a particular model. This corresponds with a major objective of any model, to maximise net benefits. Whilst other criteria have been allocated lower priorities, under this case none, with the exception of environmental impact, are lower than 50%. Hence model flexibility, considered to be medium to high priority in any scenario, has been allocated 90%, whilst other important criteria including water use efficiency, social acceptability and institutional effectiveness vary between 50-70%. With the exception of the minimisation of environmental impact, a limiting ratio of 2:1 (or 100% to 50%) has been imposed since all criteria are considered important.

The results of these weightings are shown in Table B 5.2, which indicates the strength of the preferred model (DSİ/IA/IA/-F/WUG) in meeting criteria, particularly in contrast to existing models, but also in comparison with other potential alternative models.

Case 2: Maximisation of Water Use Efficiency (Table B 5.3)

In this case, highest priority is accorded to achieving high water use efficiency. A principal strategy in achieving this will be the implementation of a realistic charging policy for irrigation water. This policy, which is also aimed at minimising overall costs, must be both socially acceptable and financially affordable to farmers, and hence these three criteria are accorded medium to high priority (70-90%).

Again, model flexibility is considered important (70%) whilst environmental impact is judged of least importance.

With reference to Table B 5.3, the preferred model again demonstrates significant strengths over other models in meeting overall water use efficiency criteria.

Case 3: Maximum Institutional Effectiveness (Table B 5.4)

In this case, institutional effectiveness and maintenance of physical performance is accorded the highest priority. This is principally linked to financial autonomy and cost recovery and hence financial viability and cost minimisation are rated highly. Again, the preferred model demonstrates significant advantages over others.

Case 4: Maximise Social Acceptability (Table B 5.5)

Unless a model is socially acceptable it will fail. This is true of many irrigation schemes worldwide. Accordingly, in this case social acceptability is rated significantly higher than all other criteria, with the exception of flexibility to which it is linked. Again the preferred model demonstrates advantages over other models.

Case 5: Minimise Environmental Impact (Table B 5.6)

All too often "project" planning incorporates an environmental impact assessment which, in the end, is accorded relatively low priority in the face of hard economics. This case demonstrates the effect of according high priority to the minimisation of environmental impact above all other criteria. This again shows the strength of the preferred model in comparison with others.

Table B 5.7 presents a summary of the five sensitivity cases analysed and shows that despite wide variations in weighting (or priority) of the evaluation criteria, the preferred model is extremely robust.

TABLE B 5.2
MOM MANAGEMENT MODELS AND KEY EVALUTION CRITERIA
SENSITIVITY ANALYSIS - CASE 1

MAJOR CRITERIA	MAX WATER USE EFFICIENCY				MINIMISE COSTS		ENVIRON. IMPACT		FINANCIAL VIABILITY			SOCIAL ACCEPTABILITY				INSTITUTIONAL EFFECTIVE. PHYSICAL PERFORMANCE					IMPLEMENT. FLEXIBILITY		MODEL SUITABILITY
KEY CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
CRITERIA WEIGHTINGS	7	7	7	7	10	10	2	2	8	8	8	7	7	7	7	5	5	5	5	5	5	9	
DSI/DSI/DSI/-IG/ID/CA	0	0	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	0	-2	-2	2	-2	-112
DSI/DSI/DSI/-COOP/SPC	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	-2	-20
DSI/DSI/DSI/-F/WUG	0	0	0	0	0	0	2	2	-2	0	0	2	2	2	2	0	-2	0	0	0	0	-2	20
DSI/DSI/-ID	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-16
DSI/DSI/-COOP	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-2
DSI/IA/IA/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	0	0	0	158
DSI/IA/IA/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0	2	200
DSI/IA/IA/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0	2	252
DSI/IA/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	0	2	0	0	0	2	146
DSI/LIC/LIC/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	0	158
DSI/LIC/LIC/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	2	-2	2	200
DSI/LIC/LIC/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	-2	2	242
DSI/LIC/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	2	156

WEIGHTINGS FOR CASE1:

* Highest Priority attached to minimisation of MOM costs (10) and hence high priority to financial viability (8)
* High priority to flexibility to0 change (9)
* Medium/high priority to water use efficiency (7) and social acceptability (7)
* Medium priority to institutional effectiveness (5) and early implementability (5)
* Low priority to environmental protection

TABLE B 5.3
MOM MANAGEMENT MODELS AND KEY EVALUTION CRITERIA
SENSITIVITY ANALYSIS - CASE 2

MAJOR CRITERIA	MAX WATER USE EFFICIENCY				MINIMISE COSTS		ENVIRON. IMPACT		FINANCIAL VIABILITY			SOCIAL ACCEPTABILITY				INSTITUTIONAL EFFECTIVE. PHYSICAL PERFORMANCE					IMPLEMENT. FLEXIBILITY		MODEL SUITABILITY
KEY CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
CRITERIA WEIGHTINGS	10	10	10	10	7	7	2	2	7	7	7	9	9	9	9	5	5	5	5	5	5	7	
DSI/DSI/DSI/-IG/ID/CA	0	0	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	0	-2	-2	2	-2	-102
DSI/DSI/DSI/-COOP/SPC	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	-2	-8
DSI/DSI/DSI/-F/WUG	0	0	0	0	0	0	2	2	-2	0	0	2	2	2	2	0	-2	0	0	0	0	-2	42
DSI/DSI/-ID	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-14
DSI/DSI/-COOP	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	6
DSI/IA/IA/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	0	0	0	158
DSI/IA/IA/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0	2	202
DSI/IA/IA/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0	2	264
DSI/IA/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	0	2	0	0	0	2	148
DSI/LIC/LIC/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	0	158
DSI/LIC/LIC/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	2	-2	2	202
DSI/LIC/LIC/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	-2	2	254
DSI/LIC/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	2	158

WEIGHTINGS FOR CASE2:

* Highest Priority attached to maximisation of water use efficiency (10)
* High priority to social acceptability (9)
* Medium/high priority to minimisation of costs (7) and finanacial viability (7)
* Medium priority to institutional effectiveness (5) and early implementability (5)
* Low priority to environmental protection

TABLE B 5.4
MOM MANAGEMENT MODELS AND KEY EVALUTION CRITERIA
SENSITIVITY ANALYSIS - CASE 3

MAJOR CRITERIA	MAX WATER USE EFFICIENCY				MINIMISE COSTS		ENVIRON. IMPACT		FINANCIAL VIABILITY			SOCIAL ACCEPTABILITY				INSTITUTIONAL EFFECTIVE. PHYSICAL PERFORMANCE					IMPLEMENT. FLEXIBILITY		MODEL SUITABILITY
KEY CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
CRITERIA WEIGHTINGS	7	7	7	7	8	8	2	2	8	8	8	6	6	6	6	10	10	10	10	10	5	7	
DSI/DSI/DSI/-IG/ID/CA	0	0	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	0	-2	-2	2	-2	-132
DSI/DSI/DSI/-COOP/SPC	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	-2	-26
DSI/DSI/DSI/-F/WUG	0	0	0	0	0	0	2	2	-2	0	0	2	2	2	2	0	-2	0	0	0	0	-2	6
DSI/DSI/-ID	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-26
DSI/DSI/-COOP	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-12
DSI/IA/IA/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	0	0	0	170
DSI/IA/IA/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0	2	218
DSI/IA/IA/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0	2	272
DSI/IA/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	0	2	0	0	0	2	148
DSI/LIC/LIC/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	0	180
DSI/LIC/LIC/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	2	-2	2	228
DSI/LIC/LIC/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	-2	2	262
DSI/LIC/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	2	178

WEIGHTINGS FOR CASE3:

* Highest Priority attached to institutional effectiveness and physical performance(10)
* High priority to costs and finanacial viability (8)
* Medium/high priority to water use efficiency (7) and social acceptability (6)
* Medium priority to early implementability (5)
* Low priority to environmental protection

TABLE B 5.5
MOM MANAGEMENT MODELS AND KEY EVALUTION CRITERIA
SENSITIVITY ANALYSIS - CASE 4

MAJOR CRITERIA	MAX WATER USE EFFICIENCY				MINIMISE COSTS		ENVIRON. IMPACT		FINANCIAL VIABILITY			SOCIAL ACCEPTABILITY				INSTITUTIONAL EFFECTIVE. PHYSICAL PERFORMANCE					IMPLEMENT. FLEXIBILITY		MODEL SUITABILITY
KEY CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
CRITERIA WEIGHTINGS	7	7	7	7	5	5	2	2	5	5	5	10	10	10	10	5	5	5	5	5	8	8	
DSI/DSI/DSI/-IG/ID/CA	0	0	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	0	-2	-2	2	-2	-88
DSI/DSI/DSI/-COOP/SPC	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	-2	-6
DSI/DSI/DSI/-F/WUG	0	0	0	0	0	0	2	2	-2	0	0	2	2	2	2	0	-2	0	0	0	0	-2	52
DSI/DSI/-ID	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-4
DSI/DSI/-COOP	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	10
DSI/IA/IA/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	0	0	0	120
DSI/IA/IA/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0	2	160
DSI/IA/IA/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0	2	236
DSI/IA/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	0	2	0	0	0	2	116
DSI/LIC/LIC/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	0	114
DSI/LIC/LIC/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	2	-2	2	154
DSI/LIC/LIC/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	-2	2	220
DSI/LIC/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	2	120

WEIGHTINGS FOR CASE4:

* Highest Priority attached to social acceptability (10)
* Medium/High priority to water use efficiency (7) and flexibility (8)
* Medium priority to cost and institutional effectiveness (5)

TABLE B 5.6
MOM MANAGEMENT MODELS AND KEY EVALUTION CRITERIA
SENSITIVITY ANALYSIS - CASE 5

MAJOR CRITERIA	MAX WATER USE EFFICIENCY				MINIMISE COSTS		ENVIRON. IMPACT		FINANCIAL VIABILITY			SOCIAL ACCEPTABILITY				INSTITUTIONAL EFFECTIVE. PHYSICAL PERFORMANCE					IMPLEMENT. FLEXIBILITY		MODEL SUITABILITY
KEY CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
CRITERIA WEIGHTINGS	7	7	7	7	5	5	10	10	5	5	5	8	8	8	8	5	5	5	5	5	8	8	
DSI/DSI/DSI/-IG/ID/CA	0	0	0	0	0	-2	-2	-2	-2	-2	0	0	0	-2	0	0	-2	0	-2	-2	2	-2	-116
DSI/DSI/DSI/-COOP/SPC	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	-2	-6
DSI/DSI/DSI/-F/WUG	0	0	0	0	0	0	2	2	-2	0	0	2	2	2	2	0	-2	0	0	0	0	-2	68
DSI/DSI/-ID	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	-4
DSI/DSI/-COOP	0	0	0	2	0	0	0	0	-2	0	0	0	0	0	0	0	-2	0	0	0	2	0	10
DSI/IA/IA/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	0	0	0	152
DSI/IA/IA/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	2	2	2	0	2	192
DSI/IA/IA/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0	2	252
DSI/IA/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	0	2	0	0	0	2	148
DSI/LIC/LIC/-CA	2	2	2	0	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	0	146
DSI/LIC/LIC/-COOP/SPC	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	2	-2	2	186
DSI/LIC/LIC/-F/WUG	2	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	-2	2	236
DSI/LIC/-COOP	2	2	0	2	2	0	2	2	2	2	2	0	0	0	0	0	2	2	2	0	-2	2	152

WEIGHTINGS FOR CASE5:

* Highest Priority attached to environmental protection (10)
* Medium/High priority to water use efficiency (7) and social acceptability (8)
* Medium priority to cost and institutional effectiveness (5)
* Low priority to environmental protection

TABLE B 5.7
MOM MANAGEMENT MODELS AND KEY EVALUTION CRITERIA
SUMMARY OF SENSITIVITY ANALYSES

HIGHEST PRIORITY	CASE 1 MINIMISE COSTS	CASE 2 WATER EFFICIENCY	CASE 3 INSTITUTIONAL EFFECTIVENESS	CASE 4 SOCIAL ACCEPTABILITY	CASE 5 ENVIRONMENTAL PROTECTION
DSI/DSI/DSI/-IG/ID/CA	-112	-102	-132	-116	-88
DSI/DSI/DSI/-COOP/SPC	-20	-8	-26	-6	-6
DSI/DSI/DSI/-F/WUG	20	42	6	68	52
DSI/DSI/-ID	-16	-14	-26	-4	-4
DSI/DSI/-COOP	-2	6	-12	10	10
DSI/IA/IA/-CA	158	158	170	152	120
DSI/IA/IA/-COOP/SPC	200	202	218	192	160
DSI/IA/IA/-F/WUG	252	264	272	252	236
DSI/IA/-COOP	146	148	148	148	116
DSI/LIC/LIC/-CA	158	158	180	146	114
DSI/LIC/LIC/-COOP/SPC	200	202	228	186	154
DSI/LIC/LIC/-F/WUG	242	254	262	236	220
DSI/LIC/-COOP	156	158	178	152	120

6 FINANCIAL AND ECONOMIC ANALYSIS OF ALTERNATIVE MODELS

6.1 Introduction

The financial implications of the different MOM models are important since the need for Government subsidies for irrigation operation and maintenance is increasing as the area under command increases. Within the GAP region, under present development projections, the total Government O&M subsidy would increase dramatically over time unless the unless the unit area subsidy is decreased. If, alternatively, the funding available for O&M decreases relative to the requirement, the standards of O&M will fall with serious repercussions for production, farmer's incomes and economic return on capital investment. hence the total O&M cost needs to be reduced through the adoption of an efficient management structure.

The projected costs for management, operation and maintenance under different MOM model scenarios are set out in section 6.2 in order to estimate the potential cost savings of the alternative models. The costs and prices quoted in this chapter are based on mid 1993 values.

It is likely that moving from the present irrigation management model, with DSİ responsible for water distribution down to tertiary level, to other models will increase the operator's ability to shift the burden of costs to the beneficiaries. However this is difficult to quantify and projections are given showing the effects of different levels of revenue collection on the need for subsidy under the different cost structures of the models.

The economic implications of alternative MOM models are important to ensure that the returns on irrigation capital investment are maximised. A reduction in cost of O&M may contribute to this objective but the main factor will be higher agricultural yields through increased irrigation efficiency resulting from improved management.

6.2 Financial Cost Implications

The consultant's estimates of annual management, operation and maintenance costs for several alternative models considered are set out below. These have been derived from actual 1993 staffing levels and costs of O&M, including overhead costs, in DSİ projects and projects managed by locally based Irrigation Districts and Irrigation Co-operatives.

Model	Source	Primary	Secondary	Tertiary	Total	Total /net Irrig. Area
1	DSİ 6	DSİ 15	DSİ 25	DSİ 40	86	107.50
2	DSİ 6	DSİ 21	IA 20	WUG 22	69	86.25
3	DSİ 6	IA 14	IA 15	WUG 22	57	71.25
4A	DSİ 6	WUG 5	WUG 7	WUG 22	40	50.00
4B	DSİ 11	WUG 10	WUG 12	WUG 22	55	68.75

Models 1, 2 and 3 are based on 10,000ha area or larger.
Model 4A for 5,000ha. Model 4B for 2,000ha.
Costs in US$ per ha.

The figures in columns 2 to 5 represent the estimated cost for that element of the supply system expressed per hectare of gross project area. Applying an irrigation ratio of 80% column 6 presents the total costs per net area irrigated. Moving from model 1 to model 2 results in estimated savings of $21.25/ha resulting almost entirely from the lower costs associated with water user groups having full O&M responsibility for the tertiary system. In this model no saving has been shown for splitting responsibility for primary and secondary systems between two organisations.

Moving from model 2 to model 3 in which the Irrigation Authority has responsibility for both primary and secondary systems results in a further saving of $15 per hectare. This is the least cost model for the larger schemes although further savings of $21.25/ha and $2.5/ha can be achieved for small and very small schemes where the water user group has responsibility for all the canal supply works.

The significance of these savings for the whole GAP irrigation development is shown in Table B6.1 which presents the estimated total annual costs of management, operation and maintenance under alternative model scenarios over the period 1995 to 2015. The second column of this table gives the consultant's projections of the net total area irrigated each year in the region. These projections are based on present available data assuming that the whole potential irrigation area will have been developed by 2015. The table also divides the total area into that for large schemes, schemes between 2,000ha and 5,000ha and schemes of less than 2,000ha.

Four scenarios have been considered, described as A, B, C and D. Scenarios A, B and C are equivalent to models 1, 2 and 3 listed above. Scenario D encompasses model C for larger schemes and models 4A and 4b for the small and very small schemes respectively. It is not feasible to move from Scenario A immediately and hence the figures for the first two years are not relevant except in respect of Scenario A. However in 1997 moving from Scenario A to Scenario B is estimated to result in saving of some US$4.5 million/annum. This increases to almost US$30 million/annum by 2015.

Table B6.1 : Annual Cost of Management and O&M of GAP Irrigation Schemes

Under Alternative MOM Model Scenarios (1994-2015)

Year	Cumulative Net Irrigation Area (ha)	Distribution of Cumilative Net Area			Total GAP Area Annual Management and O&M Cost Under Alternative MOM Model Scenarios ($US/annum)			
		Over 5000 ha	Between 2000~5000 ha	Under 2000 ha	A	B	C	D
1994	76520	70000	1660	4860	8225900	6599850	5452050	5404625
1995	125320	113000	7460	4860	13471900	10808850	8929050	8758375
1996	169320	156000	7460	5860	18201900	14603850	12064050	11890875
1997	213120	196000	11260	5860	22910400	18381600	15184800	14930875
1998	248120	231000	11260	5860	26672900	21400350	17678550	17424625
1999	278120	261000	11260	5860	29897900	23987850	19816050	19562125
2000	308280	291000	11260	6020	33140100	26589150	21964950	21710625
2001	342880	321000	14260	7620	36859600	29573400	24430200	24108125
2002	372880	351000	14260	7620	40084600	32160900	26567700	26245625
2003	414980	391000	16360	7620	44610350	35792025	29567325	29200625
2004	464980	441000	16360	7620	49985350	40104525	33129825	32763125
2005	538380	511000	18960	8420	57875850	46435275	38359575	37935625
2006	622180	591000	21160	10020	66884350	53663025	44330325	43855625
2007	704180	671000	23160	10020	75699350	60735525	50172825	49655625
2008	794180	761000	23160	10020	85374350	68498025	56585325	56068125
2009	884180	851000	23160	10020	95049350	76260525	62997825	62480625
2010	975130	941000	23160	10970	104826475	84104963	69478013	68958438
2011	1075130	1041000	23160	10970	115576475	92729963	76603013	76083438
2012	1175130	1141000	23160	10970	126326475	101354963	83728013	83208438
2013	1265130	1231000	23160	10970	136001475	109117463	90140513	89620938
2014	1345130	1311000	23160	10970	144601475	116017463	95840513	95320938
2015	1411130	1371000	29160	10970	151696475	121709963	100543013	99895938

The cost saving in moving from Scenario B to Scenario C is a further US$3.2 million/annum in 1997 increasing to over US$21 million/annum in 2015. Moving from Scenario C to Scenario D is estimated to result in cost saving of US$250,000/annum in 1997 increasing to $640,000/annum by 2015. The most main feature is that moving from Scenario A to B and then to C produces very significant cost savings, a further move to Scenario D has only limited additional savings.

Transferring responsibility for tertiary management to WUGs results in an estimated saving of 20% of the total O&M cost of Scenario A. This saving is clearly desirable since it would reduce the total cost by over $30 million at full development. Furthermore, since the beneficiaries are then fully responsible for meeting the tertiary costs, the direct cost to government of operating the schemes would be much lower. In addition to the direct cost savings of some 20% of original Scenario A costs, 25% of the original costs would be borne directly by the beneficiaries resulting in a total saving to government of 45%.

Table B6.2 presents the net costs that Government has to bear under each scenario, the differences between figures in the two tables representing the costs borne directly by beneficiaries under the alternative models. For 1997 the estimated cost to Government under Scenario B would be US$ 12.5 million/annum compared with US$ 22.9 million/annum under Scenario A, representing a cost saving of US$10.4 million/annum. By 2015 this saving would increase to US$ 68.8 million/annum.

The saving in Government expenditure in moving from Scenario B to Scenario C is the same as the overall financial cost saving, namely US$ 3.2 million/annum in 1997 increasing to US$ 21 million/annum by 2015. While this move produces additional cost savings it does not shift any costs directly to the beneficiaries. However moving to Scenario D does result in further such shifts as a consequence of transferring responsibility for primary and secondary canal management to water user groups in small schemes. For 1997 the shift of cost burden from Government to beneficiaries is US$0.33 million/annum increasing to US$0.74 million/annum by 2015.

The financial effects of moving from Scenario A to Scenario D for 1997 and 2015 are summarised as follows:

Scenario	Total O&M Cost	Cost to Govt.	Marginal Cost Saving Moving to this Scenario		
	US$ mill/annum	US$ mill/annum	Cost saving US$ mill/annum	Costs to Users US$ mill/annum	Saving to Govt US$ mill/annum
1997 costs					
A	22.91	22.91	-	-	-
B	18.38	12.52	4.53	5.86	10.39
C	15.18	9.32	3.20	-	3.20
D	14.93	8.74	0.25	0.33	0.58
2015 costs					
A	151.70	151.70	-	-	-
B	121.71	82.90	29.99	38.81	68.80
C	100.54	61.74	21.17	-	21.17
D	99.90	60.35	0.64	0.75	1.39

The move from Scenario A to Scenario D results in a saving of over 60% to Government. Although there are slight variations over the period the approximate sources of this saving in percentage terms are as follows:

Item	Cost Saving %	Cost transferred to WUG %	Total Saving to Govt as % of Scenario A
WUGs taking tertiaries	20	25	45
IA taking primary/secondaries	14	0	14
WUGs taking primary/secondaries	1	1	1
Total	35	26	60

The largest saving to Government, about 75%, arises from water user groups taking over responsibility for tertiary canal systems. Most of the remaining savings result from the transfer of responsibility for primary and secondary systems from DSİ to an Irrigation Authority. Only a very small saving is achieved by transfer of responsibility for the primary and secondary systems of small schemes to water user groups. This is due to the fact that the area involved is only a relatively minor part of the total projected development area of the GAP region. Therefore based on a financial criterion the top priority should be for widespread transfer of responsibility for tertiary systems to effective water user groups.

Table B6.2 : Annual Cost to Government of Management of GAP Irrigation Schemes Under Alternative MOM Model Scenarios

Year	Cost (US$/annum) Under Scenario :			
	A	B	C	D
1994	8225900	4495550	3347750	3141775
1995	13471900	7362550	5482750	5066525
1996	18201900	9947550	7407750	6961525
1997	22910400	12520800	9324000	8740025
1998	26672900	14577050	10855250	10271275
1999	29897900	16339550	12167750	11583775
2000	33140100	18111450	13487250	12898475
2001	36859600	20144200	15001000	14255475
2002	40084600	21906700	16313500	15567975
2003	44610350	24380075	18155375	17333725
2004	49985350	27317575	20342875	19521225
2005	57875850	31629825	23554125	22614225
2006	66884350	36553075	27220375	26152725
2007	75699350	41370575	30807875	29667725
2008	85374350	46658075	34745375	33605225
2009	95049350	51945575	38682875	37542725
2010	104826475	57288888	42661938	41493288
2011	115576475	63163888	47036938	45868288
2012	126326475	69038888	51411938	50243288
2013	136001475	74326388	55349438	54180788
2014	144601475	79026388	58849438	57680788
2015	151696475	82903888	61736938	60350788

Table B6.3 : Annual Cost to Users of Management of GAP Irrigation Schemes Under Alternative MOM Model Scenarios

Year	Cost (US$/annum) Under Scenario :			
	A	B	C	D
1994	0	2104300	2104300	2262850
1995	0	3446300	3446300	3691850
1996	0	4656300	4656300	4929350
1997	0	5860800	5860800	6190850
1998	0	6823300	6823300	7153350
1999	0	7648300	7648300	7978350
2000	0	8477700	8477700	8812150
2001	0	9429200	9429200	9852650
2002	0	10254200	10254200	10677650
2003	0	11411950	11411950	11866900
2004	0	12786950	12786950	13241900
2005	0	14805450	14805450	45321400
2006	0	17109950	17109950	17702900
2007	0	19364950	19364950	19987900
2008	0	21839950	21839950	22462900
2009	0	24314950	24314950	24937900
2010	0	26816075	26816075	27465150
2011	0	29566075	29566075	30215150
2012	0	32316075	32316075	32965150
2013	0	34791075	34791075	35440150
2014	0	36991075	36991075	37640150
2015	0	38806075	38806075	39545150

6.3 Projections of Financial Implications to Government

While the foregoing shows the projected gross cost to Government of alternative model scènarios, a major focus in the long term should be on the net cost to Government. This involves applying assumptions regarding revenue collection to the gross cost figures already discussed.

It is likely that where water is distributed to Water User Groups by an Irrigation Authority, as in Scenarios B, C and D, the level of revenue collection would be higher than where DSİ supplies water direct to farmers. At this stage the extent to which it will be possible to recover the operating costs under different scenarios is unknown. Hence a number of assumptions are required to calculate the extent to which the different model scenarios will lead to cost recovery. The assumptions of revenue collection are as follows:

Scenario:	A	B, C and D
Optimistic Assumption	12% of users' incremental income.	15% of users' incremental income less cost of user group O&M
Middle Assumption:	6% of users' incremental income	7.5% of users' incremental income less cost of user group O&M
Pessimistic Assumption:	2% of users' incremental income	3% of user's incremental income less cost of user group O&M

While these assumptions provide a sound range for the likely future outcome, it could be argued that they are generous with respect of Scenario A since a commercially oriented Irrigation Authority is likely to pursue revenue more vigorously than DSİ and it is easier to collect from water user groups than from individual farmers. Nevertheless the results show that with these assumptions Scenario A is financially unattractive.

Table B6.3 presents the projected management, operation and maintenance costs which will be borne directly by water user groups. This is calculated by combining the projected areas under irrigation with the WUG costs given in section 6.2.

Tables B6.4 to B6.6 present the projections of revenue which will be collected by DSİ and/or an Irrigation Authority from water user groups. The first column shows the projection of the net incremental benefits, except for water charges, which may accrue to the users. The per hectare unit benefits are based on farm budgets assuming US$ 500 in the first year of irrigation up to US$ 1,110 by year 6. The projected revenues under the different scenarios were calculated for each assumption based on the assumed level of revenue taking into account farmers' incremental benefits and the costs borne directly by the water user groups. The main feature of Tables B6.4 to B6.6 is the large differences in revenue between each assumption. However at present there is no available data to suggest that the range of assumptions should be narrowed.

Tables B6.7 to B6.9 summarise the net cost to Government of the four model scenarios. These figures are calculated by subtracting the revenues estimated in tables B6.4 to B6.6 from the Government's gross O&M costs. A negative net cost indicates that Government revenues exceed recurrent O&M costs.

There are two main features of Tables B6.7 to B6.9. The first is that the net cost to Government will be sensitive to the level of revenue collection. The second, perhaps more significant, conclusion is that for any revenue collection assumption the net cost to Government will vary considerably depending on which model scenario is adopted. For example under the optimistic assumption the net cost to Government in 1997 is about $US1.6 million/annum under Scenario A but under Scenario B there is a surplus of US$8.3 million/annum, increasing to US$11.5 million/annum under Scenario C and to US$ 11.7 million/annum under Scenario D. By 2015 Scenario A achieves a surplus of US$24.2 million/annum compared with US$98.1 million/annum under Scenario B, US$119.3 under Scenario C and US$ 119.9 million/annum under Scenario D. Hence the main financial benefit arises from moving from scenario A to Scenario B, and from the further move to Scenario C. There is only a very small improvement to the financial position in moving from Scenario c to Scenario D.

The figures involved under the middle and pessimistic assumptions are very different from those under the optimistic one. However the general pattern remains similar with a large improvement in financial situation moving from Scenario A to Scenario B, with further improvement from Scenario B to Scenario C and only a slight improvement from Scenario C to Scenario D.

Under the middle assumption, the net cost to Government in 1997 is US$ 12.2 million/annum under Scenario A, US$5.1 million/annum under Scenario B, US$1.9 million/annum under Scenario C and US$1.6 million/annum under Scenario D. By 2015 the per annum figures under Scenarios A, B, C and D are US$ 63.8 million deficit, US$ 11.8 million deficit, US$ 9.4 million surplus and US$ 10.0 million surplus respectively.

Under the pessimistic assumptions, the net cost to Government in 1997 is US$ 19.4 million/annum for Scenario A. This cost falls to US$ 12.5 million/annum under Scenario B, to US$ 9.3 million/annum under Scenario C and US$ 8.7 million/annum under Scenario D. By 2015 the per annum figures under scenarios A, B. C and D are deficits of US$ 122.4 million, US$ 77.7 million, US$ 56.6 million and US$ 55.9 million respectively.

Table B6.4 : Revenue Collection Projection : Assumptions Under Alternative MOM Scenarios

Year	Farmers' Net Incr. Benefit (US$/annum)	Revenue (US$/annum) Under Scenario :			
		A	B	C	D
1994	38260000	4591200	3634700	3634700	3476150
1995	81790000	9814800	8822200	8822200	8576650
1996	135120000	16214400	15611700	15611700	15338650
1997	177745160	21329419	20800974	20800974	20470924
1998	226407240	27168869	27137786	27137786	26807736
1999	266743600	32009232	32363240	32363240	32033190
2000	302625400	36315048	36916110	36916110	36581660
2001	339061600	40687392	41430040	41430040	41006590
2002	373877000	44865240	45827350	45827350	45403900
2003	414247280	49709674	50725142	50725142	50270192
2004	460429520	55251542	56277478	56277478	55822528
2005	523316200	62797944	63691980	63691980	63176030
2006	599617300	71954076	72832645	72832645	72239695
2007	683988700	82078644	83233355	83233355	82610405
2008	775950200	93114024	94552580	94552580	93929630
2009	870861200	104503344	106314230	106314230	105691280
2010	969313600	116317632	118580965	118580965	117931890
2011	1073074500	128768940	131395100	131395100	130746025
2012	1179548000	141545760	144616125	144616125	143967050
2013	1283579350	154029522	157745828	157745828	157096753
2014	1380441650	165652998	170075173	170075173	169426098
2015	1465643000	175877160	181040375	181040375	180301300

Table B6.5 : Revenue Collection Projection : Middle Assumptions Under Alternative MOM Scenarios

Year	Farmers' Net Incr. Benefit (US$/annum)	Revenue (US$/annum) Under Scenario :			
		A	B	C	D
1994	38260000	2295600	765200	765200	606650
1995	81790000	4907400	2687950	2687950	2442400
1996	135120000	8107200	5477700	5477700	5204650
1997	177745160	10664710	7470087	7470087	7140037
1998	226407240	13584434	10157243	10157243	9827193
1999	266743600	16004616	12357470	12357470	12027420
2000	302625400	18157524	14219205	14219205	13884755
2001	339061600	20343696	16000420	16000420	15576970
2002	373877000	22432620	17786575	17786575	17363125
2003	414247280	24854837	19656596	19656596	19201646
2004	460429520	27625771	21745264	21745264	21290314
2005	523316200	31398972	24443265	24443265	23927315
2006	599617300	35977038	27861348	27861348	27268398
2007	683988700	41039322	31934203	31934203	31311253
2008	775950200	46557012	36356315	36356315	35733365
2009	870861200	52251672	40999640	40999640	403376690
2010	969313600	58158816	45882445	45882445	45233370
2011	1073074500	64384470	50914513	50914513	50265438
2012	1179548000	70772880	56150025	56150025	55500950
2013	1283579350	77014761	61477376	61477376	60828301
2014	1380441650	82826499	66542049	66542049	65892974
2015	1465643000	87938580	71117150	71117150	70378075

Table B6.6 : Revenue Collection Projection : Pessimistic Assumptions Under Alternative MOM Scenarios

Year	Farmers' Net Incr. Benefit (US$/annum)	Revenue (US$/annum) Under Scenario :			
		A	B	C	D
1994	38260000	765200	0	0	0
1995	81790000	1635800	0	0	0
1996	135120000	2702400	0	0	0
1997	177745160	3554303	0	0	0
1998	226407240	4528145	0	0	0
1999	266743600	5334872	354008	354008	23958
2000	302625400	6052508	601062	601062	266612
2001	339061600	6781232	742648	742648	319198
2002	373877000	7477540	962110	962110	538660
2003	414247280	8284946	1015468	1015468	560518
2004	460429520	9208590	1025936	1025936	570986
2005	523316200	10466324	894036	894036	378086
2006	599617300	11992346	878569	878569	285619
2007	683988700	13679774	1154711	1154711	531761
2008	775950200	15519004	1438556	1438556	815606
2009	870861200	17417224	1810886	1810886	1187936
2010	969313600	19386272	2260000	2260000	1614258
2011	1073074500	21461490	2626160	2626160	1977085
2012	1179548000	23590960	3070365	3070365	2421290
2013	1283579350	25671587	3716306	3716306	3067231
2014	1380441650	27608833	4422175	4422175	3773100
2015	1465643000	29312860	5163215	5163215	4424140

Table B6.7 : Projection of Net Cost to Government of Irrigation Management and O&M Optimistic Assumption - Under Alternative MOM Scenarios

Year	Net Cost (US$/annum) Under Scenario :			
	A	B	C	D
1994	3634700	860850	-286950	-334375
1995	3657100	-1459650	-3339450	-3510125
1996	1987500	-5664150	-8203950	-8377125
1997	1580981	-8280174	-11476974	-11730899
1998	495969	-12560736	-16282536	-16536461
1999	-2111332	-16023690	-20195490	-20449415
2000	-3174948	-18804660	-23428860	-23683185
2001	-3827792	-21285840	-26429040	-26751115
2002	-4780640	-23920650	-29513850	-29835925
2003	-5099324	-26345067	-32569767	-32936467
2004	-5266192	-28959903	-35934603	-36301303
2005	-4922094	-32062155	-40137855	-40561805
2006	-5069726	-36279570	-45612270	-46086970
2007	-6379294	-41862780	-52425480	-52942680
2008	-7739674	-47894505	-59807205	-60324405
2009	-9453994	-54368655	-67631355	-68148555
2010	-11491157	-61292078	-75919028	-76438603
2011	-13192465	-68231213	-84358163	-84877738
2012	-15219285	-75577238	-93204188	-93723763
2013	-18028047	-83419440	-102396390	-102915965
2014	-21051523	-91048785	-111225735	-117745310
2015	-24180685	-98136488	-119303438	-119950513

Table B6.8 : Projection of Net Cost to Government of Irrigation Management and O&M Middle Assumption - Under Alternative MOM Scenarios

Year	Net Cost (US$/annum) Under Scenario :			
	A	B	C	D
1994	5930300	3730350	2582550	2535125
1995	8564500	4674600	2794800	2624125
1996	10094700	4469850	1930050	1756875
1997	12245690	5050713	1853913	1599988
1998	13088466	4419807	698007	444082
1999	13893284	3982080	-189720	-443645
2000	14982576	3892245	-731955	-986280
2001	16515904	4143780	-999420	-1321495
2002	17651980	4120125	-1473075	-1795150
2003	19755513	4723479	-1501221	-1867921
2004	22359579	5572311	-1402389	-1769089
2005	26476878	7186560	-889140	-1313090
2006	30907312	8691728	-640973	-1115673
2007	34660028	9436373	-1126328	-1643528
2008	38817338	10301760	-1610940	-2128140
2009	42797678	10945935	-2316765	-2833965
2010	46667659	11406443	-3220508	-3740083
2011	51192005	12249375	-3877575	-4397150
2012	55553595	12888863	-4738088	-5257663
2013	58986714	12849011	-6127939	-6647514
2014	61774976	12484339	-7692611	-8212186
2015	63757895	11786738	-9380213	-10027288

Table B6.9 : Projection of Net Cost to Government of Irrigation Management and O&M Pessimistic Assumption - Under Alternative MOM Scenarios

Year	Net Cost (US$/annum) Under Scenario :			
	A	B	C	D
1994	7460700	4495550	3347750	3141775
1995	11836100	7362550	5482750	5066525
1996	15499500	9947550	7407750	6961525
1997	19355497	12520800	9324000	8740025
1998	22144755	14577050	10855250	10271275
1999	24563028	15985542	11813742	11559817
2000	27087592	17510388	12886188	12631863
2001	30078368	19401552	14258352	13936277
2002	32607060	20944590	15351390	15029315
2003	36325404	23364607	17139907	16773207
2004	40776760	26291639	19316939	18950239
2005	47409526	30735789	22660089	22236139
2006	54892004	35674506	26341806	25867106
2007	62019576	40215864	29653164	29135964
2008	69855346	45219519	33306819	32789619
2009	77632126	50134689	36871989	36354789
2010	85440203	55025555	40398605	39879030
2011	94114985	60537728	44410778	43891203
2012	102735515	65968523	48341573	47821998
2013	110329888	70610082	51633132	51113557
2014	116992642	74604213	54427263	53907688
2015	122383615	77740673	56573723	55926648

6.4 Background to the Economic Analysis

The economic values of the main crops were taken from the Irrigation Master Plan (Dapta, 1991). The figures in that report suggest that the economic values of the main crops range from 80% to 100% of the actual 1993 farm gate prices. The overall average figure for all crops is estimated to be in excess of 90%. The average economic value of a composite of farm inputs is higher than their market prices. Fertiliser costs are well below their economic cost due to considerable subsidies although these represent only a minor part of total input cost. Consequently the economic value of costs of the composite of agricultural inputs is taken to be 15% higher than their market prices. The farm budgets suggest that input costs represent approximately 40% of the gross product financial value. This figure combined with the above shadow prices for inputs and outputs results in an economic value of agricultural benefits of around 75% of that calculated using market prices.

The farm budgets also show that, using the mid 1993 exchange rate, the overall net financial benefit of irrigation was about US$ 1,000/ha excluding perennial fruits, with the latter adding another $200/ha. Given the uncertainty with fruit in the region only 50% of its potential benefit has been used. Hence the total financial benefit of irrigation is taken as $1,100/ha and the shadow priced economic value is $825/ha. The build up to this figure during years 1 to 6 respectively is $375, $560, $750, $775, $800 and $825.

The average 1993 development cost, including GDRS costs, has been estimated as US$ 10,000/ha. This is based on the average costs presented in the Irrigation Master Plan, US$ 7,426/gross ha, including dams, diversion structures and canals down to tertiary level, combined with an irrigation ratio of 80%. The O&M costs are the average 1993 costs estimated by the consultants and summarised in 6.2.

While market prices for composite construction and O&M per hectare costs are not distortions of economic values, they appear to under-estimate the full cost to the economy. A shadow value of 1.15 has been used in the economic calculations. Shadow pricing has been applied to the costs even though they have been expressed in US$. This is because the financial dollar costs are proxies for TL costs based on the prevailing rate of exchange.

A difficulty with any current economic analysis for GAP irrigation projects is the decide which costs should be considered as sunk costs and not included in the calculations. This is straight forward for specific projects but, when undertaken on a typical per hectare basis, the appropriate level of costs which should be considered as sunk is problematic. Hence the IRR calculations have been undertaken for a series of sunk cost assumptions. The average implementation period has been taken as 17 years and the cost build up has been based on a typical pattern of increasing annual cost until a peak is reached before expenditure reduces as completion approaches.

6.5 The Effect of Alternative Models on Internal Rate of Return

When considering the effect of alternative models on the internal rate of return, the focus is on the overall effect that model selection would have on the whole GAP irrigation programme. Hence the relevant analyses are undertaken on typical average cost irrigation in the area rather than on sub-components of the overall project. The most appropriate basis of analysis is the internal rate of return at typical average cost unit areas and for that reason the calculations are undertaken on a hectare basis. The resulting rates of return would be similar to those obtained using overall GAP project costs. However they may be very different from those estimated for individual projects. The consultant combined the average unit capital cost, average unit O&M costs of the different models and average unit benefits described above, to estimate the internal rate of return of alternative models.

Table B6.10 summarises the results of the internal rate of return calculations. It can be seen from the first line of the table that, when all capital costs are included in the calculations, the IRR varies between 2.53% and 3.01%. Hence the effect of the more efficient management cost models is limited in terms of the IRR. Furthermore this 0.5% potential increased return is only applicable to a limited part of the potential irrigated area, which is those schemes between 2,000ha and 5,000ha size which are managed by Water User Groups from the primary canal. For most of the irrigated area the additional return from a more cost effective management model is only 0.3%.

The rates of return shown in the first line of Table B6.10 are much lower than those in the Master Plan since they include all capital costs. The Master Plan assumed that 36% of capital costs were sunk and therefore could be ignored in the calculations. The second, third and fourth lines of the table show the effect on the IRR of considering part of the capital as sunk. It can be seen that this has a very significant effect on the IRR. Considering the first eight years costs as sunk is close to the Master Plan average sunk cost assumption. It can be seen that this assumption of sunk costs results in an overall average rate of return of between 5.48% and 6.10% for the different models. However for most of the irrigated area the additional rate of return for the most efficient model is under 0.4%. Hence it is concluded that the effect of alternative management models on the rate of return due to O&M cost savings is very limited. This is a feature of the whole of Table B6.10 and arises mainly because the O&M costs are relatively low compared with investment costs and benefits.

Table B6.10 : Internal Rate of Return of Typical GAP Irrigation Schemes Under Alternative MOM Models : Benefit Levels, and Alternative Sunk Costs

	Case 1	Case 2	Case 3	Case 4a	Case 4b
No Sunk Costs	2.53	2.72	2.83	3.01	2.87
First 5 Years Investment Costs Sunk	3.66	3.87	4.00	4.20	4.04
First 8 Years Investment Costs Sunk	5.48	5.72	5.87	6.10	5.91
First 12 Years Investment Costs Sunk	12.63	13.05	13.31	13.71	13.39
Benefits Increased 5%	Case 1	Case 2	Case 3	Case 4a	Case 4b
No Sunk Costs	3.01	3.18	3.29	3.45	3.32
First 5 Years Investment Costs Sunk	4.21	4.40	4.52	4.70	4.56
First 8 Years Investment Costs Sunk	6.10	6.63	6.47	6.69	6.52
First 12 Years Investment Costs Sunk	13.65	14.04	14.29	14.67	14.36
Benefits Increased 10%	Case 1	Case 2	Case 3	Case 4a	Case 4b
No Sunk Costs	3.46	3.62	3.72	3.87	3.75
First 5 Years Investment Costs Sunk	4.71	4.89	5.00	5.17	5.03
First 8 Years Investment Costs Sunk	6.69	6.90	7.04	7.24	7.08
First 12 Years Investment Costs Sunk	14.61	14.98	15.22	15.58	15.29
Benefits Increased 15%	Case 1	Case 2	Case 3	Case 4a	Case 4b
No Sunk Costs	3.87	4.02	4.11	4.25	4.14
First 5 Years Investment Costs Sunk	5.17	5.34	5.45	5.61	5.48
First 8 Years Investment Costs Sunk	7.24	7.44	7.57	7.76	7.61
First 12 Years Investment Costs Sunk	15.52	15.87	16.10	16.45	16.17
Reduced Implementation Period	Case 1	Case 2	Case 3	Case 4a	Case 4b
No Sunk Costs	3.15	3.38	3.53	3.76	3.57
First 36% of Investment Costs Sunk	6.46	6.77	6.96	7.26	7.02
Benefits Increased 10%	Case 1	Case 2	Case 3	Case 4a	Case 4b
No Sunk Costs	4.35	4.56	4.69	4.89	4.73
First 36% of Investment Costs Sunk	7.99	8.27	8.44	8.71	8.49

A sensitivity analysis showed that the IRR of projects is very sensitive to capital investment costs. Recalculation of the rates of return shown in Table B6.10, keeping other variables constant and reducing the capital cost by 50%, increases the IRR by about double, showing the greatest increase where the original IRR was below 4%. However the comparative returns for different models and the conclusions regarding model selection remain unchanged. This is also true for a sensitivity analysis on the shadow prices used in the earlier calculations.

Despite the limited effect that different O&M costs have on the IRR, it does not follow that the IRR is insensitive to the selection of the optimum model. An even more important feature than O&M cost saving is the efficient delivery of water. This will have two benefits. Firstly efficient delivery should result in a given volume of water being able to irrigate the greatest area. However the effect of this may not occur for several years by which time the discounted value of the benefit would be very small. Therefore the second benefit, timely delivery, is the more relevant measure for IRR calculation. Timely delivery results in maximum crop yields while poor delivery timing will cause reduced yields.

The second, third and fourth sections of Table B6.10 show the effect on the IRR of increasing agricultural productivity by 5%, 10% and 15% respectively. It can be seen that the effect on the IRR is considerably greater than that arising from cost savings between the models. For example for the 8 year sunk cost alternative a 5% increase in yields due to more efficient water delivery leads to an increase in IRR of approximately 0.6%. Similarly yield increases of 10% and 15% would lead to increases in IRR of about 1.2% and 1.7% respectively. Hence a 15% increase in yield leads to an increase in IRR of approximately that resulting from the maximum O&M cost savings between the models.

While model 3 is the most cost effective in terms of O&M costs, the economic rationale for recommending this model should be based mainly on its effect on farm production rather than on O&M cost savings. It is suggested that model 3 will not only save costs but would also result in more effective delivery of water than models 1 and 2. If this is accepted, then the return from model 3 would be considerably higher than that from models 1 and 2 as is indicated in Table B6.10.

The choice between models 3 and 4A or 4B, where one of the latter is applicable, should include a judgement of the probable comparative achievable water delivery between an Irrigation Authority and a Water User Group. This could give a more realistic economic result than relying solely on the comparison of O&M costs.

The actual rates of return shown in this analysis are dependent on a number of assumptions made in the calculations. Apart from cost and benefit values the most important assumption is the length of the implementation period. If this is reduced the IRR will increase. The last two sections of table B6.10 show the effect on IRR of reducing the implementation period from 17 to 8 years. For the base case where there are no sunk costs the average of the five cases IRR increases from 2.79% to 3.48%. Where the first 36% of investment costs are considered as sunk costs, the average of the five cases IRR increases from 5.82% to 6.89%.

Even if the estimated IRRs vary due to changes in the assumptions, the main value of the figures lies in the comparative IRRs to the models and to variations in production. The resulting rankings are unlikely to change if other assumptions do change. The conclusions of the IRR analysis remain valid unless there is a large change in relative O&M costs.

It is concluded that there is a positive effect on the IRR of the GAP irrigation systems as a result of a move from model 1, with DSİ controlling water distribution, to model 3 with an Irrigation Authority responsible for conveyance and Water User Groups responsible for distribution. Transfer of responsibility for primary and secondary canals of small schemes to Water User Groups would also further reduce costs. However for this latter case the effect on IRR would depend on the comparative efficiency for water delivery between an Irrigation Authority and Water User Groups.

7 THE RECOMMENDED MODEL

7.1 Proposed Strategy for MOM

The Overall MOM Model embraces all those aspects of institutional and organisational design necessary to achieve the integrated and sustained development of water resources and irrigation systems in the GAP region. The aspects which are to be specifically addressed by the model include:

- Institutional Arrangements for all the major organisational entities covering in the broadest sense their form, responsibilities, functions and the relationships between them. These arrangements refer to both the core service delivery bodies and those that provide technical support and advisory services.
- Organisational Arrangements describing more specifically the responsibilities and accountabilities of main entities and the communication and coordination links between them.
- Management Arrangements setting out the organisational structures of the major entities, their procedures, systems and resources required to perform their functions.
- Guidelines for planning, implementing, operating and maintaining the physical and farming infrastructure.
- Guidelines for good on-farm agronomic and water management practices.
- Human resource training programmes for agency staff and farmers.
- Performance Monitoring and Evaluation system which provides feedback and allows modification to guidelines and structures to meet changing management requirements.
- The necessary legislative framework which will allow the required institutional and management arrangements to be implemented and sustained.

The overall strategy for MOM must be to put in place a total management system that will achieve optimum utilisation of invested resources to realise the full agricultural potential of the GAP region. The first step in this strategy is to design a management system that most effectively meets the major objectives and criteria described in preceding chapters. Subsequent steps involve: testing the model concepts in representative field trials; reviewing and modifying the model following the field trials; developing appropriate transitional arrangements for application of the model elsewhere in the GAP region; implementing the model throughout the region.

The proposed Institutional Framework for the MOM Model is illustrated in Figure B7.1. This framework embraces functions to be carried out at national, regional and provincial levels and establishes the essential coordination and communication links between the different functional responsibilities and agencies. A feature of this structure is the emphasis on horizontal lines of communication in contrast to the much more vertically structured nature of the present system which was shown on Figure A3.1.

Irrigated agriculture is a dynamic process which must respond to changing agronomic, economic and technological demands if it is to sustain a high level of productivity. Furthermore competing demands for water resources and political and economic pressures at both domestic and international levels are likely to have an impact on the future development of agriculture in the region.

The MOM model must also be capable of responding positively to such pressures if irrigated agriculture is to be sustained. The clear implication is that the MOM model initially established must be flexible and capable of changing to meet emerging demands and circumstances. This is especially significant for large irrigation development programmes, such as in the GAP region, where the systems established at both agency and farmer levels in the early stages become obsolete when the irrigation schemes are fully developed. This aspect was a feature of several irrigation developments in other countries described in Chapter 6 of Section A.

7.2 Proposed Institutional Framework

7.2.1 The National Level

The main functions to be undertaken at national level are those essentially related to economic and financial planning, policy development, resource use planning and inter agency co-ordination for activities that have nationwide effects. Those functions which are essentially related to service delivery are primarily undertaken by agencies operating at regional or provincial levels and are discussed in 7.2.2.

Within the water resources sector key functions to be undertaken at national government level include: total water resources assessment and integrated resource planning; establishment of water management policies relating to water rights of surface waters and groundwater, water quality and pollution control; development of effective water laws and other legislation to create the appropriate enabling environment for operating agencies

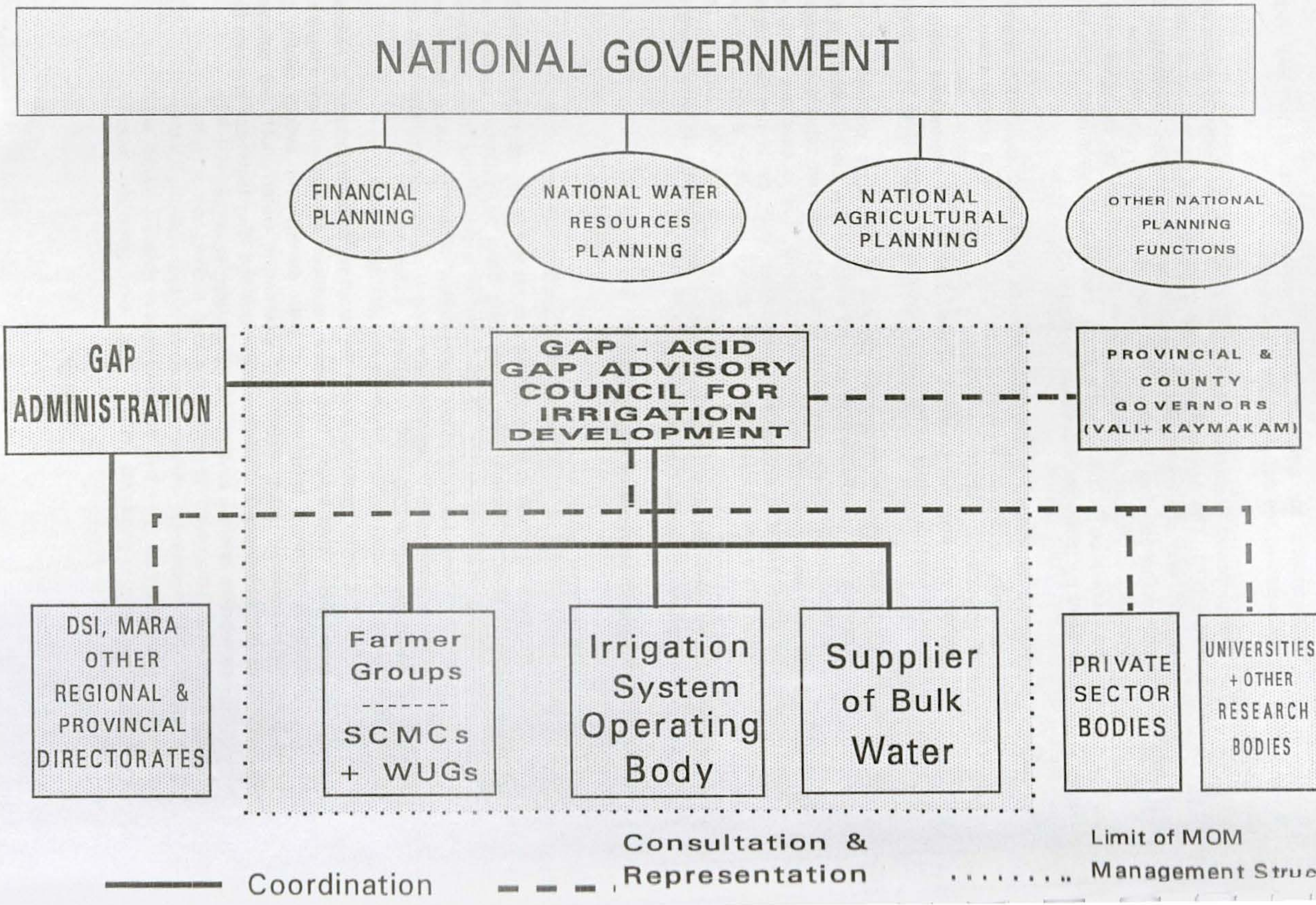


FIGURE B7.1

(Note: this is the same as Figure A3.2)

Within the agricultural sector national government functions are directed towards developing overall agricultural policies that are responsive to domestic and international market and economic demands. At this level government is primarily involved with developing overall policies and providing resources so that farmers can receive crop inputs, advisory and marketing services by the most appropriate public or private sector organisations.

Other national level planning functions which have an impact on the water resources and agricultural sectors include energy generation, transport, communication, education, the environment and health. These functions are significant in a development of the scale of the GAP irrigation schemes and are recognised in the total overall institutional framework.

The GAP Administration is seen as having a crucial role in the integration of planning activities of both national and regional level organisations.

7.2.2 The Regional and Provincial Level

The MOM Management Model comprises the core of the Institutional Framework illustrated in Figure B7.1. The primary element of the management model consists of three principle components: the Farmer Groups, the Irrigation System Operating Body and the Supplier of Bulk Water, each with its distinct function and organisational characteristics.

The Farmer Groups represent the production unit and ultimate customer for the water; their primary function is to utilise the water efficiently in order to maximise agricultural production and to bring wealth to themselves and the region. The most important skills for this group are agricultural know-how, commercial acumen and general managerial ability. The Irrigation System Operator is responsible for conveying the water from the bulk supply point to the delivery points where it is taken over by the Farmer Group; the essential requirement is that the water is delivered at the time and in the quantity that is mutually agreed with the end-user. There is no inherent definition of the number of such delivery points nor the size of the Farmer Groups; these will vary with the particular configuration of the system, the cultural characteristics and the managerial skills of the Farmer Groups but the functions remain distinct. It is this functional distinction that is important for determining the optimal institutional form for each level or layer in the overall management structure.

The responsibility of the third core component, the Supplier of Bulk Water, is similar to that of the Irrigation System Operating Body. It is responsible for supplying water, at one or more defined points, in accordance with an agreed policy. The significant distinction is that it operates at the national level rather than the regional, river basin or scheme level of the Irrigation System Operating Body. As well as meeting the agreed demands of perhaps several Irrigation System Operating Bodies, the Bulk Supplier must plan integrated water resources development at the national and international scale to meet national policy goals and to satisfy both national fiscal constraints and environmental protection requirements. There are thus almost certain to be conflicts of interest between these two distinct functions. It is therefore highly desirable that they should be assigned to separate entities, each with its own primary focus, form of accountability and organisational structure. Again, the point at which the Bulk Supplier hands over to the Irrigation System Operating Body will be a dependent on the local circumstances and may be influenced by the scale of the infrastructural works involved.

It could be argued that there should be a fourth core component whose responsibility would be the regional level disposal of irrigation return water, both from surface flow rejection and sub-surface drainage. This has not been shown explicitly on the institutional framework diagram as it is inherent in the water resources management function, which in this case has not been separated from that of bulk water supply. Although in principle such a distinction could be made, there is no immediate need to consider such an institutional change with respect to the selection of the MOM Management Model for the GAP Region. It should be assumed therefore that whenever the term Bulk Water Supplier is used, this encompasses all the functions of integrated water resource management, including the monitoring of surface and groundwater quality and the safe disposal of excess water from the irrigated ares. This does not absolve the Irrigation System Operating Body and the Farmer Groups from taking responsibility at their respective levels for minimising the outflow of excess water from the irrigation areas and ensuring that the quality of such water meets national standards. Moreover both these parties have direct responsibility for ensuring that the environment within their areas of responsibility is not irreversibly degraded and that any unavoidable short-term negative impact is carefully managed. The most sensitive of these environmental parameters are soil erosion, water quality and soil salinity. The responsibility for removal of excess water from the irrigated areas will have to be bound by mutual agreements similar to those for the supply of water and will be closely related to the issue of water management at the system operation and farm levels.

In addition to the three core components, there is a further component shown on Figure B7.1 containing the support and advisory functions provided by the existing government agencies. These agencies have been shown as an intrinsic part of the management model, as they will have a close and direct contribution to make to the efficient management and operation of the system. However this advisory and support function will be substantially independent of the institutional form and management structure of the three core components; moreover this function will form only part of their overall regional duties which will extend beyond the irrigated areas. It is on these grounds that they are separated by a dotted line from the three core components and have not been included in the MOM Management Model selection process.

The Universities, as centres of education and research, will also have a key role to play in the success of irrigated agriculture in the region. The link between then and the MOM Management Model is important and must be well defined both institutionally and organisationally. They do not however form part of the MOM Management Model, as defined, for the purposes of this project.

Similarly the private sector, while not directly involved in the management of the irrigation system, will complement the services provided by the Government agencies but in a form that by its nature will be institutionally less well defined. The involvement of the private sector in the overall coordination role is seen as important as a means of providing a formal line of communication between the users of these services and the suppliers and thereby improving the level of service that is supplied. They are thus shown as a part of the overall institutional framework but not part of the MOM Management Model.

Finally, there is seen to be a need for a body that will provide the function of coordination between these six entities. Although this role falls within the scope of the GAP RDA, it should be seen as a distinct entity with its own organisational structure. It has been shown within the MOM Management Model boundary because it will need, at least initially, to have a management as well as coordination function and take responsibility for such activities as planning and performance monitoring and evaluation and planning.

7.2.3 GAP Regional Development Administration

At the higher levels of operation of irrigation schemes, more especially where policy is determined and development is initiated, there is presently little coordination between those involved, and certainly no channels through which the farmer can make his voice heard. GAP Administration has a major role to play in this for the foreseeable future with the high rate of irrigation development planned for the GAP Region over the next two decades.

A coordinating body bringing together the main organisations involved in irrigation development is required to provide advice and guidance to the GAP Administration, to enable it to better formulate regional policy and to direct the involved departments, directorate, and authorities on irrigation development and operation and associated services.

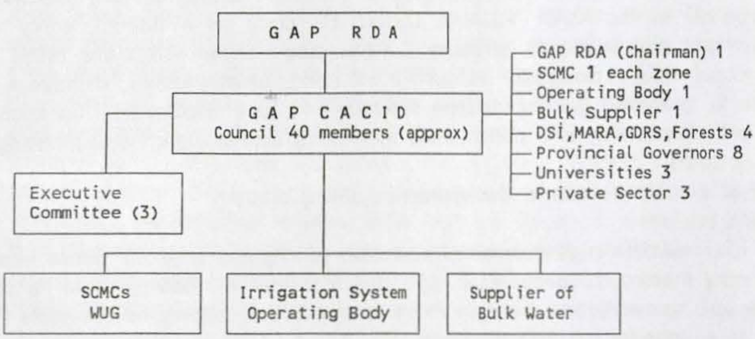
This coordinating, body with the suggested title: GAP Co-ordination and Advisory Council on Irrigation Development - GAPCACID, would comprise representatives from the following sectors and official bodies:

- Secondary Canal Management Committees or a federation of SCMCs
- Irrigation System Operating Body (Irrigation Authority)
- Supplier of Bulk Water (DSİ)
- Regional Directorate representatives of DSİ, Ministry of Agriculture, and other Regional Directorates and Research bodies

- Representatives from Private Sector Bodies.
- Provincial Governors or their representatives.
- Universities

This would provide a formal channel through which farmers' concerns and ideas could be channelled through the GAPCACID to the GAP Administration and open a route through which irrigation development could be planned taking into account the needs and wishes of farmers in the design phase in a manner which does not now occur.

This would enhance the roles of both the SCMCs and the WUGs in the important function of informing the GAP Administration, through a formal organisation, in a critically constructive manner, how irrigation development should proceed, based on actual operating experience and conditions at farmer level. The following diagram indicates the operating structure of GAPCACID:



7.2.4 Supplier of Bulk Water

Management of the major water sources and provision of water supply in bulk at supply points into the various irrigation systems are the primary responsibilities of the Supplier of Bulk Water. DSİ already undertakes these and would continue to do so as one of the principal core bodies in the model. Freed from the additional responsibilities of water conveyance and local distribution DSİ would thus be able to focus its activities on the integrated planning of water resource development and management on the broad scale.

The major roles of the Supplier of Bulk Water are as follows:

- management of river systems to ensure the sustainability of surface water resources in both quantity and quality
- construction and management of headworks storages, pumping stations and river diversion works
- monitoring, assessment and authorisation of the use of groundwater

- allocation and provision of water supply in bulk to all authorised users

- setting and collection of appropriate water charges for water supplied in bulk

- establishing level of service agreements with Irrigation System operating Bodies and other bulk users

- participation as a member of GAPCACID

- liaison with all other public and private bodies in long term planning

Further details of the role and organisation of DSİ as the bulk supplier are given in 7.3.

7.2.5 Irrigation System Operating Body

The conveyance of water in large quantities from the bulk supply points to the various distribution points is the responsibility of the specialised Irrigation System Operating Body termed the Irrigation Authority (IA). This body has as its primary focus the management of the dynamics of the irrigation system as it must match the fluctuating demands of water users at the downstream end with the availability of bulk water. As the variations of supply and demand often do not coincide it is very much the ability of the IA in devising operating rules and managing the delivery system that will determine how well the needs of water users are satisfied.

The main roles of the IA are as follows:

- operate main and secondary canal systems to convey water from bulk supply points to WUG supply points

- maintain main and secondary canals and drainage collector systems to designed and operational capacity

- liaise with DSİ for supply of bulk water in accordance with the level of service agreement

- enter level of service agreements with WUGs

- pay DSİ for bulk water received and set and collect charges for water delivered to WUGs

- participate as a member of GAPCACID

- liaise with WUGs and SCMCs on agronomic matters as they affect water requirements

- carry out long range planning for irrigation system development.

Further details of the role and organisation of the IA are given in 7.4.

7.2.6 Farmer Groups

The main function of the farmer groups, referred to as Water User Groups in the model, is to distribute water received equitably and efficiently among all farmers so as to maximise agricultural production and so ensure the economic well being of the region. The focus of the WUGs is on the farmer and his crop needs and in doing so it must act in accordance with simple but effective operational rules which are devised to meet the needs of that particular community.

In summary the main role of the WUGs is to:

- receive water from the Irrigation System Operating Body in accordance with its level of service agreement
- distribute water equitably among all member farmers
- pay for bulk water received and set and collect charges for delivered to individual farmers
- maintain tertiary canal and drainage systems in operational condition
- liaise with support and advisory organisations, public and private, on behalf of its members
- participate in the Secondary Canal Management Committee where appropriate.

Further details of the role of WUGs, their formation and how they are organised to undertake this role are given in 7.5.

7.2.7 Support and Advisory Bodies

The support and advisory bodies are those Government agencies which provide important technical, training, economic and other assistance and advice to individual farmers, WUGs and the system operators at both bulk and conveyance levels. Their role is an important and continuing one and as such they are important components of the management model although not core components. The main support and advisory agencies and their roles are as follows:

(a) Ministry of Agriculture and Rural Affairs

Through its various General Directorates and other departments MARA would provide the following services:

- extension services and training to farmers and WUGs in matters of agronomy, irrigation technology, on-farm water handling and drainage
- undertake programmes of plant production, livestock improvement and integrated agricultural development
- undertake land consolidation works
- carry out research on crops, irrigation techniques and drainage aspects
- provide technical inputs to crop production

- participate in the GAPCACID
- assist farmers with process to form Water User Groups.

(b) General Directorate of State Hydraulic Works (DSİ)

The role of DSİ as a support agency (as distinct from a bulk water supplier) is as follows:

- plan, design and construct water supply infrastructure works
- assist the IA and WUGs in establishing technical standards for operation and maintenance
- on request undertake maintenance works for the IA or WUGs on a contract basis
- provide consultancy services to IA and WUGs for long term planning of their systems
- participate in the GAPCACID.

(c) General Directorate of Rural Services

GDRS has a very comprehensive role in total village development. As an irrigation support agency its particular role is as follows:

- undertake design and implementation of on-farm irrigation systems and layouts
- design and implement on-farm drainage works
- undertake research into agricultural and water use matters
- undertake reclamation projects
- participate in the GAPCACID.

(d) Ministry of Forestry

Involvement of the Ministry of Forestry in the GAP irrigation projects has been limited to date. However an increasing role is seen for the Ministry in the development of tree crops which could provide a valuable alternative crop for irrigation usage in the region. Accordingly the Ministry of Forestry is considered as one of the support bodies with role as follows:

- trial and develop tree species for production under irrigation and make the results available to farmers through extension agencies
- undertake programmes of watershed rehabilitation where necessary to reduce erosion and siltation problems in reservoirs
- participate in the GAPCACID.

7.2.8 Universities

The universities are the major centres of education for many professional and technical staff of agencies who work in the region. The universities are also important centres for fundamental scientific research into matters concerning soil and water use, agricultural crops, engineering, environmental and other issues. Continued work in these fields is vital for the long term sustainability of irrigated agriculture in the region. It is important that the programmes of higher education and research are relevant and regularly updated to meet the contemporary needs of the region. In order to ensure that the needs of the region are appropriately covered in programmes of higher education and research the major universities in the region are regarded as a support group distinct from other public and private support bodies. The universities would all participate in the GAPCACID.

7.2.9 Private Sector

Various private sector bodies are involved with irrigation and agriculture at present although they are not formally linked to the current institutional structure of irrigation management. The Chambers of Agriculture which exist throughout the agricultural areas of Turkey, and linked by their Ankara based union, is the major private body acting to represent the interests of most farmers nationwide. The role of the private sector is certain to increase rapidly in the region to meet the expanding needs of farmers for inputs such as seeds, fertilisers and farm equipment and marketing facilities. The private sector is also likely to be increasingly involved in provision of financial and other services which Government bodies are unable to provide or cannot do effectively. The private sector will also be increasingly involved as the Government proceeds with privatisation of many existing State Economic Enterprises.

The role of the private sector is driven primarily by commercial considerations and by the nature of these bodies is less institutionally structured than that of public sector bodies. Nevertheless if the private sector is to be most fully effective it should be recognised as a support body in the management model. This involvement is formalised by inclusion of private sector representatives on GAPCACID. Such representation should include the Union of Chambers of Agriculture, farm input/irrigation equipment suppliers and marketing services.

7.2.10 Provincial Co-ordinating Committee

The Provincial Co-ordinating Committee of each province, established as a requirement under Provincial Administration Law No 5442, plays an important role as a communication link between different Government agencies including those which have only an indirect relationship to irrigated agriculture. Provincial and county level administrations will also be involved in the delivery of agricultural services to farmers.

The primary role of co-ordination of the core bodies and the support agencies, which are directly involved with irrigated agriculture, lies with GAP RDA under the MOM Model through the proposed GAPCACID. However because of the economic and social significance of the GAP irrigation schemes to the whole region there is a need to ensure that where it is relevant the programmes of other agencies are planned with an understanding of the irrigation development programme. For example as additional areas are brought under irrigation there will be considerable movement of people as additional workers arrive for employment on farms and the support industries that are created. This will bring pressure for increase in a range of Government services not directly related to irrigation such as transport, health and education. Thus the Provincial Co-ordinating Committees are seen as playing a complementary role to GAP RDA in co-ordinating the general activities all public agencies. To ensure that this link is formalised each Provincial Co-ordinating Committee should be represented on GAPCACID.

7.3 The Supplier of Bulk Water

7.3.1 Role and Function of DSİ

Management of the major water sources and provision of water supply in bulk at supply points into the various irrigation systems are the primary responsibilities of the Supplier of Bulk Water. DSİ already undertakes these and is recommended under the model to continue this role which would be enhanced without the additional responsibilities of water conveyance and local distribution. DSİ could then focus its activities on the integrated planning of water resource development and management on the broad scale taking into account national policy objectives and international obligations. It would cover aspects such as water quantity and quality, drainage and salinity control strategies, flood control and environmental considerations.

DSİ would also have direct responsibility for management of the major headworks storages, pumping stations and river regulating weirs. These large engineering structures demand the continued attention of skilled operators, backed by technical expertise, to ensure that they provide the required levels of service under all operating conditions

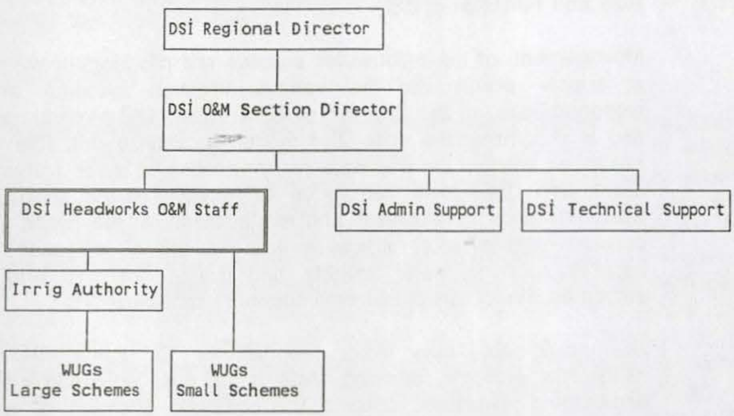
The major roles of the DSİ as the Supplier of Bulk Water are:

- management of the control and use of river systems so as to ensure the sustainability of surface water resources in both quantity and quality
- management of the operation and maintenance of headworks storages, pumping stations and river diversion works
- monitoring, assessment and authorisation of the use of groundwater
- allocation and provision of water supply in bulk to all authorised users
- setting and collection of appropriate water charges for water supplied in bulk
- establishment of level of service agreements with Irrigation System operating Bodies and other bulk users
- participation as a member of GAPCACID

- liaison with all other public and private bodies in long term planning.

7.3.2 Organisational Arrangements

The organisational `arrangements for DSİ acting as headworks storage manager and bulk supplier would be much the same as at present in those regions with such works. Storage management is undertaken by the appropriate DSİ Regional Directorate through the O&M sub directorate. Reservoir operating staff would have the availability of technical and support sections. A typical organisation chart showing the relationship of the storage management unit to other DSİ units and customer bodies is as follows:



7.4 The Irrigation System Operating Body

7.4.1 Role and Function of the Irrigation Authority

The creation of an Irrigation Authority (IA) is the recommended sub model for the Irrigation System Operator core component of the MOM Management Model. The proposed IA will take over many of the functions at present carried out by DSİ. The IA will own, manage, operate and maintain the primary and secondary delivery system, buying water in bulk from DSİ and selling it to Water User Groups (WUGs). Coordination and communication with the WUGs would be facilitated by formation of a Secondary Canal Management Committee (SCMC) representing a group of WUGs on the same secondary canal system.

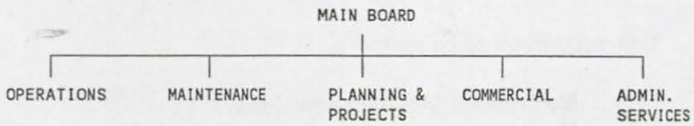
The IA will be a Government agency and should be established within the Ministry of Public Works and Settlements although outside the existing departmental structure of DSİ. It is an essential that the IA be set up under a charter which requires it to operate on a commercial, fully accountable basis with its own management and finances. This would establish it from the outset as a relatively autonomous body focussed specifically on delivery of irrigation services to a defined customer group. This would also facilitate the possible transition of the IA to a private sector body in the future.

The IA would have the following main tasks, which are closely related:

- Operation of the primary and secondary delivery systems
- Maintenance of the primary and secondary systems
- Payment for water purchased from the bulk supplier and collection of water charges from WUGs
- Planning for future development.

7.4.2 Organisation and Management

The management structure of the IA should reflect its main tasks and the associated support services. The form of the proposed structure is as follows:



The IA would be governed by a part-time management board responsible for overall policy direction, setting operational goals, financial planning, long term planning and monitoring overall physical and financial performance.

The management board needs to have expertise covering a range of disciplines and institutional interests. The recommended composition is seven persons being as follows:

- A representative of GAP RDA (Chairman)
- One representative each from DSİ, MARA and GDRS
- Two private sector representatives, one representing farming interests and one experienced in business management
- The chief executive of the IA (ex officio)

The role of each department and the range of staffing disciplines required to undertake these are as follows:

(a) Operations

- Manage and operate primary and secondary canals and pipelines
- Schedule water on a day-to-day basis
- Liaise with WUGs (through Secondary Canal Committee where established)
- Liaise with DSİ
- Water metering
- Enter into Service Level Agreements (SLAs) with DSİ and WUGs.

This department would be staffed by:

- Operations Manager and Deputy
- Primary Canal Section Engineers
- Secondary Canal Technicians
- Watermasters for each Secondary Canal
- Water Schedular/Data Manager

(b) Maintenance

- Maintain primary and secondary canals and pipelines
- Regular inspections and reports
- Plan maintenance programme
- Organise maintenance of primary and secondary canals by direct labour or contract
- Develop maintenance standards and guidelines for WUGs.

This department to be staffed by:

- Maintenance Manager and Deputy
- Maintenance Engineers
- Maintenance Technicians
- Weed Control Specialists
- Plant Technicians and Drivers
- Workshop Manager
- Workshop Technicians, etc
- Direct Labour Manager.

(c) Planning and Projects

- Research & Development
- Long-term water management
- Planning of new works and major repairs
- Design of new works and major repairs
- Project Management
- Performance evaluation
- Quality Assurance.

This department to be staffed by:

- Manager, Planning and Projects
- Research staff (agronomist, sociologist, engineer)
- Hydrologists and Computer modellers
- Planning engineers
- Design engineers
- Design technicians
- Project managers.

(d) Commercial Department

- Company Law
- Rules and Regulations
- Legal advice to Operations on Service Level Agreements (SLAs)
- Contracts Service and Secretariat
- Fee collection
- Payments to DSİ, other suppliers and contractors.

This department to be staffed by:

- Commercial Manager
- Company Lawyer
- Contracts Engineer
- Accountants
- Billing clerks
- Fee collection agents.

(e) Administrative Services

- Personnel
- Training
- Office maintenance
- Travel services
- Library services
- Post and telephones
- Computer support.

This department to be staffed by:

- Administration Manager
- Personnel Manager
- Training Manager
- Library Manager
- Post Supervisor.

7.5 Farmer Groups

7.5.1 Role and Function of Water User Groups

(a) Role

The creation of Water User Groups (WUGs) is the recommended sub model for the Farmer Groups core component of the recommended MOM Management Model. The role of Water User Groups (WUGs) as part of the recommended model will be to:

- receive water at the tertiary level from the Irrigation System Operating

Body (DSİ initially until an Irrigation Authority is formed.)

- allocate water fairly to its irrigating members
- develop an appropriate and equitable basis for water charges
- collect water charges from members
- pay to the supplying authority fees for the bulk water received
- undertake the necessary maintenance work on the tertiary irrigation and drainage infrastructure, or make arrangements and pay for the work to be carried out by other means
- undertake and pay for improvements to the tertiary system as required
- liaise and negotiate with supply and support organisations in the interests of members
- participate in the Secondary Canal Management Committee to safeguard the interests of WUGs for bulk water supply and charging from the supplier.

(b) Function

In order to carry out these various activities the WUG must be organised in such a way which will enable it to reflect the wishes and needs of its members in the interests of efficient irrigation methods and productive (profitable) agricultural production.

This will entail the bringing together of farmers as members of a WUG which will manage and operate the tertiary irrigation system so that the interests of the members are met in a way which is equitable to all concerned. To ensure that these objectives are achieved the farmers must first agree upon a constitution and a set of working rules and regulations together with the necessary sanctions against those who do not operate within the agreed rules and regulations. Such sanctions must be capable of being enforced, in the main, at the local level, with recourse to a higher level of adjudication only as a last resort.

Each WUG will, by the production of its own constitution, be able to reflect the differing needs of the irrigating community and take into account any special circumstances or conditions in the locality.

The constitution will set out the method of democratic election of office-bearers on a regular basis. It will also set out how the financial aspects of operating a WUG will be controlled and how the annual accounts will be audited for presentation at an annual general meeting. In addition, it will describe the procedures for the expenditure of WUG funds for capital purposes, running expenses, and the level of paid staff needed to carry out operations. It will also establish the procedures for setting water charges for members and the method and timing of payment and collection of the charges.

Finally, as a means of responding to changes in circumstances and operating conditions, the constitution must contain provisions and mechanisms for revising and changing the rules and regulations. This will enable the WUG to be flexible and dynamic and so reflect the wishes of its members.

(c) Benefits

In return for undertaking these roles and functions, the WUGs must expect to receive some benefits from their involvement. It is recognised that the value of land to land owners is enhanced with the establishment of an irrigation scheme on that land. The value of production is likely to be higher as a result. However, other conditions are necessary before full participation by farmers will be achieved voluntarily and enthusiastically. These conditions are:

- the WUG must be regarded as a legal entity to enable it to own assets and to have recourse to the legal system if required
- the irrigation and drainage structures within the area of control of the WUG must be collectively owned and controlled by the WUG
- the WUG must be able to negotiate with the Irrigation System Operating Body either individually or in conjunction with other WUGs, for the supply, timing and pricing of bulk irrigation water, to create an equitable customer/supplier commercial relationship between the two bodies.

In return for these conditions being met, Government can confidently expect the WUG to undertake functions which are at present not being carried out satisfactorily (or not at all in some cases) such as collection of water fees and management, operations and maintenance of tertiary irrigation systems. Implementation of appropriate local management by WUGs will provide a sound base for ensuring the well-being of present schemes and future long-term sustainability of all irrigation schemes.

7.5.2. Approach to Forming Water User Groups

(a) General

The need for greater participation by farmers in the organisation of farmer groups, as distinct from participating in groups designed by someone else, is widely recognised in many countries. The general consensus of delegates to the Şanlıurfa Workshop was that formation of WUGs having greater level of direct involvement than at present is desirable for the GAP region. There is a clear perception that this will lead to better maintenance, control, and more efficient use of water by farmers. Accordingly it is now recommended as a key component of the MOM Management Model.

Without WUGs sustained development of irrigation will be constrained. This is especially important at a time when there is greater pressure on the national budget and when there is evidence of declining standards of irrigation system maintenance. Linked to this is the lack of an efficient system of collecting water charges from users and an organised process through which farmers can participate in the planning and design of irrigation schemes which will reflect farmers' needs.

Through the creation of WUGs these vital issues will be addressed by the direct participation of users in the design and planning of the schemes for which they are to assume responsibility for management, operations and maintenance at the tertiary level. Also of importance is the creation of a customer and supplier relationship regarding irrigation water supply between the users (farmers) and the supplier (DSİ or an Irrigation Authority).

(b) Rationale

The rationale behind the formation of WUGs is that farmers have to be persuaded of the benefits of self-organisation, the benefits they are going to receive, and the need for them to be managers of the commodity, water, which will produce those benefits. The formation of WUGs will evolve over a period, rather than occur according to a pre-determined schedule. The idea that such groups will just emerge when the water flows down the canalets can be rejected, even though some may perceive that this is how groups will form.

To assist the formation of WUGs it will be necessary to place trained organisers in those areas which will receive water to act as catalysts within the farming communities. They will stimulate the farmers to come to a position where they believe that group formation desirable and necessary. Such organisers will then be able to lead farmers through the processes of group formation. This will include devising sets of working rules which will be the basis for effective group management and operation.

The organisers should have no personal interest in the eventual operation and management of the group. They should remain impartial throughout the group formation process by bringing together all shades of opinion in discussion and debate to ensure that operating rules and regulations will emerge which are fully acceptable to the community to be served by the WUG.

The main problem faced in this process is that the technique of bringing farmers together as members of a cohesive management group is one that has been little practised in Turkey. This is especially so for the types of irrigation system proposed for the GAP region. The task of group formation requires knowledge and skills related to sociology and an approach based on fostering farmer self-motivation to ensure sustainability when they are formed. This is essentially a bottom-up approach where the role of those assisting with group formation is to guide farmers rather than direct them.

It is recommended that, for the initial period of testing the group formation process in Pilot Areas, group formation officers be appointed who are not part of any existing Government department or ministry. In the longer term the responsibility for the group formation process will need to be institutionalised and MARA appears to be the most appropriate body to assume this role. This step should proceed only after the process has been tested and shown to be successful in the Pilot Areas. MARA would be invited to assist with the monitoring during the group formation process in the Pilot Areas, with a view to taking over the process after the Pilot stage.

Preparation of Group Formation officers for their task will require a considerable training input and ongoing co-ordinated support from a range of existing institutions.

7.5.3. Organisational Arrangements

The consultants propose that group formation work begins in the selected Pilot Areas. This would involve the recruitment of up to 8 GFOs who would be supervised by a Group Formation Coordinator (GFC) with support and training assistance given by a Group Formation Adviser (GFA). Before being located in the areas where they will operate, the GFOs would be given initial training through an induction course. This would be reinforced and supplemented by regular training inputs during monthly and quarterly meetings as required, in response to the situation and progress in the field.

Once posted to a Pilot Area where one or more WUGs are to be formed, the GFO would interact with farmers, lead farmers, village leaders, headmen etc to encourage the formation of a WUG which will best meet the particular needs of farmers and the community whilst undertaking the main roles required. Once all the ideas, suggestions and details have been discussed and agreed, they would be incorporated into a constitution which will set out how the group will operate, how it will be constituted, how the committee will be elected, how rules will be enforced, the basis on which water fees will be charged, and how extra working funds will be raised to cover operating expenses.

The GFO would remain assisting the WUG until such time as the constitution has been accepted by a meeting of all the members and a committee formed to undertake the business of the WUG. The GFO would then be assigned to another area where similar group formation work is to take place. If a WUG wished to retain the services of a GFO to receive continuing assistance, it will be its responsibility to make the necessary arrangements (perhaps in conjunction with one or more other WUGs), and prepare a contract which must be financed by the WUG directly. It must be clearly understood that the input from the GFO would terminate as soon as the constitution is agreed and signed and the committee elected.

The Constitution will need to include the following details:

- Name of WUG
- Qualifications for membership/admission of new members
- Geographical coverage
- Membership fee (initial and/or annual)

- Size and composition of committee
- Nominations for committee members
- Membership attendance at Annual General Meeting
- Election/re-election of committee members annually
- Presentation `of annual accounts
- Approval of annual budget (cost covering by charges on members)
- Approval for borrowing money for capital improvements to system and method of repaying loans and how members will pay for such borrowing
- Approval for hiring of paid staff for WUG operations
- Approval of schedule for regular (ordinary) meetings of WUG
- Arrangements for the calling of and Extra-Ordinary General Meeting (EOAGM) by Committee and by ordinary members
- Approval for the auditing of annual accounts (by whom and when)
- Time of year for calling the Annual General Meeting (AGM)
- Method of calling and notifying members of an AGM or EOAGM
- Approval for composition of a general meeting (agenda)
- Election of representative(s) to Secondary Canal Management Committee
- Method of approving new, or amending existing operating rules and regulations.

The operating rules and regulations will need to include the following:

- Details of the basis for calculation of water charges to members
- Details for the basis for calculation of other operating costs for which members will be charged
- Details of how members requisition for irrigation water supply
- Details of duties of Water Foreman and his powers concerning water allocation
- Details of how members use water and dispose of excess water (drainage)
- Members rights to appeal to WUG Committee when mis-allocation or non-allocation of water occurs
- Rules concerning wilful damage to structures by members or others
- Rules concerning accidental damage to structures by members or others
- Responsibilities of members in reporting all forms of damage
- Sanctions for wilful damage by members
- Actions against non-members for wilful or accidental damage
- Actions against members for accidental damage
- Methods of carrying out regular maintenance and repairs caused by fair wear and tear
- Contributions by members to regular maintenance and repairs in terms of labour and/or cash contribution
- Details of how charges will be levied and collected
- Details of date(s) when charges will be levied (start/middle/end of irrigation season charging)

- Sanctions to be take against members who do not pay their water and other charges
- Time limits to be specified for payment of charges
- Appeals by members to committee (complaints/grievances procedures)
- Appeals by members to nominated higher authority
- Actions against members for mis-use or waste of water
- Sanctions against members for stealing water or unauthorised use
- Sanctions against members for polluting or causing pollution of irrigation or drainage canals/canalettes/drains etc.
- Methods of proposing improvements/alterations/extensions to irrigation or drainage system and payment for such works.

Where a number of WUGs exist within a single scheme or geographical location, it will be in their interests to form a Secondary Canal Management Committee (SCMC). This committee would carry out the following functions:

- act as negotiating body with the Irrigation System Operating Body, representing the interests of WUGs particularly concerning level of supply of water and charges
- liaise on a day-to-day basis with staff of the Irrigation System Operating Body for the distribution of water to all WUGs drawing water from the secondary canal.

Each WUG would be required to nominate a representative to the SCMC which would act as the next higher level "operating authority" liaising on behalf of WUGs with the supplier. In the case of the SCMC representing a large number of WUGs, it would be necessary for a working committee to be elected from the WUG representatives to carry out the wishes of the SCMC. The nomination and election of a representative from a WUG to the SCMC could be made at a General Meeting of WUG members.

7.6 Communication and Co-Ordination Arrangements

7.6.1 The Customer/Supplier Relationship

An important consideration in the development and implementation of the model is the relationship at the interface between each of the core component agencies. It is highly desirable that the concept of supplier and customer be recognised to highlight the **service** nature of their joint activity. This implies a understanding and acceptance of rights and responsibilities by each party. The concept aims to establish a strong relationship between the supplier and customer based on provision of a cost effective service which meets the actual needs of the user. It also needs clear lines of communication and accountability between them. The nature of the service should be negotiated between the parties and expressed in a **service level agreement** so that each party is clear as to its responsibilities and accountabilities and what is expected of the other.

7.6.2 Contractual Arrangements and Levels of Service

The nature of the relationship between supplier and customer is a form of contract although it should be one that is freely negotiated between the parties, written in an understandable form and not seen to be highly legalistic. In this regard it can be seen in the nature of a **level of service agreement** rather than a legalistic document. The agreement should be concise and cover matters such as:

- **Supply Conditions** in terms of volume, flow rates, ordering arrangements, times of availability, procedures in the event of water shortage or surplus etc;
- **Basis of Charge** including tariff schedules, method of assessment and payment arrangements;
- **Communication and Reporting Procedures** to include formal and informal communications, contact persons, modes of communication, reporting periods and times, nature of data and information to be provided;
- **Emergency Arrangements** to cover unforeseen events such as accidents, natural disasters, extreme climatic variations or other occurrences which cause either party to change planned or existing operation with a consequent effect on the other party;
- **Guarantee of Supply** provisions including liability, funding and cash flow implications, possible sanctions or compensation to the customer in the event of water being unavailable or service below the agreed level;
- **Procedure for Changes** to the provisions of the agreement on the request of either party. It is likely that circumstances will change over time as both the supply and agricultural systems become more fully developed. In order to ensure that the level of service agreement remains relevant to contemporary needs there should be a means of regularly reviewing such agreements, for example at intervals of about five years;
- **Procedures for Dispute Resolution** between the parties including the means of appointing an independent person or body to arbitrate on such matters.

7.6.3 Responsibilities

The roles and functions of DSİ, the Irrigation Authority and the Water User Groups are described above. In order to ensure that the respective functions of each body are carried out in the proper manner it is necessary for responsibilities for the performance of particular tasks and activities to be assigned to the appropriate unit of the organisation and then to specific persons within each unit.

In the case of DSİ and the IA, which are organisations with several functional departments and relatively large numbers of staff, it will be necessary to define responsibilities for each department and management level together with the extent of geographical coverage where separate schemes and parts of schemes are the responsibility of different units. In the case of the Irrigation Authority typical statements of responsibility are as follows:

(a) Main Board

- Establishment of overall policy direction for the IA in line with legislative requirements and government directions
- Approval of expenditure budget for each functional unit
- Setting of level of water charges to WUGs
- Approval of delegations of authority for particular officers to act on behalf of the IA
- Reporting to Government at periodic intervals on expenditure and performance of the IA.

(b) Director

- Day to day management of the IA subject to main board policies
- Represent IA on external committees and as official spokesman
- Present periodic reports to main board on performance of IA such as water deliveries and system performance, expenditure, revenue collection, major works progress, liaison with other agencies, performance of WUGs.

(c) Operation Department

- Enter level of service agreement with each WUG
- Liaison with each WUG and assessment of water needs on daily monthly and annual basis
- Schedule required flows on each canal
- Order bulk water requirements from DSİ and maintain liaison on operational progress
- Develop operating rules for canals and structures
- Operate canals in accordance with operating procedures
- Arrange training of field staff in operating procedures
- Record water delivered to each WUG and advise Commercial Department
- Liaise with Maintenance Department on maintenance requirements.

(d) Maintenance Department

- Carry out regular inspections and report on condition of infrastructure
- Prepare programmes of maintenance in accordance with inspection reports and advice from operating staff
- Implement planned programme in accordance with proper standards and budget limits
- Record details of works and costs of maintenance performed.

Within each department there would be more detailed responsibility statements for smaller sub units and individual staff members. Each staff member should be fully informed of the responsibilities of his department, his own specific tasks and those other staff with whom he works. Responsibility statements for individuals can be set out in the form of a duty statement. A typical duty statement for a field canal operator would contain the following:

- Attend and operate various canals and structures at specified times
- Contact each WUG daily during irrigation season
- Contact other canal operators and DSİ staff to plan and execute water delivery
- Read water flow devices at key locations
- Record details of canal flows and water deliveries to each WUG and submit to supervisor at weekly and other intervals
- Report to supervisor on operational problems, water shortages, maintenance requirements or emergency events.

All statements of responsibility must include details and times of reporting requirements, ie to which higher level is a unit or individual required to report and which units or individuals report to it.

In the case of a Water User Group various responsibilities would be assigned to members of the committee, paid staff and individual farmer members. The detailed assignments would vary in each WUG due to the self generated nature of their rules procedures. In general terms, responsibilities of a WUG would be as follows:

WUG Committee

- set water fees for members
- convene meetings of members
- pay IA for water supplied
- nominate delegate to SCMC.

Water Foreman

- receive requests from individual farmers for water
- compile consolidated water order and submit to IA
- liaise with IA regarding receipt of bulk supply

- distribute water among farmers in accordance with WUG rules
- record areas irrigated, crops, water delivery details and submit to committee.

Individual Farmers

- order and receive irrigation water in accordance with WUG rules
- pay water fee to WUG committee
- perform maintenance on tertiary canals as required
- actively support the WUG committee.

7.6.4 Co-ordination

The recommended MOM model places considerable emphasis on proper co-ordination of activities between all the major agencies and interests. This is an essential requirement that mutually dependant activities do occur in a timely and cost effective manner. Effective co-ordination is dependent on there being effective communication processes and it is obvious that separate organisations or persons cannot co-ordinate activities if one does not know the role, actions or plans of the other.

Good co-ordination also requires a positive commitment by the parties. This implies a clear appreciation of overall objectives and willingness to work in conjunction with others, perhaps modifying individual programmes and plans, in the broader interest of the common good.

Within small organisations co-ordination is relatively easily achieved. Within larger organisations, while it is more difficult due to the numbers of people involved, nevertheless there is often good co-ordination where responsibilities are clearly defined and this is supported by appropriate internal communication and monitoring procedures.

The most difficult co-ordination is between large organisations where there are institutional constraints due to the nature of the management systems with narrowly focussed objectives, centralised decision making processes and relatively inflexible funding and planning arrangements. The MOM model attempts to overcome these barriers by giving the GAP RDA a greater role in co-ordinating all irrigation related activities in the region.

7.6.5 Communications

Management of large and complex irrigation systems is a dynamic process requiring constant interaction and information exchange between system managers, operating staff, farmers, supporting professional and technical staff and other special interest groups. Good communications are essential between all the organisations and individuals involved if these systems are to perform to meet the full requirements of the customers.

Effective vertical communication between supplier and customer at each end of the water supply system is important in assuring that water supplied is matched to crop demands and that research and development efforts are relevant to actual needs. Within the one organisation effective vertical communication processes ensure that staff at all levels are fully aware of organisational goals and also keep management aware of issues and activities of particular concern to lower level staff.

Horizontal communication refers to communication between entities at the same institutional level and is a prerequisite for good co-ordination as outlined in 7.6.4 above. It can also be applied to communication between individuals in the same or related work units.

While there are obvious difficulties for large organisations establishing effective communications where they have many staff and customers dispersed over a wide geographical region, the need for effective communications applies equally to smaller organisations. Some general principles of good communication include the following:

- The means of communication, verbal, written or electronic, should be appropriate to the nature of the information;
- The message conveyed should be understandable to the receiver;
- Effective communication is a two way process;
- Feedback from receiver to sender is desirable to ensure that a message has been received and understood;
- All matters of significance should be confirmed in writing even if the information is initially sent verbally.

The establishment of suitable communications procedures and facilities should be addressed by all WUGs at an early stage of their development.

7.6.6 Motivation

The ultimate success of any management model depends on the performance of the people involved at all levels from senior and middle managers, field staff, WUG members and individual farmers. Accountability and motivation are two related factors which provide the necessary incentive to performance in any area of human endeavour.

Accountability can act as an incentive to perform where actual performance of an organisation or individual is to be measured against a preset standard, with an implied threat of sanctions if the standard is not met. Any person in a position of responsibility, whose actions can have economic or other effects on another must expect to be held accountable for their performance regardless of whether this accountability is linked to a formal system of reward or penalty. This accountability is much clearer to define, and subsequently assess, if the role and responsibilities have been clearly established and communicated as indicated above.

The related concept of motivation can be seen as the more positive force for determining human behaviour. The economic factor is certainly a powerful incentive and sometimes the only one. For WUGs and farmers the recognition that a high level of irrigation performance can directly increase their farm production and income should act as a positive incentive for them to have the WUGs perform efficiently and cost effectively.

For staff and employees salary and wage levels, and perhaps other employee benefits, are prime motivaters especially where good performance is recognised by payment of a bonus or promotional opportunities. However, in public agencies where salary scales, are relatively fixed, the monetary factor alone might not be sufficient motivation and it is desirable to seek other less tangible incentives to ensure good performance. Examples of other staff motivating forces can include job satisfaction and personal identification with organisational performance and purpose. These aspects can certainly be enhanced and directed positively where the management system provides for staff at all levels to be kept fully informed about the organisation's role and activities and allows them to participate in decisions concerning their own area of work and expertise.

7.6.7 Mobilisation of Skills

Implementation of the MOM Model will require the appointment and training of the necessary human resources which are an essential ingredient of any management system. Human interaction within and between the different organisations is the factor that finally will determine the success of the management model. The features outlined above, namely supplier/customer relationship, levels of service, definition of responsibilities, communication and co-ordination and motivation, are all aimed at providing a management system which is capable of effective service delivery.

Staffing of the organisations comprising both the core and support elements will be drawn from both the existing organisations of DSİ, MARA, GDRS and provincial administrations and by new recruitment. In order to ensure that the human resources are used to their fullest it is necessary to implement training programmes which enhance existing technical and managerial skills and provide new ones where required. Each of these organisations already have established in-house training programmes for their staff.

Many farmers in the GAP region have considerable skills relating to dryland agriculture while some have acquired knowledge of irrigation techniques through localised private irrigation schemes. With the commencement of large scale public irrigation schemes there is a major requirement for training of farmers in specific irrigation techniques and the needs of the WUG formation process.

Proposals for training of both government agency staff and farmers, as part of the GAP MOM study, have been drawn up following a training needs analysis of the specific needs to implement the MOM model. This programme is intended to supplement existing training programmes already carried out by the respective organisations. The needs analysis identified that the GAP MOM training should be directed to four groups: managers, O&M staff, personnel involved with Water User Group formation and trainers. Further details are given in 7.10.

7.7 Procedures and Manuals

7.7.1 Procedures to be Developed

Having established the institutional, organisational and management arrangements for the model it is necessary for each entity to develop its specific operating policies so that it can properly perform its assigned responsibilities. These policies in turn will give rise to specific procedures, guidelines and operating rules which determine how the various activities are to be carried out.

The specific procedures that need to be prepared by an agency depend on the range and complexity of the functions under its control, the resources it has available and the nature of its interaction with other agencies under levels of service agreements. Such procedures need to cover technical aspects relating to particular water systems and structures as well as general procedures for management and administration.

For the Supplier of Bulk Water and the Irrigation Authority, specific technical procedures required include the following:

(a) DSİ

- Operations procedure for each major dam and diversion structure including routine daily and periodic operations and measurements, liaison with IA and other agencies, water quality, safety inspections and emergency procedures.

- Maintenance procedures for each major dam and diversion structure, including routine inspections and reports.

- Procedures for determination of available water resources and calculation of volumes to be supplied in bulk to the IA.

(b) Irrigation Authority

- Water ordering and system scheduling procedures.
- Operation procedures for primary and secondary canals.
- Supply procedures to WUGs including water measurement.
- Maintenance procedures for supply canals and drainage systems.
- Emergency procedures.

A detailed list of typical rules and procedures for WUGs has been given in 7.5.3.

In addition to the above the large agencies need to develop and issue procedural statements covering the following general areas

- **Management Information Systems** to provide the total information and data needs for managing the business. Reports to be prepared to include: financial reports giving progressive expenditure and revenue in relation to budget; operational system status reports on canal status and water deliveries; maintenance programme status; staff and employment situation; stores inventory; plant, vehicles and equipment availability. The essence of any management reporting system is that information is presented to the relevant level of management at such times and in sufficient content that corrective action can be initiated if necessary.

- **Personnel Functions and Responsibilities** to cover personnel policies, detailed organisational structures, job descriptions, recruitment procedures, employee salary and benefits, training, performance assessment.

- **Stores Procurement and Control** covering requisitioning, purchasing, delivery and receipting, accounting, custody and use of materials, equipment and services.

- **Financial Procedures** including budget preparation and approval processes, financial reporting, accounting requirements for payments and receipts, expenditure authority, revenue assessment and collection.

- **Administrative Support Procedures** including communications external and internal, data recording systems, computer services, travel arrangements, administrative, clerical, library, printing and media services.

These procedures are issued in the form of manuals, codes of practice, operating rules and staff instruction memoranda.

7.7.2 Manuals to be Prepared

The recommended MOM model is to be tested initially in several Pilot Areas commencing during. 1994. To assist staff and farmers involved with the introduction of the model in these areas and related training programmes, a series of Management, Operation and Maintenance manuals will be compiled by the consultants.

Separate versions of these manuals will be produced to cover the requirements of:

- DSİ as Supplier of Bulk Water;
- the Irrigation System Operating Body, which will also be DSİ initially pending establishment of the Irrigation Authority;
- Water User Groups.

In the case of the WUGs the draft manuals will be in general guideline form only as the basis of the group formation process is that the groups should develop their own specific operating rules rather than have them imposed by some outside authority.

The manuals will contain, in addition to procedures and instructions relating to specific tasks and activities in the Pilot Areas, an outline of principles and policies underlying the development of the GAP MOM model. In particular the arrangements for integration and co-ordination of the whole range of activities undertaken by agencies which comprise the overall model will be explained. A useful guide for the production of such manuals has been issued by the International Commission on Irrigation and Drainage (ICID, 1989) and that approach will be generally followed.

The general headings of the main sections of the manuals are as follows:

(a) Organisation and Management

In this section the overall MOM model will be explained together with the project policies, functions and responsibilities of each entity, organisational structures and the institutional arrangements for co-ordination between agencies.

(b) Project Description

This section will describe the overall water resources and supply facilities of the GAP region together with detailed description of the sources, conveyance and delivery canals and associated infrastructure supplying each Pilot Area.

(c) System Operation Arrangements

This section will describe the nature of the overall irrigation supply procedures from source headworks, through the primary and secondary canals into the tertiary system. The specific rules that apply for ordering and scheduling water, canal operation and delivery, flow measurement and control, measures to minimise water loss and emergency procedures will be outlined. The range of operational data to be collected such as water flows, delivery volumes and areas supplied, will be detailed. This section will incorporate the various levels of service agreements.

(d) Maintenance Procedures

This section will cover the maintenance policy, planning and programming arrangements as well as providing specific advice and guidance on the maintenance needs and techniques for the main components of the water supply and drainage systems.

The policy aspects of maintenance include development of a strategy which aims to ensure that the system remains serviceable at the required operational level and the need for rehabilitation is deferred until assets have reached their planned lifespan. This approach involves systematic planning, setting of priorities, achievement of a balance between immediate works and preventative maintenance needs and financial planning to fund the works from the total O&M budget.

In developing maintenance policy the following aspects must be considered:

- Design performance standard and the extent of maintenance needed to retain that standard;
- Any assumptions made at the design/construction stage as to future maintenance;
- Priority setting - Maintenance works necessary to provide immediate service usually have highest priority. However the maintenance programme must also accommodate a range of routine, preventative and cyclic works aimed at ensuring long term sustainability;
- Current maintenance needs in relation to future rehabilitation or modernisation proposals;
- Forward budget planning for the funding of long term maintenance requirements.

The maintenance manuals will also contain description of the planning, costing and scheduling of maintenance works on a seasonal basis. Detailed works schedules are required for the annual maintenance of each scheme and should include the following:

- Description, type and quantity of work to be undertaken;

the drainage charge is according to the total area of each WUG served by the drainage system. The recovery of the cost of drainage services from individual farmers will be determined by each WUG.

The full cost of each WUG would be charged to the farmers from the start of its operation.

The charges for headworks, primary and secondary canal costs would be levied to WUGs by DSİ in the transitional period until the IA is established. A legislative amendment would be required to permit DSİ to set charges on the basis of current year costs. As the present charge basis for these charges is currently well below the actual cost, it is suggested that full recovery should be phased in over a period of four years commencing in 1995. The charge would be set at 25% of the actual cost in the first year and increased by 25% each year until the charge meets the full cost.

7.8.2 Collection

A basic requirement of managing the irrigation system as a business is that each agency is responsible for setting charges for its services and recovering them, including any follow up action. The charge should be set by each supplier early in the year to which it applies requiring it to be based on an **estimate** of the year's expenditure. Variation between actual and estimated expenditure would be carried over and adjusted in the charge for the following year.

Establishment of water charges early in the year at each level is intended to provide each supplier with working capital for the first part and also to inform the respective customers of their likely charge in advance of it being incurred. WUGs need to be aware of their bulk water charge in order to finalise their own charges to farmers.

In order to improve cash flows at each level it is recommended that the water charges levied by each bulk supplier be in two instalments each payable within 30 days of the invoice being sent. Interest to be charged on overdue accounts at a realistic figure equivalent to the prevailing bank borrowing rate. The terms of payment, including any penalty charges, would be set out in the level of service agreement. In the transitional period prior to establishment of an IA, DSİ would levy WUGs a combined charge to cover headworks, primary and secondary canals.

The method of imposition and collection of water charges by WUGs would be determined by each one based on a consensus of the members. As the WUGs would also have commitments for progressive expenditure during the year it may well be appropriate for them also to adopt billing and collection in instalments. As the circumstances of the farmers might vary from scheme to scheme it would be at the discretion of each WUG to decide the number of instalments, due dates, penalties etc to suit the needs of the members.

7.8.3 Enforcement

If the agencies at each level are to become financially autonomous it is important that water charges are paid when they are due and that there is effective means of sanction in case of default. This principle was expressed by delegates to the Şanlıurfa Workshop and also by a significant number of farmers surveyed in the Socio-economic study.

An effective means of enforcement will be provided if suppliers apply a penalty interest charge in respect of overdue accounts. The penalty charge should be equivalent to the prevailing bank borrowing rate (say 8% per month at present) which would ensure that supply bodies are not penalised by late payment and potential defaulters have an incentive to pay when the charges are due.

The further means of enforcement in case of payment default is cessation of supply. It is understood that cessation of supply to individuals has rarely been applied in the DSİ schemes although a number of the smaller irrigation co-operatives and irrigation districts do threaten to stop supply and as a consequence they have little problem with arrears.

The question of stopping supply for non payment is commonly practiced by suppliers of other services in the public sector, notably electricity and telephones, as well as nearly all private sector suppliers of goods and services. However the subject becomes very contentious in relation to water, both in Turkey and elsewhere, and usually political where the supply agency is a Government agency.

It is recommended that level of service agreements should provide for both penalty interest charges and cessation of supply for non payment. The question of actually stopping supply is a policy matter to be decided by the responsible agency according to individual circumstances.

7.9 Enabling Legislation

7.9.1 Implementation Within Existing Legislation

Implementation of the recommended MOM model will involve a number of significant changes from the manner in which irrigation is managed and financed under present Turkish Law. Substantial amendments to existing legislation or new legislation are foreseen in order to establish a new Irrigation Authority and these could be expected to take some time, possibly years, to put in place. The nature of these changes is outlined in 7.9.2.

One aspect of the model which can proceed under existing legal powers is the establishment of Water User Groups. These are proposed to be formed as self generated, autonomous entities to undertake full management responsibility for operation and maintenance of tertiary supply systems constructed by DSİ. In some smaller schemes, up to about 5,000ha maximum size, it is possible that the WUGs would also manage the primary and secondary canals as well as the distribution system.

Under Law No 6200 DSİ can transfer responsibility for management, operation and maintenance functions for irrigation works to other persons or bodies having corporate status under public or private law. DSİ has already used this provision to transfer management responsibility to irrigation districts, co-operatives and other bodies and this provision can be applied for such transfers to WUGs. DSİ cannot transfer ownership of its assets to another body at this stage. The ability of a WUG to have ownership of its assets is important for achieving financial autonomy and this matter is addressed under new legislation. Nevertheless the lack of power to transfer asset ownership should not delay the initial establishment of WUGs.

If a WUG is to be established as a **public** corporate body, separate from existing bodies, such as irrigation groups or irrigation districts, it would be desirable to do so by Regulation (Yönetmelik) made by the Council of Ministers. However this approach is not favoured as it would establish WUGs as public bodies subject to official direction without the degree of independence sought under the management model.

The alternative is to establish WUGs as **private** corporate bodies. Law No 1163, covering village co-operatives generally, would allow WUGs as legal entities with considerable freedom to set their own rules and regulations which could be incorporated into their instrument of incorporation. This is the general law under which irrigation co-operatives are already formed and is seen as the most appropriate mechanism to provide WUGs with legal entity status. Therefore establishment of WUGs with legal status of village co-operatives is the recommended course of action. This would also enable WUGs to be formed at the earliest possible date without the need for new laws or regulations.

7.9.2 Required Legislative Changes

(a) Introduction

While it is possible to commence implementation of the MOM management model and commence operations in Pilot Areas by the formation of WUGs under existing legal provisions, as indicated above, new legislation is necessary to put the overall model in place. In addition there are a number of amendments which are required to existing water legislation to overcome present shortcomings and allow the management of irrigation schemes to be improved and their finances placed on a sound long term basis.

(b) New Legislation

The main need for new legislation is to establish the Irrigation Authority as an independent public agency and institutionalise the co-ordination arrangements so that the overall management model can function.

The new Irrigation Authority could be established either by amendment of Law No 6200, the establishment law of DSİ, or by a new law. The latter course is preferred as this would allow a new set of legal provisions to be developed and also should provide a greater degree of independence for the IA than if it were set up under the DSİ establishment law.

The main features of legislation to establish the Irrigation Authority are as follows:

- The IA to be set up as an independent department within the Ministry of Public Works and Settlements reporting direct to the Under Secretary;
- The IA to be governed by a part-time management board responsible for overall policy formulation and the operational and economic performance;
- The management board to comprise seven persons being:
  - (i) A representative of GAP RDA (Chairman)
  - (ii) One representative each from DSİ, MARA and GDRS
  - (iii) Two private sector representatives, one representing farmers and one experienced in business management
  - (iv) The chief executive of the IA (ex officio);
- The main functions of the IA to be: manage, operate and maintain primary and secondary canals and drainage systems in the GAP region; receive water in bulk from DSİ and sell it in bulk to WUGs and other users; carry out long term business planning to provide for the sustainability of GAP irrigation systems; operate in a cost effective manner and finance its operations through charges on users for services provided;
- The IA to have powers to own property including assets transferred from DSİ, enter into contracts with other public and private bodies, negotiate level of service agreements with customers and control its own staff.

The same legislation should provide for the establishment of the GAP Co-ordination and Advisory council on Irrigation Development as indicated in 7.2.3 which is the key co-ordinating forum for core and support agencies and customers in the GAP irrigation systems.

(c) Other Proposed Legislative Amendments

A number of amendments should be made to Law 6200 which would complement the new legislation outlined above and are necessary to allow DSİ to operate in accordance with the principles underlying the management model. The most immediate need is for amendments to allow:

- DSİ to be able to transfer ownership of primary, secondary and tertiary canals and associated works to the IA and WUGs;
- DSİ to be able to set water charges for bulk supplies based on the estimated full O&M cost in the year of operation;
- DSİ to have power to negotiate and enter level of service agreements for bulk supplies to an IA, WUGs and other users;
- In the event of non payment of water charges by any customer, after a period of one month of the due date, interest charges be imposed at an equivalent amount to the prevailing bank borrowing rate;
- In addition to imposing penalty interest charges for non payment of water charges, all water authorities be empowered to cease supply of water until payment is received.

There are a number of other shortcomings in existing water laws which have been identified and these have been referred to in chapter 5 of Section A. These apply generally to irrigation and water management throughout the country and, although not essential to the implementation of the GAP MOM model, it is highly desirable that the law be reviewed and strengthened in these matters for improved overall water management. Some of the main areas in need of such amendment are as follows:

- Rationalisation of water rights for the extraction and use of surface water resources to provide integrated management of allocations on a whole basin approach;
- Promulgation of Regulations provided for under Article 641 of the Civil Code covering the general use of public waters;
- Clarification of the water rights of individual farmers in an irrigation scheme, specifying which properties have rights to water use;
- Legal procedures to be strengthened covering the powers of DSİ to take effective action against persons who deliberately damage canals and structures or take water without authority;
- Clarification of the laws relating to spring water to include it as part of underground water in accordance with law No 167.

7.10 Mobilisation of Skills and Resources

7.10.1 Methodology

Implementation of the proposed GAP MOM Model will require the mobilisation and training of the necessary human resources. Detailed proposals for the training programme are given in a separate report, entitled ***Proposals for Training*** dated February 1994. The methodology used to identify the training needs of the various target groups and the main conclusions are summarised in this section. Details of the training programme proposed for 1994 are included in Chapter 5 of Section F.

The proposals for training have been developed in a systematic way. The first step was to review the existing situation regarding training activities and facilities in each of the main Government agencies involved in the Project. This was followed by an assessment of the training implications of the proposed GAP MOM Model. A detailed training needs analysis was then carried out, to identify which topics should be imparted to each target group in each organisation. Next a comprehensive training programme was developed to address the training needs. Finally, recommendations have been made regarding how the training programme should be implemented and an estimate of costs prepared.

The training programme will first be applied for all staff concerned with project implementation in the Pilot Areas. Later, the training will be extended to cover other GAP irrigation areas, with any modifications found desirable during the Monitoring and Evaluation Phase.

7.10.2 Target Groups and Training Needs

The existing training programmes and facilities have been reviewed. It was found that all relevant governmental agencies (DSİ, GDRS, GDOS, GDARef) have established training programmes for their staff, though as yet these are not fully developed or coordinated for the GAP irrigation project. The most important existing programmes as far as the GAP MOM project is concerned are the Agricultural Extension and Applied Research Project (TYUAP) and the Expanded Adult Education Programme (YAYCEP). TYUAP is a research and extension programme based on the Training and Visit system, whilst YAYCEP provides education in farming topics mainly through the medium of television. The training programme includes proposals for supporting and extending these projects.

Based on the roles and responsibilities identified in the proposed MOM Management Model, the training programme is required to focus on the training needs of four categories of personnel:

- Senior and middle management in the Government agencies involved (ie, GAP RDA, DSİ, GDRS, GDOS, GDARef);

- Technical training for staff who will operate and maintain the irrigation system (mainly from DSİ initially);

- Farmer training, largely through the formation and strengthening of Water User Groups (Group Formation Organisers, WUG committee members, WUG water foremen, and lead farmers);

- Training of trainers, including training coordinators and staff working in agricultural extension services (SMSs and VGTs).

The training needs analysis has identified the key training topics for each target group within each organisation. At the same time, the approximate numbers of each target group requiring training in 1994 have been estimated. A total of 15 different target groups have been identified for training. The training programme for 1994 concentrates on the personnel that will be involved in the Pilot Areas. It is concluded that a total of about 270 people will require formal training, broken down as follows:

Category 1	**Management Training**		
	Senior Managers	18	
	Middle Managers	38	Total 56
Category 2	**Operation and Maintenance**		
	O&M Engineers	12	
	O&M Technicians & Watermasters	12	
	Gatekeepers	8	
	Project planners and designers	6	
	Agricultural Researchers	10	Total 48
Category 3	**Water Users**		
	Group Formation Organisers	10	
	WUG committee members	36	
	WUG water foremen	18	
	Lead farmers	60	Total 124
Category 4	**Trainers**		
	Training Managers and Coordinators	5	
	Subject Matter Specialists	12	
	Village Group Technicians	12	
	Trainers/Lecturers	10	Total 39

The training programme proposed for 1994 to meet the identified training needs of the various target groups is described in Section F, chapter 5.

8 IRRIGATION REGIONS, IRRIGATION ZONES AND PILOT AREAS

8.1 Definition of Terminology

The following definitions apply to the different areas referred to in this chapter:

8.1.1 Irrigation Regions

Irrigation Regions are large geographical areas, established on the basis of river basins and major water supply systems, for the integrated management of all irrigation activities at the regional level. The selection of region boundaries takes into account watershed boundaries, provincial administrative boundaries and regional infrastructure.

8.1.2 Irrigation Zones

Irrigation Zones are separate administrative units within irrigation regions to be adopted as the basis of irrigation at the local level. The selection of zone boundaries takes into account factors such as location of water sources, irrigation system layout, total area, existing administrative boundaries, location of community infrastructure and services and social homogeneity.

8.1.3 Pilot Areas

Pilot Areas are sections of existing and new irrigation systems in the GAP region where the recommended MOM model will be introduced on a trial basis. The performance of the model will be monitored and evaluated and refinements carried out in the light of this experience. Specific aspects under examination in the Pilot Areas include the process of developing self generated Water User Groups and the extent to which these can assume responsibility for management, operation and maintenance of the irrigation system infrastructure mainly at tertiary level.

8.1.4 Demonstration Areas

Demonstration Areas are selected areas within Pilot Areas in which trials will be undertaken of equipment and techniques for improved water delivery, on-farm usage and drainage. The measures introduced for testing in these demonstration areas include water measurement devices, small storages, improved offtakes from canals to farm, measures to reduce on-farm water losses, improvements to furrow irrigation layouts, sprinkler irrigation and drainage methods.

8.2 Irrigation Regions

8.2.1 Introduction

Management of existing large irrigation schemes in the region is undertaken by DSİ through three Regional Directorates described below. The irrigation regions should provide the basis for management the two large water supply agencies, recommended under the MOM model - DSİ as Supplier of Bulk Water and an Irrigation Authority as the Irrigation System Operating Body.

It is desirable that both DSİ and the IA have similar or identical geographical coverage to facilitate and co-ordinate management during the transitional stage of establishing the MOM model and in subsequent operations. The DSİ regional boundaries provide an appropriate basis for establishing irrigation management at regional level and it is recommended that the irrigation regions conform to DSİ regions subject to the modification proposed in 8.2.3.

8.2.2 Existing DSİ Regional Directorates

There are three DSİ Regional Directorates covering the study area. These are Region 20, Kahramanmaraş; Region 15, Şanlıurfa; and Region 10, Diyarbakır and the boundaries are shown on Figure B8.1. The regional boundaries coincide with provincial boundaries although two include more than one province. Regional Directorate 20 includes the provinces of Gaziantep and Adıyaman in the study area as well as Kahramanmaraş province which is located outside the GAP region. DSİ Regional Directorate 15 covers the Şanlıurfa province. Region 10 includes the provinces of Diyarbakır, Batman, Siirt, Sırnak and Mardin.

DSİ is currently responsible for operating and maintaining all large hydraulic structures including reservoirs, control structures and canals up to and including tertiary canals. The responsibility for control of water sources and large regulating structures remains with DSİ under the recommended MOM Model. The location of these water sources is an important factor in deciding irrigation zones described in 8.3.

8.2.3 Possible Modifications to DSİ Regional Boundaries to Form Irrigation Regions

The existing DSİ Regional Boundaries are appropriate for management of the projects already operating. However some modification is desirable in future to provide for the nature and inter-dependency of the phased new irrigation development proposed in the region. This is of particular relevance where projects share the same water source.

The major irrigation water source in the region is Ataturk reservoir which will feed, amongst others, the Urfa-Harran and Mardin-Ceylanpinar projects. At present, responsibility for the Mardin-Ceylanpinar project is shared by DSİ Regions 10 and 15. although both projects will be supplied from the tunnel outlet at Şanlıurfa. It would be appropriate to have a single directorate covering both projects and, accordingly, it is recommended that DSİ Region 15 be extended to cover Mardin province. This will have the effect of reducing DSİ Region 10 such that it is primarily responsible for the projects in the Tigris watershed where it has control of the water sources. Figure B8.2 shows the suggested new DSİ Region boundaries which would then become the irrigation regions. The provinces covered by each would be as follows:

DSİ Regional Directorate (as modified)	Province
Region 20	Gaziantep Adıyaman
Region 15	Şanlıurfa Mardin
Region 10	Diyarbakır Batman Siirt Sirnak

8.3 Irrigation Zones

8.3.1 Functions and Objectives of Irrigation Zones

Irrigation Zones are subdivisions of Irrigation Regions whose main function is to contribute to sustainable and cost effective irrigation management at the local level. In order to achieve this the zones should be defined so that they can meet the following objectives:

- Form logical geographical units in which all the services required by farmers for support of irrigated agriculture can be located and co-ordinated.
- Provide areas in which each organisation involved in the provision of irrigation services, as supplier or support agency, can organise its resources to facilitate cost effective and efficient management services to farmers.
- Improve the co-ordination between supply and service agencies and interaction with customers by providing management units which are compatible with other community services and are related to the customers' needs.

8.3.2 Delineation of Zones

(a) Methodology

The methodology for delineating the irrigation projects into irrigation zones involves the following steps:

- Identification of parameters that are important in the context of an irrigation zone
- Mapping these parameters to define areas within which each parameter is constant
- Overlaying the mappings of individual parameters to produce homogenous areas
- Rationalising clusters of homogeneous areas to form irrigation zones

(b) Determination of Critical Parameters

All the irrigation projects and sub projects, some 88 in total, proposed for the GAP region are listed in Table B8.1. The development of appropriate zones which can be used for effective local management of all these schemes requires consideration of many factors relating to physical and geographical features as well as intangible aspects. The parameters identified during the study and adopted as the critical ones for grouping the various schemes into irrigation zones are described below.

Water Source: Irrigation zones should include project areas which each have a single water source to minimise management and administrative problems.

Distribution Network: Irrigation zones should follow the geometry of the main or primary distribution infrastructure. This will ensure that control is retained within the zone from the source or offtake regulator through to the distribution network. An important benefit of this is that the users within the zone have a sense of ownership or a link with **their** system and therefore feel a heightened sense of responsibility for its efficient working.

Size: Irrigation zones should be sized in relation to the proposed GAP project areas. Larger projects may be sub-divided into larger units to take advantage of economies of scale in terms of reduced overhead management costs.

Continuity: Irrigation zones should be continuous as far as practical and not fragmented. This is to ensure each zone forms a cohesive unit which the farmers can identify with, thereby making the management of the zone more efficient. However, an irrigation zone could encompass more than one scheme boundary if a cohesive unit can still be formed.

TABLE B8.1 : SUMMARY OF GAP PROJECTS

(Note : This is the same as Tables A1.2 and A1.3)

NO	SUB-PROJECT NAME	AREA (ha)	SOURCE	TYPE OF IRRIGATION	CURRENT STATUS	COMPLETION DATE
A-	LOWER EUPHRATES PROJECTS					
A1- Urfa-Harran Project						
1	Urfa II. Section	35192	Atatürk Dam	canalet	construction	1995
2	Urfa II. Section	18900	Atatürk Dam	canalet	construction	1996
3	Harran II. Section	28683	Atatürk Dam	canalet	construction	1997
4	Harran III. Section	22861	Atatürk Dam	canalet	construction	1995
5	Harran IV. Section	23738	Atatürk Dam	canalet	construction	1995
6	Harran V. Section	22045	Atatürk Dam	canalet	construction	1995
7	Akçakale Groundwater Irr.	15000	Groundwater	classic	operation	
A2- Mardin-Ceylanpınar Project						
1	Existing Groundwater Irr.	19650	groundwater	sprinkler	operation	
2	Planned Groundwater Irr.	111939	groundwater	sprinkler	planned	
3	I. Stage Gravity	15376	Atatürk dam	california	planned	
4	II. Stage Gravity	29390	Atatürk dam	sprinkler	planned	
5	III. Stage Gravity	65539	Atatürk dam	sprinkler	planned	
6	Viranşehir I Pumped	23952	Atatürk dam	sprinkler	planned	
7	Viranşehir II Pumped	13784	Atatürk dam	sprinkler	planned	
8	Mardin Storage I Pumped	18599	Atatürk dam	sprinkler	planned	
9	Mardin Storage II Pumped	34786	Atatürk dam	sprinkler	planned	
10	Mardin Storage III Pumped	27786	Atatürk dam	sprinkler	planned	
A3- Bozova Project						
1	Kabahaydar Irrigation	16908	Atatürk Dam	classic	planning	
2	Ovacık Irrigation	12956	Atatürk Dam	classic	planning	
3	Akziyaret Irrigation	21331	Atatürk Dam	classic	planning	
4	Gölcük Irrigation	18507	Atatürk Dam	classic	planning	
A4- Siverek-Hilvan Project						
1	Siverek-Hilvan Pumped Irrigation	237365	Atatürk Dam	canalet	planning	
2	Dumluca	1860	Dumluca Dam	canalet	construction	1993
3	Hacıhıdır	2080	Hacıhıdır Dam	canalet	construction	1994
B- SURUÇ-BAZİKİ PROJECT						
1	Baziki Gravity Irrigation	8737	Atatürk Dam	sprinkler	final design	
2	Baziki Pumped Irrigation	16915	Atatürk Dam	sprinkler	final design	
3	Suruç Irrigation	93754	Atatürk Dam	classic	planning	
4	Suruç Groundwater Scheme	7000	Groundwater	classic	operation	
C- ADIYAMAN-KAHTA PROJECT						
1	Irrigation from Atatürk Dam Reservoir					
	-Birgeni Pumped Irr.	184	Atatürk Dam	canalet	planning	
	-Mağara Pumped Irr.	5436	Atatürk Dam	canalet	planning	
	-Haceri Pumped Irr.	2531	Atatürk Dam	canalet	planning	
	-Mamai Pumped Irr.	5214	Atatürk Dam	canalet	planning	
	-Bebek-I Pumped Irr.	5662	Atatürk Dam	canalet	planning	
	-Aslanoğlu Pumped Irr.	8408	Atatürk Dam	canalet	planning	
	-Ancuz	1157	Atatürk Dam	canalet	planning	
	-Çakmak	129	Atatürk Dam	canalet	planning	
	-Şengültepe	878	Atatürk Dam	canalet		
2	Gömikan Dam	7762	Gömükan Dam	canalet		
3	Çamgazi Dam Pump & Gravity	6121	Çamgazi Dam	canalet	construction	1994
4	Koçali Dam	21605	Koçali Dam	canalet		
5	Büyükçay Dam	12322	Büyükçay Dam	canalet		

TABLE B8.1 : SUMMARY OF GAP PROJECTS (Continued)

NO	SUB-PROJECT NAME	AREA (ha)	SOURCE	TYPE OF IRRIGATION	CURRENT STATUS	COMPLETION DATE
D-	ADIYAMAN-GÖKSU-ARABAN PROJECT					
1	Gölbaşı Plain Gravity Irrigation	2665	Aksu Creek	canalet	planning	
2	Gölbaşı Plain Pumped Irrigation	3329	Çataltepe	canalet	planning	
3	Besni-Kızılin	8893	Çataltepe	canalet	planning	
4	Besni-Keysun	12029	Çataltepe	canalet	planning	
5	Araban	20947	Harmancık+Ardıl	canalet	planning	
6	Pazarcık	5943	Harmancık	canalet	planning	
7	Yavuzeli	12731	Harmancık	canalet	planning	
8	İncesu Gravity Irrigation	3773	Harmancık	canalet	planning	
9	İncesu Pumped Irrigation	2003	Harmancık	canalet	planning	
10	Besni	2820	Besni dam	canalet	planning	
11	Keysun	1950	Groundwater	classic	operation	
12	Ardıl	3535	Ardıl Dam	classic	planning	
13	Harnncık	2298	Harmancık Dam	classic	planning	
E-	GAZİANTEP PROJECT					
1	Hancağız Dam(part of Hancağız)	7300	Hancağız Dam	canalet	operation	
2	Kayacık Dam(part of Akçakoyunlu)	13680	Kayacık Dam	california	construction	
3	Kemlin Dam (part of Elbeyli)	1969	Kemlin Dam	canalet	planning	
4	Seve Dam	1400	Seve Dam	canalet	planning	
5	Pumped from Birecik Dam	66007				
	Hancağız	10736	Birecik Dam	canalet	planning	
	Barak	11419	Birecik Dam	canalet	planning	
	Gevence	13524	Birecik Dam	canalet	planning	
	İkizce	11043	Birecik Dam	canalet	planning	
	Akçakoyunlu	8973	Birecik Dam	canalet	planning	
	Doğanpınar	18711	Birecik Dam	canalet	planning	
	Elbeyli	7112	Birecik Dam	canalet	planning	
	Karacaören	2704	Birecik Dam	canalet	planning	
	Kilis	4734	Birecik Dam	canalet	planning	
F-	INDIVIDUAL PROJECTS					
1	Çalikhan Irrigation	1043	Recep Creek	classic	operation	

TABLE B8.1 : SUMMARY OF GAP PROJECTS (Continued)

NO	SUB-PROJECT NAME	AREA (ha)	SOURCE	TYPE OF IRRIGATION	CURRENT STATUS	COMPLETION DATE
A-	BATMAN PROJECT					
1	Batman Left Bank-Gravity	9574	Batman Dam	classic	final design	
2	Batman Left Bank-Pumping	9412	Batman Dam	classic	planning	
3	Batman Right Bank-Gravity	18758	Batman Dam	classic	final design	
4	Silvan I. and II. Section	8790	Batman Regulator	classic	operation	
B-	CİZRE PROJECT					
1	Nusaybin-Cizre-İdil (pumped)	89000	Cİzre Dam	classic	planning	
2	Silopi (pumped)	25000	Hezil Dam	classic	planning	
3	Nusaybin	8600	Çağ-Çağ spring	classic	operation	
4	Nusaybin Extention	9162	Nusaybin storage	classic	planning	
5	Nerdüş	2740	Nerdüş Creek	classic	operation	
C-	GARZAN PPROJECT					
1	Garzan	60000	Garzan Dam	classic	planning	
2	Garzan-Kozluk	3700	Kozluk Regulator	classic	operation	
D-	KRALKIZI PPROJECT					
1	Dicle Right Bank-Gravity	52033	Dicle Dam	classic	construction	1995
2	Dicle Right Bank-Pumping	74047	Dicle Dam	classic	planning	1995
3	Devegeçidi	7500	Devegeçidi Dam	canalet	operation	
4	Çınar-Göksu	3582	Çınar Dam	classic	construction	1994
E-	BATMAN-SILVAN PROJECT					
1	Dicle Left Bank-Gravity	200000	Silvan Dam	sprinkler	planning	
2	Dicle Left Bank-Pumping	57000	Silvan Dam	sprinkler	planning	
F-	INDIVIDUAL PROJEXTS					
1	Halilan	550	Halilan Lake	classic	operation	
2	Kale	10467	Sinek Creek/Kale Da	classic	planning	

DSİ Region and Irrigation Region Boundaries: Irrigation zones should conform to DSİ regional boundaries given that DSİ will retain control of the water sources and reservoirs and some primary distribution network. The DSİ boundaries, as modified, are also proposed as the Irrigation Region boundaries as discussed in 8.2.

Administrative Boundaries: Irrigation zones should take account of provincial administrative boundaries and as far as possible should minimise the degree of overlap in order to simplify co-ordination of administration.

Social Factors: Irrigation zones should take account of social structures and attitudes. As far as possible farmers with similar social background should be grouped together in an irrigation zone. This will ensure a greater degree of cooperation among farmers, thereby giving the project a better chance of success. Social and cultural practices may influence the nature of the management committees and this factor should be taken into account when delineating zones, such that farmers will not feel distanced from management centres.

Distance from Infrastructure and Service Centres: Irrigation zones should take account of distance from infrastructure and community services such as roads such as credit facilities, telecommunication, markets and hospitals. The irrigation zones should therefore be delineated having regard to major roads. It is also important that within each irrigation zone a town, having most of the essential services, can be identified which could become the administrative centre for the zone. The administrative centres should be a focal point for all farmers within the zone where they market produce, purchase supplies and obtain services. It is also desirable that the centres are not located too far from the furthest point in the zone so that farmers can identify with the centres. Ideally such centres should be located within the irrigation zone and, where reasonably sized towns do not exist, services at smaller towns would need to be upgraded.

MOM Models: Irrigation zones should take account of the type of MOM model to be implemented, in particular which management bodies are responsible for the canal system. This parameter will be developed in an iterative process since the MOM model is also influenced by the nature and size of the irrigation zone.

(c) Use of GIS for Initial Delineation

Various thematic maps were produced from the available data to depict the parameters described in (a) above. A Geographical Information System was used to input, analyse and map the spatial data. Each parameter was mapped as an overlay and the final maps were produced as single parameter maps or a combination of overlays. The resulting map overlays on Figures B8.1 to B8.11 as listed below.

DSI REGIONAL DIRECTORATE BOUNDARIES (EXISTING)

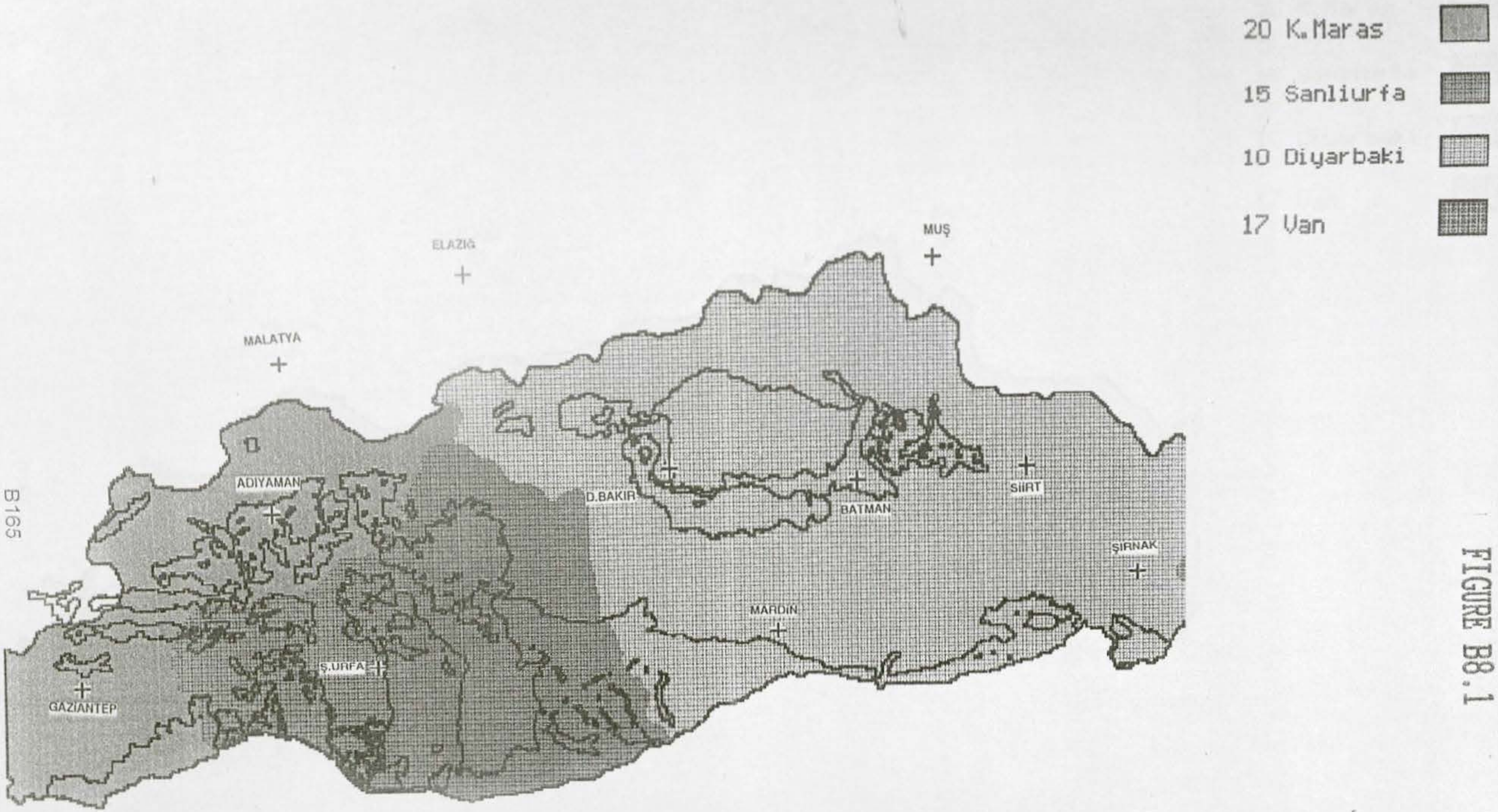


FIGURE B8.1

MODIFIED DSİ DIRECTORATE BOUNDARIES AND IRRIGATION REGIONS

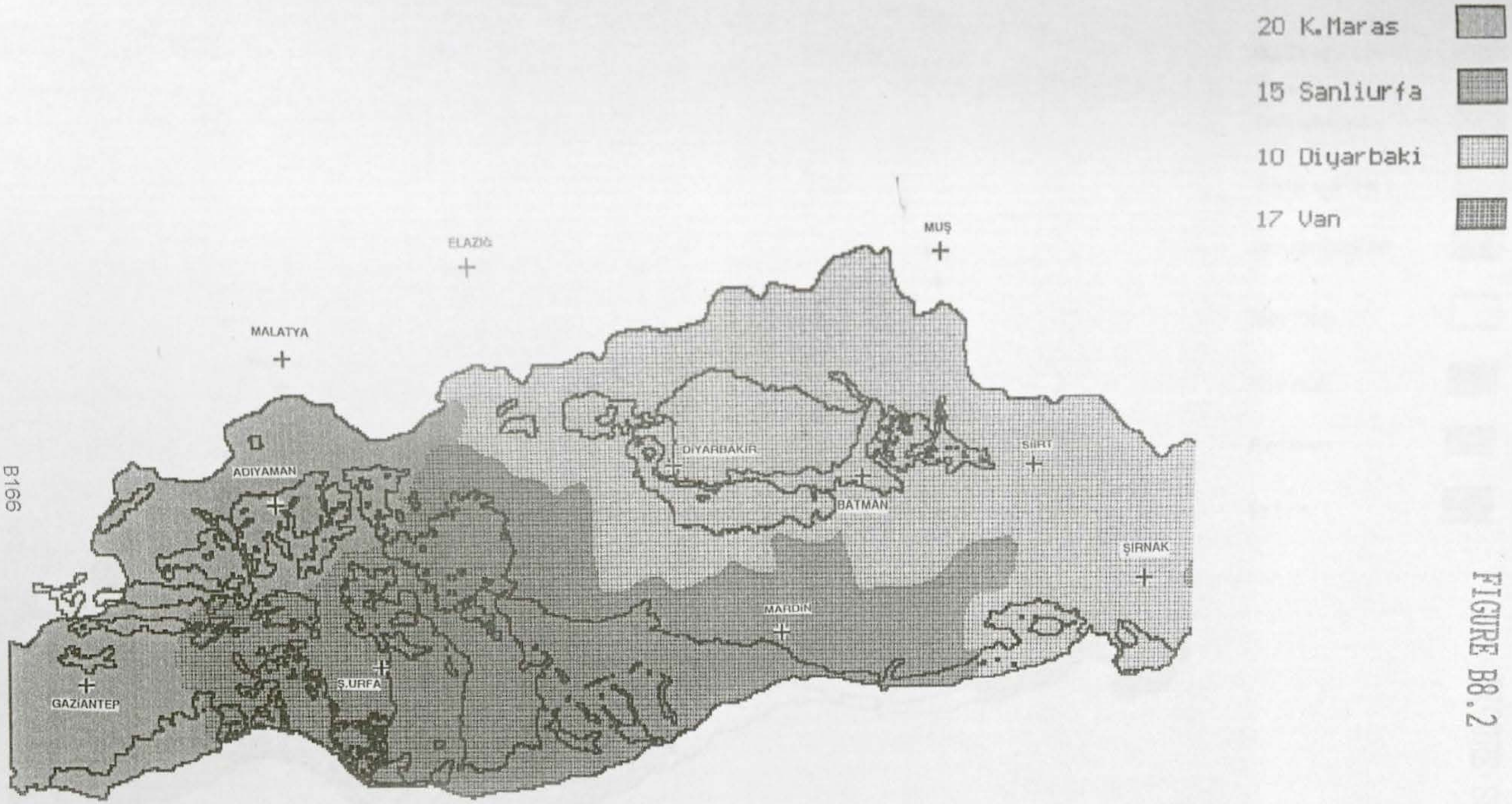


FIGURE B8.2

PROVINCIAL ADMINISTRATIVE BOUNDARIES

FIGURE B8.3

GDRS REGIONAL BOUNDARIES

Region XVIII

Region VII

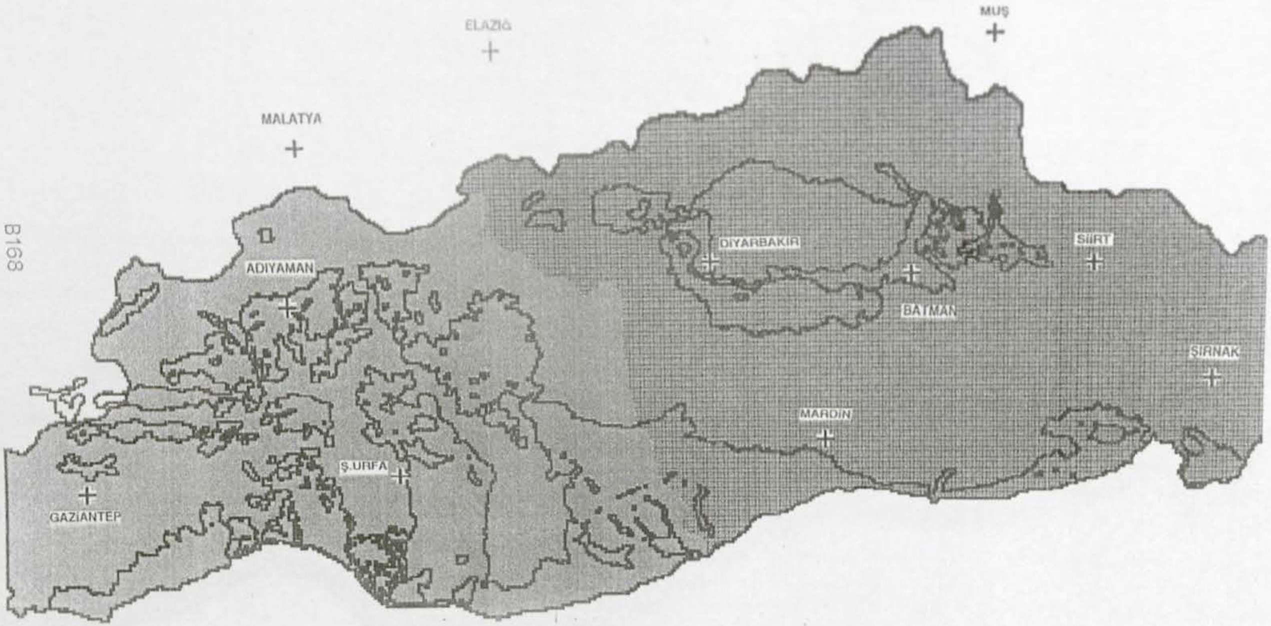


FIGURE B8.4

Watershed Boundaries

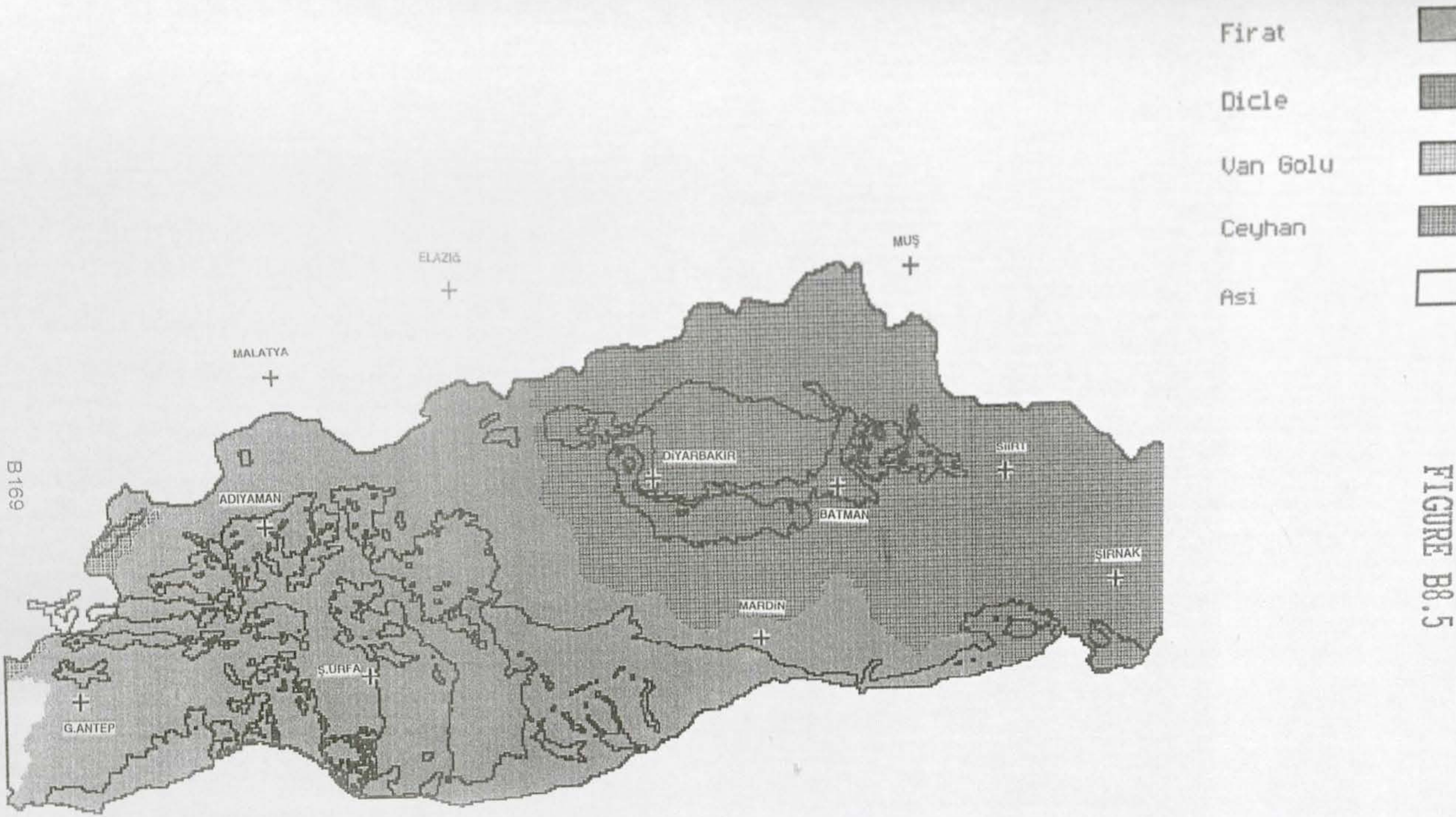


FIGURE B8.5

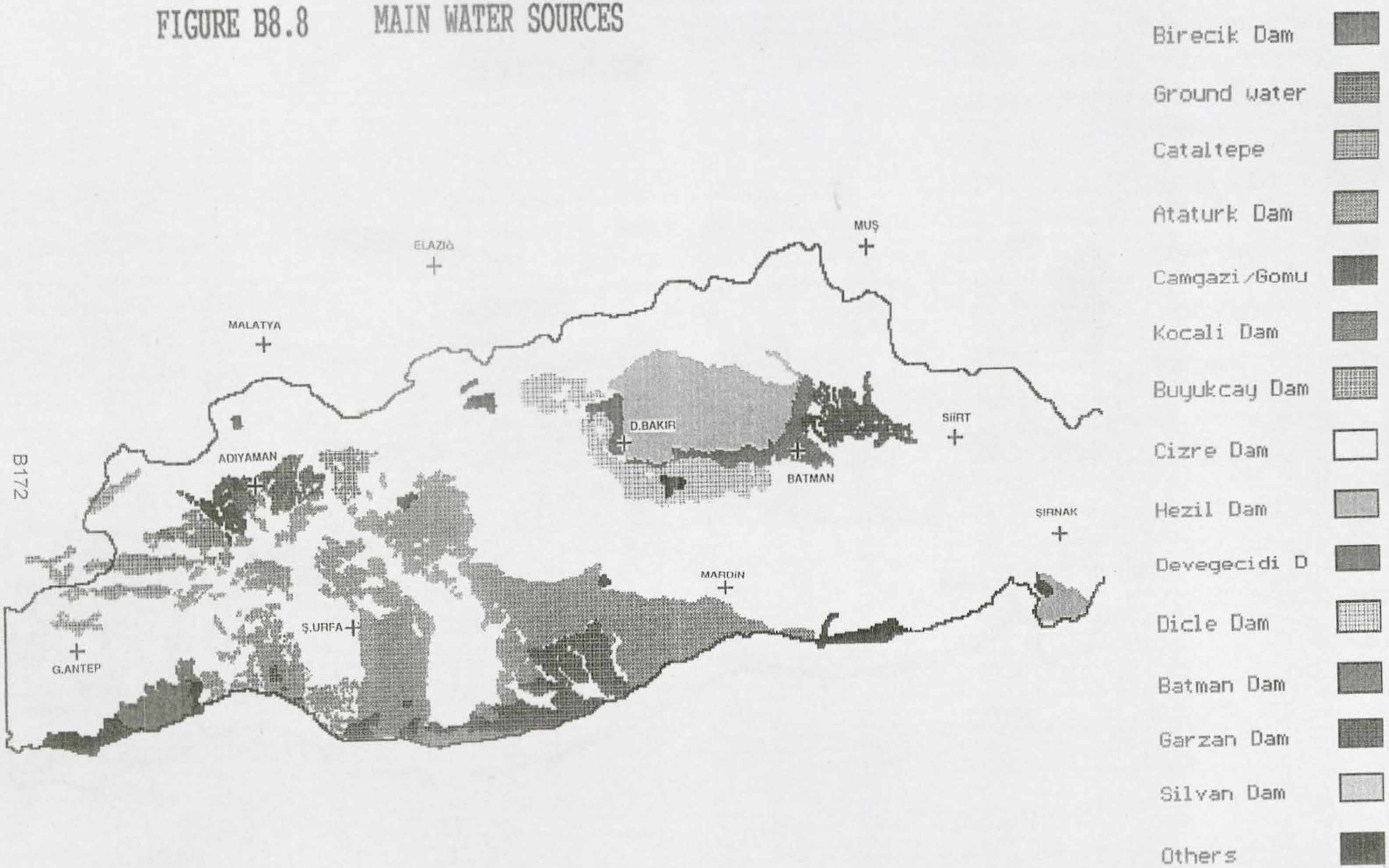
Canal Network

FIGURE B8.6

PROJECT, SUB PROJECT AND DEVELOPMENT PHASING BOUNDARIES

FIGURE B8.7

FIGURE B8.8 MAIN WATER SOURCES



INFRASTRUCTURE

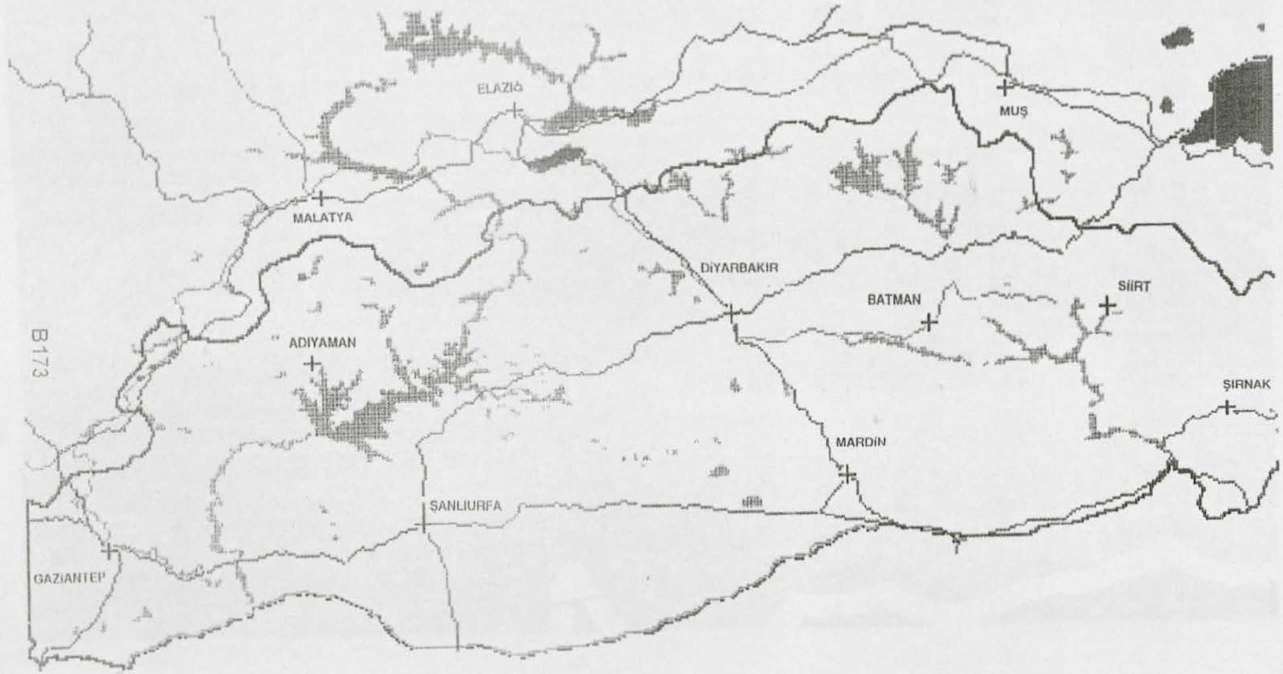


FIGURE B8.9

DISTANCE FROM MAIN ROADS

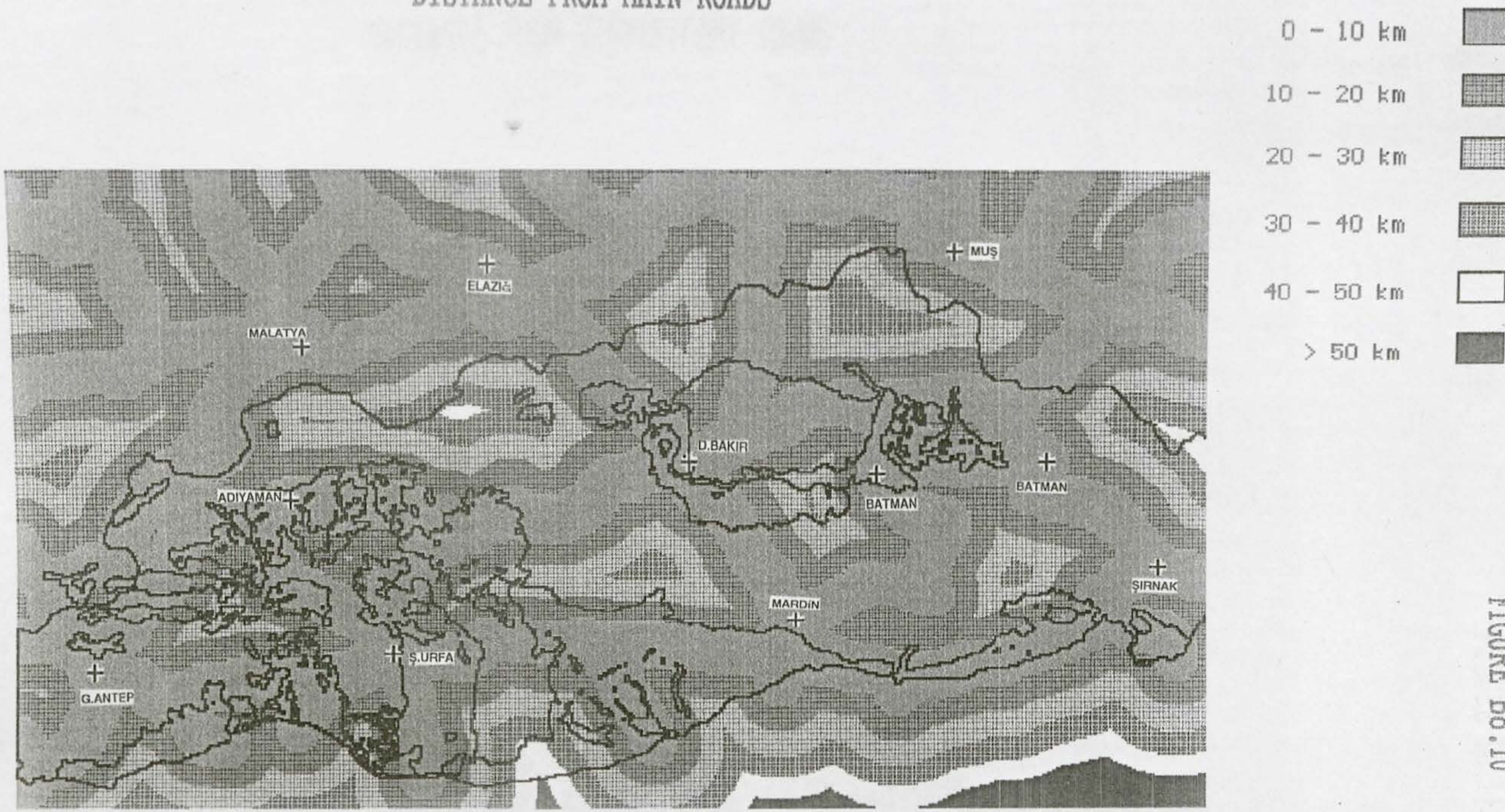


FIGURE B8.10

DISTANCE FROM SIGNIFICANT TOWNS

FIGURE B8.11

Figure B8.1	DSİ Regional Directorate Boundaries (existing)
Figure B8.2	Proposed Modified DSİ Regions and Irrigation Regions
Figure B8.3	Provincial Administrative Boundaries
Figure B8.4	GDRS Regional Boundaries
Figure B8.5	Watershed Boundaries
Figure B8.6	Canal Network
Figure B8.7	Project, Sub-Project and Development Phasing Boundaries
Figure B8.8	Main Water Sources for Projects
Figure B8.9	Infrastructure
Figure B8.10	Distance from Main Roads
Figure B8.11	Distance from Significant Towns.

The mapped parameters were then combined as a series of overlays using the GIS to identify and delineate homogeneous areas. This process resulted in a number of discrete pockets of areas which generally followed the boundaries of sub-projects or development phases. The fragmented areas were then rationalised and grouped together to form irrigation zones.

(d) Rationalisation of Zone Boundaries

The zone rationalisation process consisted of grouping or dividing the fragmented homogeneous areas by overlaying various maps such that they:

- satisfied all the criteria of a homogeneous irrigation zone
- were of a suitable size to form a manageable unit which was adopted as not greater than 50,000 ha
- took account of development phasing
- could in the future to be managed by farmer groups
- formed a discrete unit in relation to water distribution network with zonal boundaries beginning and ending at a control structure
- comprised identifiable units within which farmers operate
- maximised their compactness ratio ie. distance to the administrative centre from the furthest point of the sub-zone was minimised.

The result of the rationalisation process is shown on Figures B8.12 and B8.13. Details of each zone in terms of province, water source, area, system characteristics and possible management centre, are listed in Table B8.2.

(e) Need for Review and Modification

This initial delineation of irrigation zones has been carried out using currently available information. However for many projects specific details are not available at this stage as they are at a planning phase. It should be recognised that the delineation of irrigation zones is based on parameters which, when collectively applied, result in a homogeneous unit which is amenable to functioning as a management unit. Although these parameters are robust, the timetable for development is dynamic and project details for those projects which have not yet been designed are likely to change. Thus a review of the irrigation zones would need to be done when:

- more details become available on specific projects and sub projects relating to project boundaries and water distribution networks
- the timetable for development is modified for projects or phases of projects
- additional reservoirs are brought into operation resulting in changed water sources or modifications to water distribution networks
- operational or administrative boundaries change
- changes to infrastructure occur
- services are upgraded in smaller towns which may make them more suitable as administrative centres
- economic or social factors indicate that modifications to the zonal boundaries may be required.

8.3.3 Proposed Irrigation Zones

The irrigation projects and sub projects in the GAP region have been grouped into 50 Irrigation Zones based on the methodology described in 8.2.2. The zones are listed in Table B8.2 which indicates the main water sources, areas to be supplied, irrigation supply method and current status of works in each one. The zone locations are shown in Figures B8.12 and B8.13. The zones have been tentatively named according to the town which is seen as the possible administrative centre being mindful that some of these are only minor centres at present. In summary the numbers of zones in relation to the modified DSİ regions and provinces are as follows:

Irrigation Region	Province	No of Zones
DSİ 20	Gaziantep (1) Adıyaman	5 4
DSİ 15	Şanlıurfa (2) Mardin	21 5
DSİ 20	Sirnak Diyarbakır Batman Siirt (3)	3 10 1 1

Note: (1) One zone contains a small area in Kahramanmaraş
(2) One zone also contains a small area of Mardin
(3) Zone contains a small part of Batman

PROPOSED IRRIGATION ZONES

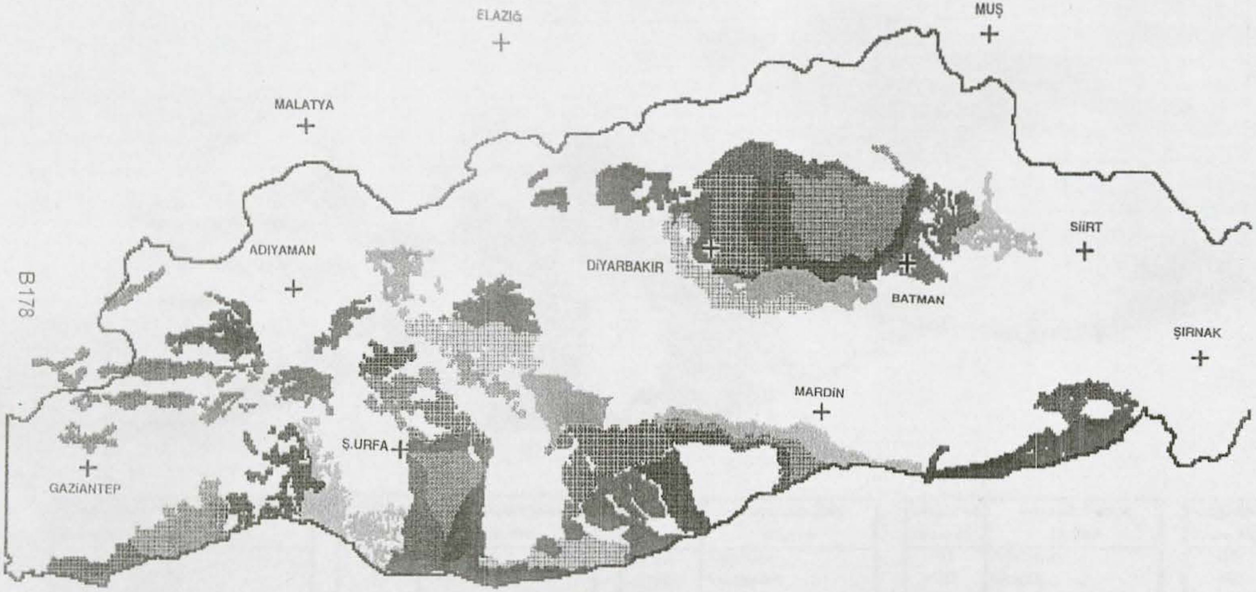
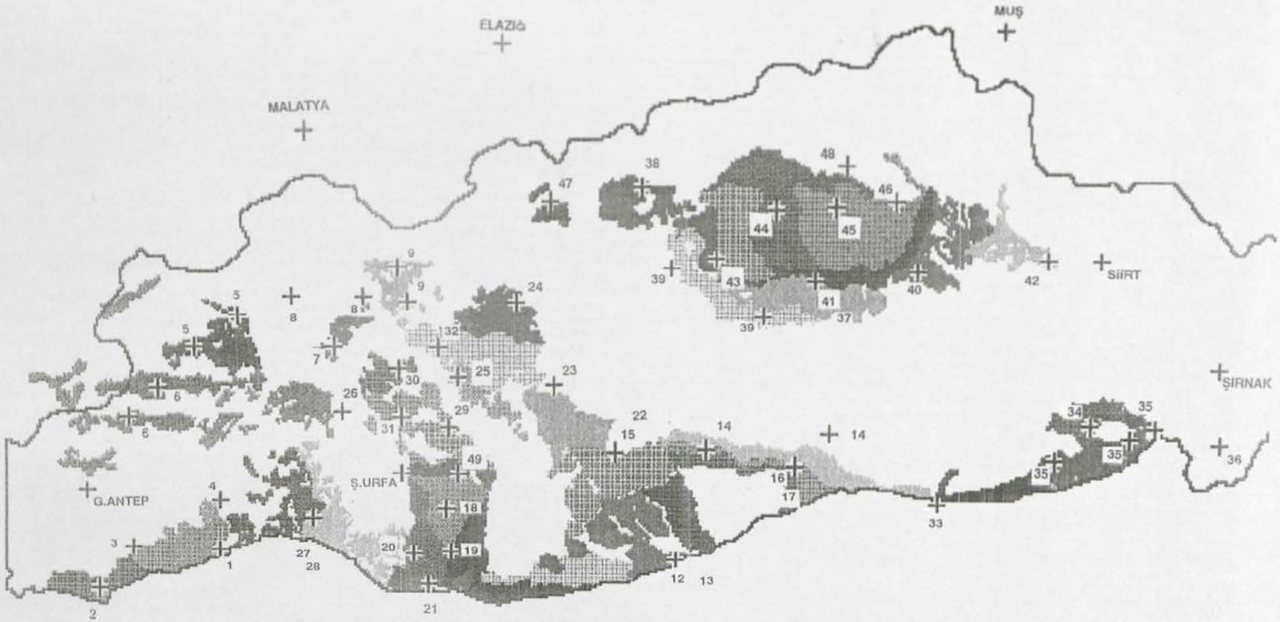


FIGURE B8.12

PROPOSED IRRIGATION ZONES AND ADMINISTRATIVE CENTRES



Irrigation Zone No.	Administrative Centre	Irrigation Zone No.	Administrative Centre	Irrigation Zone No.	Administrative Centre	Irrigation Zone No.	Administrative Centre	Irrigation Zone No.	Administrative Centre
1	Barak	11	New Town 1	21	Akçakale	31	Akziyaret	41	Bismil
2	Elbeyli	12	Ceylanpınar	22	Viranşehir	32	Gölçük	42	Kurtalan
3	Doğanpınar	13	Ceylanpınar	23	Karakeçi	33	Nusaybin	43	Diyarbakır
4	Birecik	14	Kocatepe/Mardin	24	Siverek	34	İdil	44	Mermer
5	Çakırhöyük/Sambayat	15	Viranşehir	25	Hilvan	35	Cizre/Dicle/Oyalı	45	Bağdere
6	Araban/Yavuzeli	16	Kızıltepe	26	Bozova	36	Silopi	46	Silvan
7	Samsat	17	Kızıltepe	27	Suruç	37	Bismil	47	Çermik
8	Adıyaman/Kahta	18	Yardımcı	28	Suruç	38	Ahmetli/Diyarbakır	48	Hazro
9	Akıncılar/Narince	19	Harran	29	Kabahaydar	39	Çınar/Pirincik	49	Çamlıdere/Urfa
10	New Town 2	20	Şehit Nusretbey	30	Ovacık	40	Batman	50	New Town 3

FIGURE B8.13

TABLE B8.2 : INITIAL DIVISION OF GAP-REGION INTO IRRIGATION ZONES

DSI Region	Zone	Administrative Province	Projects/Project Phases	Area ha	Source	Irrigation Method	Current Status	Completion Date	Irrigation Zone No.	Proposed Administrative Centre
20	Barak	Gaziantep	Hancağız Dam(part of Hancağız)	7300	Hancağız Dam	canalet	operating		1	Barak
20	Elbeyli	Gaziantep	Kayacık Dam(part of Akçakoyunlu)	13680	Kayacık Dam	california	under construction		2	Elbeyli
		Gaziantep	Kemlin Dam (part of Elbeyli)	1969	Kemlin Dam	canalet	planned		2	Elbeyli
		Gaziantep	Seve Dam	1400	Seve Dam	canalet	planned		2	Elbeyli
20	Doğanpınar	Gaziantep	Pumped from Birecik Dam (1)	22631	Birecik Dam	canalet	planned		3	Doğanpınar
	Birecik	Gaziantep	Pumped from Birecik Dam (2)	43376	Birecik Dam	canalet	planned		4	Birecik
20	Çakırhöyük/	Adıyaman	Keysun	1950	Groundwater	classic	operating		5	Çakırhöyük/Sambayat
	Sambayat	Adıyaman	Besni-Keysun	12029	Söğütlü Regulator	canalet	preliminary plan.		5	Çakırhöyük/Sambayat
		Adıyaman	Besni-Kızılin	8893	S1 Main Canal	canalet	preliminary plan.		5	Çakırhöyük/Sambayat
		Adıyaman	Besni	2820	Besni dam	canalet	planned		5	Çakırhöyük/Sambayat
	Araban/	Gaziantep	İncesu Gravity + Pumped Irrigation	5776	Güceği Regulator	canalet	preliminary plan.		6	Araban/Yavuzeli
	Yavuzeli	Gaziantep	Yavuzeli	12731	S2 Main Canal	canalet	preliminary plan.		6	Araban/Yavuzeli
20		Gaziantep	Araban	20997	Köklüce Regulator	canalet	preliminary plan.		6	Araban/Yavuzeli
		Gaziantep	Ardıl	3535	Ardil Dam	classic	planned		6	Araban/Yavuzeli
		K.Maraş	Harmancık	2298	S2 Main Canal	classic	preliminary plan.		6	Araban/Yavuzeli
		Gaziantep	Gölbaşı Plain Gravity + Pumped Irr.	5994	Abbasiye regulator	canalet	preliminary plan.		6	Araban/Yavuzeli
		K.Maraş	Pazarcık	5943	S2 Main Canal	canalet	preliminary plan.		6	Araban/Yavuzeli
20	Samsat	Adıyaman	Birgeni+Mağara+Haceri Pumped Irr.	8151	Atatürk Dam	canalet	planned		7	Samsat
	Adıyaman/	Adıyaman	-Mamai+Bebek I+Aslanoğlu Pumped Irr.	19284	Atatürk Dam	canalet	preliminary plan.		8	Adıyaman/Kahta
	Kahta	Adıyaman	Çamgazi Dam - Gravity + Pumped	6121	Çamgazi Dam	canalet	under construction	1994	8	Adıyaman/Kahta
20		Adıyaman	Gömikan Dam	7762	Gömükan Dam	canalet	preliminary plan.		8	Adıyaman/Kahta
		Adıyaman	Koçali Dam	21605	Koçali Dam	canalet	preliminary plan.		8	Adıyaman/Kahta
		Adıyaman	Çelikhan	1043	Recep C.	classic	operating		8	Adıyaman/Kahta
20	Akıncılar/	Adıyaman	-Ancuz+Çakmak+Şengültepe	2164	Atatürk Dam	canalet	preliminary plan.		9	Akıncılar/Narince
	Narince	Adıyaman	Büyükçay Dam	12322	Büyükçay Dam	canalet	preliminary plan.		9	Akıncılar/Narince

TABLE B8.2 : INITIAL DIVISION OF GAP-REGION INTO IRRIGATION ZONES (Continued)

DSI Region	Zone	Administrative Province	Projects/Project Phases	Area ha	Source	Irrigation Method	Current Status	Completion Date	Irrigation Zone No.	Proposed Administrative Centre
15	New Town 1(**)	Şanlıurfa	Planned Groundwater Irr. (1)	44092	groundwater	sprinkler	planned		11	
15	Ceylanpınar 1	Şanlıurfa	Existing Groundwater Irr. (1)	7464	groundwater	sprinkler	operating		12	Ceylanpınar
		Şanlıurfa	Planned Groundwater Irr. (3)	47083	groundwater	sprinkler	planned		12	Ceylanpınar
15	Ceylanpınar 2	Şanlıurfa	Existing Groundwater Irr. (2)	12186	groundwater	sprinkler	operating		13	Ceylanpınar
		Şanlıurfa	Planned Groundwater Irr. (2)	20764	groundwater	sprinkler	planned		13	Ceylanpınar
15	Çamlıdere/Urfa	Şanlıurfa	I. Stage Gravity	15376	Atatürk dam	california	planned		49	Çamlıdere/Urfa
15	New Town 2 (**)	Şanlıurfa	II. Stage Gravity	29390	Atatürk dam	sprinkler	planned		10	
15 (*)	New Town 3 (**)	Mardin	III. Stage Gravity	65539	Atatürk dam	sprinkler	planned		50	
15	Viranşehir 1	Şanlıurfa	Viranşehir I Pumped	23952	Atatürk dam	sprinkler	planned		15	Viranşehir
		Şanlıurfa	Viranşehir II Pumped	13784	Atatürk dam	sprinkler	planned		15	Viranşehir
15 (*)	Kızıltepe 1	Mardin	Mardin Storage I Pumped	18599	Atatürk dam	sprinkler	planned		16	Kızıltepe
15 (*)	Kızıltepe 2	Mardin	Mardin Storage II Pumped	34786	Atatürk dam	sprinkler	planned		17	Kızıltepe
15 (*)	Kocatepe/Mardin	Mardin	Mardin Storage III Pumped	27786	Atatürk dam	sprinkler	planned		14	Kocatepe/Mardin
15	Siverek	Şanlıurfa	Hacıhıdır	2080	Hacıhıdır Dam	canalet	under construction	1994	24	Siverek
		Şanlıurfa	Siverek-Hilvan Pumped Irrigation (2)	53765	Atatürk Dam	canalet	preliminary plan.		24	Siverek
15	Hilvan	Şanlıurfa	Siverek-Hilvan Pumped Irrigation (1)	84796	Atatürk Dam	canalet	preliminary plan.		25	Hilvan
15	Karakeçi	Şanlıurfa	Siverek-Hilvan Pumped Irrigation (3)	60984	Atatürk Dam	canalet	preliminary plan.		23	Karakeçi
15 (*)	Viranşehir 2	Mardin	Dumluca	1860	Dumluca Dam	canalet	under construction	1993	22	Viranşehir
		Şanlıurfa	Siverek-Hilvan Pumped Irrigation (4)	37819	Atatürk Dam	canalet	preliminary plan.		22	Viranşehir
15	Kabahaydar	Şanlıurfa	Kabahaydar Irrigation	16908	Atatürk Dam	classic	preliminary plan.		29	Kabahaydar
15	Ovacık	Şanlıurfa	Ovacık Irrigation	12956	Atatürk Dam	classic	preliminary plan.		30	Ovacık
15	Akziyaret	Şanlıurfa	Akziyaret Irrigation	21331	Atatürk Dam	classic	preliminary plan.		31	Akziyaret
15	Gölçük	Şanlıurfa	Gölcük Irrigation	18507	Atatürk Dam	classic	preliminary plan.		32	Gölçük
15	Bozova	Şanlıurfa	Baziki Gravity+Pumped Irrigation	25652	Atatürk Dam	sprinkler	final design		26	Bozova
15	Suruç	Şanlıurfa	Suruç Irrigation (1)	41652	Atatürk Dam	classic	preliminary plan.		27	Suruç
15	Suruç	Şanlıurfa	Suruç Irrigation (3)	52101	Atatürk Dam	classic	preliminary plan.		28	Suruç
		Şanlıurfa	Suruç 1	5040	Groundwater	classic	operating		28	Suruç
		Şanlıurfa	Suruç 2	840	Groundwater	classic	operating		28	Suruç
		Şanlıurfa	Suruç 3	1120	Groundwater	classic	operating		28	Suruç
15	Akçakale	Şanlıurfa	Akçakale Groundwater Irr.	15000	Groundwater	classic	operating		21	Akçakale
15	Şehit Nusretbey/ Akçakale	Şanlıurfa	Urfa II. Section	35192	Atatürk Dam	canalet	under construction	1995	20	Şehit Nusretbey/Akçakale
		Şanlıurfa	Urfa III. Section	18900	Atatürk Dam	canalet	under construction	1996	20	Şehit Nusretbey/Akçakale
15	Yardımcı	Şanlıurfa	Harran III. Section	22861	Atatürk Dam	canalet	under construction	1995	18	Yardımcı
		Şanlıurfa	Harran IV. Section	23738	Atatürk Dam	canalet	under construction	1995	18	Yardımcı
15	Harran	Şanlıurfa	Harran II. Section	28683	Atatürk Dam	canalet	under construction	1997	19	Harran
		Şanlıurfa	Harran V. Section	22045	Atatürk Dam	canalet	under construction	1995	19	Harran
15 (*)	Nusaybin	Mardin	Nusaybin Çağ-Çağ	8600	Çağ-Çağ spring	classic	operating		33	Nusaybin
		Mardin	Nusaybin Extension	9162	Çağ-Çağ spring/Nusaybin	classic	planned		33	Nusaybin

(*) : Modified DSİ Region 15 as suggested will include Mardin Province.

(**) : To be renamed when services have been upgraded and a suitable administrative centre allocated to the zone.

TABLE B8.2 : INITIAL DIVISION OF GAP-REGION INTO IRRIGATION ZONES (Continued)

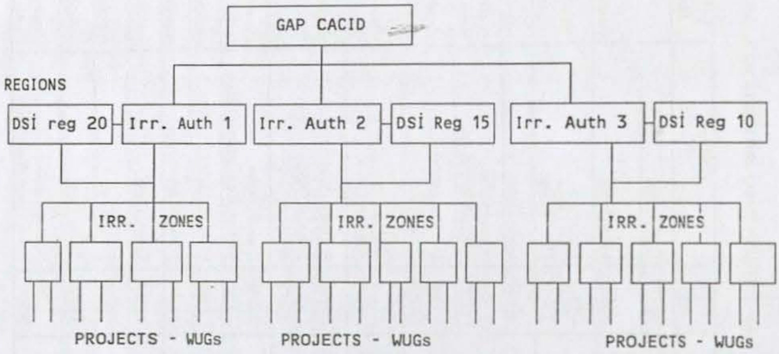
DSI Region	Zone	Administrative Province	Projects/Project Phases	Area ha	Source	Irrigation Method	Current Status	Completion Date	Irrigation Zone No.	Proposed Administrative Centre
10	İdil	Şırnak	Nusaybin-Cizre-İdil (pumped) (1)	32373	Cizre Dam	classic	Preliminary plan.		34	İdil
10	Cizre	Şırnak	Nusaybin-Cizre-İdil (pumped) (2)	56627	Cizre Dam	classic	Preliminary plan.		35	Cizre/Dicle/Oyalı
10	Silopi	Şırnak Şırnak	Nerduş Silopi (pumped)	2740 25000	Nerdüş Hezil Dam	classic classic	operating Preliminary plan.		36 36	Silopi Silopi
10	Bismil 1	Diyarbakır	Dicle Right Bank-Gravity	52033	Dicle Dam	classic	under construction	1995	37	Bismil
10	Bismil 2	Diyarbakır Diyarbakır	Batman Right Bank-Gravity Silvan I. and II. Section	18758 8790	Batman Dam Batman Regulator	classic classic	Final design operating		41 41	Bismil Bismil
10	Ahmetli/Diyarbakır	Diyarbakır Diyarbakır	Devegeçidi Dicle Right Bank-Pumping (1)	7500 31308	Devegeçidi Dam Dicle Dam	canalet classic	operating planned	 1995	38 38	Ahmetli/Diyarbakır Ahmetli/Diyarbakır
10	Çınar/Pirincik	Diyarbakir Diyarbakir	Dicle Right Bank-Pumping (2) Çınar-Göksu	42739 3582	Dicle Dam Çınar Dam	classic classic	planned under construction	1995 1994	39 39	Çınar/Pirincik Çınar/Pirincik
10	Batman	Batman Batman Batman	Batman Left Bank-Gravity Batman Left Bank-Pumping Garzan (1)	9574 9412 33468	Batman Dam Batman Dam Garzan Dam	classic classic classic	Final design planned preliminary plan.		40 40 40	Batman Batman Batman
10	Kurtalan	Siirt Batman	Garzan (2) Garzan-Kozluk	26532 3700	Garzan Dam Kozluk Regulator, Ceffan	classic classic	preliminary plan. operating		42 42	Kurtalan Kurtalan
10	Diyarbakır	Diyarbakır	Dicle Left Bank-Gravity (1)	51965	Silvan Dam	sprinkler	preliminary plan.		43	Diyarbakır
10	Mermer	Diyarbakır	Dicle Left Bank-Gravity (2)	44497	Silvan Dam	sprinkler	preliminary plan.		44	Mermer
10	Bağdere	Diyarbakır	Dicle Left Bank-Gravity (3)	48664	Silvan Dam	sprinkler	preliminary plan.		45	Bağdere
10	Silvan	Diyarbakır	Dicle Left Bank-Gravity (4)	54874	Silvan Dam	sprinkler	preliminary plan.		46	Silvan
10	Hazro	Diyarbakır	Dicle Left Bank-Pumping	57000	Silvan Dam	sprinkler	preliminary plan.		48	Hazro
10	Çermik	Diyarbakır Diyarbakır	Halilan Kale	550 10476	Halilan Lake Sinek Creek/Kale Dam	classic classic	operating preliminary plan.		47 47	Çermik Çermik

8.4 Relationship between Irrigation Regions and Irrigation Zones

The Irrigation Region is envisaged as the basis for development of an Irrigation Authority with overall policy development, planning and co-ordination being undertaken at regional level.

The individual Irrigation Zones would be the basic units for local day to day management of field activities. These activities include liaison with the Supplier of Bulk Water and Water User Groups and farmers in relation to water ordering, scheduling irrigation deliveries and operation of the supply system.

In conceptual terms the relationship between Irrigation Regions and Irrigation Zones and their relevance to major agencies under the MOM Model is depicted by the following diagram:



The above framework indicates the broad nature of the relationship between DSİ, Irrigation Authority and Water User Groups at regional and zone levels and is applicable at various stages of implementation of the MOM model. At regional level it shows DSİ and the Irrigation Authority as parallel bodies. In the initial stage of model implementation DSİ could be expected to carry out the roles of both Supplier of Bulk Water and Irrigation System Operating Body and the disposition of DSİ staff would be influenced partly by its existing organisational and staffing arrangements. The location of field staff involved in operation of primary and secondary canals should be carefully considered in relation to irrigation zones.

The precise management arrangements within each irrigation zone will need to be determined individually depending upon the number and nature of projects, sub projects and water user groups formed in each case. Furthermore the arrangements put in place in the early stages would be expected to require modification over time as additional projects are implemented and farmer managed units become more experienced and reach the stage of taking a greater responsibility for scheme management.

8.5 Pilot Areas

8.5.1 Objectives of Pilot Areas

The main aim of working in Pilot Areas will be to test the recommended GAP MOM model in new and existing irrigation schemes with a view to establishing principles and guidelines for future planning, development and operation of irrigation schemes in Turkey. The specific objectives will be to:

- encourage the formation of Water User Groups by irrigating farmers
- allow WUGs to establish their own rules and regulations within certain broad outlines
- permit WUGs to organise themselves to operate the infrastructure to distribute water on an efficient and equitable basis and to utilise or dispose of drainage water
- allow WUGs to establish acceptable mechanisms to collect water charges and impose sanctions on those who default
- ensure that WUGs maintain the irrigation and drainage infrastructure both physically and financially and make improvements to infrastructure when required
- test the training programme for O&M staff and trainers.

Criteria to be applied in implementing the objectives will be to:

- ascertain how effectively WUGs can be established given the existing or planned (i.e. future) supply system layout
- ascertain how well supply systems are planned in relation to physical characteristics (village boundaries, location of water supply structures etc.)
- ascertain to what extent farmers views and wishes are taken into account during planning of irrigation schemes

Overall, the work in Pilot Areas will assist in creating a better understanding of those factors which contribute to success (and failure) of irrigation schemes. The results will provide a basis for a methodology for wide scale use and implementation when developing new schemes or improving existing ones.

8.5.2 Proposed Strategy

The proposed strategy is to select three Pilot Areas from among existing irrigation schemes in the GAP region and three Pilot Areas within the new Urfa-Harran scheme.

Within the six Pilot Areas it is proposed to implement the group formation strategy with the assistance of Group Formation Organisers (GFOs) who will encourage farmers to form Water User Groups in order to carry out the desired objectives. Six to eight GFOs will be involved in this effort, supervised by the GAP MOM study consultants through a Group Formation Coordinator (GFC) and a Group Formation Adviser (GFA). The GFOs will be expected to live and work in the Pilot Areas. They will encourage farmers to form WUGs by a process of discussion, enquiry and debate among the farming community, explaining issues, providing information, and generally assisting them to reach a decision about group formation.

When group formation is successfully completed, the GFO will withdraw and move to another area which requires group(s) to be formed. The process of group formation was discussed in Chapter 7.5

8.5.3 Identifying Pilot Areas

(a) Approach

Initially it was expected that all the Pilot Areas would be located within the Urfa-Harran Plain which would receive water first from Atatürk Dam via the Şanlıurfa tunnels. The ongoing delays in engineering works leading to uncerta-inty concerning water availability has necessitated the identification of other pilot areas within existing irrigation schemes. Whilst preparatory work would, of necessity, go ahead in the new irrigation areas in advance of water flow, the ability to test the implementation of GAP MOM models in existing areas is seen as a positive development. Not only would this enable comparison of strategies between new and existing schemes, but it would also help the development of a methodology for introducing new and tested models for management, operation and maintenance in other existing irrigation schemes in the GAP region and the rest of Turkey.

The main factors taken into account when identifying pilot areas within pilot areas are as follows:

- physical size and shape of area
- number of villages in a group
- the location and number of water sources
- socially accepted land consolidation (parcellation)
- water distribution system is in place and useable
- irrigation water is available
- the degree of likely farmer cooperation.

(b) Physical Size and Shape of Area

The larger the area size the more difficult it will be for the group to manage water distribution efficiently. In addition the larger the area size, or less uniformly shaped the block may be, the more farmers will be distanced. Distance could affect social cohesion and reduce contact with the supplier of water, leading to a weakening of the supplier/customer relationship and the ability to respond effectively to each other's specific requirements.

(c) Number of Villages in a Group

This is related to the size of the area. Villages also vary considerably in size and composition, and area of land associated with each village.

The village is a strong social entity in rural Turkey. Successful group formation must be strongly linked to the village and its composition and internal village groupings. Existing designs of channel alignments are based primarily on considerations of topography, contours and slopes. These often conflict with village boundaries. Many villages are fragmented in that their lands are fed with water from two or more sources.

Further, the larger the number of villages, the greater will be the potential for social conflict, and the less likelihood of successful group establishment. As a result of fragmentation due to the mismatch of channel location and village boundaries caused by existing designs, the smaller the number of villages in a group, the higher the probability will be that one village will occupy a proportionately larger area. This could lead to domination by one village group with the potential for inequality of irrigation water supply.

(d) The Location and Number of Water Sources

The greater the number of off-take structures to be operated on a particular secondary canal, the more difficult will be the task of the group to achieve equitable and efficient water distribution management. This is particularly important in areas where existing designs are based on large secondary canals serving large command areas, with little sub-division into smaller sub-areas canals with a more manageable size. Also, where under existing designs sub-areas are long and narrow, downstream groups will need to develop good (and formalised) working relations with upstream groups to secure equity of water supply.

In areas where the major part of the lands of a block of villages are supplied from more than one source, the task of the group to achieve efficient and equitable water distribution management will be more complex. Farmers may also individually own land supplied from different sources and the resulting need for membership of more than one group may create problems.

(e) Socially Accepted Land Consolidation (Parcellation)

Socially accepted land parcellation, and the implementation of corresponding on farm works (including land grading), are important factors affecting water use efficiency. Parcellation and on-farm works have been implemented in some areas but not in others. The presence of drainage facilities, their maintenance and effectiveness, are also important water management factors particularly in relation to potentially adverse impacts downstream.

(f) Irrigation Water is Available

The possible limitation on water availability has led to the need to select areas where existing irrigation schemes operate. Many such schemes have a variety of different problems and adverse factors which affect selection considerations, but it would be highly unusual to find a perfect set of operating conditions within any irrigation scheme.

(g) The Degree of Likely Farmer Cooperation

Although this is a very difficult factor to assess without in-depth investigation, it is possible to draw on the Socio economic Survey information to some degree for indications. In addition, in existing irrigation schemes, DSİ has knowledge of farmers' attitudes and the likely level of cooperation. Furthermore, discussions directly with farmers and information from Village Group Technicians can provide useful information to enable such assessments to be made.

(h) Other Factors

Other factors which have been taken into account are:

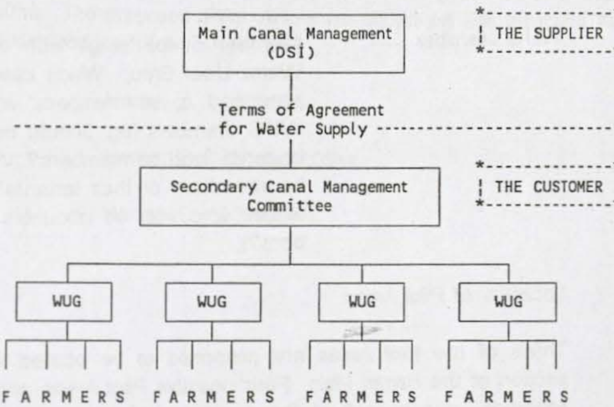
- that the distribution system is in place and useable
- areas selected will be those that will receive the first irrigation supplies from Atatürk dam when water is available
- where it is possible to install measuring devices to measure water used
- that no unusual sociological problems exist which would present the process with undue risks
- that support can be expected from Departments and Directorates directly involved

Criteria used in the selection process for existing schemes were:

- reasonably positive attitude of farmers to group formation
- area selected is secure for working
- area and process is acceptable to DSİ
- there are no unusual sociological problems which would present the process with undue risks
- deficiencies in the canals/secondaries/tertiaries can be rectified by DSİ before groups are formally constituted
- GDRS can undertake any outstanding on-farm works that may be necessary before groups are formally constituted
- Vali and Kaymakam are supportive
- positive extension support through VGTs
- farmers are willing to have GFO to help them in the process
- measuring devices can be installed for water use
- scheme is representative of similar areas in the GAP region

8.5.4 Organisational Arrangements

The proposed organisational structure within the Pilot Areas is provided below, together with definitions of the terminology used.



Terminology referred to is defined as follows:

The Supplier — The organisation contractually responsible for the provision of water to the Customer according to the standard of service specified in the contract. For GAP MOM, the Supplier will be DSİ until such time as an Irrigation Authority is formed.

The Customer — The organisation or individual contracting to purchase and pay for the water in accordance with the terms of the contract. For GAP MOM, the Customer will be the Water User Group.

Water User Group — A group of water users (usually based on one village) formed for the purpose of managing water on behalf of its members. The Water User Group (WUG) will elect committee members to oversee the day-to-day management of the WUG and will also appoint a WUG Water Foreman to manage the water on a daily basis.

Secondary Canal Management Committee — A committee made up of representatives from all WUGs served by a secondary canal. The Secondary Canal Management Committee (SCMC) will be responsible for overseeing the management of water distribution from the secondary canal. It will liaise on behalf of the WUGs with the Supplier.

WUG Water Foreman	A person appointed by a Water User Group to manage the distribution of water within the tertiary unit(s). He will also be responsible for reporting back to the WUG regarding maintenance requirements.
WUG Member	Member of the village with voting rights within the Water User Group. Which categories of villagers are permitted to be members will be decided by the WUG members (eg, Should only those villagers with irrigated land be members? Will absentee landlords be members or their tenants? Should landless villagers who work as labourers for farmers be members?).

8.5.5 Location of Pilot Areas

Three of the Pilot Areas are proposed to be located in the Urfa command section of the Harran Plain. Four possible Pilot Areas are proposed for existing schemes: one in each of the provinces of Adıyaman, Diyarbakır, Gaziantep and Şanlıurfa. Only three out of the four schemes will be considered as pilot areas. Only three out of the existing schemes will be proposed as Pilot Areas.

Brief details of each of these areas are as follows:

(a) Schemes Already Operational

- Devegeçidi in Diyarbakır province: this consists of an open channel and canalet system of gross area 6,900ha which began operation in 1972. The possible area for a Pilot Area is 2,460ha as shown on Figure B8.14.

- Hancağiz in Gaziantep province: this consists of an open channel and canalet system of gross area 6,250ha which began operation in 1989. The possible Pilot Area comprises the whole scheme as shown on Figure B8.15.

- Ceylanpinar in Şanlıurfa province: this consists of a groundwater supplied system with buried pipes and sprinkler irrigation of gross area 9,000ha which began operation in 1979. The possible Pilot Area is 180ha as shown on Figure B8.16.

- Keysun in Adıyaman province: this consists of an open channel and canalet system of gross area 1,950ha which began operation in 1985. The whole scheme is a possible Pilot Area as shown on Figure B8.17. Keysun is included as a contingency in case there are limitations in the operation of other schemes due to delay in water delivery etc.

(b) New Schemes

These consist of three adjoining areas in Şanlıurfa province comprising part of the Urfa-Harran open canal and canalet scheme currently under construction and expected to begin operation in 1994/5. The gross area of this scheme is 43,030ha. The proposed Pilot Areas are shown on the attached Figure B8.18 and described as follows:

- Harran 'A' of 4,500ha
- Harran 'B & C' of 3,000ha
- Harran 'D' of 2,500ha

FIGURE B8.14 DEVEGEÇİDİ IRRIGATION SCHEME AND PILOT AREA

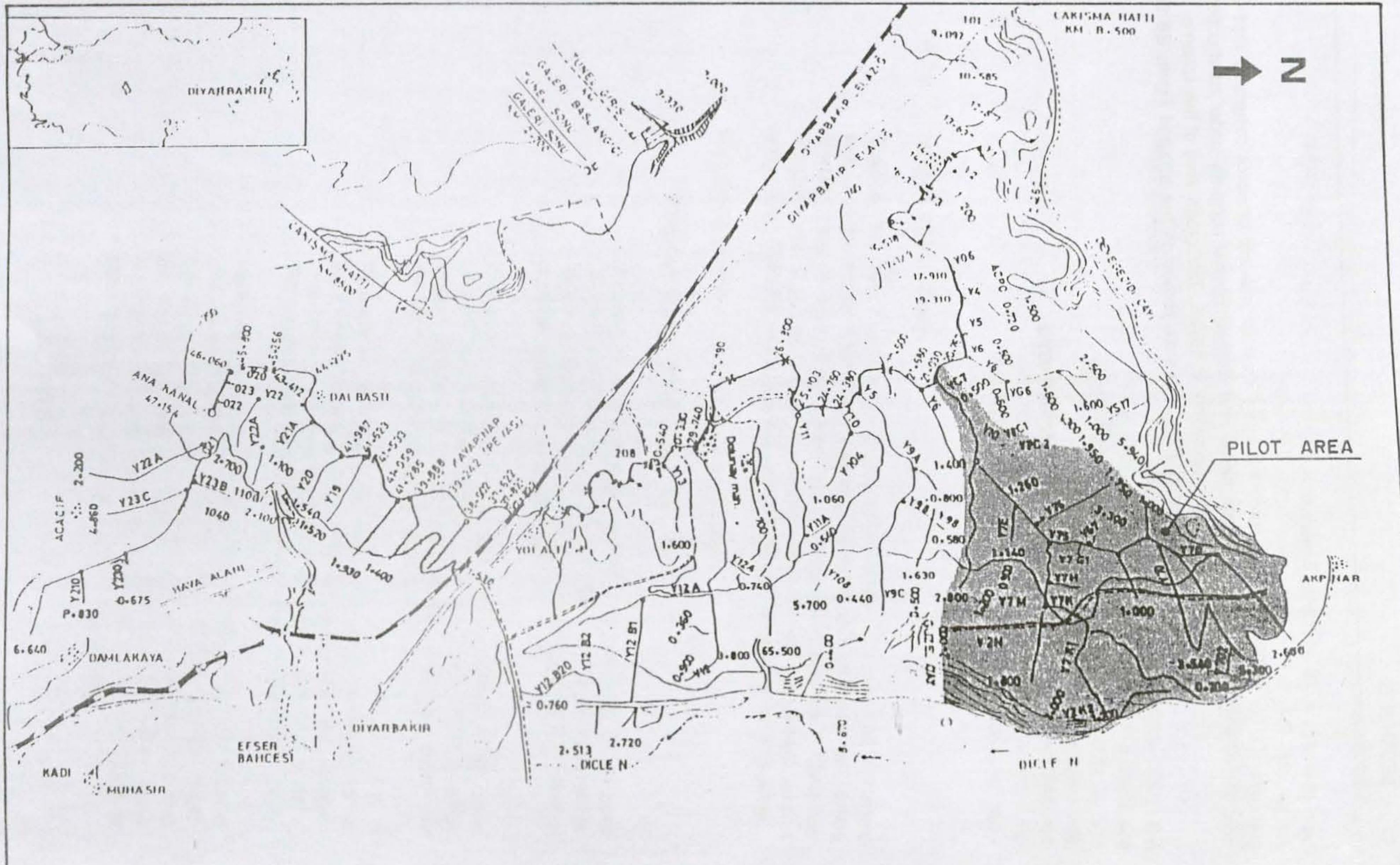


FIGURE B8.15 HANCAĞIZ IRRIGATION SCHEME AND PILOT AREA

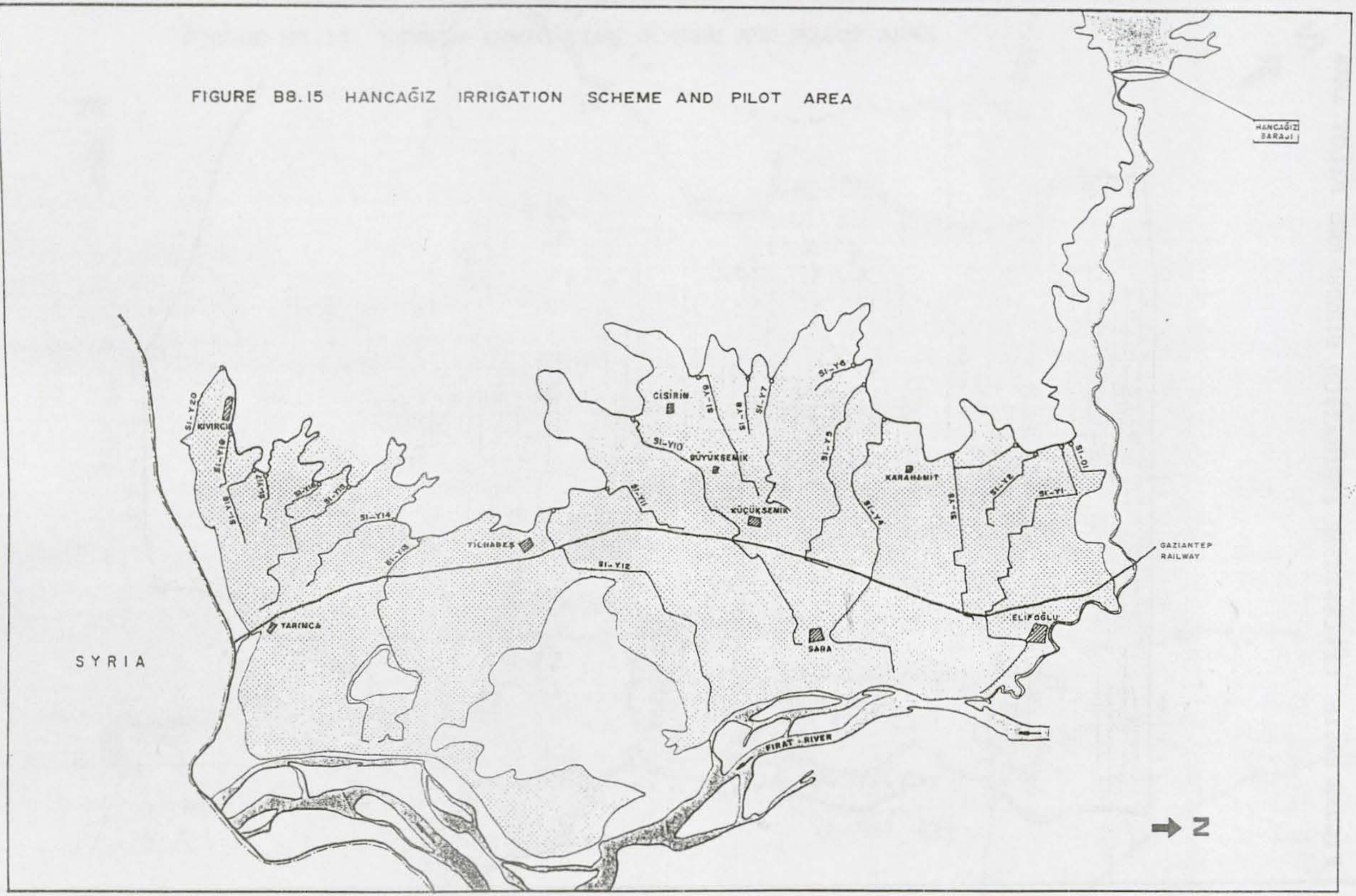


FIGURE B8.16 CEYLANPINAR IRRIGATION SCHEME AND PILOT AREA

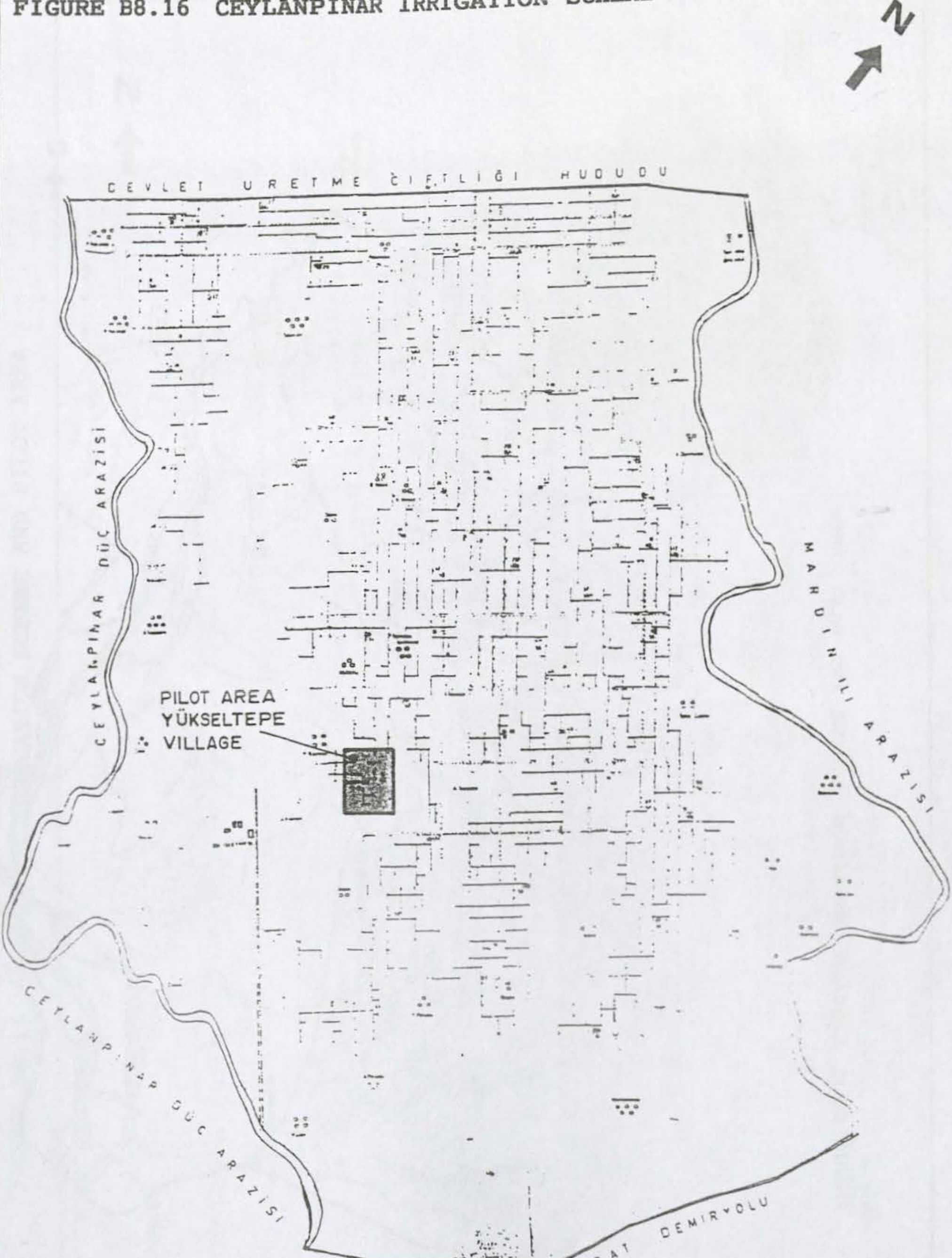


FIGURE B8.17 KEYSUN IRRIGATION SCHEME AND PILOT AREA

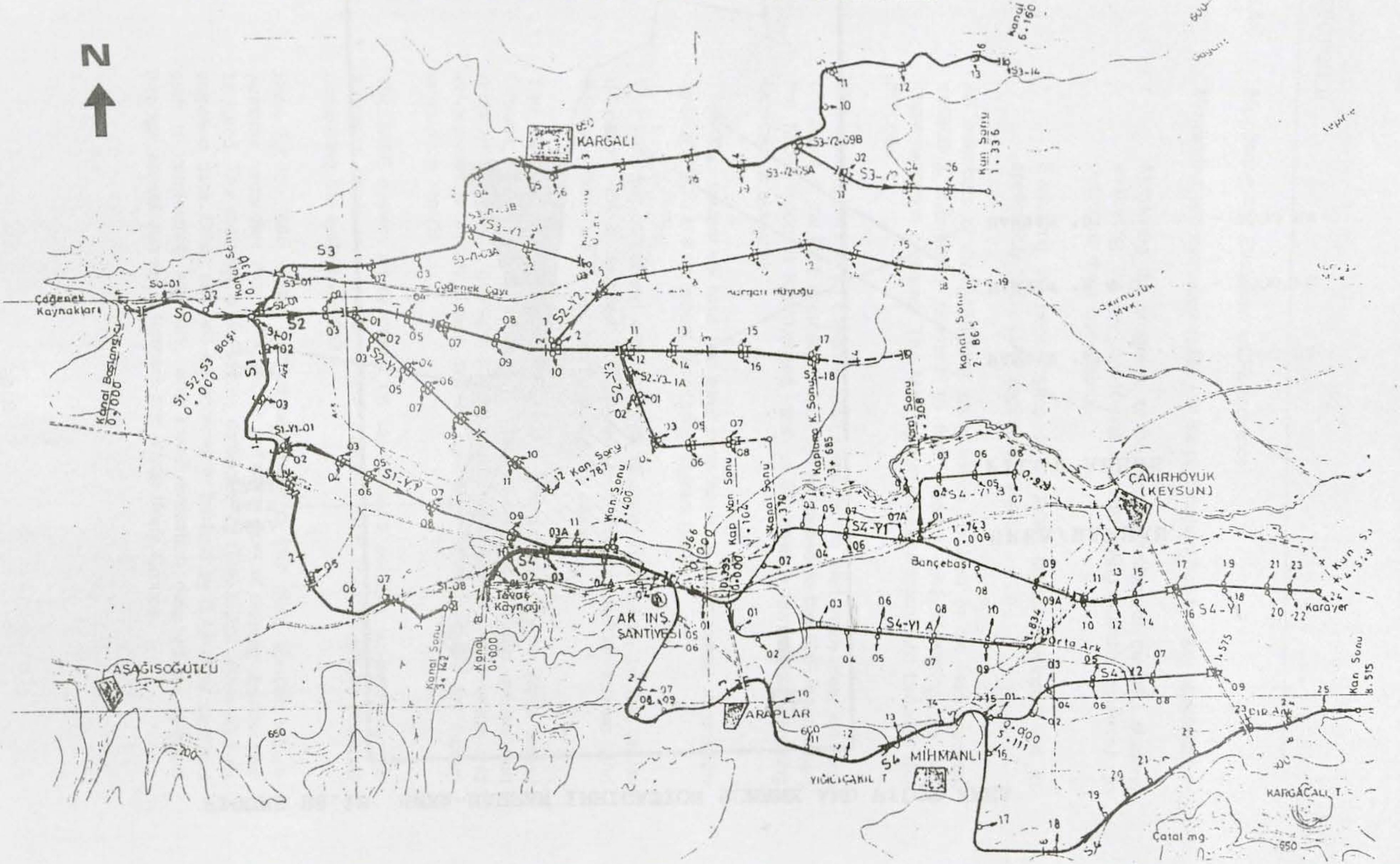
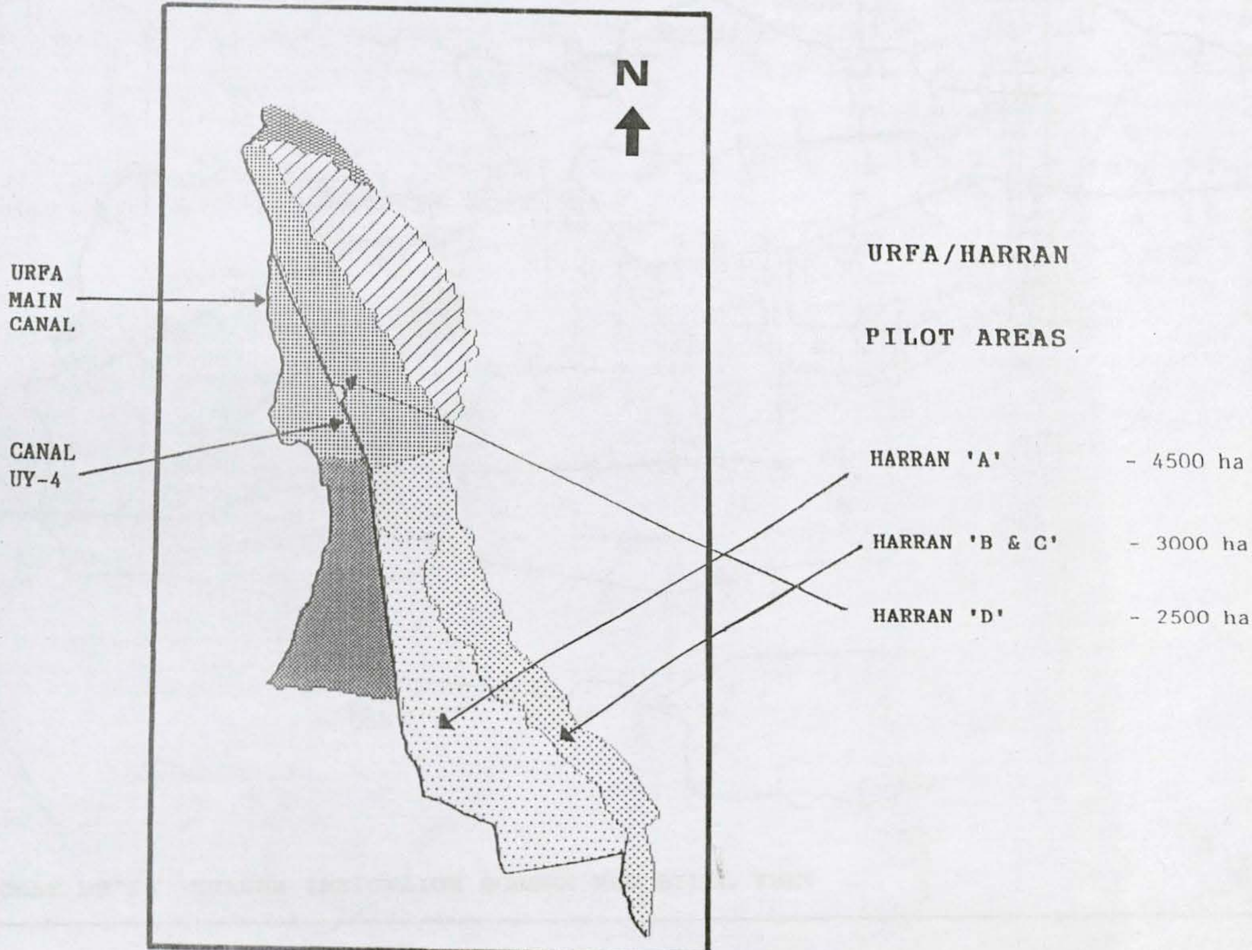


FIGURE B8.18 URFA-HARRAN IRRIGATION SCHEME AND PILOT AREA



8.5.6 Monitoring and Evaluation of Performance

Monitoring and evaluation (M&E) of the pilot studies has two key objectives:

- Monitoring the progress of the implementation of the pilot studies, evaluating the key constraints and identifying suitable measures to overcome these constraints
- Evaluating the performance of the MOM model developed and its applicability to the GAP region as a whole

All members of the GAP-MOM study will be involved in the M&E process, collecting information relevant to their interests and identifying the key implementation problems. The M&E system will supplement and formalise this process.

The development of an effective M&E system in the pilot study areas will form the basis of the M&E approach which can be applied to the GAP region when the MOM model is implemented, and at this level a formal data gathering exercise is essential.

The M&E system will have two main components, a Management Information System (MIS) and an Impact Monitoring System (IMS).

The MIS will collect and organise data on water distribution, on farm water utilisation, the development of Water Users Groups, farmer services and training. These will be reported on a quarterly basis.

The IMS will collect information on the effectiveness of the Water Users Groups, farmer training services, impact on cropping systems, income and employment effects, drainage and salinisation development, health effects and environmental effects. These will be reported in survey reports and impact evaluation reports.

The M&E system will be based on key indicators suitable for identifying the progress made and impacts of the project. A M&E manual will be prepared describing the system in detail.

Data for the M&E system will be obtained from four main sources. Where possible secondary data, collected as part of the work of existing agencies will be used. The socio-economic survey conducted by GAP-MOM will be used as baseline data. Other data will be collected in the field by GAP-MOM staff and staff of cooperating agencies, and impact evaluation data will be collected through annual surveys of farmers and Water Users Groups.

9 TIMESCALE FOR IMPLEMENTATION

9.1 The MOM Model

The recommended MOM model shown in Figure B6.1 provides for a core management structure consisting of three elements, namely the Supplier of Bulk Water (DSİ), an Irrigation System Operating Body (Irrigation Authority) and farmer generated Water User Groups. The model also provides for strengthened co-ordination links between the bodies responsible for the water supply service and support agencies and including the private sector and other interests not formally involved in the present institutional structures for irrigation management.

Due to the innovative nature of some features of the model, the need to test the processes in Pilot Areas and subsequently evaluate the performance and review the model, implementation will necessarily be progressive over several years. The establishment of Pilot Areas to cover a range of representative operating systems in the region is dependent on having the infrastructure completed, or rehabilitated if necessary in the case of existing systems, to allow the trials to be undertaken. The group formation process recommended for Water User Groups will also require a considerable lead time to bring farmers to the stage where the groups can be brought into operation.

While some aspects of the management model can be put in place under existing legislation or require only minor changes, the creation of a new Irrigation Authority will require new legislation. Other amendments are necessary in existing legislation, covering ownership of infrastructure and measures to strengthen powers in relation to financing of works, cost recovery and enforcement procedures, if the GAP management model is to be workable and achieve the project objectives. Other legal amendments are desirable to rationalise water rights and provide for integrated management of water resources on a river basin approach although these matters are not critical to implementation of the model.

Other important factors affecting implementation include resourcing the new organisations training of agency staff and farmers, establishing administrative procedures and developing suitable transitional arrangements for the proposed Irrigation Authority.

The following broad steps are proposed to implement the MOM model:

Step 1: Following acceptance of the model concept, carry out briefing sessions of all agencies affected at central and regional levels.

Step 2: Commence group formation process in selected Pilot Areas leading to establishment of Water User Groups.

Step 3: Commence training programmes for staff and farmers in proposed Pilot Areas.

Step 4: Upon formation of WUGs and completion of irrigation infrastructure in Pilot Areas, commence trials of irrigation O&M under management of WUGs.

Step 5: Draft suitable legislation to provide for establishment of an Irrigation Authority to operate at regional level, formation of a GAP Co-ordination and Advisory Council and consequential amendments needed to existing water laws.

Step 6: Develop transitional management arrangements to provide for DSİ progressively to transfer responsibility (and the necessary resources) for O&M activities on primary and secondary canals to an Irrigation Authority when it is formed.

Step 7: Monitor performance of the management arrangements undertaken by WUGs in Pilot Areas.

Step 8: Review, and modify as necessary, the management model in relation to WUGs following evaluation of Pilot Area performance.

Step 9: GAP Co-ordination and Advisory Council to commence operations.

Step 10: Irrigation Authority to commence operations in each region.

Step 11: Upon completion of the GAP MOM project establish arrangements for ongoing support of the group formation process and continued monitoring, evaluation and review of the GAP management model.

A number of these steps can proceed concurrently, particularly the planning and development of Pilot Area activities, training programmes and preparation of legislation. It is envisaged that a minimum period of five years should be allowed for the procedures to be developed, tested and implemented in final form. The actual rate of progress will depend on sufficient infrastructure works being completed to the stage where management by an Irrigation Authority and WUGs is financially viable. Further details of the timing for implementation of the model is given in Section F.

9.2 Irrigation Regions and Irrigation Zones

The timing for commencement of operation of both Irrigation Zones and Irrigation Regions is directly related to the completion of infrastructure and commencement of operation of each project and sub project. Planning for implementation of each scheme should be based on these boundaries.

The recommended Irrigation Regions correspond to DSİ regions, including a proposed amendment to transfer part of the present DSİ region 10 to Region 15. Provided this amendment is accepted the Irrigation Regions can be brought into operation as Irrigation Authorities are created.

The tentative Irrigation Zones suggested in 8.3 should apply from the commencement of operation of the relevant irrigation project. In each case it will be necessary to review the boundaries to take account of any significant changes in system layout or other parameters since the tentative zones were determined.

9.3 Pilot Areas

Implementation of Pilot Areas is one of the key steps in early development and introduction of the model. In Chapter 8.5 a total of seven possible Pilot Areas were identified, three comprising part of the Urfa-Harran system currently under construction and four in existing projects, with three to be selected from the existing areas. Full implementation of Pilot Areas requires that infrastructure be completed and certain rehabilitation works be undertaken in the existing project areas.

Subject to works being completed to allow operation, it is expected that the first Pilot Areas could commence during the 1994 irrigation season. Even allowing for the fact that some of the Pilot Areas may not be ready for physical operation until 1995, the planning of Pilot Areas activities, particularly the group formation process, should also commence in 1994.

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SECTION C

RECOMMENDED
WATER SAVING MEASURES
FOR THE GAP REGION

SECTION C - RECOMMENDED WATER SAVING MEASURES FOR THE GAP REGION

CONTENTS

SECTION C - RECOMMENDED WATER SAVING MEASURES FOR THE GAP REGION

1 INTRODUCTION

1.1 Background

A water balance study has been undertaken to review the total water resources availability of the Euphrates and Tigris basins in the context of demands arising from the planned developments throughout the GAP Region. Exploitation of those resources has three major objectives:

(a) to maximise firm power output from the hydro-electric power facilities to be implemented.

(b) to assure full irrigation water demands are met for all projects.

(c) to assure full regulated release of flows to Syria.

To meet these objectives will require not only a fully integrated approach to the operational management of the primary resource reservoirs, but also the introduction of measures to ensure the highest possible efficient use of water in the irrigation sector.

Given that for most irrigation systems in Turkey almost the entire canal network is concrete lined, low irrigation efficiencies can be attributed to four major factors:

(a) operational problems in matching supply to demand

(b) poor land preparation (grading and levelling)

(c) poor on-farm water management practices, which are related to lack of facilities and effective extension support

(d) anomalies in design assumptions about appropriate application methods, including farmer reluctance or difficulty with night irrigation.

In addition to the optimal, integrated operation of the primary water resources in the GAP region (principally major reservoirs) as a strategy for water saving, four specific areas of the water supply system offer scope for significant water saving measures to be implemented. These are at the primary, secondary and tertiary system levels, and at the on-farm level. Related measures such as the promotion of drainage re-use and the conjunctive use of surface and groundwater resources would also decrease the potential demand on the primary water resources.

1.2 Overview of Water Saving Measures

It will be necessary to implement two major categories of measures in order to bring about the maximum conservation of water resources. These are:

(a) The implementation of the most appropriate and effective **institutional framework** within which to plan, design, manage, operate and maintain water use systems,

(b) The introduction of efficient and effective **technical and social measures** to be implemented within such an institutional framework.

These two primary categories can be amplified as follows:

Institutional Framework

- The institutional framework must allow all organisations to utilise fully their resources and apply their management skills to the nation's advantage. This must include the farming community by providing them with the information, skills and support they need in order to maximise their productivity (ie extension and training);

- Within this framework there must be a management structure that assigns clearly defined responsibilities to different entities, and individuals within those entities, ensures that there is minimal overlap and that the capacity to undertake those responsibilities is in place and continuously maintained and improved;

- At the same time the interfaces between these core entities and other regional and national bodies have to be well defined and arrangements established to facilitate communication, coordination and accountability;

- The legal and financial provisions that will enable the framework to be established and to function must be identified and amendments to the existing legislation implemented and any new legislation promulgated.

Technical/Social Measures

- Measures to improve the integrated management and operation of the primary resource reservoirs in the GAP Region;

- Measures to improve the design, management and operation of the primary and secondary irrigation distribution systems;

- Measures to improve the design, management and operation of the tertiary distribution system;

- Measures to improve on-farm water handling and management practices;

- Measures to improve drainage and promote the re-use of irrigation water;

- Measures to promote the conjunctive management of surface and groundwater.

With reference to the identification and implementation of the most appropriate institutional framework for the management of the GAP irrigation systems, this is the fundamental objective of the GAP MOM study and is discussed in detail in Section B of this report. The institutional measures that could be considered necessary to bring about more effective scheme designs and hence improve the operational efficiencies of irrigation schemes are discussed in Chapter 2. The improved technical measures that could be implemented under such an institutional framework to bring about increased water use efficiency (or water saving measures) are discussed in Chapter 3.

2 INSTITUTIONAL STRUCTURE TO PROMOTE WATER SAVING

2.1 Planning and Design

2.1.1 Review of Current Practice

Under the current institutional framework, DSİ plays a central role as planner, designer, implementer and operator of large schemes. Smaller schemes (up to 500 l/s) are the responsibility of GDRS which also has responsibility for the preparation and implementation of on-farm development works (irrigation and drainage facilities, quaternary canals, land levelling, land consolidation sub-surface drains, infrastructural improvements).

State controlled organisations such as DSİ are well resourced and have the expertise to undertake all technical aspects of irrigation planning and design. However priorities tend to focus on the technical, engineering and economic aspects of project planning. The general philosophy remains one of top down management with a low level of farmer participation at the planning and design stage.

This lack of sociological emphasis and consultation with the farmers during planning and design, with due consideration for their needs and aspirations, can have serious repercussions in terms of the farming communities' acceptance of a scheme, and ultimately on how efficiently the system is operated and maintained. Under the present approach to design, a sense of ownership amongst farmers is generally lacking with consequent little motivation to look after infrastructure and a general culture of short-term interests predominates.

On the other hand, experience worldwide has shown that the involvement in the planning and design of "their" scheme by organisations with strong farmer participation such as Water User Groups (who have come together voluntarily), or small private companies, can build a strong foundation for successful projects.

It is acknowledged that this participatory planning process requires a significantly longer time-scale to complete designs than under the current predominantly engineering approach. However, the lost benefits arising from delays in uptake and lower than optimum production arising from inappropriate designs far outweigh the costs incurred in extending the planning and design horizon of schemes by say one year.

Specifically, the design process whereby the infrastructure layout of an irrigation project is identified primarily by consideration of technical factors such as topography and landslope, drainage features, soil types and classification (depth, infiltration rate etc) is not a recipe for success. Equally important social factors must also be considered such as:

- land ownership patterns based on cadastral surveys
- village administrative boundaries
- the probable delineation of water user groups which tend to be village

based and which should influence tertiary block delineation

- the probable need for water user group co-ordination and co-operation which will influence alignments of secondary canals

- current farming practices which will influence assumptions (initially) about appropriate on-farm irrigation methods and, together with land holding patterns, the most appropriate design of on-farm works

- the responsibility for drainage maintenance in relation to potential water user group areas.

The implication to be drawn from the above is that **irrigation design within the command area is essentially a social and agricultural exercise and not predominantly or exclusively an engineering exercise**. The further conclusions to be drawn from this are that:

- agencies concerned primarily with agriculture and farmer development should play a primary role in the planning and design of command areas;

- agencies concerned with engineering should play a primary role in resource planning including studies of the potential for irrigation area development, and the preparation of the detailed design of major works down to the secondary level;

- planning and design at the farm level is an interactive social, as well as a technical, exercise. This means that if schemes are to be socially acceptable to the farming community, with corresponding improvements in operation and maintenance and therefore water use efficiency, then scheme designs for the secondary and tertiary level (canals and drains) must be carried out in the project area (and therefore **at Regional level**).

2.1.2 Improving the Institutional Framework

One vital measure relating to water saving measures for the GAP Region must be that the institutional structure should guarantee the preparation of the most appropriate designs possible for every scheme. These designs should be prepared with due regard not only for technical matters, but also for social factors, including a clear perception of the operational conditions and responsibilities intended for each scheme.

GDRS, whose responsibility and skills are primarily at the agricultural or farmer end of a system (as well as for the design and implementation of small schemes), together with the GDARef which is responsible for land reform, farmer training and user rights to soil and water, should be mobilised in the future to play a far more active role in the planning and design of schemes at the secondary and tertiary level.

At present GDRS would have insufficient technical skills and staff resources to fulfil this function. There are two main institutional options to address this;

(a) GDRS would take on responsibility for command area designs. DSİ's involvement in secondary and tertiary level design would be reduced and staff relocated under the umbrella of the GDRS organisation. DSİ would still retain responsibility for:

- planning and detailed design of major engineering distribution works, down to say canals conveying 40 m^3/s.
- setting technical Codes of Practice for design and Specifications for construction;
- overall approval of design, letting of contract and supervision of construction.

(b) DSI and GDRS (in coordination with GDARef) would be jointly responsible for planning and design at the command area level. Communication and coordination between organisations would be formally strengthened, based on the principles that planning and design for command areas:

- should proceed from the field level upwards
- should most effectively be carried out at the Regional level.

These are policy matters beyond the scope of this report and in fact beyond the scope of the GAP MOM study which is concerned not with planning and design strategy, but with the best model for management, operation and maintenance of schemes as designed.

In this context, further comment relates to current practice where contracts for the preparation of designs for schemes are now being placed by DSİ with consultants in the private sector. The risks associated with this approach are that co-ordination links with other important agencies such as GDRS and GDARef become weakened and designs are prepared in offices remote from project areas by organisations with little empathy with the farming community. If designs are to be appropriate and acceptable, and are to contribute to efficient and successful water management, it is important that designs are prepared in close consultation with the farming community and all government agencies. This will normally require a project office to be set up in the project area.

2.1.3 Planning and Design Practices

Current planning and design practices which, particularly for surface irrigation schemes, tend to focus on the implementation of canalet type distribution systems and rely upon the farming community to adapt application techniques in a wide variety of topographic conditions, should be modified if improvements in water use efficiency are to achieved. This will require the development of new,and or the modification of existing, planning and design skills. This could be brought about by a judicious mixture of technical assistance enlisting both local and foreign expertise in worldwide practices. In particular improvements to planning and design should focus on:

- the design of open channel distribution systems based on up-to-date dynamic analytical techniques and modern control practices

- the detailed design of alternative on-farm works based on a range of different application techniques

- the (optimum) conjunctive use of open channel and conduit distribution systems incorporating system and farm level storage facilities.

These specific technical aspects are discussed in more detail in Chapter 3.

2.2 Operation and Maintenance

The management structure adopted for an irrigation system will affect the performance of water distribution. Under a centralised agency or operator such as DSİ, rotation schedules can be fixed in an attempt to ensure an equitable supply of water to all farmers. This simplifies management of the scheme for the operating agency, but limits the flexibility to meet the necessary varying demands of farmers. Thus the supply agency and user have divergent objectives for the operation of the system.

On the other hand, where management of a system is controlled by farmers, through water user groups, or small private companies or in some cases large individual farmers, then operational objectives coincide. Provided farmers are supported with information (extension) and the necessary skills (training), better operational efficiency can be achieved.

The nature of the management structure for system operation determines the level at which decisions are made about when and how farmers will receive water. Farmers basically want the opportunity to take water whenever they need it. In an efficient agricultural production system, the facility to take water as required should be the same as it is for other agricultural inputs for which farmers have to pay. This will be especially true if realistic water charges are introduced under which farmers have the right to expect an agreed level of service.

In order to ensure good control over water distribution, clearly defined responsibilities and lines of communication and co-ordination must be established. At the tertiary (and small secondary) level, the suggested approach is for self constituted Water User Groups to be established to take on responsibilities for operation and maintenance of their own systems. Such organisations would have their own elected management bodies, representatives from which would meet in committee with those from other adjacent or nearby groups, to agree levels of service and irrigation schedules with the secondary (or primary) level operator. This organisational structure will be highly suitable for the arranged demand system of scheduling commonly in use in Turkey, and will be an appropriate forum for negotiation between groups under conditions of limited resource availability.

At the large secondary and primary levels, the role of the operator or supplier should primarily be for the operation and maintenance of the irrigation water delivery system. In order to achieve efficient management and control of water resources, such an operator should be financially autonomous so that:

- revenue collected is related directly to the level of service provided to the customer (the Water User Group).

- expenditure by the operator is primarily focused on operation and maintenance of the system.

Additionally, high levels of accountability must be an inherent part of the operator's philosophy. On both counts of financial autonomy and accountability, organisations such as DSİ which are part of large government ministries are unlikely to be able to perform as effectively as organisations whose major remit is to fulfil a clearly drafted customer/supplier level of service agreement, focused on achieving high levels of operation and maintenance.

The constitution of Water User Groups and a supply organisation, also referred to as an Irrigation Authority, is seen as an essential modification to the existing institutional structure in order to provide a framework for implementation of significant water saving measures. This proposal is consistent with the proposed MOM model as discussed in detail in Section B of this report.

3 TECHNICAL AND SOCIAL MEASURES TO PROMOTE WATER SAVING

3.1 Primary Resource Management

3.1.1 Integrated Operation of Reservoirs

Primary resource management refers to the operational criteria for the reservoir storages. The principal objectives are twofold:

(a) to ensure that the irrigation demand is fully met at the target level of assurance

(b) to ensure that the impact of restrictions upon supply, when they do become necessary, is economically acceptable.

Regarding target levels of service, this is a complex criterion and relates to identifying optimum strategies to maximise agricultural production under conditions of water shortage. It is a function of crop yield response to water and therefore crop patterns and crop growth stage.

Sound resource management is aimed at the avoidance of frequent, sudden and dramatic incidence of restricted irrigation supply. This management policy is usually formulated as a set of control rules which are a function of the seasonal pattern of demand, the state of storage of the reservoir system and the time of year. If the rules have been properly derived, given a comprehensive study of the behaviour of the storage system under the required demands, then the consequences of a release decision over an adopted operational horizon will be known. Ideally, for irrigation purposes, only one decision should be made in any given year, at the beginning of the irrigation season which itself would usually coincide with the end of the period of peak inflow to storage.

In the Euphrates and Tigris resource systems, the decision on the allocation of supply should generally be taken at the end of May when the resources for the season can be reliably estimated. The magnitude and timing of any necessary restrictions on supply should then be made known so that the agricultural sector can respond accordingly.

The derivation of a management strategy in the form of operational control rules for a primary resource system as complex as that in the GAP Region is a fundamental requirement. The control rules must be developed using the most modern advances in water-resources simulation technology if they are to ensure the optimal allocation of water under sound and consistent management.

The overall management of the GAP irrigation systems needs to reconcile the three principal demands that will be made upon it:

- irrigation
- power

- downstream regulation

A fundamental need is for a comprehensive and integrated model of the system, based upon which a knowledge of its behaviour under various operational scenarios can be built-up. From these insights the optimal operational strategy can be identified.

At present no such model exists and the behaviour and reliability of the GAP primary resource system, given the design demands that are to be made upon it, is very poorly known. There is no integrated management or operational strategy that has the specific objective of ensuring the balanced and sustainable allocation of water resources. There is therefore a fundamental need for the development of such a model to support the overall technical planning and operation to use water resources in an optimal manner.

3.1.2 Operational Strategy to Minimise Losses

Losses from reservoir storage within the GAP Region may be almost totally ascribed to evaporation, but the operational options available to minimise it are restricted. In principal, holding water in higher level reservoirs where evaporation rates are lower, is the preferred option but this is possible only to a limited degree.

A basic water balance study of both the Euphrates and Tigris systems has revealed the need to maximise the probability that all reservoirs are full at the end of May and that during the subsequent months of peak irrigation demand, upstream reservoirs are operated to release water to those downstream. A feature of both the Euphrates and Tigris systems is that the principal upstream storages such as Keban, Karakaya, Dipni and Kralkizi have no direct irrigation demand made upon them. Their storage, however, is required to support the irrigation demands upon Ataturk and Dicle such that peak releases and therefore peak power output would coincide with peak downstream irrigation demands. Whether such an integrated use of storage could be managed such as to lead to any significant reduction in total evaporation losses is unlikely, though this could be evaluated meaningfully upon the basis of a complete system simulation model.

Such a model would also be essential for the identification of operational strategies directed at the control of spill from the storage system. Given that any downstream regulatory requirement is being fully met, any uncontrolled spill out of the system must be viewed as a loss. The maximum volume of inflow must be caught, stored and utilised to satisfy the demands upon the system. In order to ensure that this is so, simulation studies need to be carried out to investigate the maximum power output that can be maintained in the winter months whilst maximising the probability of full storages at the end of the peak flow season and minimising spill.

3.2 Improvements to Primary and Secondary Distribution Systems

3.2.1 Introduction

The basic requirement of a primary and secondary distribution system is that it should be designed with a clear perception of the intended operational rules, Designs therefore must allow flexibility of water control to meet the varying demands of the farmers at any time and location within an irrigation scheme. Within this context the reliability of supply throughout the system is of prime concern and is a function of water availability, flow rate, head and duration.

Suitable controls must be incorporated within a system to allow the balancing of supply with demand with the minimum wastage. In long canal systems with long travel and response times, such controls must include sufficient in-system storage to act as a buffer or to introduce inertia into the system, and/or sufficient control structures with appropriate levels of automation of operation.

Based on the designer's concept of system operation, detailed operational rules must be drafted for the intended conjunctive operation of all control structures under the expected range of flow conditions. Whilst an element of operational rules will be common to all systems, each system will undoubtedly be different and the clear specification of operating rules by the designer for use by operation and maintenance staff is vital. Only in this way can management of a system be improved with consequent reduction of spills due to sudden water level fluctuations arising from demand rejection or incorrect operation of control structures.

At present it appears that canal or pipe designs tend to concentrate on the determination of dimensions to ensure that the peak flow rate can safely pass through the system. Little attention is paid to how the system will be managed to cater for less than peak or unsteady flow conditions that can arise. For example designers must consider:

- if one structure is adjusted how will it affect the flows and water levels upstream and downstream?
- how often will gate operators have to make adjustments?
- when a gate setting is adjusted, what measurement will this adjustment be based upon?

In general, although comparative studies should be carried out for each case, pipe distribution systems have many advantages over open channel systems. Two major advantages are that pipe systems are highly flexible allowing true on-demand operation to be achieved; and they are highly efficient as conveyance and distribution structures given good standards of construction.Many of the operational problems associated with channel systems, such as the maintenance of command levels and minimisation of rejection losses, are avoided.

The majority of shortcomings that have been identified during the study that contribute to primary and secondary system operational losses relate to open channel systems. These include:

- **Land slope**: as the slope increases, downstream control only becomes feasible within a semi-closed pipeline system. The transmission of the "message" that flow conditions have changed (eg sudden demand increase) using the moving water body as the relay mechanism becomes impossible under open flow conditions if water surface slopes (which are a function of land slope) are too steep. Some systems, which under existing designs as intended for on-demand operation, are too steep for this to be achieved.

- **Flow measurement**: accurate flow measurement facilities within the primary and secondary distribution system are crucial for effective water management and to achieve potential efficiencies. Few formal control structures exist within current projects or under current designs.

- **Balancing storage**: efficient water use can only be achieved in these long canal systems by balancing supply with demand. Virtually no balancing storage exists within current schemes (apart from in-channel storage which in steeper reaches will be negligible) or in current designs.

- **Automation of control**: to balance supply against demand, higher water use efficiencies can be achieved by the introduction of appropriate levels of automation. These can be either hydro- or electro-mechanical but such facilities do not exist in current schemes or designs.

Against this background several measures have been identified that should be considered for inclusion in the design of future schemes to improve the efficiency of water use. These water saving measures are:

- the use of upstream control devices on the main and secondary canals
- introduction of in-system regulating reservoirs
- introduction of formal downstream control systems
- the more widespread consideration of semi-closed pipeline distribution systems
- automation of control structures and possible centralised control
- implementation of sufficient and appropriate flow measurement and monitoring structures.

Each of these measures is discussed below.

3.2.2 Upstream Control Devices

Upstream control devices provide a constant water level immediately upstream of each check structure and therefore maintain a constant head at any upstream secondary and tertiary canal offtake. The present composite type structures, installed as cross-regulators in secondary canals by DSİ on most schemes, do not provide the necessary robustness of control, nor the potential for simplified automatic control. The current structures consist of a central set of vertical lift slide gates with fixed crest spillweirs on either side. Recommended alternatives in ascending order of automation are:

- **Long fixed crested weirs** such as duckbill or diagonal side weirs.

These will give less fluctuation in upstream water levels over a wider range of flows than the current structures;

- **Radial check gates with floats** fixed to the upstream leaf face, (AMIL type) as are proposed for the upper reach of the Harran canal. Such hydro-mechanical gates will maintain better stabilisation of upstream water levels;

- **Moveable broad crested weirs** with automatic control such as the Romijn gate. These could be fully automated with upstream level sensors and electric motors fitted to gate operating gear.

The radial gates, whilst providing the most accurate control, are also the most expensive. Long fixed crested weirs are cheaper and easier to install but are also the most inflexible. DSİ should give consideration to these alternatives taking into account the costs of procurement, installation, operation and maintenance, and the potential savings in terms of the avoided losses as measured by the true marginal cost of water.

Such an exercise will require detailed, unsteady state analysis of the operation of these complex, long branched systems. Some preliminary analyses of this type have been carried out as part of the GAP MOM study to identify operational constraints. One important aspect is that all flow conditions must be analysed, not just full flow conditions. Substantial interaction of flow control structures under full flow conditions has been identified as a potential major operational problem during the GAP MOM investigation. Paradoxically, this interaction may be necessary for control under less than maximum flow conditions. Computer based mathematical modelling of irrigation systems should be a major tool used by DSI for design, as indicated in Technical Discussion Paper 22 (Halcrow 1994).

3.2.3 Regulation or Storage Reservoirs at the Secondary Level

To cater for transients between an upstream control system and the downstream distribution system where an arranged demand system operates, regulating reservoirs are essential if operational losses are to be minimised. Apart from improvements to on-farm irrigation efficiencies, this is perhaps the most effective water saving measure that can be considered for open channel distribution schemes in the GAP Region. Six hours night time rejected flow during peak demand periods that cannot be stored within the distribution system represents a loss of some 20 cubic metres of water per hectare every day. For the first phase of the Urfa-Harran system, this represents a total daily loss approaching 1 million cubic metres. Provision of such regulating reservoirs would not only significantly increase overall water use efficiency, it would avoid major drainage problems and adverse environmental impacts such as soil salinisation described in Technical Discussion Paper 11 (Halcrow 1993).

These reservoirs should ideally have sufficient volume to balance diurnal variations in flow, such as unwanted irrigation water during night hours. They can be either on-line or off-line,as follows:

- On-line reservoirs are created by enlarging the upstream canal section. They allow head to be maintained within the system thereby ensuring gravity supply. They however have the disadvantage that all the canal flows have to pass through the reservoir, which under normal flow conditions would result in very low velocities and the associated risk of sediment deposition.

- Off-line reservoirs are separate water impoundment structures constructed adjacent to the canal system. To reduce construction cost, they usually have a deep section, which requires either the stored water having to be pumped out or fed back by gravity into the supply canals at a lower elevation in the system. Large off-line reservoirs could be situated at the head of the secondary canals or alternatively smaller reservoirs could be provided at the head of the tertiary canals.

Off-line reservoirs are preferred because:

- the operation of each reservoir is more likely to be under the jurisdiction of one water user group, which makes for easier management control

- only a small percentage of the total canal flows (the fluctuations) passes through the reservoir

- canal velocities can be kept high avoiding any silt deposition in the canal.

Off-line reservoirs should be lined and be at least 3m deep to avoid sunlight penetration encouraging vegetation growth. Canal control gates will also be required both up and downstream of the reservoir intakes.

The provision of storage should be considered by DSİ as a major water saving strategy, both as a modification to existing schemes and as an integral part of the design of future schemes.

3.2.4 Downstream Control

Downstream control systems are appropriate only for the downstream ends of long distribution systems. To be effective they require suitable land and canal gradients. Downstream control allows downstream users to take water on demand and, in conjunction with upstream control in the upper parts of systems, makes for a more equitable distribution of water.

Downstream control can effectively be introduced into a primarily upstream control system by the provision of storage. This could be implemented in conjunction with the types of storage reservoir referred to above in 3.2.3.

Formally imposed downstream control systems improve overall distribution efficiency but require a degree of automation. This can be hydro-dynamically achieved using gates known as Avis or Avio gates. Distribution system control measures are discussed for two GAP systems in Technical Discussion Paper No 22 (Halcrow 1994).

3.2.5 Semi-Closed Pipe Systems

The low pressure closed pipeline system provides an on-demand supply to each field outlet but is only suitable for land with slopes less than 1%. The semi-closed system is an adaptation of the above to steeper land and uses a float valve to control the downstream flow. It automatically communicates pressure and flow rate changes from a downstream outlet back up to the source without large pressure variations with changing flow rates. Features of the system are:

- it can operate at low pressures permitting the use of less expensive pipes and equipment, with reduced erosion risk at the field outlets
- flow meters can be installed in the pipe for volumetric flow measurement
- operational spillage is eliminated in contrast to the open pipeline system
- field outlets should be just downstream of a float valve where the flow is more stable.

Consideration should be given to the more widespread implementation of this system. Whilst constraints apply in terms of maximum pipe diameters and hence flows that can be accommodated at the secondary level, such systems could be highly appropriate and cost effective at the tertiary level. This would be especially so if low pressure pipe tertiaries were used in conjunction with night storage reservoirs at the heads of tertiaries, together with transition to downstream control structures as described above.

The main concern in Turkey in relation to pipe distribution systems appears to be pipe manufacture quality and hence the potential for leakage losses. This should not preclude the initiation of such systems. High quality precast concrete canalets are currently manufactured in Turkey and manufacturers should be encouraged through the specification of such pipes to adopt current (worldwide) technology to make high quality spun concrete pipes with preformed sealed joints.

Significant water savings are possible and fieldwork in Bangladesh (Bentum, 1993) shows that in comparison with open channel systems:

- a reduction in land area occupied by the distribution system of 0.5 to 2% is possible
- conveyance losses are some 10 to 25% of those for equivalent lined canals.

Whilst construction costs may be higher, total costs including maintenance are comparable when the marginal cost of water saved is considered.

3.2.6 Local Automatic and Centralised Control

Local automatic control, especially of gates, can be either hydro-mechanical or electro-mechanical. Hydro-mechanical gates are typically Amil and Avis/Avio upstream and downstream level controls as described above. When set to maintain a particular water level they can do so to within 3% accuracy. Another method of local automatic hydraulic control is the controlled leak system in which a float operated gate is controlled by water constantly flowing into or out of a float chamber.

Electrical control of gates is an area of continuous refinement. The Littleman controller works well but only for controlling water levels close to the gate. Water levels downstream of the gate are monitored with sensors, and adjustments made to gate openings.

A number of refined systems are used for automatic local control:

- BIVAL: which uses water level information at both ends of a canal reach and attempts to maintain a constant water level between them. This is best used for long reaches where precise control at the downstream end is not required.

- CAARD: monitors water levels at several points in a canal reach and uses linear regression to establish the downstream water level. If this level is outside the range, then gate movement is considered. CAARD therefore considers gate changes before the wave has travelled along the reach and thus reduces transients.

- EL FLOW: this is a proportional controller which makes gate adjustment at a rate proportional to the error in downstream water level.

- ZIMBLEMAN: this method uses a statistical process control method to determine the need for gate movement (Zimbleman 1987). A deadband is defined as in most electrical systems within which no gate movement should occur. This reduces unnecessary gate movement. The method predicts when the water level will move outside the deadband and gate adjustments are made accordingly. This means that gate adjustments are made before the water level moves out of the deadband. Deadbands were used in the GAP MOM Study when considering the hydraulic operation of two GAP systems described in Technical Discussion Paper 22 (Halcrow 1994), but without the forward forecasting algorithm.

Centralised control refers to the situation where all the gates within a system are controlled remotely from a single location. The control can be made responsive by installing sensors to monitor water levels constantly and regularly update automatically operated gate settings. Remote control can be achieved through radio contact to gate operators in the field from a central system operations office.

Automation of control of primary and secondary distribution has distinct water saving potential for the GAP region where frequent manual control, in some cases on a 24 hour basis, is not possible. As a first step DSİ should consider implementation of electro-mechanical and hydro-mechanical control at the primary and secondary levels respectively, before progressing to integrated electro-mechanical control systems in the future.

3.2.7 Flow Measurement

Accurate flow measurement and monitoring at all points throughout the irrigation distribution is an integral part of good water management and is necessary if high levels of efficiency of use are to be achieved. Current DSI designs have little provision for accurate flow measurement (that is independent of downstream water levels). Accurate flow measurement structures should be introduced into designs at key points throughout systems (at primary regulators and at all significant bifurcations) for future schemes, and should be retrofitted for all existing schemes.

Many schemes have sufficient head available that the measurement structures could be simple broad crested weirs. Where head is not available, or cannot be improved, Parshall flumes should be considered. They should be automated appropriately, either using pressure sensors or stilling wells with levels sensors for primary structures, and at least with mechanical recorders within the secondary system. Multi-channel data loggers should be installed for primary structures and staff trained in calibration, measurement and reading.

The software package FLUME developed by the International Institute for Land Reclamation and Improvement (Wageningen) can be used for new and retrofit designs, and has been used by the GAP MOM study when considering the need for flow measurement structures within the project Pilot Areas.

It cannot be stressed too strongly that accurate flow measurement and monitoring is the key to efficient water management and control, and observations to date show that current designs are significantly deficient in this area.

3.3 Improvements to Tertiary Level Systems

3.3.1 Introduction

Many of the comments and recommendations given above for water saving measures at the primary and secondary level apply equally to the tertiary level. It is not therefore proposed to repeat these again, but merely to note their requirements as necessary for improved future design practices. Additional measures are described in appropriate detail.

3.3.2 Flow Measurement

The arguments for accurate flow measurement throughout the system are as given above, focusing principally on operational control and monitoring. An additional major reason at tertiary level is to provide the data for water charging purposes. In order to encourage efficient water use the objective should be to sell water in bulk, at realistic rates, to the constituted Water User Groups. This requires flow measurement to be carried out at key points in the tertiary systems.

Accurate flow measurement structures are proposed to be designed and retrofitted on tertiary canalets within the GAP MOM study Pilot Areas. These will be simple precast weirs, or in situ cast weirs on larger channels. The installation of such structures on all tertiary offtakes within the GAP irrigation schemes should be the design objective of DSİ. The cost implications are minimal in comparison with current practices. At present all tertiary offtakes are designed and fitted with constant head, double gated orifice structures. These were originally developed by USBR and subsequently abandoned by it some 25 years ago. Worldwide these structures are notoriously difficult to calibrate and operate.

Simple gated structures with downstream measurement facilities should be fitted instead of the double orifice gares. The main question is how flow is to be recorded on a temporal basis. Installation of autographic recorders at every measurement point would have significant cost implications, but perhaps acceptable when compared with the current cost of double gated orifices. Any installed analogue measurement structure will be open to vandalism. However neither this factor nor cost considerations should be allowed to detract from the principle that accurate and usable flow measurement structures should be constructed and calibrated at all tertiary offtakes. In the meantime the GAP MOM study will examine the effectiveness of different strategies and methods for volumetric measurement in the project Pilot Areas.

3.3.3 Piped Distribution

Low pressure tertiary pipe systems in conjunction with night storage reservoirs at the upstream end operating under downstream control should be considered as a major potential water saving measure that could be adopted for future designs.

3.3.4 Tertiary Drainage and Drainage Water Re-Use

At present there is limited construction of tertiary drains at the farm level, as well as omission of inlet structures to tertiary drains and outlet structures to secondary drainage channels To be effective, drainage systems must be combined with land grading and smoothing in order to provide a continuous slope to the tertiaries as discussed in Technical Discussion Paper No 11 (Halcrow 1993). With such an effective drainage system in place, the re-use of drained water would be an effective water saving measure. Ideally this would involve the construction of small earth collection ponds, either at the downstream end of each tertiary drain, but preferable on a farm block basis, to catch excess irrigation or drainage water. This would then be recirculated to the tertiary irrigation canal using small pumps for irrigation reuse. Such a strategy will become more attractive to farmers once realistic water pricing policies are put in place.

3.4 Improved On-Farm Designs

3.4.1 Current Design Practices

The Identification phase studies have highlighted the relatively low level of water management currently practised in many parts of existing irrigation schemes. Not only must there be improvement in these areas, planners of future schemes must seek to avoid replication of the on-farm works designs that have brought about current operational problems at the farm level.

A fundamental strategy to achieve efficient water use lies in the selection of the most appropriate water application method for a particular area. The selection of an inappropriate method will lead to:

- inequitable water distribution throughout the area resulting in social discontent
- non-uniform distribution within the fields resulting in overuse of water, variable yields and ultimately loss of revenue to the farmer.

For irrigation to be sustainable, it is important that close attention is given to the selection and implementation of the most appropriate on-farm water application methods.

If the farmer is to accept full responsibility for the operation and maintenance of the distribution system and to pay a realistic price for the water supplied to him, he must be provided with the means of ensuring that the water is put to the best possible use on his land. Failure to take such action will seriously weaken the effectiveness of implementation of irrigated agriculture in the Region.

The factors affecting the selection of appropriate water application method are discussed in Technical Discussion Paper No 20 (Halcrow 1994). In this context the experience of current schemes that have been designed and implemented should be considered. Two examples, Hancağiz and Devegiçidi, are of particular significance since they have been recommended for selection as Pilot Areas for the GAP MOM study. In these areas traditional canalet have been installed and furrow irrigation appears to be the standard on-farm water application method used. Though the soils in these areas are clayey, land slopes observed range from low lying gently sloping areas at 1 to 2%, through intermediate areas at 2 to 6%, with some lands from 8% to in excess of 12%. Additionally, the topography is gently undulating.

This situation has significant adverse implications for water use efficiency. In steeper areas it will be impossible for farmers to control effectively their on-farm water distribution and field efficiencies will be low. In these areas farmers will also be tempted to take more water than they need, to the detriment of farmers further down the system. Where land undulates, soil-water contact times will vary significantly, again adversely affecting field level distribution efficiencies.

The methods of on-farm water application assumed for the planned schemes in the GAP region are shown in Figure C3.1. A generalised irrigation suitability map, based on land slopes, is shown in Figure C3.2.

FIGURE C3.1
EXISTING OR PLANNED IRRIGATION METHODS FOR GAP PROJECTS

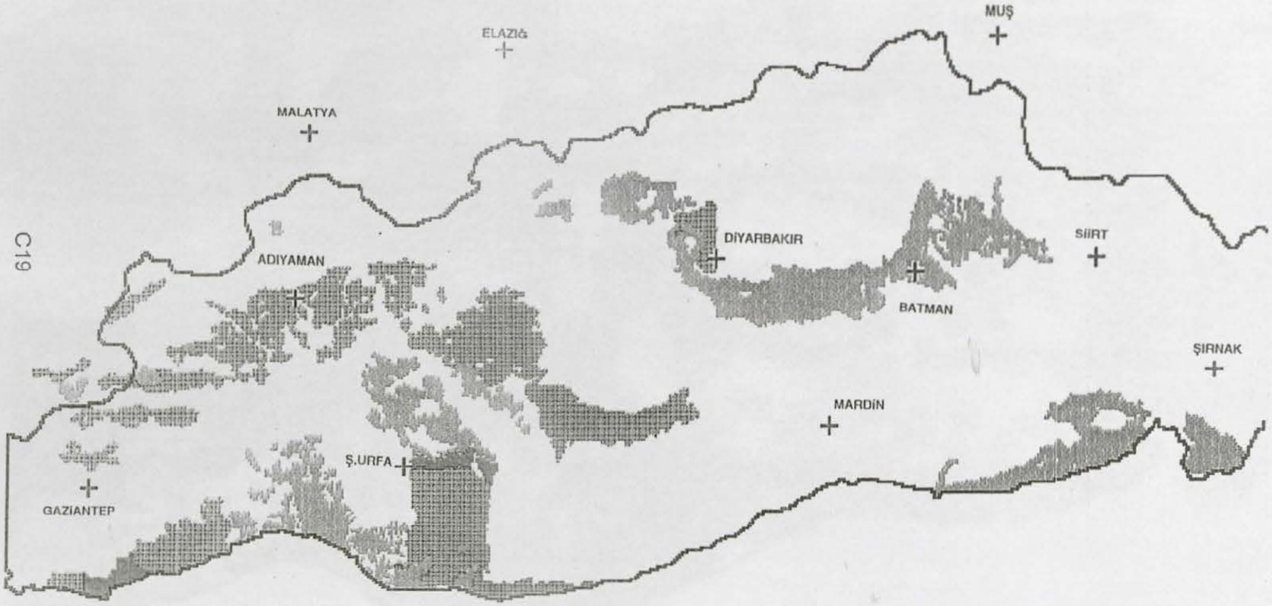
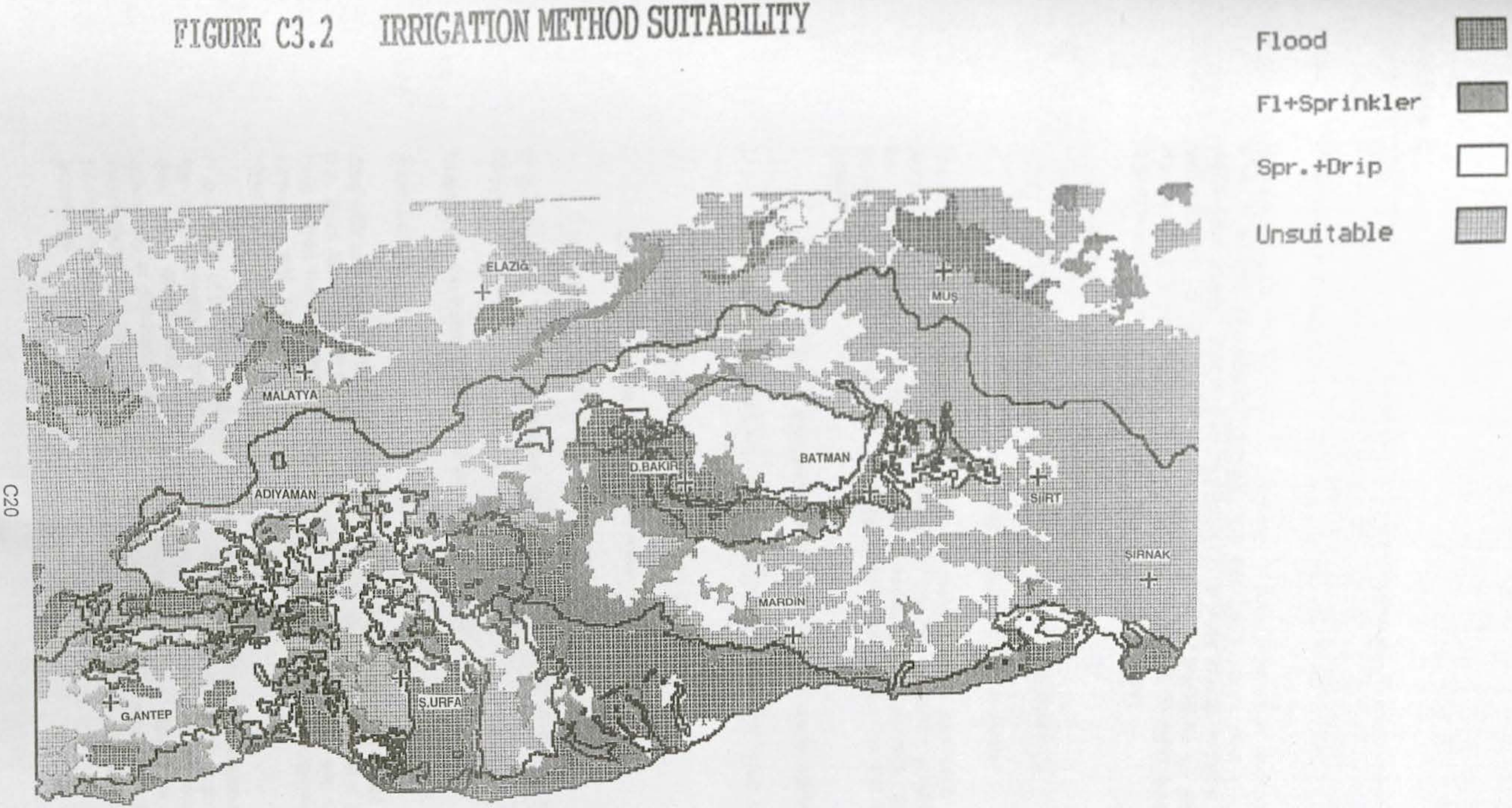


FIGURE C3.2 IRRIGATION METHOD SUITABILITY



3.4.2 Proposed Modifications

Both Devegiçidi and Hancağiz are reported to suffer from water shortages. This is for a variety of reasons, ranging from insufficient water resources to high distribution system losses. The minimisation of these losses together with the maximisation of on-farm application efficiencies is therefore of paramount importance if MOM models are to be successfully applied in these areas. That is, overall water use efficiency must be improved to ensure:

- financial viability for the farmers
- equity of supply and hence avoidance of social disharmony
- minimisation of potentially adverse environmental impacts

There is therefore a perceived need for the on-farm water application designs, particularly at Devegiçidi and Hancağiz and possibly for other projects within the GAP Region, to be reviewed. Such a review should consider alternative on-farm layouts for different application methods based on the following parameters:

- closed level furrow and level border strips in areas up to 0.05% slope
- graded open furrows up to 3% and graded borders in areas up to 2% slope
- the use of contour furrows in areas up to 6% slope
- the use of sprinkler irrigation in areas of 6% to 20% slope
- the implementation of a trial area of drip irrigation.

It is proposed to test the above techniques in the Pilot Areas as described below.

3.5 Improved On-Farm Water Management Practices

3.5.1 Introduction

The efficient use of irrigation water and effective handling of drainage water at the farm level are an essential part of good on-farm practices. It is proposed that within the Pilot Areas, as part of day to day management and operation, farmers will be introduced and trained in the use of improved water management practices.

A package of potential water saving measures these will be developed suitable for implementation throughout the GAP Region, based on the experience of the GAP MOM study over the next few years. Next to improvement in efficiency of distribution of water at the primary/secondary distribution level, the improvement of on-farm practices and efficiencies is the most important water saving measure that should be implemented throughout the GAP irrigation schemes.

Some of these measures will be simple and can be quickly implemented by the farmers themselves. Others will require small modifications to the infrastructure and will take time to introduce. This should be seen as part of an overall training programme under which irrigation technicians, subject matter specialists and, most importantly, lead farmers will have these practices demonstrated on their farms. The first step will be to identify a number of lead farmers within each Water User Group, who will be willing to adopt these practices, and whose farms can then be used as demonstration areas for other farmers within the Group.

These measures are described in the following sections in terms of how they will be implemented under the GAP MOM Project. After experience is gained with them in the Pilot Areas, these measures should generally be implemented throughout the GAP Region. The measures can be grouped as follows:

- demand for, and distribution of, water at the tertiary level
- water handling at the farm level
- drainage measures
- trials and monitoring.

3.5.2 Demand for and Distribution of Water

(a) Irrigation Water Demand

It is proposed that Village Group Technicians, Subject Matter Specialists and lead farmers receive training under the project in the concepts of crop water requirement estimation. The first two groups will have a background in this subject but farmers must be encouraged to adopt a simple approach to water budgeting. It is not suggested that this should entail the use of sophisticated soil moisture measuring equipment. A selected number of receptive lead farmers should be encouraged to have simple rain gauges set up at the edge of their farms so that they can monitor daily or weekly rainfall.

Through information prepared and made available by the project about theoretical crop water demands (in millimetres per week) they should be introduced to the idea of keeping a water balance schedule. This will promote and heighten their awareness of water use and allow them to develop a sense of relationship between "what the project theoreticians say" and what are their own "empirical" practices.

In time, progressively stricter controls should be imposed on water measurement and charging. These farmers should have then a heightened sense of the value of water and a rational basis for monitoring and controlling their own usage (and costs) to best effect.

(b) Flow Measurement in Canalets

The Project will attempt to introduce acceptable flow measurement structures in all tertiary channels in the Pilot Areas probably in the form of fixed crest flumes. It is proposed that flow measurement, and hence the total volumetric usage, will be carried out and trialled in two ways:

(i) In the majority of cases canalet structures will be fitted with gauges indicating flow versus head and head versus flow on both the inside and the outside of the canalet. In these situations, farmer groups will be required to indent for water from the water bailiff and indicate which days (and nights) they require water during the off-peak season; or they will be informed which days they will receive water on rotation during peak periods of water shortage. Farmer groups will be expected to keep a record of diverted flows on a three-hour basis when outlet gates are open from which total volume delivered will be calculated.

(ii) In a small number of cases autographic recorders, will be installed to trial their acceptability to farmers. These should preferably be installed in locations towards the head of the system where the tendency will be for WUGs to over-abstract water. The intention of this is threefold:

- to test the possibility of introducing a more sophisticated method of water metering
- to act as some form of control or benchmark against which to test other (manual) areas
- to serve as a means of bringing peer pressure to bear on dishonest practices.

(c) Water Abstraction From Canalets

At present water is abstracted directly from canalets using single large diameter syphons of up to 20 to 30 l/s Water handling can be made easier and therefore more efficient in two other ways which should be trialled:

- by the precasting (or modification) of canalets to include a slide offtake gate in the side of the canalet where they are close to the ground
- by the precasting (or modification) of canalets to include a pipe offtake and valve in the base of higher canalets.

In all cases, whether traditional syphons or modified canalets are used, farmers should be encouraged to construct small (concrete) receiving cisterns and outlet channel into which to discharge diverted flows. This will also ease water handling and minimise wastage.

(d) Water User Group Night Storage Reservoirs

The implementation of Night Storage Reservoirs (NSRs)should be a major feature for the Pilot Areas. With the exception of Ceylanpinar, the Pilot Areas are part of irrigation distribution systems with long supply canals and therefore long travel times for water movement. These systems have very little (or no) in-line storage and the efficient matching of supply to demand to minimise distribution losses will be very difficult. This will also have an impact upon the WUGs in terms of security and efficiency of supply, particularly once the project moves to a more rigorous regime of water measurement, charges and recovery.

In preparation for this the WUGs can be assisted by encouraging them to accept some in-system storage **within their own area** in the form of NSRs. This will mean land loss for someone. To sell this idea to farmers will be difficult since the benefits can be demonstrated only after the reservoirs have been built. The intention will be to demonstrate to farmers that they can achieve more efficient and convenient use of water if they control their own limited storage.

Simple construction techniques are envisaged. Providing soil conditions are suitable (high clay content), the NSRs could be simple earth ponds fed by a short upstream canalet directly below the flow measurement structure, with a simple fabricated steel gate in a concrete outlet structure. A concrete waste weir will be required to return excess flows to the secondary canal in times of emergency.

Looking to the future, these NSRs could provide the infrastructure to encourage the development of pressurised irrigation systems on a larger scale basis. In terms of size, and providing sufficient head is available, for a WUG covering (say) 1000ha, a 1.5 metre deep (active depth) pond would need to be some 0.25ha in area.

(e) Irrigation Scheduling

Lead farmers should be trained in water scheduling. Having familiarised them with the idea of crop water requirements, the concepts of soil moisture holding capacity and readily available moisture for different soils, and the concept of irrigation intervals must be introduced. The proposed On-Farm Water Management Engineer (OFWME) should then develop guidelines for irrigation scheduling by:

- determining unit stream sizes and irrigation durations for standard furrows for different crops and soils (ie, a set of fixed rules for farmers to adopt for applying (say) 50 or 100mm per application)

- drawing up a schedule of varied irrigation intervals (7 or 10 or 12 days) so that these fixed application depths can be matched to the seasonal variation in crop water demands.

3.5.3 Surface Water Handling at the Farm Level

(a) Header Ditches

Having encouraged farmers to decrease their water losses through the construction of concrete cisterns into which to discharge canalet water, they should be encouraged to minimise their losses by:

- ensuring that their ditches are kept a minimum 3 metres away from the canalet support pedestals. Softening of the ground in the vicinity of the pedestals often leads to springing of the canalet joints thereby creating seepage losses and, in time, the complete collapse of the canalet.

- lining their header ditches or using polypropylene layflat tubing.

(b) Improved Water Handling Techniques

In regard specifically to furrow irrigation which is widely practised throughout the region, various techniques should be promoted to improve water handling and minimise losses including:

- Encourage the local production and use of different shapes of double sided ploughs (deep and narrow, round, wide and shallow). Farmers would be expected to purchase them but the Project should commission some for trialing in different soil, slope and crop conditions (see below).

- Encourage the use of simple plastic sheet stop-offs to head-up and divert water.

- Encourage the use of multiple small syphon tubes to divert water from farm ditches into furrows.

- Encourage the use of lay-flat tubing to convey water from canalets to farm ditches.

- Encourage the use of gated lay-flat tubing instead of open farm ditches. Such tubing can be fitted with simple preformed plastic valves which can be punched through the tubing wall at the appropriate furrow spacing. Simple tying of the tubing with string or wire will act as a valving arrangement.

- Promote the technique of cut-back furrow irrigation. This would be particularly appropriate in the case of using layflat tube manifolds instead of farm ditches. A manifold is divided in half by tying off one side and delivering the full irrigation stream to half the furrows. Once these are fully wetted, the other side is tied off and the remaining furrows wetted. Thereafter all furrows are supplied through the entire manifold at half the original flow. This technique has been found to improve water use efficiency.

- Encourage farmers to introduce intermediate header ditches at significant changes of land slope where land has not been well graded. This could beneficially be implemented where open furrows and layflat tubing are used.

- Encourage WUGs in the re-use of excess irrigation water by the construction of collection ponds at the downstream end of tertiary drains with re-lift to the command canalet.

- Consider the conjunctive use of surface and groundwater. Many farmers own and operate their own boreholes in the Harran plain and advice should be given to farmers and WUGs about their optimum use.

Some examples of techniques suitable for furrow irrigation are shown in Plates C3.1 to C3.4.

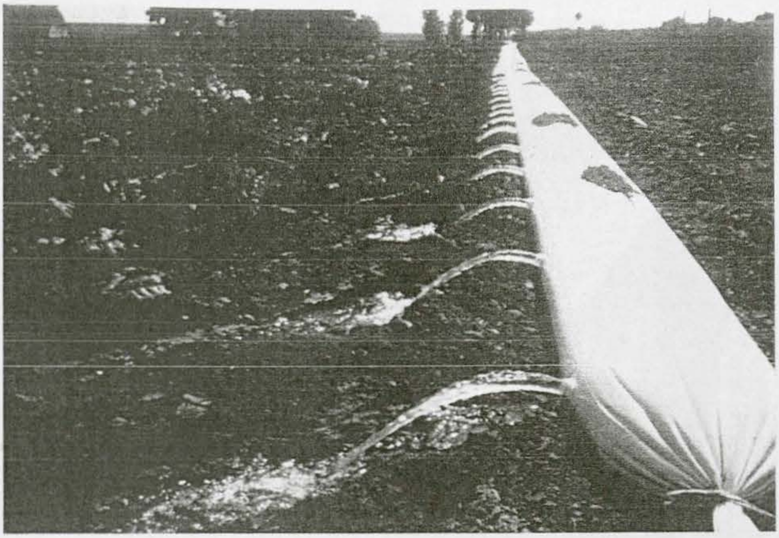


Plate C3.1
Gated Lay-Flat Tubing Used as Header Line to Individual Furrows

Plate C3.2
Gated Aluminium Pipe Used as Header Line to Individual Furrows

Plate C3.3
Individual Syphon Tubes from Concrete Lined Header Ditch to Furrows

Plate C3.4
Individual Syphon Tubes from Earthern Header Ditch to Furrows

3.5.4 Pressurised Irrigation at the Farm Level

The opportunity for the introduction of widespread pressure systems (sprinkler and drip) is currently limited in the GAP Region. Nevertheless, the Project should encourage the adoption of these water efficient measures wherever possible. Farmers will primarily be conscious of the cost commitment involved, and possibly of social factors such as the need for night irrigation (with sprinklers) during windy periods. However the project should actively educate farmers in the benefits of these systems, such as:

- lower water usage, especially if realistic water charges are being set and applied.
- minimum weed problem with consequent savings in weeding costs
- better water application control, leading to more consistent and higher quality yields with implications for better market prices.

Efforts should be made to identify about 50ha within each Pilot Area where farmers are willing to adopt trials of these methods. The Project should encourage equipment manufacturers to make equipment available at attractive rates and brief the GAP Administration on the financial implications. Sprinkler types must be related to crop type; farmers in the region report damage to cotton from higher intensity sprinklers and are therefore reluctant to use them. Low intensity sprinklers may be the answer for this situation and also for night irrigation to avoid the need to move laterals during darkness.

3.5.5 Drainage Measures

Farmers should be made aware that their regular ploughing activities create variations in graded fields with time. This not only creates the non-uniform distribution of irrigation water, but can lead to undrained standing water in fields which can adversely affect groundwater levels by creating perched water tables.

Farmers should also be made aware that uncontrolled runoff from furrows to tertiary drains results in the erosion of channel banks with subsequent siltation and increased requirements for maintenance. In some selected areas the project should initiate the monitoring of flows from farms into tertiary drains.

Technical Discussion Paper No 11 (Halcrow 1993) recommends a monitoring and research programme into groundwater levels and salinity, salt accumulation in soils, and the effectiveness of sub-surface drainage systems in swelling clays. The Project, through the proposed OFWME, should encourage and liaise with the University of Çukurova to instigate this programme within the project Pilot Areas.

3.5.6 Trials and Monitoring

(a) Furrow Irrigation

The Project should actively pursue and involve farmers in trials of water use efficiency for furrows of different alignments, lengths and slope under different soil conditions. Recommended furrow lengths are extensively covered in the literature, but final decisions on the best configurations can only be made under site specific conditions.

Farmers should be introduced to the concept of long closed furrows in flat areas (up to 0.5%) or shorter open furrows with intermediate farm ditches in steeper lands.

(b) Monitoring

Apart from the monitoring programme referred to above, the project should monitor soil moisture and hydraulic conductivity in a selected number of locations. These should be at locations where trials into different furrow lengths are being carried out.

3.6 Drainage Water Reuse

Existing field irrigation systems at present have very little provision for dealing with excess irrigation water at the tail-end of fields. Some drainage water reuse is presently practised, but there is often wastage of water through ponding in local depressions or behind field boundaries. For optimising the water resources provision should therefore be made for a more formal field drainage system to collect the drainage water and dispose of it, ideally for reuse within the irrigation system, as described above for the farm or tertiary level.

At the secondary level, check structures could be constructed at strategic locations across the secondary drains. This would allow drainage water to be diverted back into the secondary canals at a lower command level down the system. On the steeper lands this could be achieved by gravity, otherwise pumping would be required. This mixing of drainage and irrigation waters would mitigate the adverse effects of applying saline water to downstream fields. An example of such reuse is proposed under the Su-iş project for the downstream end of the Urfa canal system in the Harran Plain. This proposal is for a series of pumping stations to lift water from the drains into a canal to command the lower part of the Harran Plain (Su-iş Proje 1992).

Several GAP irrigation schemes are located adjacent to each other within the same drainage basin which would allow drainage water from the upper scheme to be reused in the downstream one. This drainage water could be diverted from the natural drainage channels by check and offtake structures or by pumping where the main conveyance canal of the downstream project passes over the drain. Alternatively excess irrigation water could enter the lower project canals directly from the tail escapes at the end of the upstream canal system. Schemes which could benefit from this form of reuse are:

- upper sections of Mardin-Ceylanpinar taking drainage water from Bozova and Siverek-Hilvan projects

- Batman right bank taking drainage water from Batman-Silvan project.

3.7 Conjunctive Use of Groundwater and Surface Water

Aquifer management is required to optimise the drawdown and yield in the aquifer with respect to its storage capacity. This will maximise the drainage water and storm runoff that is induced into the aquifer because of drawdown. This applies particularly to those aquifers which are unconfined and have a large storage potential such as those within the Ceylanpinar plain. On the other hand the groundwater resources of the Harran plain are already exploited to a very large extent and there is little potential for further extractions from this source.

To operate such a management procedure effectively, the areas where fully saturated groundwater conditions occur along the natural drainage channels or newly constructed drains will need to be defined. The response of the aquifer to pumping will also have to be fully understood. It is recommended that the implementation of this form of groundwater manipulation be undertaken in phases. The expansion of well fields within an irrigated area is dependant upon the successful balance between effective drawdown and maximising the aquifer yield.

A practical constraint arises due to the need to install a large number of wells to abstract the required quantity of water. In the case of the Ceylanpinar it is estimated that about 2,500 wells with discharge capacity of 40 l/sec could be required to provide sufficient groundwater to supplement surface resources in the proposed irrigation areas.

The groundwater conditions in the Harran and Ceylanpinar basins, which are the most significant ones in the GAP region, are fully discussed in Technical Paper No 16 (Halcrow 1993).

3.8 Other Improvements to Surface Irrigation

Land levelling, using modern laser controlled levelling techniques, enables the final field grading to be very precise, particularly where large earth moving equipment is used. It is recommended that land levelling be undertaken prior to the commencement of irrigation, and in such a manner that the land is levelled to its best condition with minimal overall earth movement and exposure of sub-soil. According to the existing topographic situation this could involve the formation of:

- on the steeper land (>3%), level or graded terraces
- on less steep land (1-2%), fields with uniform slope for furrow or border strip irrigation
- on shallower sloping land (<1%), level basins or uniformly graded fields.

On completion of the land levelling and respreading of topsoil the farmers' land would be immediately ready for irrigation. It would then only require land smoothing operations to be undertaken by the farmer after each cropping season to maintain a uniform land profile within the field. Efficiency of water use would thus be maintained.

SECTION C

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SECTION D

DRAINAGE CONSIDERATIONS

SECTION D - DRAINAGE CONSIDERATIONS

CONTENTS

SECTION D - DRAINAGE CONSIDERATIONS

1 DRAINAGE IN THE GAP REGION

1.1 Introduction

The purpose of this section of the Identification Report is to review the provisions for drainage included in the main GAP irrigation schemes and indicate the potential for improving overall drainage performance (and hence overall irrigation efficiency). Some of the schemes have been constructed or are under construction. Others are still at the planning stage.

A brief review of the standards currently adopted for drainage planning and design is given below in this chapter. Chapters 2 and 3 discuss the drainage situation for irrigation schemes in the GAP region, with particular attention being given to the Urfa-Harran Plain (Chapter 2) and the Devegeçidi and Çınar Ğöksu schemes (Chapter 3). There then follows in Chapter 4 a review of the potential for water re-use and the factors affecting disposal of drainage water. Chapter 5 discusses the operation and maintenance aspects of the drainage facilities and reviews the feasibility of making a charge to farmers for drainage services. Conclusions and a summary of the recommendations are given in Chapter 6. Further information on drainage issues is given in Technical Discussion Paper No 11, Drainage Requirements.

1.2 Overview of Drainage Systems

In the GAP region it is estimated that 22,000km of open drainage canals will be constructed. The purpose of the canals is to collect and convey runoff from spring rainfall as well as excess water from summer irrigation. Drainage systems consist of different levels or orders of drainage canal. The largest unit, the main or primary drainage canal, will generally be located in the lowest part of the project area, along natural drainage lines. This will receive water draining from the next level of drainage canal, the secondaries, and convey it to an outlet point. Main drains and secondaries may also serve to carry water generated outside of the project area to the outlet point. Primary drainage canals are often very large. For example, the primary drain from the Urfa-Harran Plain scheme has a capacity of 80 m^3/s. The secondary drainage canals receive water direct from the tertiary field drains which in turn receive the water from the surfaces of the fields. The tertiaries are generally about 0.75m deep, have a bed width of about 1m and sideslopes of 1:1. In large flat areas such as the Urfa-Harran Plain, they are intended to be spaced at intervals of about 350m and have a length of 1-3km.

The drainage canals will function only as surface drainage systems; that is, they have no direct influence on the depth to water table or the control of salinity. To affect these would require deep subsurface drainage systems. The indirect influence of surface drainage systems on water table and salinity can be considerable, by removing water from the surface which would otherwise have to infiltrate and drain away through the soil profile. There are no current plans to install buried pipe drainage systems in the GAP region.

1.3 Current Drainage Design Practice

1.3.1 Design Procedures

The design of drainage systems for large irrigation schemes is the responsibility of the State Department for Hydraulic Works (DSİ). The drainage design procedures and standards used are set out in a DSİ Design Manual (DSİ, 1988). These have evolved from systems largely developed by the United States Bureau of Reclamation and as such are sound.

Drainage needs are determined at the planning stage on the basis of information on rainfall, soils, irrigation water quantity and quality, depths to water table and groundwater salinity. Key data concerns the depth of the soil, its permeability and the salinity of the groundwater. Generally, sub-surface drainage (buried pipes or deep ditches for water table and salinity control) is not considered necessary if the soil and water table are deep and the groundwater salinities low. Details of the drainage system are prepared by the DSİ design department in Ankara. In due course, after a contract has been let, construction work is supervised by the local DSİ office.

Current DSİ design practice does not provide surface inlets to avoid soil erosion by water flowing into a tertiary drainage canal. Water either stagnates on the surface or flows into the drains in an uncontrolled manner. This results in the formation of gullies in the slopes of the tertiaries and deposits of silt on the beds of the channels. This adds considerably to the burden on maintenance and is a major cause of under performance of drainage systems. The solution is to provide small structures at suitable points to take the water from the fields and lead it through pipes into the tertiary drainage canals.

In-field drainage works including land levelling and the installation of subsurface drainage systems are the responsibility of the General Directorate for Rural Services (GDRS). In-field drainage systems constitute a quaternary level of drainage, designed using updated manuals based on American and European practice.

1.3.2 Calculation of Discharges

The DSİ design procedure requires discharges in the surface drains to be estimated as the sum of surface runoff and percolation. Discharges include consideration of short term storm runoff from within the project as well as from external areas, and also longer duration flows generated within the project area by prolonged rainfalls. The highest estimated discharge forms the basis for design.

Short term storm runoff is determined using either the Rational Formula (catchments under $5km^2$) or the USSCS Mockus method. Discharges generated within the project areas by longer duration rainfalls are determined using the McMath method, a USBR procedure based on a 1 in 10 year rainfall. The highest discharges usually occur during the peak of the irrigation season and include contributions by surface runoff from irrigation, deep percolation from irrigation and losses from canals.

An alternative approach, recommended by the FAO (1980), assumes that for furrow, border strip or small basins, at least 25% of the water applied on the field will percolate. This results in percolation rates which are broadly in agreement with DSİ estimates. GDRS also recommend that the discharges calculated during summer should include all losses from the canal distribution system as well as all losses occurring at the field level. Discharges calculated in this way are very similar to the DSİ values.

1.3.3 Discussion

The DSİ drainage design manual was developed for application in Western Turkey where the rainfall is higher and the temperatures lower. It needs some modification for the more arid conditions prevailing in the South-East of the country. The techniques used to determine drain discharges assume that the soils are at field capacity in spring. This might apply in high rainfall areas and in the Tigris valley such as Devegeçidi where winters are cold. The soils of the southern Urfa-Harran Plain however are only likely to return to field capacity during wetter than average years.

Problems may arise as a result of basing the decision on the need for sub-surface drainage solely on the existing depth to water table and groundwater salinity. In semi-arid areas such as the Urfa-Harran Plain, the natural expectation is that water tables will be deep and groundwater salinities low. Drainage designs should be based on an appraisal of the conditions which are likely to exist after project implementation, taking into account the potential for waterlogging and salinisation.

The drainage design process suffers from the separation between the various parties involved. The planners do not take an active part in the collection of the field data and often may not have visited the scheme. They make the key decisions on the need for surface or sub-surface drainage. The designers then apply the guidelines in the drainage manual in a prescriptive way. Although they have access to extensive data, the accuracy of the data is often insufficient to ensure sound design. The local DSİ office is then responsible for the supervision of the contracts but they are not formally involved in any redesign at the local level. It would help greatly if a resident design team was based on site during construction, to make amendments as required. Another improvement would be to transfer responsibility for design to the regional level, where the actual conditions in the field can be checked easily.

The design of the entire irrigation project from the secondary level down, including the entire drainage system to the tertiary level should be the responsibility of one organisation. At present responsibility is divided between DSİ and GDRS.

2 IRRIGATION PROJECTS IN THE EUPHRATES BASIN

2.1 The Urfa-Harran Plain Scheme

2.1.1 Design

Full details of the drainage design for the Urfa-Harran Plain, including the basic data, have been published by DSİ in a 7 volume report. This includes maps at a scale of 1:25000 of depths to water table (annual maxima and minima), groundwater salinities, the locations of soil inspection pits, boreholes, water table observation wells and the detailed layout of the surface drainage system.

The climate is hot and dry during summer and cool during winter. Annual rainfall varies across the plain from 330mm at Akçakale to 472mm at Şanlıurfa. The clay soils at Akçakale are unlikely to return to field capacity during spring although they are at Şanlıurfa where the rainfall is higher.

2.1.2 Soil Properties

The soils are predominantly clay or silty clay with relatively high levels of calcium carbonate, 40% of all soils having calcium carbonate contents in the range 20-30%. Cation exchange capacities (CEC) of 20-30meq/100gm indicate that the clay contains a relatively high proportion of the swelling clay mineral smectite, otherwise known as montmorillonite. Soil salinities range from 0.5 dS/m in rainfed areas to over 10 dS/m in low lying areas which receive excess water; the exchangeable sodium ranges from 1-30%.

Hydraulic conductivities based on the auger hole method have been obtained for 23 locations in the high water table areas near Harran and Akçakale. These indicate that the K values for the clay soils are moderate to high. An additional 30 tests by DSİ have resulted in K values ranging from 0.2-3.5m/day with an average of 0.98m/day. Inspection of the soil profiles and discussions with Professor Dinç of Çukurova University confirm the impression that the clay soils are unusually permeable. The explanation appears to be due to the existence of some structure in the deeper parts of the soil formed by old root systems, which are stabilised by the high levels of calcium carbonate, aluminium and iron oxides.

Clay soils are generally considered to be very difficult to drain because of their inherently low permeability. Swelling clay soils in particular expand during wetting, especially in the presence of water of low salinity (eg. rain water). Infiltration can virtually cease, making it very difficult to deliver the irrigation and drainage requirement. The soils of the Urfa-Harran Plain appear to have characteristics which will help avoid such problems.

2.1.3 Water Quality

The salinity hazard of the water in the DSİ boreholes currently being used for irrigation is generally rated as being medium to high (C2-C3) and the sodium hazard low to medium. The salinities in village wells tend to be low in the deeper water table areas (1000mg/l) but higher in the shallow water table areas (2,000-10,000mg/l). The salinity hazard of the water from Atatürk is rated as being medium and the sodium hazard low (C2S1).

Recent information has been obtained on the quality of the water impounded by the Atatürk Dam and the groundwater in the deep wells beneath the Urfa-Harran Plain near Akçakale. The data confirm that the quality of the water available from the Atatürk Dam is good. The salt concentration is low and, in particular, is relatively rich in the more favourable ions such as calcium and magnesium and low in the unfavourable ion sodium.

2.1.4 Water Table

In the upper parts of the Plain, in the vicinity of Kısas, the depth to water tables recorded in village wells during 1977 was 10-35m. Soil salinities were low, typically 1000mg/l. West of Harran and in the centre of the Plain, water table levels were 10-17m, but were much shallower, 2-5m, in the flat areas immediately to the South-East. In the lower parts of the Plain, near Akçakale, the minimum depth to water table varied typically from 1-8m and the groundwater salinities from 1,000-17,000mg/l (vicinity of Demirkuyu).

2.1.5 Drain Layout

The Urfa-Harran Plain, flanked by hills to the East and West, slopes down gently in a southerly direction towards the Syrian border. Streams emerging from the surrounding hills lose definition after about 1km. In the upper parts of the Plain near Kısas, slopes are moderate, around 3%, and the natural drainage network fairly well defined. In the South near Akçakale, the land is quite flat, slopes 0-1%, and the natural drainage less well defined.

Main drains have generally been located along the lines of the existing natural stream channels. The original planned length of drains included 90km of main drain, 410km of secondary and 195km of tertiary, encompassing a total area of 119,465 ha. The planned total was thus about 700km, but this has since been increased to 850km, of which 600km of main and secondaries has been completed.

The planned density of tertiaries at under 2m/ha is very low compared to the density of 28m/ha which would be required if the tertiaries were to be installed at the required 350m spacing. This raises the important issue of the mismatch between the planned densities of the irrigation canals (about 30m/ha) and the planned densities of the drainage canals (about 8m/ha). This implies that in practice, large parts of the Urfa-Harran Plain will not be provided with tertiary drains, in spite of the DSİ design guidelines. Such areas will effectively be undrained, with potentially serious consequences.
Blocks of land up to several hundred hectares in extent will have no formal means

of evacuating water to the secondaries. One inevitable result will be that farmers will be forced to make cuts in the secondary embankments to relieve flooding within the lower parts of their areas. This will further add to the problems of maintaining drains. .

Though the major part of the main and secondary drainage systems have been completed, many are silted up or remain to be connected to the main drainage system. The necessary work should be carried out before irrigation releases start to flow.

Surface drain inlet structures are not provided to convey water into the tertiaries, Water will therefore find its own way into the drain, causing erosion of the side slopes and siltation of the drains. This will further increase the need for maintenance. The 0.75m deep drains are shallow and will have negligible influence on water table levels.

It appears that few if any of the planned tailwater escapes, intended to take reject water from the tertiary irrigation canals and return it to the drainage canals, have been provided. This has significant implications for drainage since water will accumulate at the ends of the tertiary canalets and cause problems. Farmers may tend to relieve these by making cuts directly into the secondary or even primary drainage canals. Maintenance access to these drains will be hindered.

2.1.6 Discharges

Check calculations of the drainage discharges that may be anticipated in the Urfa-Harran Plain have been made. The range of discharges at the end of drain D1 include $70m^3/s$ based on short term storms and $22.8m^3/s$ based on the removal of excess rain over a 48 hour period. The peak irrigation season discharges include surface runoff from irrigation, deep percolation from irrigation and canal losses, amounting to 5.83mm/day. The unit discharge of 0.67 l/s/ha results in a peak discharge of about $80m^3/s$ at the end of drain D1.

2.2 Akçakale Scheme

The Akçakale scheme consists of 15,000 ha under irrigation. The main crop grown is cotton with increasing amounts of wheat and barley, both of which are very salt tolerant. The water for irrigation is drawn from groundwater using 314 DSİ operational wells. The salinity of the water from the limestone aquifer is medium to high and the sodium hazard low.

Irrigation has resulted in the development of perched water tables and salinity problems which have been the subject of recent investigations by DSİ. Extensive data are available on the depths to water table and salinities measured in the observation wells.

Prior to 1978, water table levels were moderately deep and groundwater was moderately saline. This indicates that Akçakale is in an area which receives excess waters (surface runoff and/or groundwater flow). These have contributed to the general rise in salinity. The most striking feature since 1978 is the rise of the water table level to heights which are able to support an upward flow of saline groundwater. This has caused secondary salinisation. Areas of land formerly used to cultivate cotton are now abandoned and either bare or occupied by halophytes (plants able to tolerate high salinities). In some cases soil surfaces were darkened by high sodium levels. Trees in surrounding villages had either died or were severely affected by salinity. Bare patches in cotton appeared to be associated with salinity.

Four 3m deep soil pits were excavated in the Akçakale area to inspect soil profiles. All had high clay contents, were well structured and of moderate density (1.4gm/cm^3). Soils were moist due to capillary rise and all contained the remnants of old tree roots. The pits were dug to below the water table and it was obvious from the rapid rate of water entry that the soils were permeable. In some cases water was actually observed to be entering the pits through old root channels.

2.3 Ceylanpınar Scheme

The Ceylanpınar scheme provides irrigation for 442,072ha of land between Mardin and the Syrian border. The land consists of gently sloping hills occupied by deep, light or medium textured soils of moderate permeability. Much of the land is used for dryland farming but some is irrigated using water abstracted from wells located in the unconfined aquifer beneath the area and applied through moveable set sprinklers.

At the planning stage, no problems due to high water tables or salinisation were anticipated. During the field visit, a number of irrigated fields were inspected. The soil textures were, as expected, medium to light and there was no evidence of any drainage or salinity problems. There was also no evidence of soil erosion, partly because of the choice of sprinkler irrigation and partly because of the high infiltration rates. The conclusion in the DSİ planning reports that there are unlikely to be drainage problems at Ceylanpınar thus appears to be correct.

2.4 Discussion

2.4.1 Flooding and Water Table Issues

Practically no provision for surface drainage at the field level has been made for the Urfa-Harran Plain irrigation scheme. Surface water is unable to leave the fields because of the existence of small earthen bunds surrounding each one. Fields adjacent to open secondaries are being drained by spilling water off the surface direct into the secondaries, causing erosion of the side slopes and siltation of the drains.

In the future, it is expected that the land will be graded and either border strip irrigation or long furrow irrigation introduced. Excess surface water will then be able to flow directly to the tertiaries, provided of course that they are installed.

However, because of the absence of surface inlets, this will continue to cause erosion of the drain side slopes and siltation of the drains. Inability to cope with such demands has been a major cause of drainage under performance in other parts of Turkey.

The proposed drainage system will remove the excess surface water generated both by rainfall and by irrigation. The combined discharges from the area wide contributions will be high and it will not be possible to prevent the flow, from rainfall at least, from continuing on into Syria. The lack of an outfall, however, will cause flooding in low lying areas such as Akçakale.

The introduction of irrigation from the Atatürk Dam will result in a general and sustained rise of the water table level in the Urfa-Harran Plain. Because of the nature of the underlying soils, perched water tables will develop, particularly in the lower lying areas which are believed to receive inflows from other parts of the Plain. Experience from around the world indicates that water tables rise at the rate of about 1 to 2m per year, even higher if the irrigation efficiencies are low. Subsurface drainage is essential when the water table begins to enter the rootzone, 1-1.5m.

2.4.2 Salinity Issues

If percolation is hindered, a sustained rise in the levels of soil salinity will result. The less soluble salts will precipitate out in the soil profile, leaving the more soluble chlorides to accumulate until they eventually begin to affect crop yields.

The following table provides an estimate of the time it will take before salinity alone begins to affect yields. This is conservatively based on the assumption that there will be no sustained deep percolation in the clays and that instead salts will accumulate within the upper metre of soil. The soil data is based on soil from the Koruklu Field Research Substation, which has a field capacity moisture content of 46% (volumetric basis) and a saturated paste moisture content of 92%.

The extended time periods shown in the table explain why there are no salinity problems evident in existing irrigated areas within the Urfa-Harran Plain. However, there can be little doubt that the problems currently affecting the Akçakale area of the Urfa-Harran Plain will eventually spread northwards throughout the Plain. Problems will first become apparent in the lower central parts of the Plain and then gradually spread elsewhere.

TIME TO REACH CRITICAL LEVELS OF SALINITY

CROP	ECe VALUE FOR 10% YIELD REDUCTION	YEARS BEFORE CHLORIDES REACH CRITICAL LEVELS
WHEAT	7.4	73
COTTON	9.6	99
TOMATOES	3.5	29
MAIZE	2.5	17
BEANS	1.5	6

Many factors can influence these estimates, beneficial ones being the existence of some deep percolation, and the effect of rainfall and irrigation in washing salts down to the base of the rooting zone. Other factors will have the opposite effect; these include the over application of irrigation, the presence of historical salinity within the soils of the Plain. High water tables are particularly dangerous because they support an upward flow of salt towards the surface which contributes to secondary salinisation.

The water from Atatürk Dam and also from the deep aquifer beneath the Urfa-Harran Plain is of medium quality with relatively low levels of sodium and chlorides. There is no doubt that irrigation, particularly of salt tolerant crops, could continue for many years without the need for a subsurface drainage system, provided that sound irrigation practices are employed. Equally, there is no doubt that the time periods will be much foreshortened if water is allowed to remain on uneven field surfaces for any length of time. Much can be achieved by recognising the important role that surface drainage can have in preventing water from remaining on the surfaces of the fields.

The irrigation of deep permeable soils as at Ceylanpınar will also result in increased deep percolation and a rising water table. In most alluvial valleys, natural drainage is insufficient to cope with the increased percolation and so water tables continue to rise to shallow levels, creating the serious risk of secondary salinisation. A review of groundwater resources in the Urfa-Harran and Ceylanpınar Plains confirms that the sediments at Ceylanpınar overlie an unconfined aquifer. It is therefore probable that the percolation from irrigation will enter and be drained away by the aquifer. In this case salinity and water table control will be provided indefinitely.

2.4.3 Need for Subsurface Drainage

Before high salinity effects on yields become apparent (about 30 years, given good irrigation management), a system of deep (1.8m) buried pipe drains at suitable spacings (10-50m in clay soils) should be installed. Water draining from the pipe laterals will then need to enter a deepened tertiary canal or collector pipe system which will ultimately flow into 3-3.5m deep secondary or main drainage canals. In order to achieve this, the entire drainage system will need to be deepened.

If subsurface drainage is not provided when required, farmers will be faced with increasing difficulties as they attempt to stem the rising tide of salinity. Ultimately, the farmers will be forced to abandon their land. The accumulated salts will then move back towards the surface causing severe salinisation and alkalisation. Reclamation involving the leaching of salts and the replacement of sodium by calcium on the exchange complex will then be needed before the land can be restored to agriculture. An intensive subsurface drainage system is essential if reclamation is to succeed.

Sub-surface drains are unlikely to be needed at the outset in areas where water tables are deep (>10 m) but they are needed now in the shallow water table areas near Akçakale. Parts of this area also need to be reclaimed.

2.4.4 Irrigation Management

The most common cause of drainage problems in irrigated areas is inefficient irrigation practice at the field level. Factors contributing to this are poorly graded fields, inexperienced irrigators, inflexible delivery systems and poor standards of maintenance.

The best solution in these circumstances is to improve irrigation practices before drainage problems occur. The need to install a very expensive subsurface drainage system may be deferred or even avoided entirely if good irrigation management practices are employed.

3 IRRIGATION PROJECTS IN THE TIGRIS BASIN

3.1 Devegeçidi Scheme

The Devegeçidi scheme has a gross area of 8,040ha and a net irrigable area of 6,900ha. It lies at an elevation of 580-730m and has an annual rainfall of 474mm. In the planning report, it was recognised that parts of the area were steeply sloping and unsuitable for irrigation. Other parts contained large quantities of rocks (up to 250m^3/ha) within the soil profile or the soils were thin, overlying bedrock.

Devegeçidi is typical of projects in the Tigris basin which experience hot dry summers and cool or even cold winters. The low evaporation rates during winter in combination with the rainfall, will ensure that the soil moisture returns to field capacity. This probably occurs during February, with soils remaining wet until sometime in April. Excess rainfall during this period will be about 130mm, a figure coincidently confirmed by the 130mm of runoff into the Devegeçidi barrage.

At the planning stage, it was recognised that over 60% of the area was occupied by swelling clays. A fifth of these were thinner than 1.2m but rested on permeable gravels. Of the 14,323ha investigated, 1% contained class 1 soils, 47% class 2 and 16% class 3. Class 6 soils, considered unsuitable for agriculture, occupied the remaining areas.

DSİ monitoring of depth to water tables during 1991 had indicated that localised high water table levels existed around the villages of Güvenderen (canalets Y1, Y9 and Y8), Güzelköy (Y9) and Başlık (Y7). The farmers at Güvenderen confirmed the localised nature of drainage problems which they said influenced their ability to cultivate crops such as vegetables. One poorly drained area adjacent to the canal was caused by backslopes which had hindered natural drainage. Generally, however, there did not appear to be any serious drainage problems.

Canalets in secondary canal Y12 were leaking very badly, particularly at the joints. Because of the strong slopes, escaping water was flowing on downslope and either being returned to the canal or diverted to the fields for irrigation. Without exception, farmers had aligned their furrows straight down the main slope. Their upper sections were very badly eroded whilst their lower sections were partly submerged in eroded sediment. One farmer confirmed that erosion was a matter of great concern.

The electrical conductivities of water in the DSİ observational boreholes varied from 0.7dS/m to 1.6dS/m. The values are low and indicate that there are currently no salinity problems.

3.2 Çınar Göksu Scheme

The Çınar Göksu irrigation scheme, east of Diyabakır, is currently under construction. It consists of left and right bank canals supplying water to 3582ha of land on the flanks of the valley. Prevailing slopes are steep to moderate (up to 12%). The climate is broadly similar to that at Devegeçidi, with soils returning to field capacity in February, the excess then draining away either by surface runoff or by groundwater seepage.

The main canals follow the contour and there is no provision for cross drainage. Overland flow will convey sediment into the main canals, increasing the need for cleansing before the start of the irrigation season. Provided that this is accepted, using the irrigation canal to intercept surface runoff in this way is practical.

The most serious drainage problems in this project will be caused by soil erosion. During winter, the land will contain either cereals or be left bare, awaiting the planting of summer crops. It will be at its most vulnerable from erosive rainfall during spring.

Surface irrigation should be supplied in a non-erosive manner, for example in a concrete lined or similar channel. Application to the field should either be to short furrows on terraced land, or to furrows laid out across the contour on a non-erosive grade. Provision should be made to intercept the excess irrigation or runoff at the end of the furrows and convey it away in an erosion control waterway. Such facilities are not currently included in the scheme.

Irrigation will introduce salts into the soil which be must leached away if they are not to accumulate. This will either happen naturally by percolation down into the underlying formations or by downslope seepage; the latter resulting in the formation of localised areas of high salinity. Generally, there should be no problems with high water tables because of the tendency for sloping lands to shed excess surface water.

3.3 Batman Scheme

The Batman irrigation scheme is still at the design stage. It has a gross area of 51,903ha and a net irrigable area of 47,439ha. The project consists of a series of plains at elevations varying from 540-750m. The slopes are generally 0-2% but with some steeper areas, up to 12% slope. The annual rainfall is 481mm and the open water evaporation 2010mm. The irrigation water from Batman Creek is of high quality, low in sodium and with an EC of 0.1dS/m.

The soils are derived from calcareous marls and schists. Approximately 38,311ha of the area is occupied by swelling clay soils but most are underlain by sandy soils, usually encountered at depths of 0.35-1.5m below the surface.

Generally, the soils are regarded as being deep and permeable; drainage problems are not expected. Monitoring of water tables and groundwater salinities during 1991/92 in 7,600ha of irrigated land has indicated that the maximum water table depths in over 90% of the land exceed 2-3m below the surface; low groundwater salinities (2dS/m) also appear to confirm the impression that there are no significant drainage problems at the present time.

3.4 Discussion

Many of the projects in the Tigris basin occupy hilly land where there are severe risks of soil erosion. Farmers everywhere appear to be irrigating straight down the main slopes. In extreme cases, sediment had submerged and destroyed the crops at the foot of fields.

One solution to the problem of erosion is to restrict the length of furrow for a given slope. A second is to align furrows across the contour on a shallow non-erosive grade. A third is to terrace the land. The last two solutions, require the provision of waterways to intercept and lead the excess water safely down the slope.

Systems in use in other parts of the world include the use of graded channel terraces. These comprise a shallow channel on the downslope side an earthen embankment, designed to intercept water at the end of the furrows and convey it away on a non-erosive grade (about 0.4%) to waterways aligned straight down the main slope, spaced at intervals of about 300-400m. The waterways must either be shallow and wide, or narrow and deep, but if the latter they need energy dissipation structures.

The secondary canalets at Devegeçidi were in a very poor condition, possibly reflecting some of the inherent difficulties of applying the system of canalets to strongly sloping land. Leaks invariably result in flow taking place directly beneath the canalet, contributing to a weakening of the canalet support foundations, and their eventual collapse.

4 THE RE-USE OF DRAINAGE WATER IN THE URFA-HARRAN PLAIN

4.1 Suiş Proje Approach

The report by Suiş Proje published in 1992 concluded that there would be insufficient water from Atatürk Dam to irrigate the entire Urfa-Harran Plain. A detailed study of the water resources was undertaken, taking into account including groundwater and the possible re-use of drainage water. (Table D4.1)

The resulting water balance is shown in Table D4.2. 1,595 10^6m^3 of water is used for irrigating 145,713ha of land, plus a further 44 10^6m^3 released to Syria. To meet the requirements, 1,219 10^6m^3 comes from Atatürk Dam, 253 10^6m^3 from groundwater and 123 10^6m^3 from re-use. Groundwater would be abstracted from about 1,800 wells. The drainage would be collected by five new diversion structures and conveyed to new pumping stations where it would be lifted back into canalets to irrigate the lower parts of the plain.

Little information is given in the Suiş Proje report about the quality of the drainage re-use water, other than the statement that its quality will change from C2S1 to C2S2 (0.25-0.75dS/m, SAR <8 to SAR <16).

4.2 Re-Use Options

The impact of re-use on the quantity and quality of water draining from the Urfa-Harran Plain has been modelled by the MOMJV consultants. The options include no re-use and the re-use of 25%, 50% and 75% of the drainage. Based on recent estimates of irrigation demand made by the MOMJV consultants, the model assumes that 2,200 10^6m^3 of water will be required for irrigation between March and November. The major part of the water will be met by the Atatürk Dam, with a fixed quantity of 253 10^6m^3 being taken from groundwater in accordance with the estimates prepared by the Suiş Proje.

The policy of re-use finally adopted will depend upon the way in which irrigation and crop patterns develop within the plain. Table 4.2 provides an indication of the impact of some of the options. It should be borne in mind that the model takes no account of the complex chemistry taking place between the application of salt with the irrigation and its eventual drainage from the plain at the outfall, in particular, the effect of precipitation of the less soluble carbonates and sulphates. The data can best be considered as representing the worst case, which might be expected to exist when the project reaches full development and reaches a chemical equilibrium.

4.3 Drainage Quantities and Qualities

Subject to these qualifications, the findings indicate that there are considerable advantages in re-using as much drainage water as possible. Without re-use, the total quantity of water released from the Atatürk Dam will have to be 1,960 10^6m^3,

TABLE D4.1 MONTHLY RELEASES OF WATER FOR IRRIGATION

SOURCE	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	TOTAL
ATATÜRK	25.20	130.90	265.60	299.40	274.70	66.00	47.70	9.24	1219.0
RE-USE	1.34	11.23	28.06	36.61	29.03	14.23	2.55	0.49	123.0
WELLS	-	-	61.77	127.64	63.83	-	-	-	253.0
DRAINAGE	1.37	3.69	9.51	12.19	9.51	4.72	2.74	0.41	44.0

All quantities in $10^6 m^3$ Source: Tables 7-9, Suiş Proje (1992)

TABLE D4.2 ANNUAL DRAINAGE QUANTITIES AND QUALITIES WITH RE-USE

ANNUAL QUANTITY AND QUALITY ESTIMATES		
Salt concentration of Atatürk water		241 mg/l
Salt concentration of groundwater		426 mg/l
CASE 1: NO RE-USE	Water Quantities ($10^6 m^3$)	Salinity (mg/l)
Dam Release	1960	241
Groundwater	253	426
Drainage	885	655
CASE 2: 25% OF DRAINAGE RE-USED		
Dam Release	1760	241
Groundwater	253	426
Re-used Drainage	201	661
Drainage at Outlet	684	777
CASE 3: 50% OF DRAINAGE RE-USED		
Dam Release	1580	241
Groundwater	253	426
Re-used Drainage	367	666
Drainage at Outlet	513	952
CASE 4: 75% OF DRAINAGE RE-USED		
Dam Release	1440	241
Groundwater	253	426
Re-used Drainage	508	671
Drainage	372	1221

leaving 885 10^6m^3 to drain from the Plain. The average salt concentration of the drainflow will be 655 mg/l, roughly corresponding to an electrical conductivity (EC) of 1dS/m. Water of this quality is widely used throughout the world to irrigate crops.

If 50% of the drainage water were to be re-used, a realistic target in the medium term, the diversion from the dam could be reduced to 1,580 10^6m^3. The water requirements would then comprise 1,580 10^6m^3 from the dam, 253 10^6m^3 from groundwater and 367 10^6m^3 from drainage. The salt concentration of the drainage water re-used for irrigation would be 666 mg/l, roughly equivalent to an EC of 1dS/m. This would have to be used with care to avoid a build up of salts. The water draining finally from the Plain would have been reduced in quantity to 513 10^6m^3, and its salt concentration would have increased to 952 mg/l.

In the case of 75% re-use, the diversion from the dam could be reduced to 1440 10^6m^3, again taking 253 10^6m^3 from groundwater, 508 10^6m^3 from drainage at a salinity of 671 mg/l, leaving 372 10^6m^3 to be disposed of at a salt concentration of 1,221 mg/l, roughly corresponding to an EC value of 2dS/m. This water is very saline and would either have to be used in intensively drained land with salt-tolerant crops, such as cotton, or for agro-forestry, again using salt tolerant tree varieties.

The quantities and the qualities of the water draining during July, the peak month of irrigation, have also been determined because these have a direct bearing on the capacity of the drains. The results indicate that the peak discharge during July without re-use would be 73 m^3/s, decreasing to 57 m^3/s for 25% re-use, 43 m^3/s for 50% re-use and finally 31 m^3/s for 75% re-use.

The peak total monthly drain discharge with 75% re-use is 83 10^6m^3 with an overall salinity level of 1,221 mg/l. If this were to be collected and returned to the Euphrates at Karkamış, and assumed to be flowing at 500 m^3/s with a salinity level of 241 mg/l, the effect would be to raise the salinity of the river to 380 mg/l. The findings represent the worst case by assuming that all of the salts contained in the irrigation water drain through the system.

4.4 Discussion

There are three main reasons for re-use of drainage water: a reduction in the quantity of water needing to be abstracted from Atatürk Dam; a reduction in the magnitude of the disposal problem; and a greater than expected reduction in the salt load to be transferred downstream.

Elsewhere, particularly in the United States, irrigation practices aimed at reducing the net discharges of drainage have been found to result in a significant decrease in the quantities of salts needing to be transferred downstream. Part of the reason for this is the increased precipitation of less soluble salts which efficient irrigation promotes.

Factors helping to moderate salinity include:

- the irrigation will take some time to develop across the Plain, and as a result drainflow is expected to increase steadily, in line with the increase in irrigated area
- during the early years, the newly irrigated soils will not be saline and will act as a sink in which salts will accumulate
- in practice, more irrigation water of low salinity is likely to be rejected than intended because of the system of 24 hour flow and the difficulties of irrigating at night
- some of the less soluble carbonates and sulphates contained in the irrigation water will precipitate out in the soil profile, reducing the salt load to be disposed of.

Factors tending to reinforce salinity include:

- the existence of known saline areas such as near Akçakale
- the probable existence of other areas within the Plain containing historical accumulations of salt.

The impact of uncertainties such as these can only be resolved once the scheme begins to operate by continuous monitoring of the discharge and the quality of the water draining from the Plain.

5 THE DISPOSAL OF DRAINAGE WATER

5.1 Quantities of Drainage

The estimates of the drainflow during the irrigation season indicate that, without re-use, as much as 40% of the water supplied for irrigation will be lost to drainage. This figure accords with experience gained in irrigation projects throughout the world, including Turkey. It is also consistent with the original design estimates prepared by DSİ.

There is clearly a strong argument for re-using all or part of this water. In practice, there will continue to remain uncertainty about the actual quantities involved because of the uniqueness of the situation (clay soils, the possible existence of historical salinity in parts of the area, etc.). Because the problems of disposal and re-use are relatively recent phenomena, there has been little experience regarding methods of solution. A major activity of irrigation management must therefore be to monitor the quantities and the qualities of the drainage waters in order to prepare sensible plans for their re-use.

Without re-use, the quantity of water draining from irrigation at full development between March and November would be 885 $10^6 m^3$, with a peak discharge in July of 73 m^3/s. The average salt content of the water draining is estimated to be 655 mg/l.

With 75% re-use, the total volume of water to be disposed of would be reduced by about 50% to 372 $10^6 m^3$, whilst increasing its salt concentration from 655 to 1,221 mg/l. Experience gained in the United States concerning the disposal of drainage from irrigation indicates that salinity levels do not rise on a pro-rata basis with the reduction in flow; in practice, the water quality is found to be somewhat better than expected.

5.2 Reducing the Impact of Disposal

5.2.1 Factors Affecting Water Quality

The salinity of a river normally increases along its course due to abstractions and return flows of more saline drainage effluents. The proportion of sodium relative to calcium and magnesium will also increase, with magnesium tending to precipitate out within the soils in the irrigation schemes.

Water percolating through the soil, either naturally or to a subsurface drainage system is generally degraded in quality, and in some cases contains high levels of trace elements such as boron, molybdenum or selenium, all of which are likely to be of geo-chemical origin. This is because the introduction of irrigation into a previously dry arid area results in increased percolation which then tends to mobilise resident salts.

5.2.2 Management Options

Management options to reduce the impact of disposal of drainage water include:

- source control of water, achieved by improved on-farm water management
- re-use, involving either direct re-use or blending with fresh irrigation water
- disposal to a suitable outfall.

In the United States, source control has been found to be the most effective and immediate means of reducing disposal problems. Source control is the term used to describe the policy of taking every possible means to reduce the amounts of water which have to be diverted from the primary source (ie. a dam). In its most tangible form, it involves seepage control and on-farm water management (OFWM). Source control results in an immediate reduction in the quantities to be disposed of, as well as reducing the quantities needing to be diverted. Research in the Grand Valley, Colorado demonstrated that such a policy can reduce the net tonnage of salts to be transferred downstream by about 50%. The reduced applications lead to reduced percolation and an increased consumption of shallow groundwater by the crops, a factor which is always ignored in water scheduling. In California, improved OFWM is now the main means of reducing disposal problems.

With re-use, there is a net decrease in the quantities of water which have to be diverted from source as well as a net decrease in the volumes of water which have to be drained. The salinity of the drainage water, however, will rise as the water is recycled, though not on a pro-rata basis. The ultimate limit on the recycling of drainage water will be the salt tolerance of the crops. Fortunately, in the case of plants such as cotton, wheat and barley, tolerance is relatively high.

The various options for re-use indicate that it should be possible to reduce the quantities of water to be drained considerably, a reduction in peak flow rates from 73 m^3/s to 31 m^3/s in July being achieved by a policy of re-using 75% of the drainflow. A parallel reduction in the water needing to be diverted from the Atatürk Dam, from 1,960 $10^6 m^3$ to 1,440 $10^6 m^3$, make this an attractive proposition. There will still be the need to dispose finally of 372 $10^6 m^3$ of water at a peak discharge rate of 31 m^3/s at the outfall of the main drain from the Urfa-Harran Plain.

5.2.3 Disposal Options

The disposal of the final effluent could include the following:

(a) De-Salting

Generally, desalting has been confirmed as being technically feasible but is very costly. In the end, it still leaves the problem of disposal of concentrated brine. The costs of desalting in the United States are between US$ 110-200/1000m ^{3}. This translates into the unrealistic annual figure of several billion US dollars, just for the drainage of the Urfa-Harran Plain and assuming a policy of 75% re-use has been adopted.

(b) Injection

Injection into the aquifers is also a very costly option. The water has first to be cleaned and pre-treated before it can be injected, otherwise the injection wells become clogged. Investigations by DSİ close to Akçakale in 1992 indicated that this would require a very large number of wells; it was not considered feasible from a technical point of view. Injection will also reduce the quality of the water in the aquifer. This method is therefore not recommended.

(c) Diversion to the Euphrates

One possibility is to return the final effluent to the Euphrates at Karkamış, either through a pumping main or along a canal linked by pumping stations at regular intervals. This distance involved is over 100km, with a steady rise of 250m over the first 90km from Akçakale (elevation 350m) and then a drop back to the Euphrates at an elevation of 400m. The section falling back to the Euphrates could be used to generate electricity and thus offset some of the pumping costs.

Provisional cost estimates have been prepared for the case of a pumping main consisting of two 2.5m diameter pipelines. During July, with a peak discharge of 31 m^3/s, the power requirements are 150MW and the running costs US$ 2m per annum. Diversion for the entire 9 months of the irrigation season will involve an annual power cost of about US$ 9m. Taken in conjunction with the high capital costs of such a project, estimated as being US$ 90m (>US$ 700/ha), this option is unlikely to be feasible.

(d) Agroforestry

Disposal of the effluent into forested areas is another possibility, although this still leaves the problem of the final disposal of saline effluent from the forested area. The aim is deliberately to use evapotranspiration from salt tolerant trees to reduce the quantities of water to be disposed of. So far, however, such usage has only been experimental.

900 hectares of land in the San Joaquin valley in the USA have been planted with eucalyptus, casuarina, mesquite and elderica pines in 1985, as part of a programme designed to manage salinity. During the first year the seedlings were irrigated with fresh water but drainage water was used thereafter. It is reported that, after establishment, trees were successfully able to extract moderately saline groundwater. The trees that are

particularly suitable for use in saline areas include: Acacia aurioliformis, Casuarina equisetifolia, Eucalyptus camaldulensis and the Prosopsis species of juliflora, chilensis, alba, tamarugo and cineraria. All of these are able to withstand high levels of salinity as well as alkalinity.

The area of forest needed to evaporate the water remaining after 75% re-use is considerable, 25,000ha, and it still leaves the problem of disposing of 7 m^3/s of highly saline water which will be of very poor quality.

(e) Use of evaporating basins

Evaporating basins have been used in Australia as well as in the USA for the final disposal of saline drainage waters. In Australia, there are two basins having a combined area of 2,000ha. In the USA, 27 facilities occupy a combined area of 4,000ha and provide a total storage of 8,500 $10^6 m^3$. Purpose made evaporation ponds are usually quite small, 10-50 ha. They are normally lined and are often constructed so that flow occurs through a series of cells, evaporating to dryness within the final one. An alternative is to identify a suitable depression and then pump the water from the project area into it, leaving it to stand and evaporate naturally.

There has been concern in the United States about the environmental impacts of evaporation ponds because of the potential for leaks and also because of the accumulation to toxic levels of harmful substances such as heavy metals. There is a danger that, by attracting wildfowl, heavy metals enter the biological cycle; already this has caused severe problems of fertility and deformity at the Kesterton Reservoir in California. This incident led to the enforced closure of all the farmers' subsurface drains. So far, the main response has been to introduce ultra-efficient methods of irrigation (such as drip) to minimise deep percolation. The only other alternative, to convey the water to the sea at San Francisco, is also proving controversial. It is a very expensive option.

The area within the Urfa-Harran Plain which would be needed to evaporate directly the discharges during July, even assuming 75% re-use, is 25,000ha. This far exceeds the area that might be available and so this option is considered unfeasible.

5.2.4 Conclusion

All of the methods of drainage water disposal considered above are considered to be impracticable and/or very expensive for the Urfa-Harran Plain scheme. Some of the methods could possibly be used in combination as part of an integrated package of measures designed to help solve the problem. For example, there could be a combination of re-use, use of forested areas, perhaps located in different areas, evaporation ponds, with final disposal of the very poor quality effluent either to a suitable depression or even to the Mediterranean sea.

The only viable option appears to be to plan for the maximum possible re-use, of the order of 75%, and then leave the remaining drainage water to flow into Syria at the outlets from the Plain. The predicted quality of this water, 1,221 mg/l, is poor but could be improved by mixing with fresh irrigation water.

6 OPERATION AND MAINTENANCE OF DRAINAGE SYSTEMS

6.1 Drain Maintenance .

Regular maintenance is essential if drainage systems are to function properly. A deficiency in maintenance at any point will adversely affect the drainage of the entire area above that point. Regular maintenance is needed to remove weeds which grow rapidly in the nutrient rich waters in the warmth and light as well as to remove rubbish and accumulations of sediment. The sediment, particularly that entering the tertiaries, originates from erosion of the fields, erosion gullies at the points of water to the drains, erosion of the side slopes as well as bank slippages.

One aspect of standard DSİ drainage design which is contributing to the high maintenance requirements is the absence of surface drain inlets to lead the water from the fields into the drains. Under the present arrangements, water finds its own way in, causing erosion gullies in the side slopes and forming silt bars in the beds of the channels. There are two ways to prevent this, the first being the preservation of a permanent vegetated strip between the field and the drain, the second being the provision of an inlet box on the field surface to receive the water followed by a pipe to convey it down into the drain.

The proliferation of simple open cut inlets to drainage canals, made by farmers to evacuate excess water, seriously hampers drainage maintenance programmes by making access along the banks very difficult for equipment.

In the longer term subsurface pipe drains will be required to control salinity; these will also require maintenance. Most problems in buried pipe drainage systems are caused by damaged or blocked outfalls and silted up sections of pipes. Pipes may become choked by the roots of aggressive trees such as willows or poplars or become clogged by chemical slimes. There is much evidence indicating that many problems occur during installation.

A recent DSİ report on maintenance of irrigation systems indicates that up to two thirds of all subsurface drains in the Seyhan Project malfunction. Of these, one third are believed to be not working at all and only one third are functioning as intended. Investigations in the Turgutlu, Nazilli and Seyhan Projects have also revealed that at least half of the permanent structures within the open drainage system were installed at the incorrect level, with a significant number being 0.7m or more out. The result is that it is not possible to prevent the drainage canals from silting up, at least to the invert levels of the structures. This indicates that the supervisory role of DSİ during construction needs to be improved.

Generally it was found that drainage canals were being cleaned at intervals ranging from one to five years. At least half needed cleaning annually because of the excessive amounts of weed and sediment accumulating in them. The maintenance of open drains and pipe drains are skilled operations which require costly equipment operated by skilled personnel. One question therefore which needs to be addressed is to what extent this can continue to be undertaken by DSİ. It could be undertaken by private contractors, or by the Irrigation Authority proposed as the preferred MOM Model.

6.2 Responsibilities for Drainage

It is recommended that the responsibilities for the operation and maintenance of drainage systems within the GAP region should match the responsibilities recommended for the operation and maintenance of the irrigation systems.

The responsibility for the disposal of water from the project should remain, as with its supply, with DSİ. The disposal of water is a matter which has regional and international importance and as such is beyond the scope of the operators of the irrigation system.

Within the irrigation system, the operation and maintenance should be the responsibility of the operating authority, either DSİ or a newly established Irrigation Authority. The new authority should be responsible for the provision of water to the farmers or their representatives and logically should remain responsible for the transfer of drainage from the tertiary level to the outlet point. The policy regarding the re-use of water within the scheme should remain with DSİ because of its wider implications.

The tertiary drainage canals serve the immediate needs of a group of farmers. It is therefore recommended that the proposed Water User Groups (WUGs) be held responsible for their operation and maintenance. In this way, the main beneficiaries will be made aware of, and responsible for, poor drain performance within the unit. The group would also be responsible for arranging for the annual weedcut and the bi-annual desilting. Contractors might undertake this work or, subject to payment, the Irrigation Authority or DSİ.

Quaternary field drainage systems, comprising shallow field canals plus, in the future, buried pipe drains, should remain the responsibility of the farmer, both for raising the necessary finance for their installation and subsequent maintenance. Advice and assistance should be made available through the extension services and/or GDRS.

A major difficulty will arise when the time comes to install buried pipe drains. There will first be the need to deepen the entire primary, secondary and tertiary drainage network in order to allow subsurface drains to be installed at a suitable depth, 1.5-1.8m. The secondaries and primaries are likely to need deepening to about 3-3.5m. Buried pipe drains are very expensive and there will be a great temptation amongst farmers to avoid installing them until the situation becomes critical. In Europe, it has generally been found that the only way to persuade farmers to install buried pipe drainage systems is for the government to provide assistance. This may take the form of freely available advice, as well as a direct contribution to the costs of the work.

The Water User Groups may choose to replace all of their tertiary drainage canals by closed collector pipes, as is the practice elsewhere in Turkey. This has the advantage that it considerably reduces the burden of maintenance. Simultaneously, it would be sensible for farmers to install subsurface pipe drainage, although this could remain a matter for the individual farmer. Farmers choosing to connect their pipes to the collector at a later date would be obliged to meet conditions laid down by the Water User Groups.

6.3 Drainage Charges

Experience has indicated that, if it is difficult to persuade farmers to maintain and pay for irrigation, it is even more difficult with drainage. The unpalatable truth is that drainage is usually out of sight or else is considered a problem for someone else to deal with downstream.

The beneficiaries of the irrigation should be expected to pay for the services provided, including drainage. DSİ or the proposed Irrigation Authority should ultimately pass on the full cost of maintaining the primary and secondary drainage systems to the Water User Groups, possibly as part of a standing charge.

In theory, DSİ should also be reimbursed for the costs of disposal of the drainage water. This might be included as part of the overall charge for water. It could instead be regarded, at least in the medium term, as being a duty of Government.

It is in everyone's interest to maintain the value of the irrigation system, but this will require the active participation of the farmers. If farmers are expected to contribute to the costs of drain installation, they will be that much more aware of their value and of the need for maintenance. The worst situation would be for Government to pay for all of this work, for then Government would be expected to maintain it indefinitely.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 The Effect of Irrigation

Under natural conditions, most of the annual rainfall will replenish the soil moisture and subsequently be evaporated or transpired by vegetation. A proportion will run off and some will percolate to the water table. Based on experience, percolation is likely to be about 10-15% of the annual rainfall. The depth to water table reflects the balance between the input of percolation and the lands natural drainage capacity. Water tables in semi-arid regions are generally encountered at depths in excess of 10m.

The introduction of irrigation will result in a significant increase in the depths of water applied (1500mm for cotton) and a parallel increase in deep percolation rates (150-300mm per year). Experience has shown that the natural drainage of flat plain areas is frequently unable to cope with the additional percolation; the existence of heavy clays such as in Urfa-Harran Plain makes this a real possibility. In such cases, water tables rise to such shallow depths that capillary rise and evaporation are able to balance out the deep percolation.

Unfortunately, capillary rise transports salts towards the surface, causing what is termed secondary salinisation. In the absence of buried pipe drainage, this insidious process will eventually lead to abandonment of the land.

7.2 Identification of the Need for Drainage

In their planning reports, DSİ determine the need for drainage based on the existing depths to water table under dryland conditions, the depth of soil and the quality of the existing groundwater. A large amount of data is assembled before a project is begun but the design procedures are then often applied in an unimaginative way.

The division between the field data collection teams, the planners and designers in Ankara and the failure to use resident design teams to modify designs, all contribute to a unsatisfactory approach to soil and water management. A survey of completed irrigation schemes in Turkey also supports the view that standards of construction are poor, partly as a consequence of inadequate supervision.

7.3 The Effect of Low Irrigation Efficiencies

The greatest single cause of drainage problems in irrigation schemes is poor irrigation practice. In particular, low field application efficiencies increase the amounts of percolation and accelerate the process of salinisation. Typical field application efficiencies in Turkey are rather low by world standards.

The depth of water which must be drained in order to provide salinity control is small. It is usually exceeded considerably by the inevitable losses which occur, particularly under surface irrigation. The important skill in managing an irrigation scheme successfully in semi-arid areas is to minimise the depths of deep percolation by improved field irrigation practices. Improved field efficiencies will significantly reduce percolation rates and thus delay the time when sub-surface drains need to be installed.

It is of first importance that GDRS should complete the land consolidation and the grading of the land in the Urfa-Harran Plain so as to allow improved methods of irrigation to be introduced. Secondly, DSİ should arrange for the tail escapes at the ends of the canalets to be constructed. As a temporary measure, these could serve as surface water inlets to provide an escape for excess water from within a tertiary unit. Finally, DSI should arrange for the installation of the tertiary drains on a one per tertiary unit basis to be completed.

Without these measures, runoff due to rainfall will remain on the surfaces of fields and collect against the embankments of the secondary drains in the lowest parts of the area. Farmers will be obliged to make unauthorised cuts in the embankments to evacuate it. Excess water from the irrigation of fields will gravitate to fields further downslope and in a random way contribute to raising the level of the water table. The omission of the tail escapes will lead to localised problems of waterlogging at the end of the canalets and contribute to premature failure of the canalets.

7.4 Irrigation of Sloping Lands

Irrigation of sloping land areas, especially of heavy soils, will result in losses of water due to runoff from the ends of the fields, plus some deep percolation. On strongly sloping lands, infiltration can occur only during the actual time of irrigation; the combined effects of limited time for infiltration and the removal of excess water helping prevent the over irrigation which tends to occur in flatter areas.

The penalty for irrigating on steep slopes is the considerable soil erosion, which is frequently occurring. DSİ appear to make no attempt to combat soil erosion, regarding this as an operational matter to be resolved by others at a later date. This incomplete approach to the problem of soil and water management is unsatisfactory.

7.5 Hydraulic Conductivity and Drain Spacing

The costs of a sub-surface drainage system required in the future will be largely determined by the depth and the permeability of the soils. Clay soils are generally regarded as being very poorly permeable but in the case of the Urfa-Harran Plain, this does not appear to be the case. Almost certainly, the moderate hydraulic conductivities reflect the influence of root channels.

Research programmes should be started as soon as possible to determine the effectiveness of buried pipe drainage systems in the swelling clay soils. Although conditions appear promising in the Urfa-Harran Plain, such may not be the case elsewhere. The drainage of irrigated clay soils presents one of the greatest challenges in irrigated agriculture today. The problem is not so much a technical one as an economic one, as the spacings often need to be very close to be effective, 10m not being uncommon. The drainage systems are likely to cost several thousand US dollars per hectare and be uneconomic. It is important to recognise that drainage of these soils is likely to prove difficult. The results of reliable research will be invaluable when decisions have to be taken.

Research into drainage methods should be undertaken only by an experienced team of researchers, such as exists at the University of Çukurova. The team there has both the necessary understanding of the complexities of soils and considerable experience of similar irrigated soils in the Seyhan project near Adana.

7.6 Monitoring

DSİ has a good policy of monitoring the depth to water tables and groundwater salinities on all projects using observation wells installed on a 1 per 100ha basis. These are read monthly and the data used to identify the critical highs and lows. In practice, it appears that in places the density of observation boreholes falls far below the minimum required. The monitoring of water tables and salinity levels is perhaps the most important tool for drainage management in the GAP region. It should be maintained on the same basis using the recommended density of boreholes.

Research programmes should be started to establish the pattern of salt and water movement in the soils after irrigation. In particular, they should establish if and where salts are accumulating and provide some guidance on the rates of deep percolation. Such studies need to be carried out in the clay soils of the Urfa-Harran Plain, the clay soils of the hilly project areas such as Devegeçidi, as well as the more permeable soils in areas such as Hancağiz and Ceylanpınar.

7.7 Re-use and Disposal of Drainage Waters

The most difficult problem facing projects adjoining the Syrian border are the lack of suitable outlets for the drainage water. Drainage will occur in spring due to rainfall and in summer due to irrigation.

Spring discharges will be high and there is no realistic way that this water can be prevented from moving downslope into Syria. The lack of an outfall will result in flooding of the low lying border areas. The quality of the runoff in terms of salinity will generally be good, except in areas where there are contributions of polluted water from urban areas.

The disposal of water from summer irrigation presents greater difficulty. In the early stages of development of a project such as the Urfa-Harran Plain, the excess will be composed of tail water from fields plus rejection flows from canals. Quality should be satisfactory. Later, the drainage will begin to contain salts, quality will deteriorate and adversely affect the environment.

Consideration of re-use has shown that this is feasible and also desirable. A policy of re-using as much of the drainage water as possible is recommended. Not only will this significantly reduce the amounts of water needing to be abstracted from the Atatürk Dam, but it will also reduce the problems of disposal at the outfall.

For disposal of drainage waters, consideration has been made of desalination, injection to the aquifers, disposal to sacrificial areas of salt tolerant woodland, disposal to evaporation ponds, and return of the water back to the Euphrates. Desalination is far too expensive to justify further consideration. Injection to the aquifer is also very costly because of the need to clean the water before injection. Moreover, tests indicate that it is not technically feasible in this area. Disposal in forests is technically feasible but requires a large area to be effective (>20,000ha). It also leaves the problem of the final disposal of very salty water to be dealt with. Evaporation basins also require a large area and there is also the potential for groundwater pollution by the brine. The final option of returning the effluent from the Urfa-Harran Plain to the Euphrates is also very costly. Furthermore, this would cause a rise in the salinity level of the river in the range 240-380mg/l.

The methods considered singly are not particularly promising but they could be used in combination as part of an integrated package of measures designed to help solve the problem. A possible viable combination would be: re-use for irrigation, disposal to forested areas, the use of some evaporation ponds, with final disposal of the poor quality effluent either to a suitable depression for final evaporation or, if the discharges are small enough, even to the Mediterranean sea. Further studies are needed to refine the costs and the technical feasibility of the various options.

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SECTION E

ENVIRONMENTAL IMPLICATIONS

SECTION E - ENVIRONMENTAL IMPLICATIONS

CONTENTS

1 INTRODUCTION

1.1 Background

The GAP project will involve construction of 22 dams, 19 hydro-electric power stations, and the irrigation of some 1.7 million hectares in a semi-arid area of the country where already over 3 million hectares is cultivated. The introduction of irrigation to over half the existing land will bring beneficial and adverse environmental effects, which have to be manipulated to maximise benefits with minimal damage to the environment.

The main benefits of widespread irrigation and hydro-power development are:

- flood control and use of flood water that would otherwise have been wasted
- increased incomes
- economic and infrastructural development in the region
- improvements in nutrition levels
- improvements in livestock welfare.

Adverse environmental impacts can be reduced to a greater or lesser extent by a series of mitigation measures, such as:

- management strategies to ensure efficient scheme operation and maintenance
- training for managers, operators and farmers
- technical solutions
- integrated regional planning, including watershed planning, resources planning and environmental health planning.

The management strategies and technical solutions are relatively straight forward to put in place and could significantly reduce adverse impacts such as those related to the overuse of water or the need for drainage installations. Those mitigation measures which depend on training and integrated regional planning are more difficult to undertake as they depend on the co-operation of the farmers and other organisations.

Considerable environmental impacts are expected as a result of :

- damming and regulating rivers, resulting in reduced flows, changes in downstream water quality, ecology and river morphology, and inundation of ecological and cultural heritage sites

- on-field irrigation, which can lead to rising groundwater tables, saline drainage and groundwater contamination, ecological changes and environmental health problems

By identifying potential environmental impacts it is possible to identify the need for mitigation measures, which can then be planned and implemented at an early stage. If this is not done irrigation may lead to adverse environmental impacts which, by the time they occur and have been identified by the authorities, are very costly or impossible to mitigate. In the worst cases this will lead to falling yields and the abandonment of agricultural land. An environmental impact assessment can identify at an early stage the strategy required for sustainable development with minimum disruption to the environment.

1.2 Environmental Impact Studies in the GAP Region

Environmental studies have been started for the Euphrates Basin by the MOE, and for the Tigris basin by Dicle University, funded by GAP. The former started three months ago (late 1993), the latter one year ago.

The studies will be undertaken in a three year programme; year 1 is a desk study to provide background data; year 2 is intended to allow a monitoring programme to be developed and field tested; and year 3 is intended to allow the monitoring system to be installed. The year 1 report by Dicle University has been prepared, and covers Diyarbakir, Mardin, Batman, Siirt and Sirack. A new contractor will take over this work from March 1994.

The studies will cover environmental pollution of water, air, noise and soil. Pollution maps are required, and full flora and fauna lists. The effects of the regional transportation and infrastructure plan is to be studied. A feasibility study for an environmental M&E programme is required, giving technical, institutional and equipment requirements. Measures and policies to overcome identified problems are required.

Environmental monitoring for the GAP-MOM study will make use of the outputs of these studies where possible.

2 POTENTIAL ENVIRONMENTAL IMPACTS DUE TO IRRIGATION DEVELOPMENT

2.1 Hydrology

2.1.1 Low Flow Regimes

Impoundment and abstraction of river water alters river regimes over considerable lengths and dampens natural discharges. The effects of this will not only be felt in Turkey, but in downstream Syria and Iraq. International agreements to maintain downstream flows are taken into account in the water resource study currently being undertaken to assess the balance between hydro-power and irrigation needs. Low flow regimes will also have adverse effects upon irrigation, especially if shortfalls occur during peak irrigation demand between June and September, affecting crop yields and economic value.

Reservoir construction significantly affects flood regime control by the storage of excess flow, thus preventing flooding. This also makes the downstream development of the fertile flood plains more secure and predictable.

The operating rules within irrigation projects give the opportunity to maximise the use of water resources by flexible manipulation and to effect flow compensation, balancing low flow against high flow. This requires detailed analysis and models developed to balance flows for optimal storage and usage.

2.1.2 Water Table Falls

Water table falls and deficits are already recorded in both the Harran Plain and in the Ceylanpınar aquifers due to the extraction of groundwater, although the latter is considered slight in the context of aquifer size. Recharge resulting from new irrigation water will help to alleviate and reverse aquifer drawdowns, but continuing use of aquifer water will be required in conjunction with use of new reservoir water and will need to be continually monitored.

2.1.3 Water Table Rise

Water table rise or the development of perched water tables can result from over irrigation, especially where provision of subsurface drainage is poor or non-existent. The dangers in a semi-arid environment are that salinisation will occur when water tables rise resulting in the reduction in productivity and eventual abandonment of land for agricultural purposes. Predictable water table rises must be monitored and controlled before damage occurs, and the necessary drainage measures put in place in the early stages in advance of problems arising.

2.2 Pollution

2.2.1 Solute Dispersion

The impounding of waters for irrigation inevitably results in significant reductions of river flow, particularly during winter and spring. The potential for solute dispersion of effluents by dilution is subsequently reduced, whether industrial or domestic, waste water from towns or return water from irrigation. Water quality modelling work is required in such circumstances to assess the impact of flow reduction on water quality.

Toxic substances may be introduced to soils through irrigation waters by pollution or by over application by farmers. Examples of toxification of waters in the GAP region already exist in Hancağız and Devegeçidi as a result of industrial pollution which is not being effectively controlled. As industrialisation increases there will be greater temptations to discharge pollutants into water courses unless steps are taken to enforce existing legislation.

Agro-chemicals can also be a source of toxification of soils and groundwaters, although usages in the GAP region are low. However, with the increased productivity anticipated there will be increased use of fertilisers and extra usage of nitrogen in particular could increase the level of soil nitrates which could be leached by excess irrigation. Higher levels of production and the creation of different crop micro-climates may also favour increased pest levels which may require additional or new pesticides for control.

2.3.2 Organic Pollution

Organic pollution may also occur if large amounts of farmyard manure is used as sources of nutrients, although the risk is small.

The potential increase in fertilisers and organic wastes in drainage water are likely to have anaerobic effects and create unsatisfactory conditions in drains particularly if there is standing or slow flowing water in them. This has severe adverse impacts on aquatic ecology and has implications for human health and the amenity value of lakes and reservoirs.

2.3 Soils and Drainage

2.3.1 Soil properties

Soil properties can be changed by irrigation affecting either the chemical composition or physical characteristics of the soil, and this can affect infiltration rates and hence irrigation efficiency. Physical factors such as droplet size from irrigation sprinklers and compaction of soils by heavy machinery can cause damage, although much of this is reversible and unlikely to cause severe adverse long-term effects.

2.3.2 Saline Drainage

Drainage waters are likely to be more saline than the original irrigation water. Estimated increases in saline drainage in the Harran Plain indicate that present levels of 0.5 dS/m are expected to rise to about 1.25 dS/m with increased irrigation.

Irrigation projects around Atatürk Dam draining into the dam could increase the salinity in the dam but this is likely to be offset by the annual inflows. Projects downstream of Atatürk would increase the salinity levels in the Euphrates river, but the seriousness of this would depend on the cumulative input of the return flows and releases, and salinity levels from the dam.

Current drainage conditions along the Syrian border combined with increased discharges may cause major problems, such as surface flooding, recharging aquifers with saline water, and water table rises, unless proper drainage outfalls are constructed. Such problems are already occurring around Akçakale where groundwater abstraction has been going on since 1977. Drainage water reuse is feasible on the Harran Plain and would reduce the volume to be discharged, but without the necessary outfalls and subsurface drainage, saline return flows would rapidly cause serious problems.

2.3.3 Saline Groundwater

The major groundwater resources in the southern plains are generally reported to have good water quality but there are localised areas of highly saline ground-water. Derogation of the main aquifer is already occurring.

Unless a subsurface drainage system is installed and an outlet found for discharges, saline drainage water from irrigation on the Urfa-Harran plain may recharge the alluvium aquifer which overlies the main limestone aquifer. This would lead to the deterioration of water quality in the alluvium and also in the limestone aquifer from leakage across the aquiclude. A similar process may occur in other areas in the plains. Once groundwaters are contaminated it is very difficult to improve the water quality. It is better to prevent contamination in the first place. In the hilly areas natural drainage would encourage surface run off in preference to deep percolation. Consequently the risk of saline drainage water affecting groundwater resources is much lower in these areas.

2.3.4 Soil Salinisation

Both water and soil naturally contain salt. Soil salinisation can develop if drainage is impeded and the water evaporates from the soil. Where groundwater levels are close to the ground surface secondary salinisation may also occur whereby soluble salts in the groundwater or lower soil profile rise through the soil due to capillary action. Soil salinisation is a serious hazard, resulting in the eventual abandonment of agricultural land, because saline soils are toxic for many plants. In the GAP Region soil salinity is a localised problem with soils usually containing low salt levels. Saline soils occur on flat bottomlands where drainage would also be a problem. Reports of soil salinity in irrigated areas are centred on the Akçakale area of the Urfa-Harran plain. Field evidence includes white salt crusts, dark patches on the şoil surface indicating high sodium levels, the abandonment of agricultural land due to poor crops, dying trees and the presence of halophytic vegetation. This area has been irrigated for some time, has drainage problems and is experiencing rising groundwater levels in the alluvium aquifer. The problems experienced here are an indication of what could happen to the Urfa-Harran plain without suitable mitigation. Irrigation on the Harran Plain could have a limited life unless solutions are found to the problems of drainage reuse, recycling and disposal. This is described in Technical Discusssion Paper No 11 Drainage Requirements (Halcrow 1994).

2.4 Sediments

2.4.1 Field Erosion

The risk of field erosion is affected by soil type, land slope, irrigation application methods and the design of canals and ditches.

Soil infiltration rates, texture, structure, clay mineralogy and organic matter content affect soil erodibility. Soil erosion increases with land slope due to higher run off velocities. Certain types of irrigation application methods are more suitable for different land slopes. Basin irrigation requires level land or terraces. On shallow slopes (0.2% - 3%) furrow or border strip irrigation is appropriate. Furrow irrigation can be practised on higher slopes (0.2% - 8%) provided some soil and water conservation measures are applied such as aligning the furrows across the slope. Sprinkler irrigation can be used on slopes up to 12%. Drip irrigation is appropriate for fruit crops and some vegetable crops.

The soil erosion risk due to irrigation applications is minimal with drip and sprinkler irrigation provided run off does not occur. The soil erosion risk is also low for basin irrigation as water is ponded. Furrow irrigation can cause soil erosion if the depth and velocities of water are sufficient to detach and entrain particles.

Border strip irrigation has a high erosion risk particularly if the land is not prepared properly. Cross slopes or an uneven surface can concentrate the water increasing its erodibility. The risk is greater still for wild flooding.

Within the GAP Region areas with low slopes (0-2%) occur on the southern plains and in the bottom lands of the Tigris basin, but land slopes up to 12% occur in many other areas, for example in the Batman-Silvan project area.

Erosion Susceptibility within the planned GAP irrigation project areas are shown in figure E 2.1. The erosion susceptibility class is based on land slope, soil depth and present erosion as presented on the soil management map for Turkey, (GDRS 1987), and reported in detail in Technical Discussion Paper 18, Soil

FIGURE E2.1 EROSION SUSCEPTIBILITY

Conservation and Water Quality, (Halcrow, 1993).

Pressurised water systems suitable for sprinkler irrigation are planned for the Mardin-Ceylanpınar project, the Baziki gravity and pumped irrigation project, and the Batman-Silvan project. All these areas have potentially severe erosion susceptibility (with the Batman-Silvan project being most susceptible) so sprinkler irrigation is appropriate. Given that the farmer determines the irrigation method in most instances it is difficult to predict how severe field erosion will be.

Wind erosion is a possibility although mean monthly wind velocities are low in the region and few days in the year have high wind speeds which would cause damage to soil surfaces.

Soil erosion may also occur in the drainage canals which are unlined and do not have proper inlet structures. The problem is most acute in recently dug ditches as the banks are not compacted, are relatively unstable and not protected by vegetation. However too much vegetation can cause problems due to inefficient drainage and the creation of habitats for disease vectors.

The risk of soil erosion is expected to increase under irrigation without soil and water conservation measures. This would be an adverse environmental impact.

2.4.2 Local Siltation

Local siltation in canals encourages weed growth and suspended solids affect the functioning of sprinkler and drip systems. It is important to avoid siltation where possible because of the impacts on operation and maintenance. Water from the reservoirs will have very low suspended sediment concentrations. Siltation in the canals would mainly occur as a result of wash from the fields entering the canals. Sediments have been washed into canals under construction on the Harran plain due to run off carrying soil off the fields. This problem is likely to continue where

- the canals are in cut and the slopes are not stabilised by vegetation or lining
- they are not fully lined to the top of the slope
- there is no obstruction to off-field drainage, and
- fields are ploughed close up to the canal.

The existing Ceffan, Batman and Nusaybin schemes are supplied by run-off-river diversion weirs. It is possible that bed load and suspended sediment could enter the canal system during flood flows in the river and deposit sediments within the schemes, and this is a recognised problem on the Batman scheme.

Local siltation in drains will occur because, in the absence of proper inlet structures, they receive run off direct from fields including eroded soils. This can impede drainage and contribute to flooding and weed growth. The problem is exacerbated by erosion of the fields and channel slopes, low channel slope, lack of an outfall (for example on the Urfa-Harran plain) and poor maintenance. Consequently siltation is anticipated as an adverse effect.

With regard to sediment yield, the reservoirs act as sediment stores and their life depends on rates of sedimentation (and soil erosion in the catchment). Peak discharges in the Euphrates and Tigris rivers are often associated with snowmelt. As such the amount of suspended sediments would be a function of entrainment from the river bed. Sedimentation into Atatürk is controlled largely by the presence of the Karakaya and Keban dams upstream. No information has been obtained on sedimentation rates in the existing reservoirs in the GAP Region as they are relatively young. Consequently it is difficult to assess rates of sedimentation and whether the effect is adverse.

Concerning the channel regime, almost all the off-take structures for irrigation are from reservoirs, and would not be affected by erosion in the reservoir. Exceptions are the Ceffan,Batman scheme and the Nusaybin schemes which should be checked periodically.

2.4.3 River Morphology

Regulation of the rivers will change the sediment supply, bank erosion and transporting capacity. This will affect the plan form and cross-sectional and longitudinal profiles of the rivers as the morphology adjusts to the magnitude and frequency of the modified fluvial processes. Such changes are widely documented for regulated rivers. They involve the development of a delta upstream of the reservoir with a reduction in bed slope, and increases in meandering and greater flood risk during high flows. In addition, the scouring of the river bed and banks downstream of the dam as released water entrains sediment causes adjustments in the morphology of the river bed to the new flow regime. These changes may affect land uses upstream of reservoirs and lands adjoining the river banks and may have ecological impacts.

2.4.4 Hinterland Effects

Changes in the hinterland and catchment areas of reservoirs can affect erosion and downstream sedimentation in the reservoirs. Such changes include increased pressure for grazing or agricultural intensification. The GAP Master Plan recommends watershed management to control erosion in these areas and promotes afforestation. This would reduce the soil erosion problems, provide a cash crop for the landowner, and have ecological benefits. Well developed shrubland is also effective in reducing erosion, is ecologically suited to the area and can develop more rapidly than woodland.

2.5 Ecology

2.5.1 Project Lands

The widespread introduction of irrigated farming over an area of some 1.7 million ha will result in the loss of semi-natural habitats and the modification of existing areas of dryland farming. Some of the potential impacts are:

- the loss of semi-natural shrublands and grasslands, and pseudo-steppe of dryland farming;
- the loss of rare and endangered species of flora and fauna and the contraction of fauna into more remote areas;
- a decrease in biodiversity and the genetic resources;
- changes in the species composition in soil flora and fauna, insects, and pests, in response to altered microclimates, and changes in cropping practices;
- poisoning flora and fauna with agro-chemicals;
- the introduction of new species of flora and fauna, including pests;
- the development of degraded habitats due to soil salinisation, erosion and drainage.

2.5.2 Water Bodies

The construction of dams will lead to the immediate and permanent loss of steppic fauna and flora, possibly including rare plants by inundation, the creation of new habitats, and the modification of habitats along the shores of reservoirs. A total area of 2,629 km^2 of new reservoirs (at full capacity) will be created in the GAP region. This will cause the drowning of sites of ecological conservation value and the loss of rare species.

The new reservoirs will create aquatic habitats and modify conditions around the sides of dams. The ecological value of the reservoirs in the longer term will depend on the process of natural colonisation, the water quality and operational use.

Indications are that water quality should be relatively good given the available data for the rivers. Rapid fluctuations in water level and prolonged drawdown can have an adverse effect on fish stocks, marginal habitats and wildlife supported by the dam.

2.5.3 Surrounding Areas

It is difficult to assess whether the development of irrigation will lead to an intensification of the remaining areas of dryland farming, semi-natural vegetation and grazing lands in the catchments. There may be an increase in pressure on grazing land although in the longer term irrigation should increase the availability of fodder crops.

2.5.4 River Corridors

Along the river corridors the changed pattern from natural to regulated flows in the Euphrates and Tigris and on the smaller tributaries would be expected to reduce the amount of biomass supported within and along the rivers. There would be changes in species diversity and the abundance of certain species. Long term changes in water quality such as increased salinity, organic substances and nutrients would also affect aquatic ecology. An assessment of the magnitude of these impacts would depend on further studies to identify the characteristics of the existing riverine habitats and water quality changes.

2.5.5 Rare and Endangered Species

Within the GAP region there are rare and endangered species including the wild forms of some cultivated plants. It is possible that irrigation development may lead to the extinction of some of these species. However this is difficult to assess because the geographical distribution of many species is not known. Despite the lack of data this impact is considered to be an adverse effect but further field work is required to assess the magnitude of the impact.

2.5.6 Animal Migration

Animal migration is likely to be affected by the water conveyance systems in some areas where they form a barrier to movements of some animals including livestock and wild animals such as tortoises and lizards. The primary and secondary canals in particular pose a serious risk of drowning. These are often in deep cuts with no barriers alongside, do not have embayments to allow animals to escape from, and once in operation would carry fast flowing water. The tertiary canals may be embanked or on pedestals (canalets). The latter would not pose a problem to animal movements or safety.

There would be little effect on bird migration routes. However in some areas the construction of raised canalets may stop some ground nesting species from breeding within or close to irrigation areas. Ancillary developments such as transmission lines from the hydropower stations can be a significant cause of death for birds.

2.5.7 Natural Industry

Timber, hunting, fisheries, apiculture and silviculture are all dependent upon natural resources for their operations. Indications are that the Region's forestry resources cannot meet the internal existing demand for timber. In addition with the development of the region, domestic and industrial demand for timber is expected to rise. Some of this demand could be met by afforestation programmes and on farm tree-planting for soil and wind erosion control, but would mainly have to be met from resources located outside the region. In view of the already very small areas of natural forest in the GAP region there is considerable potential for more afforestation to prevent further deterioration of the region's forestry due to pressure from demand, without proactive programmes to develop and preserve forestry resources.

Irrigation development would not be expected to affect hunting directly. Indirect adverse impacts may occur due to the contraction of fauna to smaller areas leading to a reduction in populations.

There is considerable potential for aquaculture development in the new and proposed reservoirs in the GAP Region. Assuming a total surface area of 175,000 ha at normal operational levels and 300 fish/ha, it has been estimated that the total fish stocks could be in the order of 50 million. This represents a valuable source of income for fishermen provided they can catch and market the fish. Hatchery development and fish stocking programmes are under way. The main fish for stocking are carp species, but stocking with predatory fish like pike and catfish which are also being considered may pose a threat to the development of aquatic ecology. This will also be affected by the operating rules for the reservoirs and future changes in water quality such as salinity and BOD. Reservoirs subject to repeated or prolonged drawdowns will not be suitable for aquaculture.

Bee keeping is widely practised in the GAP Region which has suitable ecological and climatical conditions, and sericulture (silkworm production) is practised in Diyarbakır, Adıyaman and Siirt provinces.

2.6 Socio-Economics

2.6.1 Population Structure

Population structure has been changing, the main features being a high rural birth rate, resulting in large families and a high proportion of the population under 15 years of age. Population growth is above the national average and is expected to reach 7.6 million in 2005. This is likely be accompanied by increasing urbanisation with an estimated 63.5% of the population living in urban centres by the year 2005. This would continue the process of social change, which has occurred in the region as nomadic people have settled and responded to urbanisation and technological change, leading to a weakening of the traditional social structure.

The current internal human migration takes place from rural to urban areas, from east to west, and from the mountains to the plains. The rate of urbanisation is very high and this is likely to continue with the expected development of the region. Intra-regional seasonal migration will increase due to the greater labour requirements for irrigated crops such as cotton. As irrigation develops there may be a shortage of seasonal labour.

There is currently a strong net out-migration from the region. The rate of out-migration could decrease due to a return migration from western areas such as Adana, and would depend to some extent on the increase in employment opportunities created in the GAP region.

Resettlement has already occurred with the construction of Keban, Karakaya and Atatürk dams. The effects of relocation on the people are being studied in a separate project under GAP. Relocation has an adverse effect on people as it disrupts the structure and way of life of both the displaced persons and the communities receiving them.

2.6.2 Land Consolidation

Land consolidation is a major feature of irrigation development in the GAP Region. The canal conveyance system as designed and constructed often does not fit the pattern of land tenure, and in this event, for all farmers to have access to irrigation facilities, the farmland needs to be redistributed. Farmers benefit by having access to irrigation water and new roads. However they may end up with less land (due to the area required for the canals and roads), differences in land quality, loss of access to wells, and social problems such as being further from the village, being located alongside people they do not like or feeling they have been unfairly treated. Another problem is that in most areas in the Harran plain the canal distribution network has not taken village boundaries into account. This complicates the process of developing water user groups to manage irrigation at the tertiary level.

In some areas cadastral surveys have not been undertaken and the land ownership is not clear. There are also cases where land is owned by absentee landlords, and farmed without any legal or traditional contract, and sometimes without the knowledge of the landowner. These circumstances complicate the process of land consolidation. The GAP-MOM study household survey indicates a general acceptance of land consolidation. Although the short term effects of land consolidation may be adverse on the farmers and village communities, there are long term benefits as land consolidation is a prerequisite to equitable distribution of irrigation water.

2.6.3 Role of Women

The role of women is not expected to undergo major change in the short term as a result of the development of irrigation. Some factors may lead to long term changes such as decreases in family size, an increasing need for labour on farms or in newly developing industries, and changes in social structure resulting from increasing urbanisation.

2.6.4 Marginal Groups

The main marginal groups in the area are landless farmers and seasonal workers. The majority practise sharecropping and some animal husbandry. Seasonal work outside the region also provides an income for these people.

With irrigation development landless farmers would probably have greater opportunities to appropriate land through various forms of rental agreements as has happened in the Adana area where irrigation has been practised for about 30 years.

Seasonal employment opportunities for landless farmers within the GAP Region would increase due to the cultivation of more labour intensive crops such as cotton and vegetables. Some of the employment opportunities may be partially or wholly offset in the future due to the increase in the numbers of people of employable age, and increased mechanisation for some crops.

2.6.5 Heritage Sites and Tourism

Many heritage sites have been lost following dam construction although a considerable amount of archaeological investigation was undertaken at the Atatürk dam site. More sites are threatened by the remaining construction programme. Irrigation water and wetter conditions may affect the fabric of buildings and the preservation of archaeological sites. Soil salinisation may lead to salt corroding materials while the wetting and drying of soils may affect the bearing load of soils and the preservation of artifacts in the soil.

Tourism within the GAP Region represents only a very small portion of the total tourist arrivals (2.8% in 1987) in Turkey. There are attractions in the area particularly with regard to sites of cultural heritage. There is potential to develop reservoirs for recreation; however the success of this would be dependent on the operation of the reservoirs.

2.7 Health

2.7.1 Water Supply and Sanitation

The current standards of sanitation are inadequate in rural and urban areas. The situation could be worsened by irrigation if people used irrigation and drainage water for domestic chores such as washing. Wetter soil conditions and a more humid climate could also increase the number of parasitic organisms.

The strong trend in urbanisation has created squatter areas around towns and unplanned development. This leads to problems of substandard housing, water supply and sanitation. This trend is likely to continue for the foreseeable future.

In rural areas problems with habitation include large numbers of people in small houses which facilitates the spread of infection, lack of sanitation facilities, and the presence of disease hosts such as mosquitoes and sandflies.

2.7.2 Health Services

Existing health services in the region are under-resourced. The development of irrigation will increase the risk of waterborne diseases vectors, particularly mosquitoes. An increase of diseases such as malaria would put a considerable strain on existing health resources. In addition the lack of routine health monitoring would mean that any increase in prevalence would not be identified at an early stage thus adding to the burden on the health service.

Given that the main thrust of the GAP project is to develop agricultural production, which in turn is expected to increase income levels, it is probable that nutrition would improve.

2.7.3 Relocation Effects

The intensification of agriculture would lead to higher labour demands. This would occur particularly where labour-intensive crops like cotton and vegetables are grown. Consequently relocation effects are anticipated, with an expected increase in intra-regional migration and possibly in-migration.

Migrant seasonal workers tend to be accommodated in temporary shelter without proper water supply and sanitation facilities. This exposes them to diarrhoeal diseases. Temporary accommodation is often located close to the fields and workers often sleep outdoors in hot weather. This increases their susceptibility to malaria infection. An influx of seasonal migrant workers could have a significant adverse effect on the health of the resident population by spreading infections.

2.7.4 Disease Ecology

It is very likely that large scale irrigation development will lead to an increase in the type of ecological habitats favoured by disease vectors. The main cause for concern is the increase in habitats for *Anopheles sp* of mosquitoes, but the spread of habitats for *Bulinus truncatus* snails is also of concern.

The malaria epidemic which occurred in the Çukurova area during the 1970s following the development of the Lower Seyhan irrigation scheme illustrates the effects of such schemes on disease ecology. In this scheme the most important breeding sites were the drains which were always full of water due to the high water table and weed blockage. Other breeding sites included pools where water leaked from the canals or were created by syphons taking water from the canalets into the fields. In addition, borrow pits in villages and alongside roads, flood control levees, and nearby marshes all provided potential breeding sites.

Possible breeding habitats for mosquitoes include the reservoirs, canal system, fields, and drainage channels. Inefficient water use resulting in leaks, overflows and standing water from poor drainage further exacerbate the problem.

2.7.5 Disease Hosts

Ten species of *Anopheles* mosquitoes have been recorded in Turkey, three of which are malarial disease hosts . These occur across the GAP Region. Two things should be noted about the ecology of mosquitoes. Firstly, there is a seasonal variation in mosquito populations, with low populations between December and January followed by a general increase from February to peaks in May-June and September-October. Secondly, in geographical terms the mosquitoes carrying malaria are approaching their northern limit. Irrigation would extend mosquito breeding sites in SE Anatolia where such sites are currently limited by the dry conditions.

Cutaneous leishmaniasis has increased in some areas following irrigation. This may be due to an increase in sandfly breeding sites such as garbage around houses and in the houses themselves, or an increase in populations of *Meriones sp.*

Relatively little is known about other disease hosts in Turkey such as *Meriones*, *Bulinus truncatus*, sandflies and flies.

The snail *Bulinus truncatus*, which acts as a host for the parasites which cause schistosomiasis, has been found in Ceylanpınar. This snail can live in fresh and dirty water conditions and would be able to colonize vegetated drains. The current distribution of *Bulinus truncatus* is approaching its northern limit. However the extension of irrigation along the Syrian border and an amelioration of the climate could extend its habitat. Although schistosomiasis does not occur at present in Turkey it could develop and find a ready host if migrants bring the disease with them.

2.7.6 Disease Control

There is considerable practical experience in disease control of malaria in the Çukurova region but not currently in the GAP Region. Malaria can be controlled in the first instance by avoiding the creation of breeding sites. If such sites occur these can be treated with chemical or biological control measures, which has also resulted in a reduction in sandflies which breed in houses. However, chemical spraying is problematic because mosquitoes develop resistance and many people are opposed to using insecticides in their houses.

Improvements in water supply and sanitation can lead to marked reductions in diarrhoeal related diseases, especially if this is accompanied by health education. Improved hygiene and waste disposal will also help to reduce the risk of infections carried by flies.

2.7.7 Cultivation Risks

The main cultivation risks for human health come from the increased risk of parasitic infections, misuse of agro-chemicals and consumption of vegetables which may be contaminated by bacteria or chemical residues. There is little available data on these problems.

2.7.8 Safety

At present the main and secondary canals do not have any safety provisions. Given that these canals will generally be over 2.5m deep, have relatively high velocities and structures such as gates, culverts and syphons there is a very high risk that any person or animal falling in will drown.

2.8 Imbalances

2.8.1 Pests and Weeds

Following wide-scale introduction of irrigation it is very likely that there would be changes in prevalent crop pests and diseases. Existing pests and weeds may become more prevalent and new pests and weeds may be introduced into the region. However it is difficult to predict what these changes would be because it depends on future cropping patterns, water use and ecological dynamics.

In order to assess potential impacts it is necessary to study other areas where irrigation has been introduced. The nearest large scale irrigation project to the GAP Region is the Lower Seyhan Project in Çukurova province, although this is environmentally different from the GAP region.

In Çukurova a variety of animals are pests - voles, house mice, fruit-eating rats, rooks, starlings, ducks, red fox, wolves and jackals. Cotton production has been affected by *Thrips tabaci* which causes *Xanthomonas malvecearum*. This is difficult to control and results in higher use and cost of pesticides. In the Lower Seyhan area the percentage of land under cotton has fallen in recent years in response to problems of economics and marketing of cotton. There is not currently a problem with cotton grown in the GAP Region, but this may be because the areas under cotton are relatively small and the crop is recently introduced. Large scale development of the crop could lead to an increase in disease. This could result in an increase in the usage of pesticides and herbicides as farming becomes more intensive.

2.8.2 Livestock

The numbers of livestock held by farmers where irrigation is practised are declining. One cause is the lack of pasture where cultivation has expanded. With the introduction of irrigation there is likely to be further decline in extensive animal rearing and a move to intensive livestock rearing.

These changes would bring about several improvements in livestock rearing. Intensive production would lead to a reduction of large scale animal movements including cross border movements which would reduce the spread of contagious animal diseases. The cultivation of a wider range of foodstuffs including fodder would improve the diet for livestock and reduce current health problems with associated with malnutrition.

The main disadvantage would be the increase in risk of parasitic diseases. Parasites are kept in check to some extent in the GAP Region due to the dry conditions unfavourable to them. The spread of irrigation and an increase in soil moisture may improve the ecological conditions for parasites leading to an increase in these diseases for livestock reared in the countryside. In areas where there are drainage problems livestock may be increasingly affected by *Fascioliasis* due to the spread of water-borne disease vectors. Overuse of pastures leads to a build up of parasites from infected herds.

Overall the impact of irrigation development on animal disease is considered to be a benefit.

2.8.3 Aquatic and Other Weeds

Aquatic and other weeds growing in and alongside conveyance canals and drainage channels are a recognised problem in Turkey. They affect the carrying capacity of canals and drains, encourage siltation, block or damage water control structures, cause damage to the canal itself and provide shelter for disease vectors such as mosquitoes, snails and other vermin.

In the GAP region the primary and secondary canals are large, lined and will be carrying relatively high flows of clean water during the irrigation season. Consequently there should not be a significant problem with weeds within the canals especially if these structures are well built and suitably maintained. However weed growth in canals has been reported for irrigation projects through-out Turkey. Weeds found in existing main irrigation canals in the region have been controlled with chemicals such as copper sulphate, paraquat, 2.4-Amin, dalapon and glyphosate, posing toxicity risks.

Aquatic weeds may become a problem if silt is washed into canals and water velocity is reduced. Weeds also grow alongside irrigation canals where there are leakages resulting from poor construction or maintenance.

However, the main problems with weed growth are likely to occur in the drains which tend to be broad, shallow and unlined, where dense stands of reeds (*Phragmites sp*) and bulrushes (*Typha sp*) tend to occur. These trap silt, reduce water velocities and storage. Subsequent problems include the development of habitats for disease vectors such as mosquitoes, snails and parasites.

Consequently the impact of irrigation is considered to be adverse due to the problem of weeds in drainage channels and implications for human and animal welfare.

It is considered unlikely that plants or animals will cause structural damage to the conveyance system mainly because these systems will be lined. Good maintenance will further reduce the risk of these biological impacts.

3 MITIGATING AND MONITORING ENVIRONMENTAL IMPACTS

3.1 Introduction

This chapter describes the measures recommended to mitigate environmental impacts, and the monitoring activities required to identify environmental effects and to measure the implementation and effect of the measures taken to counteract them.

The recommended mitigation measures and impact monitoring requirements are tabulated by the eight main impact groups in table E 3.1 to E 3.8, under the following heads:

- impacts on hydrology
- pollution impacts
- impacts on soils
- impacts from sediments
- impacts on ecology
- impacts on socio-economics
- impacts on environmental health
- impacts on biological imbalances.

Each mitigation measure is classified in two ways:

- relevance to the pilot study area or to the regional level
- anticipated impact.

Items identified as relevant to the pilot study areas will require some form of activity during the implementation of the pilot studies, as it is anticipated that noticeable effects are likely during this period. Items identified as relevant at the regional level are not expected to have an effect on the pilot areas, but will become noticeable when irrigation is widespread in the region. **It should be understood that all impacts at the pilot study level will also effect the region as a whole.**

The anticipated impact of each item is classified into three categories:

- major impact on viability of irrigated production
- secondary effect or of interest to special interest groups
- minor effect or uncertain outcome.

Items which are anticipated to have a major effect on the viability of irrigation production are of prime importance to the financial and economic viability of sustainable irrigation in the GAP region. These items must be taken into account in the design and operation of the MOM model and the implementation of the GAP project and should form an integral part of planning and development. There are 43 of these recommendations.

Items which are anticipated to be a secondary effect or of interest to special interest groups are not currently anticipated to be of primary importance to the viability of irrigated production, but may have considerable local effects or considerable effects on other aspects of the environment. These items may need to be included as part of the design of the GAP-MOM model and incorporated in the planning of the GAP project, but in other cases may be best dealt with by the particular group which is being affected. There are 31 of these recommendations.

Items which are anticipated to be minor effects, or for which the outcome is uncertain, have a lower priority in the planning process. In general these items will not be included specifically in the pilot study, and it is unlikely that there will be the resources and funds to undertake the recommendations at the GAP regional level. There are 24 of these recommendations.

It should be clearly understood, however, that the relative importance of the items identified as potential environmental impacts are certain to change during the implementation of the GAP project, and the GAP-MOM pilot studies, and it is possible that items that have not been identified at this stage may be found to be important. Identification of environmental impacts should be an ongoing activity, and the IEE should be repeated if this is considered necessary.

The specific mitigation measures focus on action to be taken at irrigation sites. The types of measures put forward include technical solutions, training, irrigation management, operational procedures and maintenance requirements. The general mitigation measures are concerned with an integrated approach to mitigation involving non-irrigation organisations, the development of infrastructure and regional planning.

The success of the mitigation measures will depend on:

- provision of sufficient funding and incentives to carry out the work to a high standard
- quality construction work and supervision of all technical inputs towards solutions of problems
- provision of sound technical advice
- responsiveness of farmers to training and providing incentive schemes at the tertiary level for environmentally sound management
- full and committed involvement of concerned organisations.

Impact monitoring requirements are shown against each item in the tables. Where a monitoring activity is relevant to several items in a particular subgroup it is shown against the subgroup heading, and is not repeated for each individual item.

3.2 Impacts on Hydrology

3.2.1 Low Flow Regime in Rivers and Canals

Due to the overall shortage of water to carry out the irrigation programmes planned under GAP it will be critical to develop conjunctive reservoir operating rules to maximise use of available water resources at the regional level. This requires studies of reservoir operating regimes and the water distribution system, which have been undertaken as part of the GAP-MOM identification process. These are outside the scope of the pilot studies, but will effect the pilot study areas.

The performance of the irrigation system needs to be monitored, and progress towards defining the monitoring system will be made during the implementation of the GAP-MOM study. Critical measures include time series data on reservoir levels, water inflows and releases, distribution efficiencies, water sales and utilisation, cropped areas and so on, and will involve a number of agencies and specialist staff. The system will be partially established in the pilot studies, (see Technical Discussion Paper 8, Impact Monitroring System, (Halcrow 1993) for the initial identification of requirements) but will need to be developed over time for the GAP region, and may require considerable specialist inputs.

Within the pilot study model it is critical to maximise the efficiency of irrigation water use at field level by training farmers to adopt water efficient irrigation methods, water conservation techniques, and developing water reuse schemes. The charging for water on a volumetric basis will encourage the above measures. Increasing the efficiency of water use has positive effects in reducing many adverse environmental impacts (see below), whilst maximising the returns to the GAP project as a whole.

These aspects will be closely monitored during the implementation of the pilot studies through farmer Knowledge Attitudes and Practice (KAP) surveys conducted annually and periodic field water efficiency experiments undertaken as part of the pilot study.

3.2.2 Shallow Water Table Rise

Mitigation of the effects of the anticipated rise in shallow water tables is a critical part of the GAP-MOM model design and is expected to have a major impact on the viability of irrigation at regional level. Monitoring of groundwater levels and quality, which is undertaken by DSI, using established procedures, is therefore, critical to the future of the GAP region.

Mitigation measures include providing surface and subsurface drainage, which will be vital in the long term, minimising the problem by decreasing the amount of water lost to groundwater by improving irrigation efficiencies, improving water application methods and decreasing the quantity of return flow by developing reuse schemes. These are described elsewhere.

Progress with these mitigation measures will be monitored through measurement of water flows, estimates of the area of crop irrigated and through special field experiments and studies of the effects of water reuse systems developed during the pilot study. At regional level it may be necessary to measure water reuse through farmer surveys.

3.2.3 Deep Water Table Fall

Deep water table levels are expected to fall in some areas as a result of groundwater abstraction. Sustainability of irrigation depends on mitigating drawdown of groundwater by controlling pumping from groundwater aquifers. It will be necessary to enforce existing regulations for protecting groundwater resources through effective licensing of boreholes and wells, and setting limits on abstraction rates. This may require stringent penalties for non-compliance.

Monitoring of deep water levels in groundwater abstraction areas is important, and will be carried out using standard DSI procedures. The effectiveness of enforcement of groundwater licensing will be monitored through the routine reporting of the licensing authority.

The GAP-MOM study has recommended that a study be carreid out of the scope for groundwater aquifer manipulation by recharging from surface runoff during the wet season, in particular in Ceylanpınar. Groundwater modelling will need to be developed to allow this to be established. Progress with this activity will be monitored through the output of technical reports on the study. This may lead to specific recommendations and further monitoring requirements.

Groundwater requirements can be reduced by increasing the water supply from surface sources, which would be achieved by improved efficiency as described above.

The mitigation measures and monitroring requirements for impacts on hyrdrology are detailed in table E 3.1.

TABLE E 3.1
IMPACTS ON HYDROLOGY

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Low Flow in Rivers and Canals						
Develop conjunctive reservoir operating rules to maximise use of available water resources	Performance assessment of the irrigation system		Yes	Yes		
Maximise efficiency of irrigation water use at field level with realistic water charges	Water charge collection	Yes		Yes		
Train farmers to adopt efficient irrigation methods	Farmer surveys	Yes		Yes		
Train farmers in water conservation	Farmer surveys	Yes		Yes		
Develop water reuse schemes	Field water efficiency studies	Yes		Yes		
Shallow Water Table Rise	Water table level Groundwater quality					
Provide surface and subsurface drainage		Yes		Yes		
Decrease amount of water used	Water flows Crop areas	Yes		Yes		
Decrease quantity of return flow with reuse schemes	Special Studies	Yes		Yes		

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Deep Water Table Fall	Water table level					
Enforce licensing of boreholes and wells, and set effective limits on groundwater abstraction rates	Reported activity of the licensing authority		Yes	Yes		
Examine scope for groundwater aquifer manipulation by recharging from surface runoff during wet season	Recommendations prepared		Yes	Yes		
Increase water supply from surface sources	Performance assessment of irrigation system		Yes	Yes		

3.3 Pollution

Pollution effects have been assessed as secondary effects in the GAP region and for the GAP-MOM model. Whilst water quality studies should be maintained at the regional level, through the studies being undertaken by GAP and the MOE, these effects are not thought to be critical to the viability of the irrigation system in the medium term, and will not be considered further.

Despite this the utilisation of farm chemicals will be monitored during the pilot study, as part of the farmer level KAP surveys, and if potentially serious pollution is identified resulting from irrigation activities specific proposals will be prepared to counteract them.

The mitigation measures and monitroring requirements for pollution impacts are detailed in table E 3.2.

TABLE E 3.2
POLLUTION IMPACTS

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Solute Dispersion	Water quality studies in reservoirs and rivers					
Allow reservoir releases if water quality deteriorates			Yes		Yes	
Develop waste water treatment infrastructure			Yes		Yes	
Control discharges into reservoirs		Yes			Yes	
Toxic Substances	Water quality studies in reservoirs and rivers					
On farm training on application methods for agro-chemicals	Farmer surveys	Yes				Yes
Good subsurface drainage to avoid groundwater contamination			Yes		Yes	
Close links between research institutes and extension services	Farmer surveys	Yes			Yes	

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Organic Pollution	Water quality studies in reservoirs and rivers					
On farm training on recommended procedures for composting and applying farmyard manure			Yes			Yes
Improve quality of river water by prevention of pollution from urban settlements and towns			Yes		Yes	
Anaerobic Effects	Monitor BOD and COD levels in reservoirs and rivers					
Train farmers to use recommended levels of fertilisers and follow recommended practices to avoid loss of nutrients in drainage waters	Farmer surveys	Yes				Yes
Implement good drainage design and carry out maintenance to avoid standing or slow flowing water	Annual survey of condition of drainage system	Yes		Yes		

3.4 Impacts on Soils

3.4.1 Soil infiltration and compaction

Minor effects are expected due to sprinkler irrigation and soil compaction using heavy equipment. Due consideration will be given to sprinkler design in the pilot study areas, and these recommendations should be available for future sprinkler irrigation. Compaction effects are expected to be minimal, as it is difficult to use machinery on the main soil types when wet. Compaction problems will be borne in mind during the implementation of the pilot studies and action taken if required.

3.4.2 Saline Drainage

Saline drainage water, and its effective disposal, are likely to be one of the most serious environmental impacts for the GAP region in the medium to long term, but are unlikely to be of major importance in most of the pilot study areas. However it is essential that the GAP-MOM model takes into account the effects of saline drainage in order for this impact to be minimised.

The installation of effective drainage collection and discharge is critical to the long term sustainability of irrigation in the GAP region, and leads to problems of disposal. These can be addressed by discharging drainage water to rivers provided salinity levels and flows in the rivers are sufficient to dilute drainage water to acceptable levels and by operating reservoirs to provide compensation flows to offset deterioration of river water quality if there is sufficient water to allow this.

Development of these operating rules will need to be developed over time at the regional level, based on experience and the monitoring of saline drainage impact. This will require large scale routine sampling of drainage, reservoir, river and groundwater to monitor quality and salinity levels. These are standard DSI operations, but will generate substantial data sets that will require analysis and reporting. These data will be monitored in the pilot study areas as part of the GAP-MOM study.

3.4.3 Saline Groundwater

Saline groundwater conditions are a potential adverse environmental impact which can be avoided if an adequate MOM model is adopted. Specific measures include reducing aquifer recharge with saline reuse water by installing suitable drainage systems. This will require the institutional procedures for protecting groundwater resources to be strengthened in the GAP region and considerable investment in drainage infrastructure.

Monitoring of saline groundwater will require water quality studies already described and monitoring of physical development based on GOT agency reports.

3.4.4 Soil salinisation

Soil salinisation will occur if adequate protection of the soil by maintaining groundwater levels and quality fails. The problem can be prevented by measures already described, maximising on field water use efficiency, installing drainage to manage groundwater levels so that water table does not rise to within 1.5m of the ground surface. If soil salinity occurs the effect can be mitigated by leaching soils annually by adding excess water to wash out the salts. Soil salinisation will have a major impact on the sustainability of irrigation, and the means to counteract the problem will form an important component of the GAP-MOM model. Farmers need to be trained to recognise the problem, its causes, and the mitigation measures they can adopt.

The extent of soil salinisation, which already occurs in the GAP region, will be monitored through soil surveys. This could be undertaken either by physical surveys by MARA or DSI staff, or through surveys of farmers or farmers groups. Within the pilot study areas soil salinisation will be monitored by direct observation during field work. Farmers knowledge and mitigation practices will be monitored in the pilot study areas through the annual KAP survey.
The mitigation measures and monitroring requirements for impacts on soils are detailed in table E 3.3.

TABLE E 3.3
IMPACTS ON SOILS

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Infiltration						
Encourage use of appropriate sprinkler application methods		Yes				Yes
Train farmers on soil improvement measures and actions to avoid sprinkler effects on soil	Farmer surveys	Yes				Yes
Compaction						
Improve the soil structure by adding organic matter, gypsum, sulphur to soil	Farmer surveys Soil studies	Yes				Yes
Rip or deep plough soils		Yes				Yes

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Saline Drainage	Drainage, Reservoir, River water and Groundwater salinity					
Install effective drainage collection and disposal		Yes		Yes		
Discharge drainage water to rivers provided salinity levels are maintained at acceptable levels			Yes	Yes		
Allow compensation flows from reservoir to offset deterioration of river water quality			Yes	Yes		
Strengthen institutional measures for protecting surface water resources			Yes	Yes		
Saline Groundwater	Groundwater quality					
Reduce aquifer recharge with saline reuse water by installing suitable drainage			Yes			Yes
Allow recharge with low salinity surface waters			Yes			Yes
Strengthen institutional procedures for protecting groundwater resources	GOT reports		Yes	Yes		
Make sure procedures and funds are in place to construct subsurface drainage	GOT reports and budget allocations		Yes	Yes		

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Soil salinisation	Soil surveys					
Maximise on field water use efficiency		Yes		Yes		
Install drainage and manage groundwater levels		Yes		Yes		
Leach soils annually by adding excess water to wash out the salts	Farmer surveys	Yes		Yes		
Train farmers to recognise the problem, its causes, and mitigation measures	Farmer surveys	Yes		Yes		

3.5 Impacts from Sediments

3.5.1 Field Erosion

Field erosion in steep areas of the GAP region could lead to loss of irrigated area and yield reductions and have a major impact on sustainable irrigation. The GAP-MOM pilot study will include measures to mitigate field erosion problems. These can be reduced by:

- designing the canal system with regard to topography and land parcels so that farmers are not forced to irrigate down steep slopes
- undertaking careful land grading and preparation
- using the most appropriate irrigation application method for the terrain
- maintaining a vegetated buffer zone downstream of fields to trap sediment on field
- constructing bunds, walls or terraces to prevent soil loss on steep slopes
- compacting the sides of drains and providing drainage inlets so water does not flow into drains uncontrolled
- fully lining canals to stop bank erosion.

It will be necessary to identify and train farmers on the most suitable application method for a given terrain, crop and soil type to minimise erosion. Experience with the pilot study will assist in developing soil and water conservation policies and extension advice. At the regional level institutional arrangements will be required to ensure these measures are understood and implemented by farmers, through the MARA extension services, and that large scale works are undertaken by GDRS and DSI.

Within the pilot study areas field erosion will be studied by specific soil loss measurement studies and periodic inspection by field staff. In the longer term the WUG should be capable of assessing the damage and counter measures. Expertise in this type of field study is available at the University of Çukurova.

3.5.2 Local Siltation

Siltation in canals, but more importantly in drains, can lead to serious problems and reductions in production. These effects can be mitigated by regular maintenance to clean out canals and drains, stopping natural and field drainage entering canals. This can be achieved by digging ditches alongside canals, planting buffer zones downstream of fields, and seeding steep slopes near canals, designing canals and drains to maintain velocities to prevent siltation without scour and establishing buffer zones around fields to reduce soil movement. These measures will be adopted in the pilot study areas where they are required, and will form part of the GAP-MOM system.

Siltation effects will be monitored in the pilot study areas by periodic inspections by field staff. The WUG will need to be trained to recognise the problem and take the neccessary actions by development of suitable extension programmes. Farmer practices in the pilot study areas will be monitored through annual KAP surveys.

3.5.3 Sediment Yield and Hinterland Effects

At the GAP regional level sediment problems can be reduced by developing a watershed management plan to reduce soil erosion, which would include programmes for afforestation, reducing overgrazing and prevention of forest fires. Watershed areas should be forested, and this will require institutional strengthening to ensure policies are put into practice.

These activities will not require monitoring in the pilot studies.

3.5.4 River Morphology

Changes in river morphology resulting from reservoir construction should be monitored at the regonal level to identify problems such as bank erosion and reservoir delta formation. Specific measures may then need to be developed to mitigate such effects.

The mitigation measures and monitroring requirements for impacts from sediments are detailed in table E 3.4.

TABLE E 3.4
IMPACTS FROM SEDIMENTS

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Field Erosion	Field survey of soil loss Periodic inspection					
Design tertiary canal system to avoid irrigation down steep slopes		Yes		Yes		
Undertake careful land grading and preparation		Yes		Yes		
Train farmers to use the most appropriate irrigation application method for the terrain		Yes		Yes		
Maintain a vegetated buffer zone downstream of fields to trap sediment on field		Yes			Yes	
Compact sides of drains and provide drainage inlets so water does not flow into drain uncontrolled		Yes		Yes		
Fully line canals to stop bank erosion			Yes		Yes	
Develop soil and water conservation policies and ensure appropriate body has the authority to carry them out			Yes	Yes		

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Local Siltation	Periodic field inspections					
Regular maintenance to clean out canals and drains		Yes		Yes		
Stop natural and field drainage entering canals		Yes		Yes		
Design canals and drains to maintain velocities to prevent siltation without scour			Yes			Yes
Sediment Yield and Hinterland Effects	Reservoir sedimentation					
Develop a watershed management plan			Yes	Yes		
Undertake afforestation in watershed areas			Yes	Yes		
Institutional strengthening			Yes		Yes	
River Morphology	Bank erosion					
	Reservoir delta formation					
Bank protection			Yes			Yes

3.6 Impacts on Ecology

The identified ecological impacts are detailed in table E 3.4. All of these effects are, at the present time, anticipated to be secondary or minor, and will not form a major part of the pilot study or require detailed monitoring. The major ecological effects of widespread irrigation are unlikely to be changed by the adoption of alternative MOM models, and have been accepted, by implication, by the decision to implement the GAP programme. The pilot study will, however, encourage on farm tree planting, a balanced cropping programme and appropriate pest control measures.

Ecological effects on conservation areas and rare species should be monitored by those with a special interest in these matters, and by the environmental studies being conducted by GAP and the MOE. The needs and mitigation measures required will be more effectively identified by special interest groups in the area.

The mitigation measures and monitroring requirements for impacts on ecology are detailed in table E 3.5.

TABLE E 3.5
IMPACTS ON ECOLOGY

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Project Lands	Condition of significant sites Populations of rare species					
Encourage on farm tree planting		Yes				Yes
Identify sites of conservation value and protect these sites by restricting agricultural development			Yes			Yes
Develop a management plan for Ceylanpınar State Farm			Yes			Yes
Discourage the development of widespread monocropping e.g. of cotton	Crop areas	Yes			Yes	
Discourage overuse of herbicides and pesticides	Farmer surveys	Yes				Yes
Encourage organic and mechanical pest control measures	Farmer surveys	Yes			Yes	
Water Bodies	Limnological studies of new reservoirs		Yes			Yes
Stocking programmes which do not have an adverse impact on indigenous fish species			Yes			Yes

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Surrounding Areas						
Watershed management plans to include nature conservation	Condition of significant sites Populations of rare species		Yes		Yes	
River corridors	Condition of special sites					
Protect sites of conservation value			Yes		Yes	
Consider need to augment river flows			Yes			Yes
Rare Species	Populations of rare species					
Identify rare species of flora and fauna			Yes		Yes	
Transplant rare species or raise from collected seeds			Yes		Yes	
Animal Migration/Movement						
Install fences or rails along the main canals and trash racks upstream of structures			Yes			Yes
Natural industry	Output levels					
Support the development of natural industries			Yes			Yes

3.7 Impacts on Socio-Economics

3.7.1 Resettlement and Land Consolidation

Large scale irrigation developments require that populations move, and that land consolidation is undertaken. The disruption and problems can be reduced by taking suitable measures. In the long term, at regional level, land consolidation carried out well will increase irrigated production and reduce conflicts. Improvements are required in the design of canal systems so that they are laid out in accordance with village boundaries and property lines as far as possible, which currently is not being attempted.

Progress with design and land consolidation will be monitored through GDRef, and DSI, reports, which should be reviewed to assess how well detailed designs fit into the local social structure.

3.7.2 Heritage Sites and Tourism

Protection of heritage sites and tourism development will not form part of the GAP-MOM model, and do not affect the pilot study areas. The measures required at regional level are better identified and undertaken by those with a special interest in these matters.

The mitigation measures and monitroring requirements for impacts on socio-economics are detailed in table E 3.6.

TABLE E 3.6
IMPACTS ON SOCIO-ECONOMICS

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Resettlement and Land Consolidation	GDRS reports					
Design canal systems in accordance with village boundaries and property lines			Yes	Yes		
Heritage sites						
Avoid irrigation near the site			Yes			Yes
Drain area to avoid waterlogging and salinity, and improve soil bearing capacity			Yes			Yes
Fund archaeological surveys and explorations as part of design			Yes			Yes
Reconsider design where sites of high conservation value are found			Yes		Yes	
Fund archaeological excavations of affected sites			Yes		Yes	
Tourism	Visitors and spending					
Develop a tourism development plan and reservoirs for tourism			Yes		Yes	

3.8 Impacts on Environmental Health

Health impacts of large scale irrigation are substantial, and in particular there are substantial risks of malaria epidemics. The effects of disease can have a major impact on the returns to irrigation, and on the welfare and benefits to the population affected. These risks are relevant to the pilot study areas, and will require monitoring and control measures. This requires medical expertise, which should be obtained by GAP through the MOH, who should assist in the implementation of the MOM model in pilot study areas, with a view to developing the overall health programmes that will be required by GAP at regional level. This health team would carry out the detailed monitoring and mitigation activities identified below, and would be responsible for further development of the health programme and health planning.

3.8.1 Water and Sanitation

Irrigation creates new health hazards and health education should be part of general extension services. Health education programmes aimed at women are particularly important, and will be included in the pilot study areas. At the regional level public health measures to improve the waste water treatment facilities in rural and urban areas and to provide solid waste disposal facilities are required. Domestic water supplies have been greatly improved in the last ten years, and this programme is expected to continue.

No specific monitoring programme is envisaged for these activities for the pilot study areas.

3.8.2 Heath Services

If adequate health provision is to be developed as part of the GAP programme it is essential to involve senior Ministry of Health staff in overall planning of irrigation development at an early stage. In order to provide for anticipated health effects a programme to train health personnel in the GAP region about specific diseases, especially malarial and parasitic illnesses, is required. Formal contingency plans with funds and resources to cope with disease outbreaks, especially of malaria, need to be devloped.

A regional disease incidence monitoring programme will be required to allow epidemics to be identified and contained. The detailed design of such a programme could be developed during the pilot study if the resources are provided to allow this.

3.8.3 Relocation Effect

At the regional level large scale migration, especially of seasonal labour, may have health effects. These can be mitigated by providing semi-permanent accommodation for seasonal workers with water supply and sanitation facilities, to reduce exposure to disease vectors. A health screening service should also be provided to determine whether seasonal migrants are carrying diseases, are likely to have low immunity, or are carrying diseases when returning home at the end of the season.

These programmes are not generally relevant to the pilot study areas and will not be monitored.

3.8.4 Disease Ecology

Disease ecology is substantially affected by irrigation, and can have a major impact on health, and on irrigated production. Suitable mitigation measures will form an essential part of the GAP-MOM model, and of the pilot area studies. These include adopting an irrigation management system which maximises on-field water efficiency, providing efficient drainage so that there is no standing water, and training farmers to avoid practices which create habitats which allow disease vectors to live and breed, such as pools under syphons, ditches or borrow pits. This can be reduced by using closed pipe systems for irrigation. Irrigation system maintenance at all levels, especially clearing silt and weeds out of drains, is important to control disease.

The effects of controlling diseases will be monitored throgh the disease monitoring programme, and specific mitigation measures will be monitored as described in the relevant sections.

3.8.5 Disease Hosts

At the regional level there is a need to undertake research on the ecology of disease vectors under local conditions. This will not form part of the GAP-MOM study.

3.8.6 Disease Control

At the regional level the major disiease control requirement is to set up a unit to carry out a programme to control diseases especially malaria. This would involve identifying breeding sites, controlling numbers of disease hosts by chemical or biological control, and spraying other sites where hosts such as mosquitoes and sandflies may rest.

Within the pilot study area it will be necessary to advise farmers on prevention measures, such as, hygiene, use of low cost mosquito nets, putting nets on windows, avoidance of sleeping outdoors near mosquito breeding sites, issuing of sprays and anti-malarial drugs.

The monitoring of disease control is a specialised area which would be developed in detail by medical specialists.

3.8.7 Cultivation Risks

Farmers will be trained in the pilot area on the correct procedures for using agro-chemicals and on what to do in case of accidents. This will be monitored through the KAP surveys.

3.8.8 Safety

Measures are needed at regional level to reduce the dangers of new, fast flowing, irrigation channels. This can be achieved by fencing off main and secondary canals where they pass villages. The public should be alerted to the danger by installing warning signs and public information programmes using the media. Installing means of getting out of the canals such as trash racks upstream of structures (especially syphons and culverts), hand rails, steps, or chains placed across the canals will prevent fatalities. Providing swimming pools will encourage people to learn to swim and avoid dangerous channels.

Monitoring of the safety problem will be undertaken by using regional mortality statistics for drownings. No specific monitoring will be undertaken in the pilot study areas.

The mitigation measures and monitroring requirements for impacts on environmental health are detailed in table E 3.7.

TABLE E 3.7
IMPACTS ON ENVIRONMENTAL HEALTH

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Water and Sanitation	Water availability and quality					
Instigate health education and include health education in extension services		Yes			Yes	
Improve waste water treatment facilities			Yes		Yes	
Provide solid waste disposal facilities		Yes				Yes
Health services	Irrigation related disiease monitoring					
Involve senior Ministry of Health staff in overall planning of irrigation development		Yes		Yes		
Train health personnel in malarial and parasitic illnesses			Yes	Yes		
Set up contingency plans with resources for outbreaks of malaria	MOH workplans and budget		Yes	Yes		

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Relocation Effect						
Provide semi-permanent accommodation for seasonal workers with water supply and sanitation facilities		Yes			Yes	
Provide health screening service for seasonal migrants			Yes		Yes	
Disease ecology	Disease incidence					
Maximise field water efficiency		Yes		Yes		
Provide efficient drainage to reduce standing water		Yes		Yes		
Train farmers to avoid creating habitats suitable for disease vectors		Yes		Yes		
Clear silt and weeds out of drains		Yes		Yes		
Disease Hosts						
Undertake research on the ecology of disease vectors			Yes		Yes	

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Disease Control	Diseases incidence baseline and monitoring programe					
Set up a regional malaria control unit.			Yes	Yes		
Advise farmers on prevention measures		Yes			Yes	
Use closed pipe irrigation systems		Yes		Yes		
Cultivation Risks	Farmer surveys					
Train farmers on correct procedures for using agro-chemicals and on what to do in case of accidents		Yes			Yes	
Safety	Fatalities					
Fence off main and secondary canals where they pass villages			Yes		Yes	
Install warning signs and public education			Yes		Yes	
Install means of getting out of the canals			Yes		Yes	
Provide swimming pools			Yes			Yes

3.9 Impacts on Imbalances

3.9.1 Pests and Weeds

Pest and weed incidence can change and worsen under irrigation, and measures to counteract these problems will be included in the GAP-MOM model. This requires extension advice to farmers on pest and weed control and close liaison between the Plant Protection Directorate, Extension Services and farmers.

Farmers practices with regards to pest control will be monitored in the pilot study areas through the KAP surveys.

3.9.2 Aquatic Weeds

Aquatic weeds in irrigation channels can reduce flows and have a serious impact on irrigated production. At the regional level the problem an be mitigated by ensuring canals are constructed to a high standard to avoid leakages and designed to maintain velocities in channels greater than 0.3 m/s. Within the pilot study area farmers will be encouraged to undertake regular weed clearance, and canal and drain maintenance, which forms an important part of the MOM model.

Within the pilot area weed growth will be monitored by periodic inspections by field staff.

3.9.3 Structural damage

Regular maintenance should include checks for structural damage including damage caused by weeds, animals and deliberate actions by farmers in both canals and drainage structures. This is an essential part of the MOM model.

Monitoring of structural damage will be undertaken in the pilot study areas by field staff, and would become a WUG function.

3.9.4 Animal imbalances

The populations of animals such as beneficial and harmful insects and pests should be monitored as part of the plant protection and environmental health programmes. Specific action will need to be developed in response to problems identified by the monitoring programme. The monitoring programme would be included as part of the MOH enviromental health teams' programme, and also forms part of the environmental studies being carried out by GAP and the MOE.

The mitigation measures and monitroring requirements for impacts on biological imbalances are detailed in table E 3.8.

TABLE E 3.8
IMPACTS ON BIOLOGICAL IMBALANCES

Mitigation measures	Impact monitoring requirements	Relevant to Pilot Study	Relevant at regional level	Major impact on viability of irrigated production	Secondary effect or of interest to special interest groups	Minor effect, or uncertain outcome
Pests and Weeds	Pest and disease incidence					
Advise farmers on pest and weed control		Yes		Yes		
Close liaison between the Plant Protection Directorate, Extension Services and farmers	Agency reports	Yes			Yes	
Aquatic Weeds	Weed growth inpsection					
Construct canals to a high standard to avoid leakages			Yes		Yes	
Maintain velocities in channels over 0.3 m/s			Yes		Yes	
Undertake regular canal and drainage maintenance and weed clearance		Yes		Yes		
Ensure that there are clear guidelines and funding as to maintenance requirements at all levels of the canal and drainage network		Yes		Yes		
Structural damage	Field survey					
Check for structural damage		Yes		Yes		
Animal imbalances	Pest populations		Yes	Yes		

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SECTION F

ACTION PLAN

SECTION F - ACTION PLAN

CONTENTS

SECTION F - ACTION PLAN

1 INTRODUCTION

The recommended MOM model consists of three principal elements, namely the Supplier of Bulk Water (DSİ), an Irrigation System Operating Body (Irrigation Authority) and farmer generated Water User Groups. The model also provides for strengthened co-ordination links between these bodies and support agencies, including the private sector and other interests not formally involved at present.

Implementation will necessarily be progressive over several years. The initial stages will focus on the establishment of Water User Groups in representative Pilot Areas in order to develop the process of group formation and test the effectiveness of the model under field conditions before it is adopted for wider implementation throughout the region. Trials of a number of water saving measures and improved irrigation and drainage techniques will also be undertaken as part of the Pilot Area Development. It is proposed that this will commence in 1994.

Those aspects of the management model, such as the creation of a new Irrigation Authority, which require new legislation will take some time to be implemented. Other important factors affecting implementation include establishing and improving co-ordination arrangements, resourcing the new organisations, training of agency staff and farmers, developing administrative procedures and suitable transitional arrangements for the proposed Irrigation Authority.

The following steps will be taken to implement the model:

Step 1: Following acceptance of the model, carry out briefing sessions of all agencies affected at central and regional levels.

Step 2: Commence group formation process in selected Pilot Areas leading to establishment of Water User Groups.

Step 3: Commence training programmes for staff and farmers in Pilot Areas.

Step 4: Upon formation of WUGs and completion of irrigation infrastructure in Pilot Areas, commence demonstrations of irrigation O&M under management of WUGs.

Step 5: Draft suitable legislation to provide for establishment of an Irrigation Authority to operate at regional level, formation of a GAP Co-ordination and Advisory Council for Irrigation Development (GAPCACID) and consequential amendments needed to existing water laws.

Step 6: Develop transitional management arrangements to provide for

DSİ to progressively transfer responsibility (and the necessary resources) for O&M activities on primary and secondary canals to an Irrigation Authority when it is formed.

Step 7: Monitor performance of the management arrangements undertaken by WUGs in Pilot Areas.

Step 8: Review, and modify as necessary, the management model in relation to WUGs following evaluation of Pilot Area performance.

Step 9: GAPCACID to commence operations.

Step 10: Irrigation Authority to commence operations in each region.

Step 11: Upon success of the group formation process in the Pilot Areas, make arrangements for the process to be institutionalised.

Step 12: Upon completion of the GAP MOM project establish arrangements for continued monitoring, evaluation and review of the GAP management model.

Some of these steps can proceed concurrently, particularly the planning and development of Pilot Area activities, training programmes and preparation of legislation. It is envisaged that a minimum period of five years should be allowed for the procedures to be developed, tested and fully implemented.

2 INSTITUTIONAL ARRANGEMENTS

2.1 Establishment of GAP Co-ordination and Advisory Committee on Irrigation Development

The GAP Co-ordination and Advisory Committee on Irrigation Development (GAPCACID) is seen as the key coordinating body bringing together the main organisations and interests involved in irrigation development in the region. This committee would play a major role in providing advice and guidance to the GAP Administration to enable it to formulate regional policy and to co-ordinate the activities of involved departments and organisations. In particular it will provide a formal channel through which farmers' concerns and ideas could be directed to the GAP Administration so that irrigation development is planned taking into account the needs and wishes of farmers in the design phase of future projects.

GAPCACID would comprise representatives from the following sectors and bodies:

- Secondary Canal Management Committees representing WUGs
- Irrigation System Operating Body (Irrigation Authority)
- Supplier of Bulk Water (DSİ)
- Regional Directorate representatives of DSİ, Ministry of Agriculture, and other Regional Directorates and Research bodies
- Representatives from Private Sector Bodies.
- Provincial Governors or their representatives.
- Universities

It is desirable that GAPCACID be brought into operation at a relatively early stage so that it can begin to influence planning for future projects. It could commence at any time involving those bodies which already exist. However successful interaction with farmer bodies would suggest that the appropriate time for commencement would be when there are several WUGs firmly established and organised to make worthwhile contribution to the co-ordination process. The size of GAPCACID would be increased appropriately as additional WUGs or SCMCs and the Irrigation Authorities are formed in each Irrigation Region.

The full GAPCACID, as described in Section B, would initially comprise about 20 members and would grow to 40 or more as additional SCMCs provide members. The whole council should meet twice per year for regular business. However, to provide ongoing attention to the needs of co-ordination, there should be a small executive of three persons appointed by the council to meet at least monthly and act on its behalf.

2.2 Role of Provincial Co-Ordination Committee

The existing Provincial Co-ordinating Committees of each province provide an important communication link between different Government agencies including those which have only an indirect relationship to irrigated agriculture. The primary role of co-ordination in relation to all organisations directly concerned with irrigated agriculture is with GAPCACID under the MOM model. However because of the economic and social significance of the GAP irrigation schemes to the whole region, there is a need to ensure that the programmes of all other agencies are planned with an understanding of the irrigation development programme. This is particularly important in respect of Government agencies responsible for services such as transport, health and education which, although not directly involved with irrigation, will face increased demands on their services as irrigation development proceeds. The Provincial Co-ordinating Committees will play an important role in co-ordinating the general activities of all public agencies, which is a complementary role to that of GAPCACID. Representation of each Provincial Co-ordinating Committee on GAPCACID will strengthen the overall co-ordination.

2.3 Establishment of Irrigation Authority

The creation of an Irrigation Authority (IA) is the recommended sub model for the Irrigation System Operation Body core component of the MOM Management Model. The proposed IA will take over functions at present carried out by DSİ. The IA should own, manage, operate and maintain the primary and secondary delivery system, buying water in bulk from DSİ and selling it to Water User Groups (WUGs). Coordination and communication with the WUGs would be facilitated by formation of a Secondary Canal Management Committee (SCMC) representing a group of WUGs on the same secondary canal system.

The IA will be a Government agency and should be established within the Ministry of Public Works and Settlements although outside the existing departmental structure of DSİ. It is an essential that the IA be set up under a charter which requires it to operate on a commercial, fully accountable basis with its own management and finances. This would establish it from the outset as a relatively autonomous body focussed specifically on delivery of irrigation services to a defined customer group. It would also facilitate the possible transition of the IA to a private sector body in the future.

It is expected to require several years for the various arrangements to be finalised for implementation of an IA. The immediate need will be to prepare suitable legislation to allow the IA to be established. A subsequent step will involve detailed planning, resourcing and financing of the activities to be performed.

In addition to the need to have appropriate legislation for an IA, the timing for it to commence operations as a separate agency will depend on progress in completing irrigation supply infrastructure works. Ultimately, when all the GAP region irrigation works are completed, it is proposed that there be a separate Irrigation Authority for each of the three major Irrigation Regions, defined in Chapter 8 of Section B. However, the process of developing these Irrigation Authorities is likely to be an evolutionary one. For a period of about four years it can be expected that DSİ would carry out the Irrigation Authority functions under transitional arrangements. After that time separate Irrigation Authorities should come into operation in the Euphrates and Tigris River basins. Given the likely period at least of 20 years to full development, it may be convenient and most cost effective to have a single Irrigation Authority covering all the Euphrates River schemes, based on DSİ Regions 15 and 20, until full development is reached.

2.4 Establishment of Irrigation Regions and Irrigation Zones

The process of delineating Irrigation Regions and Irrigation Zones was described in Chapter 8 of Section B.

It is recommended that the whole GAP region be considered as three regions, based on river basins and major water systems, for the purpose of overall water resource and irrigation planning. The proposed regions correspond generally to DSİ Regional Directorate boundaries with the recommendation that the existing DSİ boundaries be amended to transfer Mardin province from Region 10 to Region 15. This would ensure that all the major water supply systems to be supplied from Atatürk dam via the Şanlıurfa tunnels are within the same region.

50 Irrigation Zones have been tentatively identified. These would form the basis of administration units for day to day management at the local level. These have been delineated having regard to location of water sources, irrigation system layout, area, administrative boundaries, community infrastructure and services and social homogeneity. The tentative zone boundaries need to be reviewed at the time when new projects are being brought into operation to ensure that they still provide an appropriate basis for management.

2.5 Formation of Water User Groups

The creation of Water User Groups (WUGs) is the recommended sub model for the Farmer Groups core component of the recommended MOM Management Model. It will be the responsibility of a WUG to undertake the total management function for irrigation services at the tertiary level. This is the component of the model which needs to be put in place immediately in the proposed Pilot Areas so that the development process can be tested for wider application throughout the region.

WUGs will be organised so that they reflect the wishes and needs of members in the interests of efficient irrigation methods and profitable agricultural production. The farmers must first agree upon a constitution and a set of working rules and regulations. By producing its own constitution each WUG will be able to reflect the differing needs of the irrigation community. The minimum legal conditions for every WUG are that:

- it is created as a legal entity to enable it to own assets, open a bank account and have recourse to the legal system if required;
- it is to be managed by a committee, elected regularly by all the members and accountable to all the members;
- financial accounts of the WUG to be audited annually.

The necessary legal status can be provided by establishing WUGs as Village Co-operatives.

The need for greater participation by farmers in the organisation of farmer groups, as distinct from participating in groups designed by someone else, is recognised worldwide and is the main thrust of the group formation process. The rationale that farmers need to be persuaded of the merits of self-organisation, the benefits they will receive and the need for them to manage directly the water which will produce those benefits. The formation of WUGs will evolve over a period rather than according to a pre-determined schedule. The formation of WUGs will be assisted by placing trained organisers within the farming communities who will stimulate the farmers to believe that group formation is desirable. They will then be able to lead farmers through the processes of group formation including development of working rules for effective group management and operation.

It is proposed that the group formation process will begin in the selected Pilot Areas with the appointment of group formation officers (GFOs) who are not part of any existing Government department or ministry. At a later stage, after the process has been tested, the responsibility for the group formation process will need to be institutionalised and MARA appears to be the appropriate body to assume this role. MARA would be invited to assist with the monitoring of the group formation process in the Pilot Areas.

Preparation of Group Formation Organisers for their task will require a considerable training input and ongoing co-ordinated support from a range of existing institutions and the consultants. Up to 8 GFOs will be recruited who will be supervised by a Group Formation Co-ordinator with support and training assistance from a Group Co-ordination Adviser. The GFOs will receive initial induction training supplemented by regular follow up sessions.

2.6 Establishment of Secondary Canal Management Committee

Where there are a number of WUGs within a single large scheme it will be desirable to form a Secondary Canal Management Committee (SCMC) for co-ordination with the Irrigation Authority. This committee would carry out the following functions:

- negotiate with the Irrigation Authority on behalf of WUGs particularly concerning level of supply of water and charges;
- liaise on a day-to-day basis with staff of the Irrigation System Operating Body for the distribution of water to all WUGs drawing water from the secondary canal;
- represent WUGs on GAPCACID.

Each WUG would be required to nominate a representative to the SCMC which would act as the next higher level operating authority liaising on behalf of WUGs with the supplier. The nomination and election of a representative from a WUG to the SCMC could be made at a General Meeting of WUG members.

2.7 Planning and Design Working Group for Pilot Area Development

It is important to utilise all expertise and knowledge within the various agencies and organisations involved in irrigation development in the region. Close co-ordination and consultation will be promoted specifically between the GAP MOM team and GDRS, GDAReF, DSİ and the agricultural extension services.

For the implementation of the agricultural and engineering measures to be undertaken in the Pilot Areas, a Planning and Design Working Group (PDWG) is proposed. This group should consist of staff from the following organisations:

- GAP RDA who would have overall responsibility;
- The GAP MOM Study Team who would be directly responsible to GAP RDA, and have responsibility for co-ordination, planning, and management of design and implementation of the work;
- DSİ who would set design standards and specifications for secondary and tertiary distribution systems; specify requirements for contract agreements and documentation for supply and construction contracts; prepare design drawings and documents;
- GDRS who would set design standards and specifications for works at the farm level; and prepare design drawings and documents as necessary; and
- extension services departments would provide advice on appropriate practices and extension methods.

The PDWG will function as an integrated team at the project offices in Şanlıurfa, and it will be the responsibility of the GAP MOM Study Team to initiate and co-ordinate activities on a day-to-day basis.

The PDWG should comprise the following staff:

(a) GAP RDA: a Pilot Area Development Coordinator

(b) GAP MOM Study Team

- the GAP MOM Deputy Project Manager would be responsible for overall development in the Pilot Areas;

- a Pilot Area Development Engineer, who would be a new appointment to the consultant's team to supervise the planning, design and implementation of the engineering measures. He would be assisted by two existing engineers from the Study Team, each responsible for two schemes, and

- an expatriate On-Farm Water Management Specialist from the Study Team who would plan and supervise implementation of the agricultural measures assisted by a local specialist from the Study Team.

(c) DSİ and GDRS

- one staff member each from DSİ and GDRS from the Regional Directorates involved in the pilot areas

(d) Ministry of Agriculture

- a liaison officer from the Extension Services department in each provincial directorate involved in the pilot areas, and

- a liaison officer from GDAReF.

Further description of the agricultural and engineering measures proposed in the Pilot Areas are contained in a report entitled "Pilot Areas Development" (Halcrow, 1994). The functions of the PDWG are set out in Appendix 3.

3 ENABLING LEGISLATION

3.1 Introduction

One of the important initial steps to implement the recommended management model is to commence the process of forming Water User Groups to take direct management responsibility for operation and maintenance of the tertiary level irrigation works. The principle underlying the successful introduction of these WUGs is that they should be developed as farmer generated organisations. This implies that there should be a bottom up approach with as little external direction as possible. From the legal perspective, therefore, the formation of groups can proceed provided that there is an adequate basis for their creation and they have power to operate water supply works. If these two requirements are met it is unnecessary, indeed undesirable, to await the making of any new law which might be prescriptive as to how WUGs are formed and should operate.

DSİ has power, under its establishment law, to transfer responsibility for management of its irrigation systems to both public and private organisations provided that they have corporate status. Creation of WUGs as village co-operatives would give them appropriate legal status while leaving sufficient flexibility to meet local circumstances.

Using existing legislation to the maximum extent will allow implementation of some aspects of the model to proceed without delay. It is foreseen that new legislative provisions will be required to establish the proposed Irrigation Authority, institutionalise co-ordination arrangements and strengthen certain areas of water law. Development and making of any new legislation will take time and it would be beneficial to draw upon experience gained during the initial testing of WUG operations in preparing such legislation, including any need to provide additional legal support for WUGs.

3.2 Operation and Maintenance of Irrigation Works

The main requirement for new legislation is to establish an Irrigation Authority as an independent public agency and institutionalise the co-ordination arrangements so that the overall management model can function. This legislation should be as a new law, rather than as an amendment of Law No 6200, although it may include some features of the latter.

The main features of legislation to establish the Irrigation Authority are as follows:

- The IA to be set up as an independent department within the Ministry of Public Works and Settlements;

- The IA to be governed by a part-time management board responsible for overall policy formulation and operational and economic performance;

- The management board to comprise seven persons being:

  (i) A representative of GAP RDA (Chairman)
  (ii) One representative each from DSİ, MARA and GDRS
  (iii) Two private sector representatives, one representing farmers and one experienced in business management
  (iv) The chief executive of the IA (ex officio);

- The main functions of the IA to be: manage, operate and maintain primary and secondary canals and drainage systems in the GAP region; receive water in bulk from DSİ and sell it in bulk to WUGs and other users; carry out long term business planning to provide for the sustainability of GAP irrigation systems; operate in a cost effective manner and finance its operations through charges on users for services provided;

- The IA to own property including assets transferred from DSİ, enter into contracts with other public and private bodies, negotiate level of service agreements with customers and control its staff.

The legislation should be framed in such a manner that a separate Irrigation Authority can be formed in each of the three Irrigation Regions which is the preferred long term aim. However during the development period there might be only one Authority.

The same legislation should provide for the establishment of the GAP Co-ordination and Advisory Council on Irrigation Development as the key co-ordinating forum for core and support agencies and customers in the GAP irrigation systems.

Other amendments are necessary to existing legislation, particularly Law No 6200, which are complementary to the new law setting up the Irrigation Authority and required to make the management model workable. The most immediate of these amendments are for:

- DSİ to be able to transfer ownership of primary, secondary and tertiary canals to the IA and WUGs.

- DSİ to have power to negotiate and enter level of service agreements for bulk supplies to an IA, WUGs and other users;

- Existing provisions covering the power of DSİ, or an Irrigation Authority, to take effective action against persons who take water without permission or damage canals and structures, need to be strengthened.

Other legal changes, which should be included in the new legislation for the Irrigation Authority and by amendment of DSİ Law No 6200, apply to water charges and are discussed below.

3.3 Irrigation and Drainage Charges

In order for the objective of full recovery of O&M costs to be achieved it is necessary that the basis for both DSİ and the Irrigation Authority to set bulk water charges be defined in legislation and that this be supported by effective collection and sanction powers. The key components of this water charging and collection mechanism are:

- water charges for bulk supplies be set based on the estimated full O&M cost in the year of operation, with operating surpluses or losses carried over to the following year;
- Separate charges be calculated for water supply and drainage services provided by the one body;
- In the event of non payment of water charges by any customer, after a period of one month of the due date, interest charges be imposed at an equivalent amount to the prevailing bank borrowing rate;
- In addition to imposing penalty interest charges for non payment of water charges, all water authorities be empowered to cease supply of water until payment is received.

3.4 Water Rights

There are a number of shortcomings in existing water laws which have been identified in Section A which apply generally to irrigation and water management throughout the country. A number of possible amendments to overcome these shortcomings have been proposed already by DSİ. Although not essential to the immediate implementation of the GAP MOM model, it is highly desirable that the law be improved in these matters for effective overall water management. The main requirements are as follows:

- Rationalisation of water rights by any organisation or person for the extraction and use of surface water resources to ensure integrated management of allocations on a whole basin approach;
- Promulgation of Regulations provided for under Article 641 of the Civil Code covering the general use of public waters;
- Clarification of the water rights of individual farmers in an irrigation scheme, specifying which properties have rights to water use;

4 ESTABLISHMENT OF PILOT AREAS

4.1 Identification of Areas

Investigations to identify pilot areas have centred on 6 possible locations. One location is within the Urfa command system of the Harran Plain, which will receive the first supplies from Atatürk dam, and the remainder are at five existing irrigation schemes. Three pilot areas in the Urfa system have been selected. Four possible pilot areas have been identified in existing schemes from which three will be selected. Within these six areas the GAP MOM Water User Group model will be tested and compared to allow the processes of organising WUGs in new irrigation areas, and established schemes to be studied. The methodology of the group formation process and the experience gained from such work will be replicated in other schemes within the GAP region eventually, and may provide a model for regional and national implementation. The areas selected are as follows:

Name	Province	Gross Area (ha)	Demonstration. Area (ha)
Devegeçidi	Diyarbakır	6900	2460
Hancağiz	Gaziantep	6250	6250
Ceylanpinar	Şanlıurfa	9000	180
Harran 'A'	Şanlıurfa	43040	4500
Harran 'B & C'	Şanlıurfa	43040	3000
Harran 'D'	Şanlıurfa	43040	2500
Keysun	Adıyaman	1950	1950

The Keysun scheme is included as an alternative to be selected if any of the other possible areas are not available.

4.2 Formation of Water User Groups

The process of formation of Water User Groups will be undertaken by Group Formation Organisers (GFOs). It is proposed that GFOs will be full time contract staff. They will act as catalysts within one or more communities, assisting through discussion, debate, enquiry, advice and information, the process of formation of Water User Groups for irrigation purposes, leading the community to the stage of election of a WUG Committee and appointment of a Water Foreman. In the process a set of self-governing rules and regulations will be produced by the community.

GFOs will receive initial training, supplemented by quarterly training as required. Field support and supervision will be provided by the Group Formation Coordinator who will also act as a liaison person between GFOs and the GAP MOM Project. Additional professional support and guidance will be provided through the Group Formation Adviser.

Regular monthly meetings will be the main medium of reporting progress or otherwise, and a means of sharing experience with other GFOs and providing mutual support. GFOs will be required to regularly maintain records of progress through the group formation process for monitoring purposes and for future use as training material.

4.3 Establish Organisational Structure

The operating structure for group formation work and staff organisational linkages are shown in Figure F4.1.

The activities to be undertaken are detailed in Table F4.1 and cover the following main aspects:

- Introduction of GFOs to leaders and farmers in village areas.
- Explanation of the group formation process to farmers.
- Survey of area and meeting all farmers.
- Meetings and discussions on the group formation process.
- Finalisation of rules and regulations leading to formation of Water User Groups.
- Formation of Secondary Canal Management Committees for a number of WUGs.
- Training of WUGs, water foremen and farmers.

The timespan for completing these activities will depend very much on the rate of progress on formation of WUGs. The indicative time required to complete this process in the Pilot Areas is two years.

FIGURE F4.1

GAP FORMATION PROGRAMME ORGANOGRAM

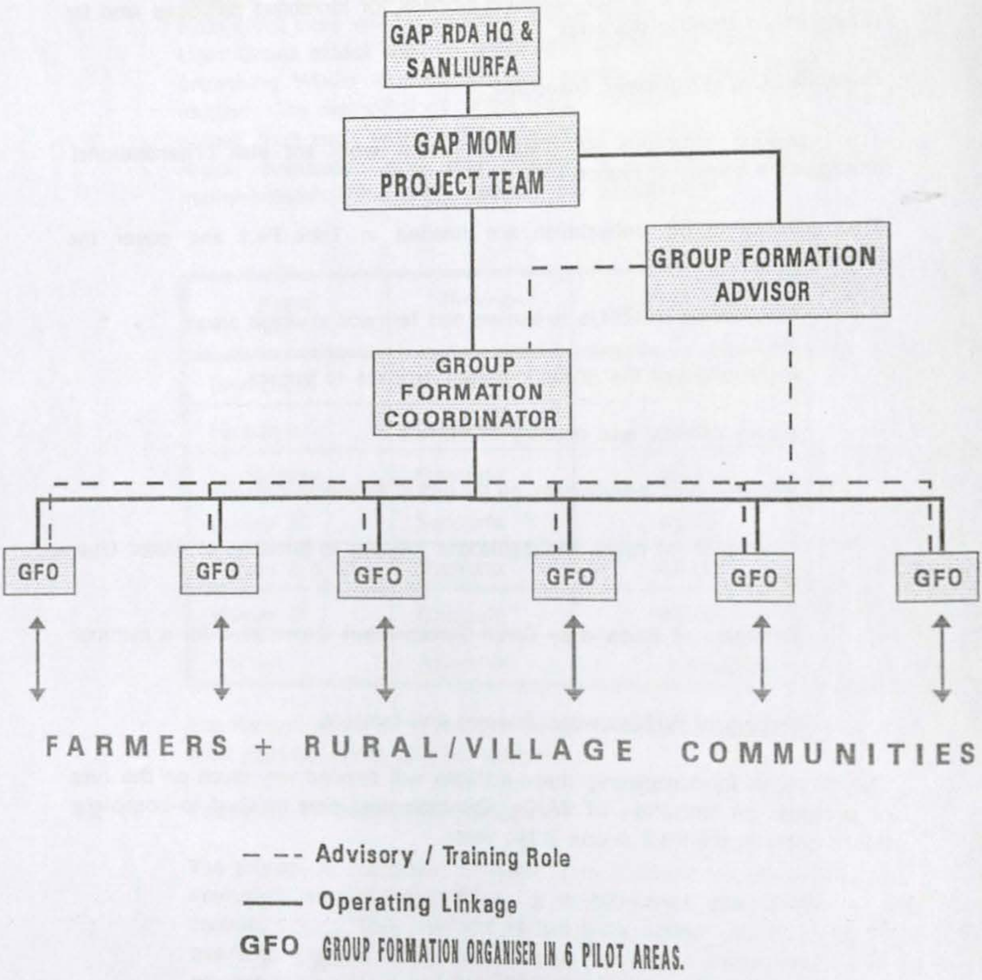


TABLE F4.1 GAP MOM PROJECT - PILOT AREAS
ANTICIPATED WORK PROGRAMME FOR GROUP FORMATION ORGANISERS

Step	Description of work	Person(s) involved
1	Recruit Group Formation Organiser(GFO).	GAP RDA GAP MOM JV Team
2	Train GFOs.	GAP MOMJV Team
3	Briefing DSİ to (a) outline the GAP MOM concept; (b) requirements for the Pilot Areas; (c) agree ongoing meeting schedule.	GAP MOMJV Team GAP RDA
4	In Pilot Areas (a) brief Muhtars on GAP MOM concept and need for Pilot Areas. Obtain: (a) agreement for work in the pilot area; (b) set date(s) for meeting(s) to brief key farmers.	GAP MOMJV Team members GAP RDA
5	Briefing Meeting(s) with Muhtar and key farmers on GAP MOM concept and group formation. Obtain general acceptance. Introduce GFO. Explain GFOs role. Arrange GFO accommodation, and date for commencement of work. Explain formation of Water Users Groups (WUG) and Secondary Canal Management Committee (SCMC).	GAP MOMJV Team members GAP RDA
6	Return to village to formally establish GFO "on site".	GAP MOMJV Team members
7	GFO arranges meetings with village dignitaries - Imam, school teacher, VGT, health worker, Jandarma, etc.	GFO
8	GFO commences group formation work. Organises small group meetings with Muhtar (or his representative) and all farmers from the Pilot Area. Outlines the principles of GAP MOM and the aims for the coming season. Aims to get initial agreement to the concepts of GF.	GFO
9	GFO introduces himself to individual farmers in command area, locations of farms and farmers' houses by walking the command area. Marks landholdings on a cadastral map. Makes list of all farmers and their landholdings to assist in organisation of the Water User Group (WUG).	GFO
10	GFO organises village meetings to outline need for farmers to prepare WUG's rules and regulations.	GFO
11	GFO continues to work with farmers gaining their confidence. Learns about previous years' cropping pattern, the water supply situation, distribution problems, etc.	GFO
12	Periodic visits from GAP MOMJV staff to provide backup and support to GFO and further discussions with Muhtar and farmers to build up relationships.	GAP MOMJV Team GFO
13	Meeting of GAP MOMJV and GAP RDA with DSİ to discuss the Terms of Agreement for Water Supply (TAWS) to Pilot Areas.	GAP MOMJV Team GAP RDA

Step	Description of work	Person(s) involved
14	Final meetings to discuss and agree WUG's constitution and rules and regulations.	Farmers & GFO
15	GFO assists in organising elections for WUG Committee Members. Members appoint a Water Foreman.	GFO
16	Training of WUG Committee Members and Water Foremen commences	GAP MOMJV Team
17	Once WUGs formed meetings held with other WUG Committees to discuss the formation of the Secondary Canal Management Committee.	GAP MOMJV team GFO
18	Preliminary meeting to form the Secondary Canal Management Committee. Outline by GAP MOMJV of (a) concept of Customer-Client relationship with water supply agency; (b) introduction of the Terms of Agreement for Water Supply (TAWS); (c) TAWS discussed by individual WUGs.	GAP MOMJV Team GFO
19	SCMC formed. Members formulate guidelines for operation and maintenance of the secondary canal. SCMC meets with DSİ Staff (Technician) to discuss arrangements for managing the Secondary Canal.	GFO
20	Training of SCMC Committee members commences.	GAP MOMJV Team GFO
21	Training of DSİ Technician commences with some joint training with WUG Water Foremen.	GAP MOMJV Team
22	WUGs discuss TAWS with GFO.	GFO
23	Periodic meetings with DSİ and GAP MOM Project discuss the Terms of Agreement for Water Supply	GAP MOMJV Team GAPRDA
24	Discussions continuing with and within DSİ on TAWS	GAP RDA & MOMJV Team
25	Further meetings with DSİ on TAWS. Agreement on revisions and amendments.	GAP MOMJV Team GAP RDA
26	Further meetings with Secondary Canal Management Committee to discuss TAWS.	GAP MOMJV Team GFO
27	Final meeting with SCMC and DSİ to sign TAWS. Binding contract made. Formal ceremony held in Pilot Area to acknowledge the contract. DSİ, GAP MOMJV, GAP RDA and farmers attend. Services of GFO now withdrawn.	GAP MOMJV Team GAP RDA GFO
28	WUG Water Foreman collects data from farmers on season's planned cropping pattern.	WF & Farmers
29	SCMC collects data from WUGs on cropping pattern and water demands.	SCMC
30	Statement by DSİ of water supply pattern fot the year to Pilot Area.	DSİ

Step	Description of work	Person(s) involved
31	Discussion and agreement between DSİ and SCMC of cropping pattern pattern within Pilot Areas.	SCMC, DSİ & MOMJV Team
32	Farmers notified through WUGs of agreement on cropping pattern and approval of individual's cropping pattern.	WUG WF
33	Start of season.	
34	WUG Water Foremen in Pilot Areas submit water requests to DSİ Technician on daily basis. DSİ Technician collects requests and submits to Supplier (DSİ) for delivery.	WF & DSİ Technician
35	Daily monitoring by DSİ Technician of supply into Pilot Area. DSİ Technician supplies water to WUG Water Foremen.	SCMC & WF
36	GAP MOMJV monitor performance of Client/Customer agreement during season	GAP MOM JV Team
37	GDRS Research Institute studies performance within Pilot Areas as a research activity. Also studies situation on main canal to ascertain if Pilot Areas are getting preferential treatment.	GDRS Research Institute
38	Periodic meetings, as required, of WUGs to discuss matters arising.	WUG
39	Periodic meetings of SCMC, as required, to discuss matters arising.	SCMC
40	Periodic meetings, as required, of SCMC with DSİ to discuss matters arising.	GAP MOM JV Team
41	End of season meeting of WUGs to review season's performance	WUG
42	End of season meeting by SCMC to review season's performance	SCMC
43	End of season evaluation of performance by GAP MOMJV	GAP MOMJV Team GAP RDA

4.4 Engineering Measures Necessary to Address Constraints

The philosophy of the GAP MOM study is that, not only will appropriate MOM models for development be identified, but that these will be tested and evaluated by implementation in selected Pilot Areas. Thus, for the Study to be effective and successful in meeting its objectives, implementation within the Pilot Areas must also be successful.

Within this framework, and with regard to the existing situation in the proposed Pilot Areas, studies have identified three major constraints. These constraints, together with the proposed engineering measures to address them, are discussed in the following sections.

4.4.1 Infrastructure Rehabilitation

The existing infrastructure at Devegeçidi is in poor condition requiring substantial rehabilitation. Many canalets have high leakage losses.

At both Devegeçidi and Hancağiz, main canal leakage losses need repairing, and at the latter, sections of canalet need replacing. At Urfa-Harran, much work needs to be completed at the tertiary level before the system can be operated. This includes the installation of control gates and the completion of many tertiary outlets.

At Ceylanpinar, both the buried pipe distribution system as well as the on-farm application equipment and hydrants require substantial rehabilitation.

In order that effective operation and maintenance regimes can be put in place in these areas, and moves made towards encouraging farmers to accept a realistic charging policy for irrigation water, the existing infrastructure must be either completed or rehabilitated as required.

Further detailed information can be found by reference to Appendix B of GAP MOM Study report entitled **Pilot Areas Development** (Halcrow, 1994).

4.4.2 Water Measurement Structures

Very few, accurate flow measurement facilities exist or are planned throughout the distribution systems of the Pilot Areas. Such structures would be used to achieve good water management. Flows diverted to the systems, and flow division within the systems need to measured and monitored.

This would form the basis for charging Water User Groups on a bulk supply basis for irrigation water. It would also form the basis for monitoring distribution system and field level efficiencies, and generate management information for improving operational procedures, and for decisions about infrastructure and control improvements.

Measurement structures are required at both the secondary and tertiary levels. They would include broad crested weirs and long throated flumes in secondary canals, and precast sills and hand held meters for tertiary channels. The pipe distribution system at Ceylanpinar will require conventional flow meters (analogue and totaliser).

Without such facilities, the credibility of the management measures to be introduced into the Pilot Areas will be undermined. This would be particularly so in relation to the introduction of water saving measures, and realistic water charges.

Further details can be found in Appendix C of the **Pilot Areas Development** report.

4.4.3 On-Farm Water Application Method Designs

Studies to date have highlighted the relatively low level of effective water management currently practised in parts of existing irrigation schemes. A fundamental strategy for achieving efficient water use lies in the selection of the most appropriate water application method for a particular area. If the method selected is inappropriate, this will lead to:

- inequitable water distribution throughout the area resulting in social discontent, and

- non-uniform distribution within the fields resulting in overuse of water, variable yields and ultimately loss of revenue to farmers.

For irrigation to be sustainable it is important that early attention is given to the selection and implementation of the most appropriate on-farm methods. If the farmer is to accept full responsibility for the operation and maintenance of the distribution system and to pay a realistic price for the water supplied to him, he must be provided with the means of ensuring that the water is put to the best possible use on his land.

At Devegeçidi and Hancağiz, traditional canalets have been installed and furrow irrigation appears to be the standard on-farm water application method assumed in designs, and encouraged in practice. Though the soils are clayey, land slopes range from gently sloping areas of 1 to 2%, through intermediate areas of 2 to 6%, with significant areas from 8% to in excess of 10-12%. Additionally the topography is gently undulating.

This situation has significant adverse implications for water management and water use efficiency. There is an urgent need to review and revise on-farm designs in substantial parts of these areas to allow farmers to take up alternative application practices.

Further details can be found in Appendix D of **Pilot Areas Development.**

4.4.4 Agency Coordination

In order to implement the above engineering measures it is essential to utilise all expertise and knowledge that exists within the various agencies and organisations involved in irrigation development. Close co-ordination and consultation will be promoted specifically between the GAP MOM team and GDRS, GDAReF, DSİ and MARA GDOS (extension services). It has been recommended that a Planning and Design Working Group (PDWG) should be formed to undertake these functions, as described in detail in 2.7 above.

4.5 On-Farm Water Management

4.5.1 The Need for On-Farm Water Management

The efficient use of irrigation water and the effective handling of drainage water at the farm level are an essential part of good MOM practices, and an important element in the overall strategy of water saving in the Region.

As an integral part of the day-to-day management and operation of the proposed Pilot Areas, it is therefore essential that farmers are introduced and trained in the use of improved farming or agricultural practices that will lead to improved water use efficiency.

Some of these measures will be relatively simple and can be implemented quickly by the farmers themselves. Others will require small modifications to infrastructure and will therefore take some time to introduce. Others will require the (local) manufacture or procurement of appropriate equipment, which again will require time to implement.

4.5.2 Improved Water Management Methods

All of these measures should be seen as part of the overall training programme for the study. Irrigation technicians, subject matter specialists, and, most importantly, lead farmers must have these practices demonstrated to them on their farms.

These measures can be categorised into five broad types, all aimed at promoting water savings, as follows:

(a) Water Demands

- farmers should be trained in the concepts of crop water requirements;
- a number of selected, receptive lead farmers should be encouraged to have simple rain gauges set on their farms and trained in the concept of keeping water budgets;
- farmers should be trained in the concepts of irrigation scheduling, leading to appreciation of the relationship between application depth, timing and yields. Tensiometers could be used for this purpose.

(b) Water Distribution

- pre-cast concrete flow measurement structures should be set up on all Pilot Area tertiaries. Simple gauge staffs should be installed, except that two tertiaries per area should have autographic recorders installed. Two hand held flow meters would be provided for each pilot area;

- a limited number of canalets would be modified and equipped with side slide gates, or bottom outlet valves, to improve water abstraction efficiency;

- at least one Water User Group in each Pilot Area would be encouraged to provide a limited area of land (0.25 ha) on which to construct a Night Storage Reservoir (NSR).

(c) Water Management on the Farm

Measures to be introduced to improve surface irrigation practices include those listed below.

- improved header ditches including alignments, alternative construction techniques and materials and use of intermediate ditches;

- improved furrow forming equipment;

- use of alternative furrow shapes;

- portable stop-offs and portable flow measurement equipment for the farm level;

- use of multiple small syphons;

- lay flat tubing for headers;

- gated pipe techniques;

- cut-back furrow irrigation techniques, and

- tail ponds for drainage water collection and re-use.

Pressurised irrigation methods should be introduced wherever possible in terms of physical and social suitability, as follows:

- conventional hand-moved multi-sprinkler systems;

- low pressure and low application rate multi-sprinkler systems, particularly for night irrigation (avoidance of lateral moves during darkness), and

- drip irrigation for row and tree crops.

(d) Drainage Measures

These should include:

- completion of land grading (coordinated with GDRS) and effective land preparation techniques;
- effects of regular ploughing on land grades and hence water distribution and drainage;
- construction of secure outlets to tertiary drains;
- construction of inlet structures at end of canalets;
- re-use of drainage water through collection ponds and pumping.

4.5.3 Trials and Monitoring

- farmers should be actively involved in trials of water use efficiency for furrows of different alignments, shapes, lengths and slopes under different soil conditions;
- the use of open ended and closed ended furrows should be promoted in appropriate conditions, and
- the project should actively monitor soil moisture and hydraulic conductivity at a selected number of locations, or grouped fields.

Further details can be found in Appendix A of **Pilot Areas Development.**

Agency Coordination would be achieved for these measure as described in 4.4.4.

5 TRAINING PROGRAMME

5.1 Training Courses

The methodology used to identify the training needs of the various target groups has been described in Section B, 6.10. The training programmes proposed for 1994 is related directly to the needs of the Pilot Areas.

Based on a comprehensive training needs analysis, reported in the consultant's report **Proposals for Training** (Halcrow, 1994), training on various aspects of implementing the MOM Model is required for four categories: management, operating and maintenance staff, farmers and trainers. The subjects to be included for each category are as follows:

Category 1 Management

This group includes senior and middle level managers from GAP RDA, DSİ, GDRS, GDOS, and GDARef who need an understanding of the overall project and the roles and responsibilities. Middle level managers will need to have a good practical knowledge of management techniques and tools for effective coordination effectively with counterparts in other organisations. A series of 5 courses will be held to provide this training.

Category 2 Operation and Maintenance

In this category DSİ O&M personnel will be trained in methods of operating primary and secondary delivery systems serving the demonstration areas (both new and existing irrigation schemes). Staff to be trained in this category will be O&M Engineers, Project Planners and Designers, O&M Technicians/Watermasters and Gatekeepers, and the training will be undertaken in six courses at three different levels.

Category 3 Water Users

This category covers people most closely involved with establishing water user groups in Pilot Areas: Group Formation Organisers (GFOs), WUG Water Foremen, selected farmers, and WUG Committee Members.

The training for GFOs will cover an introduction to the GAP MOM project, rural sociology, extension methodology, introduction to irrigation, roles of WUGs and principles of formation. This will be given in a 10-day induction training course supplemented by regular in-service training on a monthly/quarterly basis.

When WUGs are formed, training will be given to WUG Committee Members in organisational subjects necessary for the successful management and running of a water user group. Four short courses will be held for committee members, commencing with the first WUGs to be formed.

Irrigation farmers and Water Foremen will be trained in efficient water use and maintenance and other related activities through six short courses covering each Pilot Area. It is expected that the selected lead farmers will impart the knowledge gained to other farmers. This will be supplemented by inputs from MARA GDOS Village Group Technicians and SMSs through the normal extension system. More general information will also be provided to farmers using television, radio and video media.

Category 4 Trainers

The training for trainers course will given for training coordinators, extension staff (SMSs and VGTs), and course lecturers from various organisations. Four such short courses will be held for those most closely involved with the Pilot Areas, and the training coordinators from the various departments.

Training courses are recommended for 17 groups in 1994, amounting to about 270 persons. 11 different courses are suggested, some of which will be repeated several times. The proposed courses are listed in Table F 5.1. Dates and venues have been provisionally suggested for all of the courses planned. An intensive programme is necessary, to ensure the training matches the proposed timescale for the Pilot Areas. It is necessary to start the training courses in April 1994 and continue each week until the end of the year, whilst avoiding the harvesting and vacation months of July and August. Some rescheduling may be necessary if there are delays in establishing the Pilot Areas, the formation of WUGs or the commissioning of irrigation system works. The tentative timetable for 1994 is given in Figure F5.1.

5.2 Implementation Arrangements

The proposed training programme should be coordinated, managed and financed by GAP RDA, to ensure control and long-term sustainability. The Training Coordinator recently appointed by GAP RDA should manage the implementation and evaluation of the training programme with the support and assistance of the consultant.

A Training Coordination Committee should be formed, chaired by the Training Coordinator, with representatives from all the Government agencies involved, and the consultants, to advise and assist GAP RDA in all aspects of the training programme.

The Training Coordinator should establish a system of training administration to ensure that all actions related to each training course are carried out at the required times and that the relevant records are maintained. Further details are given in the **Proposals for Training** report.

Some special equipment will be required for the courses, particularly for practical training in flow measurement and soil testing. A number of special training videos are also recommended to extend the series already available under the YAYÇEP Project. The demonstration of different irrigation techniques in the Pilot Areas will serve to give practical and technical back-up to the training and videos.

TABLE F5.1 PROPOSED TRAINING COURSES

Target Group	Course Title	Duration days	Events in 1994 No.
CATEGORY 1 : MANAGEMENT			
Senior Managers	Management Seminars on selected topics	1	4
Middle Managers	Project Workshop	3	1
CATEGORY 2: O&M STAFF			
O&M Engineers, Planners, Designers, Agronomists, etc	Introduction to the GAP MOM Project	2	2
O&M Engineers	Water Management for the GAP Irrigation Canal System	5	2
O&M Technicians Watermasters, Gatekeepers	Operating the GAP Irrigation Canal System	3	2
CATEGORY 3: WATER USERS			
Group Formation Organisers	Establishing Water User Groups	10	1
WUG Water Foremen, Lead Farmers	On-farm Water Management	3	6
WUG Committee Members	Management of Water User Groups	2	4
Category 4: **TRAINERS**			
Training Coordinators	Training Coordination Seminar	2	1
Trainers and Lecturers	Communication Skills Workshop	2	1
Extension Agents	Irrigation Workshop for Extension Agents	2	2

FIGURE F5.1 : TRAINING TIMETABLE FOR 1994

APRIL			MAY			JUNE			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
1	Fri		1	Sun		1	Wed	OM 02/01	1	Thu		1	Sat		1	Tue	WU 02/03	1	Thu	WU 03/05
2	Sat		2	Mon		2	Thu	OM 02/01	2	Fri		2	Sun		2	Wed	WU 02/03	2	Fri	WU 03/05
3	Sun		3	Tue		3	Fri	OM 02/01	3	Sat		3	Mon		3	Thu	WU 03/03	3	Sat	
4	Mon		4	Wed		4	Sat		4	Sun		4	Tue		4	Fri	WU 03/03	4	Sun	
5	Tue	TT 01/01	5	Thu		5	Sun		5	Mon		5	Wed		5	Sat		5	Mon	WU 02/06
6	Wed	TT 01/01	6	Fri		6	Mon		6	Tue		6	Thu		6	Sun		6	Tue	WU 02/06
7	Thu	MS 01/01	7	Sat		7	Tue		7	Wed		7	Fri		7	Mon	OM 02/02	7	Wed	WU 02/06
8	Fri		8	Sun		8	Wed	OM 03/01	8	Thu		8	Sat		8	Tue	OM 02/02	8	Thu	WU 03/06
9	Sat		9	Mon		9	Thu	OM 03/01	9	Fri		9	Sun		9	Wed	OM 02/02	9	Fri	WU 03/06
10	Sun		10	Tue		10	Fri	OM 03/01	10	Sat		10	Mon	WU 02/01	10	Thu	OM 02/02	10	Sat	
11	Mon	OM 01/01	11	Wed		11	Sat		11	Sun		11	Tue	WU 02/01	11	Fri	OM 02/02	11	Sun	
12	Tue	OM 01/01	12	Thu		12	Sun		12	Mon		12	Wed	WU 02/01	12	Sat		12	Mon	
13	Wed		13	Fri		13	Mon	MS 02/01	13	Tue		13	Thu	WU 03/01	13	Sun		13	Tue	
14	Thu	TT 02/01	14	Sat		14	Tue	MS 02/01	14	Wed		14	Fri	WU 03/01	14	Mon	OM 03/02	14	Wed	
15	Fri	TT 02/01	15	Sun		15	Wed	MS 02/01	15	Thu	MS 01/03	15	Sat		15	Tue	OM 03/02	15	Thu	
16	Sat		16	Mon		16	Thu		16	Fri		16	Sun		16	Wed	OM 03/02	16	Fri	
17	Sun		17	Tue		17	Fri		17	Sat		17	Mon	WU 02/02	17	Thu	MS 01/04	17	Sat	
18	Mon		18	Wed		18	Sat		18	Sun		18	Tue	WU 02/02	18	Fri		18	Sun	
19	Tue		19	Thu		19	Sun		19	Mon		19	Wed	WU 02/02	19	Sat		19	Mon	
20	Wed	WU 01/01	20	Fri		20	Mon	TT 03/02	20	Tue		20	Thu	WU 03/02	20	Sun		20	Tue	
21	Thu	WU 01/01	21	Sat		21	Tue	TT03/02	21	Wed		21	Fri	WU 03/02	21	Mon	WU 02/04	21	Wed	
22	Fri	WU 01/01	22	Sun		22	Wed		22	Thu		22	Sat		22	Tue	WU 02/04	22	Thu	
23	Sat		23	Mon		23	Thu	MS 01/02	23	Fri		23	Sun		23	Wed	WU 02/04	23	Fri	
24	Sun		24	Tue		24	Fri		24	Sat		24	Mon		24	Thu	WU 03/04	24	Sat	
25	Mon	WU 01/01	25	Wed		25	Sat		25	Sun		25	Tue		25	Fri	WU 03/04	25	Sun	
26	Tue	WU 01/01	26	Thu	TT 03/01	26	Sun		26	Mon		26	Wed	OM 01/02	26	Sat		26	Mon	
27	Wed	WU 01/01	27	Fri	TT 03/01	27	Mon		27	Tue		27	Thu	OM 01/02	27	Sun		27	Tue	
28	Thu	WU 01/01	28	Sat		28	Tue		28	Wed		28	Fri		28	Mon	WU 02/05	28	Wed	
29	Fri	WU 01/01	29	Sun		29	Wed		29	Thu		29	Sat		29	Tue	WU 02/05	29	Thu	
30	Sat		30	Mon	OM 02/01	30	Thu		30	Fri		30	Sun		30	Wed	WU 02/05	30	Fri	
			31	Tue	OM 02/01							31	Mon	WU 02/03				31	Sat	

O&M Courses

TT Courses

MS Courses

WU Courses

6 PREPARATION OF MOM MANUALS

6.1 Management, Operation and Maintenance Manuals

To assist staff and farmers involved with the introduction of the model in Pilot Areas and related training programmes, a series of Management, Operation and Maintenance manuals will be compiled by the consultants.

Separate versions of these manuals will be produced to cover the requirements of DSİ, the Irrigation Authority and Water User Groups.

In the case of the WUGs the manuals will be in general guideline form only as the basis of the group formation process is that the groups should develop their own specific operating rules.

The manuals will contain, in addition to procedures and instructions relating to specific tasks and activities in the Pilot Areas, an outline of principles and policies underlying the development of the GAP MOM model. In particular the co-ordination of the whole range of activities undertaken by agencies which comprise the overall model will be explained. The general approach for the production of manuals issued by the International Commission on Irrigation and Drainage (ICID, 1989) will be followed.

The general headings of the main sections of the manuals are:

(a) Organisation and Management

In this section the overall MOM model will be explained together with the project policies, functions and responsibilities of each entity, organisational structures and the institutional arrangements for co-ordination between agencies.

This section will also include reference to the various administrative procedures required to support the management model and allow it to function. This includes matters such as management information systems, personnel functions and responsibilities, stores procurement and control, financial procedures and administrative support procedures.

(b) Project Description

This section will describe the overall water resources and supply facilities of the GAP region together with detailed description of the sources, conveyance and delivery canals and associated infrastructure supplying each Pilot Area.

(c) System Operation Arrangements

This section will describe the nature of the overall irrigation supply procedures from source headworks, through the primary and secondary canals into the tertiary system. The specific rules that apply for ordering and scheduling water, canal operation and delivery, flow measurement and control, measures to minimise water loss and emergency procedures will be outlined. The range of operational data to be collected such as water flows, delivery volumes and areas supplied, will be detailed.

(d) Maintenance Procedures

This section will cover maintenance policy, planning and programming arrangements as well as providing specific advice and guidance on the maintenance needs and techniques for the main components of the water supply and drainage systems.

The policy aspects of maintenance include development of strategies which aim to ensure that the system meets all service needs and the need for rehabilitation is deferred until assets have reached their planned lifespan. This approach involves systematic planning, setting of priorities, achievement of a balance between immediate works and preventative maintenance needs and financial planning to fund the works at an adequate level.

The maintenance manuals will also contain description of the planning, costing and scheduling of maintenance works on a seasonal basis. Detailed works schedules for the annual maintenance of each scheme should include matters such as description and type of work, timetable of works, resource requirements and liaison arrangements with operations staff, customers and other agencies.

6.2 Cropping Techniques Manual

Agricultural research on field crops is being carried out on various field crops by several institutions in the region These are the Eastern Anatolia Research Institute in Diyarbakır, the Agricultural Research Institute in Akçakale, the GDRS Research Institute in Şanlıurfa and the Çukurova Research Farm at Koruklu.

The research results published by these institutes have been examined to ascertain the agronomic inputs needed for each of 45 crops to achieve optimum yields under the agronomic conditions in the northern and southern zones of the GAP region. The main objective of this study is to assist extension specialists to prepare their training material.

The agronomic inputs required for each crop have been determined in terms of:

- seedbed preparation
- recommended varieties
- seeding date

- seeding depth
- row spacing
- N rate at seeding time
- P rate at seeding time
- Possible fertiliser combinations at seeding time
- N rate and dates for broadcasting
- Possible P fertilisers for broadcasting
- Harvest date
- Yield level
- By-product level

As part of the same study, the water requirements of each crop have been determined, expressed as mm/10 days, using the method set out in the FAO publication "Guidelines for Cropwat" (FAO, 1991).

After the results of this study are confirmed with the researchers they will be used to compile a manual for use by extension specialists.

6.3 Monitoring and Evaluation Manual

A Monitoring and Evaluation manual will be prepared describing the system in detail. This will be undertaken as a joint exercise with the Monitoring Officer appointed by the GAP RDA. A proforma quarterly report layout will be prepared and the information required will be obtained from the pilot study areas. This will identify the data availability, collection and acquisition procedures, data handling requirements and the reporting procedures. A survey design for the impact monitoring surveys will be prepared and field tested, and a data entry system, tabulation layout and report outline prepared. The M&E manual should be completed in May 1994.

6.4 On-Farm Water Management Guidelines

Following investigations into improved on-farm water management, outlined in Chapter 5, a set of guidelines for irrigation scheduling will be prepared for use by farmers and extension staff.

These guidelines will be prepared for the range of crops, soil conditions and irrigation methods used throughout the region. Matters to be covered would include:

- Determination of unit stream sizes and irrigation duration. This could be in the form of a set of fixed rules for farmers to adopt a particular water depth for each application.

- Prepare a schedule of irrigation intervals (e.g. 7,10 or 12 days) so that the fixed application depths can be applied on different days to match the seasonal variation in crop water demands.

7 MONITORING AND EVALUATION OF PERFORMANCE

7.1 Introduction

This chapter summarises the monitoring and evaluation requirements envisaged at the end of the identification phase. Monitoring of the pilot studies is a fundamental component of the GAP MOM study, and is the primary objective of the third phase of the project. The monitoring system will be described in greater detail in the M&E Manual, which is expected to be prepared by May 1994.

7.2 Objectives of the Monitoring Programme

Monitoring and evaluation of the GAP MOM study has two key objectives:

- Monitoring the progress of the implementation of the pilot studies, evaluating the key constraints and identifying suitable measures to overcome these constraints

- Evaluating the performance of the MOM model developed and its applicability to the GAP region as a whole

If a beneficiary led, market driven MOM model is adopted in the GAP region the availability of information from GOT agencies will be reduced. Information to allow development to be controlled, implementation problems to be identified and controlled and future developments to be planned will need to come from well directed monitoring operations.

The lessons learnt during the development of an effective M&E system in the pilot study areas will form the basis of the M&E approach which can be applied to the GAP region.

7.3 Design of the Monitoring and Evaluation System

7.3.1 Overview

The M&E system will have two main components, a Management Information System (MIS) and an Impact Monitoring System (IMS).

The MIS will monitor the progress of implementation of the planned activities of the GAP MOM study, and should provide management with the information required to:

- oversee progress, ensure that planned inputs are available when required, that work schedules are achieved and targeted outputs obtained; and

- identify problems at an early stage and take steps to resolve them.

The GAP MOM study involves several agencies in a complex task, so the monitoring of their activities will play a crucial role in ensuring the project achieves its objectives.

The Impact Monitoring System will make use of the outputs of the MIS, and will collect additional information which allows the causes of the events observed to identified, and the impact of the changes made to be evaluated. This will be achieved by field surveys of the participants of the pilot studies to establish agricultural (and water utilisation) knowledge, attitudes and practices, the activities of the Water Users Groups, the effectiveness of farmer training services, impact on cropping systems, income and employment effects. Studies will also be undertaken to monitor drainage and salinisation development, health effects and environmental effects.

7.3.2 Management Information System

The MIS will collect and organise data on water distribution, on farm water utilisation, the development of Water Users Groups, farmer services and training. These will be reported on a quarterly basis. The MIS will be based on key indicators identified as suitable for measuring the progress made and impacts of the project. The development of the water distribution system will be monitored, including specifically new construction and facilities required to operate the pilot study areas. Water delivery and flow measurements will be collected in some detail during the pilot studies. Meterological data for the pilot study areas will also be collected.

Data on the development of the water distribution arrangements, dispute settlement, water management and water charges in the pilot study areas will be collected regularly.

Irrigated crop area data will be obtained from DSI and MARA staff. The development of Water Users Groups will be monitored by the Group Formation staff. WUG activity will also be reported. The performance of the farmer service operations will be monitored. Farmer training activities will be monitored through training reports and reports of extension staff activity.

7.3.3 Impact Monitoring System

The IMS will collect information on the effectiveness of the Water Users Groups, farmer training services, impact on cropping systems, income and employment effects, drainage and salinisation development, health effects and environmental effects. These will be reported in survey reports and impact evaluation reports.

The impact of the pilot study will, to a large extent, depend on progress with WUG formation. In addition to MIS data on group formation and activity periodic field surveys will be undertaken to establish attitudes, perceptions and sustainablility.

The effectiveness of the farmer training services for both crop development and irrigation management will be estimated by annual surveys of farmers in the pilot areas to assess the existing knowledge of the farmers of the practices recommended, whether the practices are adopted, and reasons for practices not being adopted. These surveys are often called Knowledge, Attitudes and Practice (KAP) surveys.

The impact on crop production will be assessed by using data collected by the KAP surveys to identify the cropping systems and crop management practices adopted. In addition data on crop area and the use of inputs by farmers in the pilot areas will be estimated. These data will be used to construct crop budget and estimates of economic returns.

Annual household surveys will determine the major sources of household income within the pilot areas, and will collect simple household inventory data to identify changes in wealth, and therefore income.

The impact on drainage will be estimated by field observations of water tables in and around the pilot areas, collected by DSI. Salinisation effects within the pilot areas will be estimated by direct field observations and using the water quality data collected by DSI.

Environmental health effects are described in detail in Technical Discussion Paper 17 Environmental Health, (Halcrow 1994), which identifies the main disease problems. The major risks are (i) a malaria epidemic, though other diseases may become important; and (ii) the spread of disease as a result of labour migration. A disease and vector monitoring unit under MOH will be required at the GAP regional level.

It will not be possible to undertake impact monitoring studies of all the potential environmental impacts. A regional environmental impact assessment is being undertaken by GAP and the MOE, which is due to be completed in 1996. The monitoring requirements are, in practice, those required to evaluate the performance of the MOM models in the pilot areas, and the data collection details are described above. The specific items identified are the performance of the irrigation system, based on special studies and records of reservoir operations and water releases; water flows, irrigation system and drainage system maintenance, groundwater utilisation, water table levels and water quality; on farm water utilisation, water charging, reuse of drainage water, use of agricultural chemicals, irrigation systems, and weeds, pests and diseases, which will be included in the KAP surveys; and, crop areas and soil loss studies.

7.4 Sources of Data

7.4.1 Overview

To the extent possible the M&E system will rely on existing data collection. Data for the M&E system will be obtained from four main sources, described below.

7.4.2 Secondary Data

The main source of data will be the DSI, which will include groundwater level observations, salinity records, reservoir operations, water releases and water pumping. The DSI seasonal crop census is undertaken using a sample survey approach on every scheme under DSI control. Data on area and production are collected by farmer recall.

The GDRS will provide data on construction of field works, land grading and road development. GDRS staff provide monthly progress reports on construction. GDARef will provide data on land consolidation.

Crop area and production data at a village level will be utilised, as collected by MARA by recall from the Muhtar, on an annual basis.

Other relevant data will be obtained from the Agricultural Bank and the State Institute of Statistics. Data from population census, agricultural census and village surveys will be utilised.

7.4.3 Socio-economic Survey

A socio-economic survey was conducted by GAP MOM in 1993 and is reported in Technical Discussion Paper 19 Socio-Economic Studies (Halcrow 1993). The pilot study villages were included in the sample, and this survey will provide baseline data.

7.4.4 Data Collected By The Pilot Study

Data will be collected directly in the field by GAP MOM project staff and staff of cooperating agencies. These will include water flow measurements, progress and activity of the WUG formation process, progress with physical completion of structures and special studies. These data will be incorporated into the MIS where required.

7.4.5 Evaluation Surveys

Impact evaluation data will be collected through annual sample surveys of farmers and Water Users Groups. The main survey will be the KAP survey, although it may also be necessary to collect crop area and production data.

7.5 Preparation of the M&E Manual

A M&E manual will be prepared describing the system in detail. This will be undertaken as a joint exercise with the Monitoring Officer appointed by the GAP RDA. A proforma quarterly report layout will be prepared. A survey design for the impact monitoring surveys will be prepared and field tested, and a data entry system, tabulation layout and report outline prepared. The M&E manual should be completed in May 1994.

7.6 Work Programme and Timetable

The M&E manual will be prepared between March and May 1994. The implementation of the pilot studies will be under way by June 1994 and the MIS should be established from that date, and Quarterly Reports will produced. Training for the Monitoring Officer (MO) will be undertaken in conjunction with the preparation of the M&E Manual, and during subsequent visits of the MES.

Field surveys will be required each year to collect impact evaluation information from farmers and WUGs. Field work should be undertaken in October, followed by data entry and verification, and initial analysis and tabulation. Annual evaluations are scheduled for February 1995 and 1996. A Project evaluation is expected in December 1996, which will be based on the progress made, and data available at that date.

7.7 Staffing and Support Requirements

The MES will provide inputs of thirty days each in February 1995, February 1996 and December 1996. An additional input of about 40 days in September 1994 is recommended.

The MO and alternate appointed by GAP RDA can be expected to be fully employed on the MIS and IMS at least up to February 1995. Survey staff will be required to carry out the impact evaluation surveys in the pilot study areas for about six weeks each year.

8 IMPLEMENTATION PROGRAMME

8.1 Institutional Arrangements

8.1.1 Introduction

The various aspects of the management model will be introduced progressively in accordance with the rate of commissioning of supply works, the rate of establishment of Water User Groups and the availability of new legislation required to create an Irrigation Authority.

The steps required to develop and implement the institutional framework are set out in Chapter 1. Some of these steps can proceed concurrently, such as the planning and development of WUGs, training programmes and initiation of legislation procedures. The WUGs will be introduced progressively in accordance with the group formation process to match the completion of supply works. The transfer of management responsibility to a newly created Irrigation Authority will be a phased process requiring transitional arrangements from DSİ to the new agency.

Figure F8.1 shows the activities required by the GAP MOM Study to implement and monitor the model over the remainder of the consultancy. The activities are shown in the form of a time based activity chart covering preparation of manuals, institutional arrangements, WUG formation, Pilot Area development, training, monitoring and evaluation and reporting.

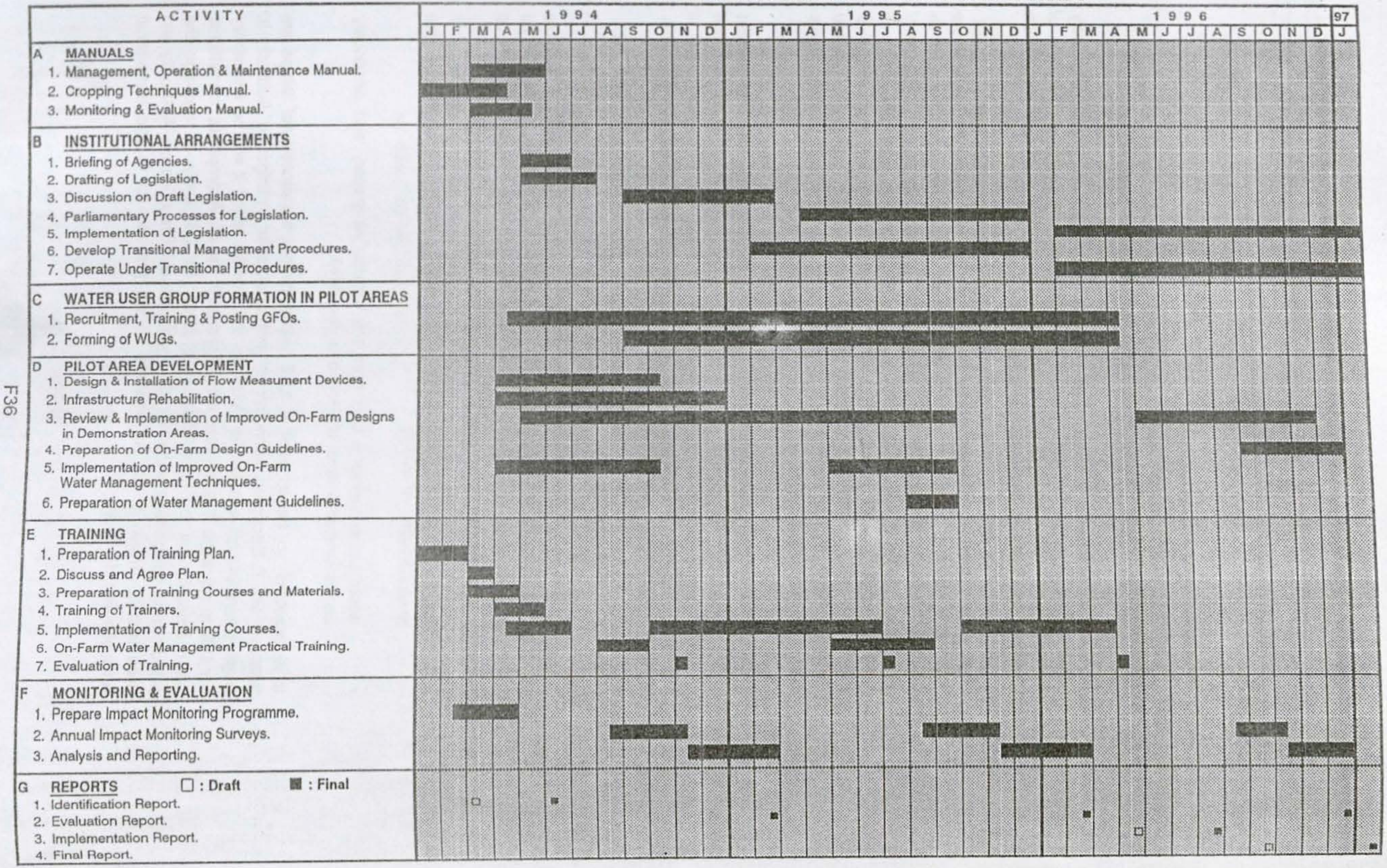
8.1.2 Transitional Arrangements

Following adoption of the model the preliminary steps for developing suitable legal mechanisms will begin and these are outlined in 8.2. Planning should be on the premise that as each new scheme is brought into operation it is to be operated in accordance with the following main principles of the model:

- management of the tertiary distribution system be wholly the responsibility of WUGs
- water be supplied in bulk from the source via primary and secondary canals under a level of service agreement.

It is expected to be at least 4 to 5 years before the procedural steps are finalised and it becomes economically practicable for an Irrigation Authority to begin operation as a separate entity. In the interim period it will be necessary for DSİ to manage the primary and secondary canals. Appropriate transitional arrangements will be developed to provide for DSİ firstly to manage the primary and secondary systems on behalf of the future Irrigation Authority and then transfer them to it. The matters to be provided for in the transitional arrangements include:

FIGURE F8.1 : GAP MOM PROJECT ACTIVITY CHART PHASES 2 AND 3



- Organisational structure and staffing levels based on future needs. Staff engaged in operations that will be later transferred to an IA should be organised in units separate from general DSİ activities.

- Funding arrangements.

- Revenue collection procedures. From the outset all matters concerning billing and collection of water charges for bulk supplies to WUGs should be handled by DSİ.

- Administrative procedures.

- Plant, vehicle and equipment stocks.

- Office facilities.

- Liaison arrangements with WUGs including level of service agreements.

- Timetable for progressive transfer of activities, staff, assets and facilities to the IA.

- Staff communications.

The restructuring of public organisations into more efficient, cost effective bodies which are responsive to customer needs is a worldwide trend and the experience of other countries is of relevance. If the process is to be successfully achieved it must have support and commitment by Government, customers and agency staff at all levels. Issues of staff morale and concerns about future job prospects must be addressed positively from the outset. Regular communication with staff and direct involvement of staff at all levels in developing working arrangements are important factors in transition to a new organisation.

It is probable that the overall future staffing requirements of the Irrigation Authority will be lower than for DSİ to perform the same activities. In order to avoid the possibility of numbers of redundant staff in future it is imperative that staffing numbers for the Irrigation Authority be determined on a **future needs basis** and not on past DSİ staffing policies in other regions. In this regard, as the GAP development is new and there are relatively few existing O&M staff, there is the opportunity to develop an appropriate staffing structure from the outset. With this approach any future staff redundancy problems should be minimised and capable of managing through normal attrition (retirements and resignation).

A small working group, of about five persons, should be convened during early 1995 to commence development of the transitional arrangements. This working group would be convened by GAP RDA with inputs from DSI and the consultant Deputy Team Manager and Institutional and Organisation Specialist.

8.2 Amendments to Legal Framework

The main legislation changes needed to implement the management model are:

- New legislation to provide for establishment of an Irrigation Authority to manage primary and secondary canals as an autonomous public sector agency.
- Legislation to create the GAP Co-ordination and Advisory Council on Irrigation Development.
- Amendment of the DSİ establishment law to enable it to transfer ownership of canals and related works to Water User Groups and an Irrigation Authority.
- Other legislation to provide for full cost recovery and strengthened revenue collection procedures by all agencies.

The process of making such new legislation should be initiated at an early date to allow adequate time for consultation with all interested organisations. The steps involved are set out below with an indication of the time requirements:

- Prepare outline of requirements of new legislation (3 months).
- Discuss draft legislation with government agencies and interested private sector bodies, seeking their comments, suggestions and broad agreement to the proposal (6 months).
- Submit proposed law to Council of Ministers seeking approval to proceed with an application for Parliamentary approval (6 months).
- Submission for Parliamentary debate and approval (3 months).
- Presidential signature and bringing into law (1 month).

These are minimum likely times so that an elapsed period of up to two years could be required to finalise the legislative steps. Responsibility for initiating the legislation should be taken by GAP RDA in consultation with DSİ and GDRS. The consultants would also provide assistance especially for developing the initial draft law and in the consultation process.

8.3 Establishment of Pilot Areas

The establishment of Pilot Areas and processes leading to the formation of

WUGs in these Areas is planned to commence in April 1994 and continue for at least two years.

The proposals for development of the Pilot Areas including implementation of both agricultural and engineering measures for improved water handling is also planned to commence in April 1994. This programme will be influenced significantly by the completion of necessary infrastructure works including rehabilitation.

8.4 Training Programme

The training programme is geared to the requirements of the Pilot Areas and WUG formation. Preliminary planning has been completed and training programmes are scheduled to commence in April 1994.

8.5 Preparation of MOM Manuals

Preparation of manuals covering management, operation and maintenance, cropping techniques and monitoring and evaluation procedures has commenced and will be completed by May 1995.

8.6 Monitoring and Evaluation Programme

The detailed impact monitoring programme will be prepared in the period March to May 1994 and implemented by annual field surveys undertake in the post harvest period each year and then evaluated. The management information system providing information on a range of physical factors from agency sources will be reported quarterly.

8.7 Consultancy Programme

Opportunity has been taken at this stage to review the consultancy inputs during the Implemetation, Monitoring and Evaluation phases of the Study based on the activity chart shown Figure F8.1. The proposed modified inputs are shown on Figure F8.2A & B.

A - FOREIGN CONSULTANTS

FIGURE F8.2A : GAP-MOM PROJECT CONSULTANCY STAFFING REVIEW

POST	NOMINEE	TOTAL
Project Director	E P Evans	1.0
Quality Control	A P G Russell	1.0
Team Manager	W I Lawson	40.0
Inst/Org/Mgt. Spec.	B E Foley	17.0
On Farm Org &Ext Spec.	F P Smyth FJH Pullen	25.0
System O. & M. Spec.	J H Mapson	3.0
Drainage Specialist	D Rycroft	1.8
Hydrol/Water Resources	P T Adamson	4.0
Environmental Specialist	C Francis	1.5
Health Specialist	J Jewsbury	1.1
Ecologist	R V Lansdown	1.0
Irrig. Systems Spec.	S N Suter	7.0
Agri. Economist	D Browne	6.6
Training Specialist	M A Burton	3.0
Training Specialist	M R Starr	2.5
M&E Specialist	L Hesling	8.5
Principal Modeller	R Harpin	1.0
Modelling Engineer	R H Khatibi	5.0
Irr. & Drainage Expert	H G Johnson	0.6
Planning & Devt. Spec.	J R Rydzewski	0.3
Inst. Org.& Mgt. Spec.	D J Constable	0.3
Water Use Specialist	Z Svehlik	0.4
I & D Research	M G Bos	0.3
Groundwater Specialist	J Lloyd	0.4
Soil & Water Quality	A R Key	2.1
GIS Specialist	M Shah	2.1
Pilot Area Infra. Engineer		15.0
On-Farm W. M. Spec.		12.0

TOTAL 163.5

Input in Turkey. Input in UK. = Intermittent UK and Turkey

B - LOCAL CONSULTANTS

FIGURE F8.2B : GAP-MOM PROJECT CONSULTANCY STAFFING REVIEW

POST	NOMINEE	TOTAL
Dpty. Team Manager	S Bekişoğlu	40.0
On Farm Ext. & Train.	C Yeniçeri	23.0
System O. & M. Spec.	M Kanalıcı	30.0
Data Manager	S Adıgüzel	28.0
Irrigation Engineer	H Karaata	18.0
Backstopper/Inst. Spec.	M Oktar	8.0
Legal Expert	S Aksoy	4.0
Principal Sociologists	B Akşit/A Akçay A Atauz	7.3
Sociology Team Leader & Field Workers	G Coşkun etc.	19.8
Irrig. Agronomist	M Güler	19.0
Groundwater Engineer	S Ayna/ E Bulutlar	1.2
Agri. Economist	A Erkuş	3.0
Group Formation Coord.		24.0
Group Formation Advisor		4.0

TOTAL : 229.3

9 PROJECT RESOURCE AND FINANCIAL REQUIREMENTS

9.1 Manpower Resource Requirements

9.1.1 Pilot Area Development

Staffing requirements to implement the proposed engineering and agricultural measures are:

(a) GAP RDA: Pilot Area Development Coordinator.

(b) GAP MOM consultants: Deputy Team Manager responsible for the ongoing development programme. Expatriate staff to comprise a Pilot Area Development Engineer and an On-Farm Water Management Specialist for 12 months each. These inputs would be partly offset by re-arrangement of the initially planned inputs.

(c) DSİ and GDRS to nominate one staff member to the PDWG from each regional directorate involved in the Pilot Areas.

(d) MARA to provide an officer from the extension department in each provincial directorate and one from GDARef to the PDWG.

9.1.2 Water User Group Formation Process

The following staff are required to implement the group formation process in Pilot Areas:

(a) GAP RDA: Appointment of six Group Formation Organisers for a 24 month period.

(b) GAP MOM consultants: A Group Formation Co-ordinator for 24 months and a Group Formation Adviser for 4 months.

(c) MARA to provide an officer from the extension services department of each provincial directorate to assist monitoring the formation process.

9.1.3 Monitoring and Evaluation

The M&E staffing needs are as follows:

(a) GAP RDA: Two Monitoring Officers to be full time for the first 12 months of implementation. The nature of this involvement to be reviewed early in 1995. Five field staff are required for six weeks each year for three years to carry out impact evaluation surveys.

(b) GAP MOM consultants: An input of 1.5 months is proposed for the consultant's expatriate Monitoring and Evaluation Specialist in Sepember/October 1994 in addition to previously planned inputs. This is so that his guidance is available to the GAP RDA Monitoring Officers at the time of planning the first impact monitoring survey.

9.1.4 Legislation

A further one month (part time) input is foreseen by the consultant's legal specialist during the development of draft proposals for legislation in the period may to July 1994.

9.1.5 Training

Most of the training will be undertaken by the consultants and existing MARA extension staff (SMSs and VGTs). The specific staffing implications are:

(a) GAP RDA: Nomination of a Training Co-ordinator.

(b) GAP MOM consultants: Training inputs to be provided by local and expatriate staff within planned inputs.

(c) An estimated 32 days of external lecturers is planned to assist in the 1994 training programme.

9.2 Physical Resource Requirements

The major requirement for additional physical resources is in respect of the agricultural and engineering measures proposed for the Pilot Areas development programme. These requirements are detailed in the report (Halcrow, 1994). Equipment needs for this programme includes the following items which will need to be purchased or manufactured:

(a) Agricultural measures: rain gauges, soil moisture equipment, soil tensiometer, portable flow meters, layflat tubing, gated pipes, syphons, sprinkler and drip irrigation equipment and drainage pumps.

(b) Engineering measures: fixed flow measuring equipment, portable flow meters.

There is also a requirement for construction and rehabilitation of supply infrastructure and on-farm facilities in order to be able to undertake the Pilot Area Development programme. These works comprise:

(a) Agricultural measures: slide gates and valves as canalet offtakes, night storage facilities, tertiary drain outlets and drainage tail ponds.

(b) Engineering measures: rehabilitation and/or completion of supply canals in the Pilot Areas and installation of flow measurement facilities.

The other major physical resource is the purchase of six motor cycles for use by the Group Formation Organisers.

9.3 Financial Requirements

9.3.1 Pilot Area Development

The estimated cost of proposals for agricultural and engineering measures to improve water management and on-farm irrigation in Pilot Areas is as follows:

Item	Agricultural Measures US$ (000s)	Engineering Measures US$ (000s)	Total US$ (000s)
Consultant Staff	-	270	270
Equipment	515	28	543
Construction	70	2,365	2,435
Total	585	2,663	3,248

9.3.2 Water User Group Formation

The staff costs are estimated as follows:

Item	Cost US$ (000s)
Group Formation Adviser	33
Group Formation Co-ordinator	144
Group Formation Organisers	100
Total	277

The main additional cost is for purchase and operation of motorcycles for each of the GFOs. The capital cost is estimated at US$9,000 for six motorcycles with annual running costs of US$800 per vehicle, totalling US$4,800.

9.3.3 Monitoring and Evaluation

The main cost is associated with the proposed additional input by the consultant's expatriate M&E Specialist. This is estimated at US$ 28,500 based on 1.5 months input.

9.3.4 Legislation

The estimated additional cost for a one month input by the consultant's Legal Specialist to the development of new legislation is US$ 8,240.

9.3.5 Training Programme

The MOMJV consultant will assist GAP RDA in the coordination and evaluation of the training programme and with presentation of the courses. Direct costs of running the training programme cover non-recurrent and recurrent items. Non-recurrent costs will arise from the purchase of special training equipment and training videos. Recurrent costs arise each time a course is presented, in respect of such matters as room hire, refreshments and lunches, training manuals, fees for external lecturers and transport for field trips.

The total estimated cost for the 1994 programme is TL 1,600 million (January 1994 costs), as detailed in the report (Halcrow, 1994) and summarised as follows:

(a)	Non-recurrent Costs		
	• Special training equipment	TL	200 million
	• Training videos	TL	600
	Total Non-recurrent costs	TL	800
(b)	Recurrent Costs 1994 for 26 courses	TL	800
(c)	Total Costs (1994)	TL	1600 million

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APPENDIX 1

STUDY TERMS OF REFERENCE

REPUBLIC OF TURKEY

PRIME MINISTRY

GAP

REGIONAL DEVELOPMENT ADMINISTRATION

MANAGEMENT, OPERATION AND MAINTENANCE OF GAP IRRIGATION SYSTEMS

TERMS OF REFERENCE

JULY, 1992

CONTENTS

1. BACKGROUND

The South-eastern Anatolia Project (GAP) is the largest and most comprehensive regional project in Turkey and one of the largest in the world.

The project implementation area (referred to as the Region hereafter) covers 8 provinces that correspond to 9.2% of the National population (5.2 million) and 9.5% of the total surface area (74 000 sq. km) of Turkey.

GAP is an integrated, multi-sectoral regional development project and as such, it involves development in all social and economic sectors, including but not limited to agriculture, industry, infrastructure, health, education, tourism etc., in an integrated and co-ordinated manner.

A master plan study has been carried out to investigate the potentials, resources, bottlenecks and problems in regard to the Region's socio-economic development and to set the development objectives, goals and strategies both at macro and sectoral levels. The GAP Master Plan also established a set of priorities that would provide a general guidance for the implementation.

Currently, agriculture is the dominant economic sector in the Region, claiming approximately 40% of the gross regional product, GRP (the same ratio for Turkey is below 18%); Manufacturing industries contribute a low 12% to GRP (the national share of manufacturing industries from GDP is 25%).

The population is very dynamic in the Region with a 3.87% annual rate of increase in spite of an outward movement from the Region to the larger cities in the country.

2. WATER RESOURCES DEVELOPMENT

The project area is rich in soil and water resources. Euphrates and Tigris Rivers altogether make up approximately 28% of the Nation's water supply by river basins. The economically irrigable lands in the Region correspond to 19% of the national total. The Region's development, therefore, is strongly tied to the development of these two very important resources.

To utilize this potential, plans have been made and 13 project groups have been established. These project groups, when completed, will include 22 dams, 19 hydropower plants and numerous irrigation schemes. A total area of 1.7 million hectares of land will have been opened to irrigation and a hydroelectric power capacity of approximately 7 500 MW will have been created with an average annual generation over 27 billion kilowatt-hours.

The GAP water resources development projects are in different phases of realization. The Karakaya Dam, with a generating capacity of 1 800 MW, has already been completed and in operation for several years as well as a number of other dams and irrigation networks. The biggest structures in the project (the embankment volume), the Atatürk Dam is nearly complete; the largest irrigation tunnel system in the world, The Şanlıurfa Tunnels have reached a realization rate of 80% and many other water resources structures are under construction.

The planning, design and construction of the storage, conveyance and distribution works for such a vast irrigation development program is a major task that the Turkish Government (through DSİ) is performing with adequate technical skills and financial means, substantially through the domestic budget. In this context, a detailed investigation on water saving methods and technologies for efficient use of water is considered of paramount importance.

In addition, it is well understood that the achievement of the expected results in the shortest period and at maximum level requires not only a sound design and a good implementation of the engineering structures but also a suitable policy (strategies, procedures and organizational structures) for the Management, Operation and Maintenance (M.O.M.) of such systems.

The management of an irrigation system and the design of its structural components are intimately interrelated. In many cases structures (headgates, checks, turnouts, water measurement devices, etc.) in an irrigation system design would require or mandate a particular type and intensity of management through farmer participation and by the agency personnel assigned to operate and maintain the system. Likewise the specification of the type and intensity of the management (procedures, farmer assignment, etc.) that an irrigation system is to utilize, determines the type and intensity of infrastructure that the system will require. This is to say that there are important trade-offs between the structural and management components of an irrigation system for given levels of performance. The choice of an appropriate management-structural combination, therefore, is an important decision to take and the grounds for making such a decision are many - administrative feasibility, economic efficiency, national interest, acceptance by farmers, applicability etc.-

3 TERMINOLOGY

It is important for the terminology of irrigation water management to be well understood among the many professionals involved in the management of irrigation systems. This common understanding enhances the quality of communication, whether spoken or written and makes the professional involment more fulfilling and the accomplishment of objectives more efficient.

Irrigation is commonly defined as the science of supplying water to meet crop production needs by itself or as a supplement to rainfall. Irrigation is conducted in a social environment involving farmers, irrigation operation and maintenance personnel, managers of systems, irrigation agencies or departments, farmer organizations, irrigators' associations and numerous other individuals and institutions. Irrigation takes place in an economic environment where inputs have costs and outputs have values attached, investments require payment of principal and interest, commodities are grown for urban populations or to earn foreign exchange and some resources must be imported to support the national production enterprise. Irrigation involves a biological environment where the major output is the result of a biological growth process and numerous biological entities have life cycles and growth habits that determine the quality and quantity of the product. Irrigation involves a physical environment including the soil, water on the earth, as well as in the atmospheric processes and the numerous structures that are used to control the water. Irrigation requires the application of social, economic, biological and physical principles focused on supplying water to grow a crop.

The irrigation system is defined as the entire set of interacting social, economic, biological and physical factors, objects and entities from the source of water through the conveyances to the farm and the land that is irrigated including the drainage network that removes excess water from the boundary of the irrigation service area. This definition includes the irrigation agency, its personnel, the farmers and their organizations and all of the related institutions serving irrigated agriculture.

Management is defined as the act or art of controlling, conducting or supervising a process with feedback to allow the improvement of performance. It includes the rules and procedures that are used to guide the control of the process. Management is practiced at many levels in the production system, from the decision making associated with allocation of water among various and often competing uses, the control of the source of water, the diversion and conveyance of the water, distribution of the water to farmers who in turn convey, allocate and apply it and remove the surplus when necessary.

Irrigation water management then is the integration of all the contributing disciplines, primarily sociology, economics, agronomy and engineering, to the process of supplying, diverting, storing, allocation, conveying, distributing, applying and draining of water that is aimed at the production of a food or fiber output from a crop. Irrigation water management is divided into two major subcategories; first is management, second is management.

Irrigation system management is that portion of irrigation water management that attempts to integrate supervision and control of source of water through the steps of diversion, storage, allocation, conveyance, and distribution to and including the point where individual farmers or groups of farmers take control to allocate, convey and apply the water for their cropping enterprise and continuing at the point where farm drainage collects and is removed in the drainage network. Irrigation system management is further subdivided into categories of main system management, secondary system management, and tertiary system management. The irrigation system management process in its most general form must, by very definition, include the integration of the irrigation water requirements aggregated from the root zone of the crops, to the field, to the farm (or the farm subsystem) such that water can be allocated and supplied in a sufficient quantity, with an adequate quality and on timely schedule to meet the needs of the crop in a manner convenient to the farmer.

Irrigation system management deals with abstracting water from the source, its allocation, conveyance, distribution as well as the removal of excess water mainly from the point of view of the central irrigation bureaucracy. The personnel of the central irrigation bureaucracy generally are looking up the system for their instructions, rewards and sanctions and may or may not be responsive to farmer demands. Irrigation system management can be a joint irrigation agency and farmer organization activity where farmers collectively through an irrigators' (water users') association assume responsibility and authority over the irrigation water in a greater portion of the conveyance and distribution system perhaps at the tertiary system and/or the secondary system level.

The irrigation water management at the farm level is the responsibility of the farmers, while the responsibility between the water source and the secondary or tertiary level belongs to the government.

Farm water management deals with water in the hands of the individual farmer as directly used in crop production or by a small community of irrigators who share an irrigation turnout and must in turn allocate, convey and apply the water to crops in a mutually beneficial and agreed upon manner. Most irrigation organization at this level is informal and accomplished without written rules or an organizational charter. The norms for taking water are generally well understood by all participants as are the sanctions imposed when the norms are exceeded. Informal arrangements are made for periodic individual or group maintenance work, for water sharing in time of water scarcity and for conflict management. Farm water management is a subset of overall farm management and has primary concern focused on storing water in the crop root zone with concern for productivity and exertion of the optimal amount of effort. How well this placement of water in the plant root zone is accomplished will largely determine the outcome of the cropping enterprise and the consequences will be carried by the individual farmer.

4 OBJECTIVES AND SCOPE

The study will cover five interconnected aspects:

"Water saving" : To identify the conveyance, distribution and application methods that maximize the production value of the water.

"Quality control": To minimize the environmental impact of the irrigation and drainage activities.

"Management": To establish the most convenient method of use of the physical infrastructure which constitutes the irrigation system, according to three factors varying in course of time: Water availability, climatic conditions, cropping pattern.

"Operation": To apply the management rules to each component of the system both in normal regime and in case of contingency.

"Maintenance": To assure continuous and perfect efficiency of the physical infrastructure to allow the regular performance of the operation.

The study will consist of 3 main components:

4.1 Identification

- Appropriate alternative models for the management, operation and maintenance of the irrigation systems will be identified.
- MOM simulation models/model will be prepared for the proposed alternatives.

4.2 Implementation

- The proposed models will cover the general structure of the organization, and the relations between the irrigation districts and the interaction between the irrigation districts and the government. The organization proposed in the model will act as an "information clearing house" and inform the farmers of the government and private organizations' studies. Besides, it will develop recommendations related with the coordination, integration and reorganization of the works carried out by different agencies;

- The existing laws and regulations, during the designing of the MOM model will be evaluated and new regulations and changes in the existing system will be proposed;

- The selected model and/or models to sample irrigation areas both in Euphrates and Tigris basins will be applied, and the required personnel will be trained;

4.3 Monitoring

- The model application will cover the studies of the irrigation district and its higher level organization and the interactions between them;

- The irrigation district will be responsible from the management of water at the field level (from the tertiary or secondary to the field);

- An M & E system will be established, which will carry out a mid-term survey and an ex-post evaluation within the project period. The system will be able to make the necessary modifications.

5 PROJECT CRITERIA, CONDITIONS AND CONSTRAINTS

5.1 General

The proposed solutions must be in line with the legislative frame in force in Turkey with special reference to the relationships between the central power and the regional and provincial authorities. However, the large dimension of the project -both in physical and economic terms- could suggest to adopt special measures in this sector. First of all it should be checked whether the regulation standards adopted in other areas of the country may be satisfactory applied to the GAP Afterwards, the organizational structures (segregated organizational structures -implies the existence of dynamic social groups capable of developing their own organizations according to their needs and organization develops from bottom to the top- or integrated organizational structures -recognizing the absence of such groups, it is necessary to have a centralized management providing for the needs of the individuals and the organization develops from the top to the bottom-) adopted in other countries for the complex irrigation systems should be examined.

A through examination of all related (legal, social, administrative, practical, technical) aspects of existing bodies (state agencies, cooperatives, irrigation groups, agri-input providing systems, distribution and marketing systems) is to be carried out. Arrangements specific or applicable to GAP are to be studied.

The State is necessarily the main figure from the technical and financial point of view in the implementation phase of the GAP; but in the following utilization phase, some tens of thousands of farmers will be deeply involved; the development process will be realized through them; they will receive benefits but will also be called to make substantial changes and improvements in their farms to introduce irrigation; it is from them that at least a part of the capital invested in the execution of the works must return to the community. Therefore, these farmers must be let in for the M.O.M. operations through duly studied participation procedures which are technically financially and socially feasible.

A considerable number of technicians should be assigned to the M.O.M. activities; their recruitment and training represent a very delicate task to be realized in a well-planned and timely manner.

The passage from the rain-fed to the irrigated agriculture involves a radical modification of the agricultural practices and habits. It also entails the need that each farmer accepts the constraints connected with the collective use of the water; such a passage has to be supported by intense training of and technical assistance to the farmers. It is, therefore, necessary to prepare the trainers in order to organize the performance of the vocational training.

The size of the irrigable area requires a multilevel organization with decision-making and executive centers differentiated by tasks and size of territory managed; the highest level will be in charge of the general planning of the whole GAP; the lowest level will be in charge of the distribution of the water to homogeneous areas of a few thousand hectares; the hydraulic units supplied by only one main derivation point correspond to the intermediate level. Passing from the highest to the lowest level the user's involvement through selected delegates increases. Any bureaucratic complication should, however, be minimized.

The degree of completeness and flexibility of the works carried out in relation to the operation requirements have to be verified according to the selected model; as regards the works to be executed integrations or modifications of the design criteria could be suggested to assure the maximum efficiency both in normal regime and in contingency cases.

An incentives system will be proposed the encourage farmers to adapt modern irrigation and farming technologies and to use optimum crop patterns. The incentives proposed will include those which should be provided by the Government as well as those which the irrigation district system or individual districts should provide.

The possibility or feasibility of integrating, linking or coordinating the proposed farmer participation in irrigation with other agriculture-related activities and their official or semi-official organizations is to be considered.

The existing framework, although not a constraint, must be taken into account as an alternative over which modifications and improvements can be proposed.

The optimization of the water use -through suitable water saving methods and technologies- covers a number of factors: cropping pattern, application methods, distribution procedures, field and conveyance efficiency, reservoir management, reuse of drainage water; takes into account the constraints caused by water, land, labour power, technical skill, investment and working capital availability; may refer to the farm, region or country level as well as to the general development policy.

5.2 The Human Dimension

Irrigation scheme design choices and their management are often made with little or no regard for the existing indigenous structures of social relations and organizational aspects. As a result, the outcome can be disappointing in terms of reaching desired goals in levels of productivity and economic rate of investment in the systems established. Furthermore, such schemes can actually be negative in their consequences, by giving way to poor management, little self-management by the peasant farmers, increasing disparities between power and income groups in the project site, further marginalization of under previledged social stratas ad categories (such as rural women, the landless, nomads, ethnic groups and the like).

Thus, there is a direct relationship between technical and design choices and socio-economic factors. Therefore, best technological intervention is one which best complements the local conditions, people's socio-cultural orientation, their farming system, rather than, offering the farmers the "technically-best" solution with the hope that they may use it properly.

Achieving a sustainable, farmer managed irrigation system requires a structural design which meets user's needs. If the design is too rigid and leaves no room for possible future adaptations, the results may be low yields, poor water distribution and unanticipated social conflicts. Irrigation design has implications reaching far beyond the physical system itself. There is need, therefore, for socio-economic data to enable a better understanding of the interplay between technical and social structures. Such data should particularly reflect the components of three levels of relationship involved in an irrigation scheme:

(1) Production system - The factors to be considered are: the importance of irrigated crop versus other activities, labour availability, mobilization of labour. Control over production, the extent of cash-cropping versus subsistence production, availability and use of inputs, tools and machinery, division of labour and mutual relationships among household members (men, women, the elderly, youth), and existing rights to the use of land.

(2) Social organization and management system - The factors to be considered are: hierarchy and leadership within the social structure, existing social groups, categories and classes, already existing organizations, communal activities and dependency relationships.

(3) External relation system - The level involves relations with market and state mechanism through the input/output processes. The factors to be considered are: the actual functioning of the market and the government services, and to the demands specific irrigation designs will make upon them. For this purpose information is needed about transport facilities, input distribution, policy plans of the government, global price fluctuations and so forth.

Focus on the above level of relationships will also reveal insight into the potential areas of conflicts of interest, such as, (a) between government and farmers, (b) among indigenous population, (c) within government.

Irrigation scheme designers implicitly or explicitly make assumptions regarding the 3 levels of relationships and conflict of interests, however, these assumptions may not always reflect reality. Interdisciplinary team effort guided by sociological analysis can facilitate design decisions to be based on extensive information and sounder assumptions about the factors involved.

Interdisciplinary and participatory approach to management, operation and maintenance of irrigation systems, is based on the assumption that such an approach would produce relevant intervention strategies and receive wider support from local community and therefore have greater and longer lasting impact.

5.3 Other Considerations

The study should take into account the points mentioned below to apply effective and economic methods and technologies for conveyance, distribution and application of water:

- Capacity of existing water sources,
- Hydraulic parameters of distribution and application,
- Soil characteristics of the agricultural lands,
- Necessities of the amendment and improvement,
- Applied crop pattern and rotation
- Water requirements of the crop pattern,
- Drainage,
- Erosion and aridity problems,
- Return flow control,
- Irrigation origined environmental effects.

The irrigation systems are connected with and conditioned by the drainage and road networks. Consequently, the proposed organization should be also in charge with these networks. Furthermore, the following should be considered:

a) The relations and constraints with other water utilization forms: hydropower, drinking water supply, recreation, fishing;

b) The environmental problems: landscape preservation, water quality control, wildlife protection, water born diseases, soil salinity.

5.4 Conformity and Coordination With Existing Framework

All inputs that are to be used in the study will be in conformity with the plans, studies and projects that have been prepared or will be in preparation during the course of the study. Items such as hydrological analyses, water supply, water, cropping patterns, farm and land classifications etc. are but a few of the required inputs. Many of these inputs are, however, either the outputs or by-product of existing or planned studies. These studies include, but not limited to, the following:

- GAP Master Plan Study (State Planning Organization)
- Crop Pattern and Marketing Study (GAP-RDA)
- Regulation of Water in Irrigation Canals and Water Saving Irrigation Methods and Technologies (GAP-RDA)
- The Economic Analysis of Agricultural Enterprises: Identification of Short, Mid and Long Term Credit Requirement (GAP-RDA)
- The Model Study of an Economic Development Agency (GAP-RDA)
- Water Resources Development Plans and Projects (General Directorate of State Hydraulic Works)
- Irrigation Master Plan Study (General Directorate of State Hydraulic Works)
- Farmer Extension Programs (Ministry of Agriculture and Rural Affairs)
- On-farm Development Plans and Programs (General Directorate of Rural Affairs)
- Projects Related with Environment (Ministry of Environment)
- Education Master Plan (Ministry of Education)
- Health Master Plan (Ministry of Health)

6 WORK PLAN

The Study will be performed in three phases:

<u>Phase one "IDENTIFICATION"</u> will include these tasks:

<u>Task - 1</u>

Task-1.1 Collection and analysis of existing documentation;

The first step of the Study will be compilation of Turkish laws, rules and regulations relating to the planning, design, financing, supervision, operation and maintenance of hydraulic public works, as well as to the establishment and management of cooperatives, farmer consortiums, water users' associations, environment protection, water rights, etc.

Similar documentation will be obtained from countries with long irrigation experience like France, Italy, Spain, Australia and United States.

Methods and technologies currently used in Turkey and in other countries for the conveyance, distribution, application of the irrigation water will be duly analysed.

The knowledge of the socio-economic characteristics of farms and farmers will allow to evaluate the need of vocational training (type, duration, dimensions) as well as the most appropriate participation of the farmers to the M.O.M. activities.

Task - 1.2. Review of the preliminary and final designs; identification of limiting factors;

The preliminary and final design of the irrigation systems in the GAP will be carefully examined in order to acquire deep knowledge of the following aspects:

- Source of water, expected deficit risk;
- Regulation and control structures (gates, measuring devices, emergency spillways, tail escapes);
- Flexibility of system;
- Reference cropping pattern;
- Unit water requirements (monthly values);

The examination may lead to suggest a number of improvements or amendments aimed at a more efficient operation of the systems.

Task -2. Identification of Pilot Areas;

Within this task, the pilot areas will be identified parallel to the identification parallel to the identification of infrastructure and personnel requirements.

Task-3. Building of alternative M.O.M. models and recommendations for the model selection;

After collection, review and processing of the institutional, technical and socio-economic data it will be possible to define alternative models for the management, operation and maintenance of the irrigation systems within the GAP.

The models will then be compared to select the one recommend to the Government. The selection will be based not only on technical and economic merits but also according to the expected acceptance by the farmers.

During the study management operation and maintenance models/model which will take into account the project criteria, with a date base, will be prepared for each alternative model proposed. Additional training programmes on planning, projecting and management aspects of the proposed models, for the technical staff of DSİ. The programmes will be loaded to DSİ's computers for their use.

Task - 4. Evaluation and comparison of criteria, methods and technologies related to the water saving and quality control issues; preparation of a detailed programme for demonstration fields.

The guidelines to reach the more effective water use will be defined for each of 13 GAP Irrigation Projects with special reference to: suitable methods and technologies for water application, distribution, and conveyance, lowering field and canal losses, proper integration between irrigation and drainage, suitable water charges policy, technical assistance and training (farmer training programmes; preparation of training material such as video cassettes, brochures; farmer training trips).

The comparison of methods and technologies will be based on the preliminary results of the M.O.M. study and on the comprehensive evaluation of the "scenario" of each project (soil, land and climate features; land tenure and cropping patterns; water, power and labour availability; drainage, erosion and salinity problems; constraints related to the conveyance systems and to their operation; adaptability and expected acceptance by the farmers; etc.). Water quality, reuse of drainage water and environment protection are to be carefully considered.

Long term analysis and evaluation of investment, operation and maintenance costs will be performed. Economic and financial Internal Rate of Return (I.R.R.), Return of Investment (ROI) and foreign currency component of each proposed method will be evaluated.

The agreement with GAP-RDA other selection criteria will be defined. For instance, maximization of net (or gross) income referred to the unit of land, water, or labour.

For the recommended solutions the Consultant will provide:

- Design guidelines and parameters;
- Technical specifications;
- Demonstration programmes to introduce and make acceptable the proposed methods and technologies in the farmers' world;
- Detailed planning and cost evaluation for pilot implementation schemes.

The irrigation districts system layout must be established for the whole GAP area. The layout should indicate the size and functions of each individual irrigation district, its approximate coverage and interactions between them. The hierarchy of districts must also be given. This has to be done during the identification phase, in line with the M.O.M. model being proposed.

An Identification Report will describe the work done and the conclusions reached during the phase one. A special section of the Report will supply the final results of the studies concerning the "water saving" and "environmental" aspects. The whole documentation collected will be attached to the Report.

<u>Phase two "IMPLEMENTATION"</u> will start after the selection of the M.O.M. models to be applied and will include these tasks:

<u>Task - 1.</u> The preparation of M.O.M. Manuals;

The model approved by the Administration will then be applied to sample areas. Obviously, areas where the irrigation system was implemented in six months after first phase and required personnel has been hired for operation. The model application will be done through the preparation of a M.O.M. Manual. The guide for the preparation of Management Operation and Maintenance Manuals being issued by the International Commission on Irrigation and Drainage's (I.C.I.D.) Working Group will be of help in the performance of this task.

The manual can be divided into three main sections:

<u>1st Section</u>: Organization and Management

- Scope of manual
- Physical and social description of the area
- Water rights
- Institutional frame

- The Government's role
- The farmer's involvement and participation
- Policy, rules and regulations
- Cost estimates and funding
- Organization structure
- General administration and staff
- Planning of activities
- Water price policies
- Land registry
- Irrigation and drainage links
- Public relations
- Assistance to farmers

<u>2nd Section:</u> Operation

- Basic criteria
- General responsibility
- Day to day requirements
- System and irrigation scheduling
- Staffing
- Water management
- Water conservation and water quality concerns
- Water measurement
- Water distribution
- Automation and remote control
- Communications
- Contingency measures
- Collection of water charges
- Priorities of water use
- Written procedures
- Monthly and yearly records
- Introduction of new technologies

<u>3rd Section:</u> Maintenance

- Basic criteria
- Annual and long range work plans
- Staffing
- Facilities and equipment
- Contingency measures

- Written procedures
- Monthly and yearly records
- Safety measures
- Health problems
- Introduction of new technologies

The Manual will be prepared with specific reference to the selected sample area, but will contain a series of principles, criteria and rules applicable to all GAP schemes, being the expression of the policy which is means to be adopted.

<u>Task-2.</u> The performance of a training programme

Possible improvement of existing farmer training and extension programs and development of the vocational courses for DSİ personnel operating in the M.O.M. structure will be studied in all details; on-the-job training will be performed with the counterpart personnel; it will also be extended to some KHGM and the Ministry of Agriculture and Rural Affairs' personnel. Furthermore, the organization scheme of these programs including training material will be prepared. This is intended to extend among the water users the knowledge of the procedures of water distribution and of the relationships existing between the M.O.M. organization and the single user.

Study tours for the involved personnel will be organized.

<u>Task -3.</u> The actual M.O.M. activities within sample areas.

An Implementation Report will describe the work done and the documentation produced during the phase two, as well as the results of the application to pilot areas of the selected M.O.M. model. The irrigation district system and its network will be modified according to the above results.

Phase three "MONITORING" will include these tasks:

<u>Task -1.</u> Establishment of an M&E system and the preparation of related manuals.

At this phase an M&E system will be established and Manuals for the application of the proposed system will be prepared.

Task-2. The monitoring and evaluation of the M.O.M. activities;

The appraisal of the results obtained in the sample areas by carrying out a mid-term survey after the first irrigation season and an ex-post evaluation after the second irrigation season; the modifications in the proposed M&E system; the review of the M.O.M. Manuals and training programmes; the recommendations for further actions for all G.A.P. irrigation schemes.

The study will be performed in a 48-month-period, as follows:

Phase one	12 months
Phase two	24 months
* preparation	(6 monhts)
* training	(12 months)
* field implementation (two irrigation seasons)	(24 months)
Phase three	36 months (overlapping Phase two)

A tentative time schedule is given in Figure 2.

The monitoring phase will be strictly linked to the previous one, following the various steps of the sample area development.

It is intended to check the actual reactions of the human and environment realities to the applied rules and structures, by applying a mid-term survey after the first irrigation season and an ex-post evaluation after the second irrigation season, as well as to suggest any suitable improvement or amendment based on the gained experience. The M.O.M. Manuals will be also reviewed and improved.

A Final Report will be prepared at the end of the 48-month-period, giving full evidence of the work done and of the results obtained.

7. STUDY TEAM

The Study will be performed by a joint venture of local and foreign firms specialized in the field of Irrigation Planning Design and Management.

The bulk of the activity will be performed at Şanlıurfa where GAP-RDA Regional Directorate.

During the phase one the team will comprise: team leader, agronomists, hydraulic engineers, irrigation engineers, economists, sociologists, technical assistants and legal administration experts.

During the phase two the team will be composed of: team leader, agronomists, hydraulic engineers, irrigation engineers, economist, sociologists, one technical assistant and one administration expert.

a) Preparation of the M.O.M. Manuals;

b) Establishment of an M&E system;

c) Preparation of training programmes;

d) Technical assistance to the Turkish personnel in change of M.O.M. of the sample area.

During the phase three only one engineer will be full-time on the field; visits will be paid by the other members of the team during the mid-term survey and the ex-post evaluation.

In order to show the way of interdisciplinary sharing of data give an idea on some duties of the study team, data collectors, users, and types of data are mentioned below:

Interdisciplinary Sharing of Data

Primarily Collected By	Used By	Types of Data
Sociologists Engineers	Sociolists Agronomists	Farmers' perceptions about night and day irrigation , major water problems inhibiting increased yields, solutions to major water problems.
Sociologists Economists	Engineers Agronomists Sociologists Economists	Farmer decision-making processes related to crop production, when to irrigate a given crop, when to stop irrigation, water lift methods, who applies water at given irrigation?

Sociologists	Engineers Agronomists Sociologists	Farmer' estimations of infiltration depth of water, depth of the crop's root penetration, crop water requirements, critical water demand periods and stages of growth, sources of major losses, magnitudes of losses, waterlogging.
Agronomists	Economists Engineers Agronomists	Farm management practices: cropping patterns and intensities, seedbed preparation, levels of farm technologies, seed rates, quality and seeding methods, fertilizer inputs, timing, amount and placement methods, harvest methods, storage methods, crop water requirements, soil characteristics, problem soils.
Sociologists Economists	Agronomist Sociologists	Adoption of improved technologies; rate of adoption, information sources used at each stage in the process, characteristics of the innovation, farmers trust in information sources.
Economists	Engineers Economists	Economic returns and costs, lifting water (alternative methods), various crop mixes, storage systems, transportation, marketing.
Sociologists Economists	Economists Agronomists Sociologists	Legal and organizational factors, delivery of water to command area, distribution of water, pricing of water, settlement of disputes -- formally and informally, farmers' interaction with irrigation officials, use of incentives.
Engineers	Agronomists Engineers	Water supply and removal, conveyance efficiency, field application efficiency, water quality, consumptive use, return flow, field topography.
Economists Sociologists	Engineers Economists Sociologists	Information used for farm-level decision-making: marketing and irrigation schedules, closures, extension, quality and quantity of information.

Full support will be given by the Consultancy Headquarters to the field team through a Project Coordinator; short time missions of specialists in various sectors are foreseen.

Translators, technical assistants, draftsmen, clerks, interpreters, accountants, drivers, typists and other personnel will be hired locally.

8 GAP-RDA CONTRIBUTION

GAP-RDA will provide a supervising team for the study which will consist of a senior engineer, an agronomists, a hydraulic engineer and a sociologists. The team will facilitate the Consultant's contacts with governmental and municipal agencies and make the necessary arrangement for the Consultant to have access to documents such as maps, reports and drawings.

GAP-RDA will establish a steering committee to monitor and review the Consultant's work as well as to provide the Consultant with the expert opinion on important issues. The committee will convene periodically at intervals as stated by GAP-RDA, when a report is submitted, and when a decision is requested on an important matter. The committee will be chaired by the GAP-RDA and will include experts from the GAP-RDA, DSİ, General Directorate of Rural Services (K.H.G.M.) and other related State Agencies.

GAP-RDA will try, in its capacity, to provide office space in the GAP campus in Şanlıurfa. In case, office space is provided by GAP, it will be unfurnished and unequipped.

9. ADDITIONAL TERMS

All equipment , goods and supplies, including but not limited to office equipment, computers, typewriters, vehicles, furniture, air conditioners, books which are purchased for the study will be the property of GAP-RDA and will be turned over to GAP-RDA upon the completion of their use of for the purpose of the project.

The Consultant will provide GAP-RDA with working papers, interim reports, briefings, books and any publications on matters relevant to the study when requested.

The Consultant will provide assistance with promotion and presentation activities concerning the study, its findings, or its results, in form of printed or audio-visual material and consultancy.

APPENDIX 2

ISSUES AND RESPONSES
ARISING FROM STUDY WORKSHOP

APPENDIX 2

GAP MOM STUDY

STUDY WORKSHOP, ŞANLIURFA, 6 - 8 DECEMBER 1993

ISSUES DISCUSSED AND RESPONSES FROM PARTICIPANTS

1 INTRODUCTION

The main objective of the Workshop was to put forward the initial findings of the study and the methodology adopted by the consultant for selection of MOM models. These matters could then be discussed among a wide range of professionals involved in irrigation development throughout Turkey. The Workshop was conducted towards the end of the initial identification phase of the study so that the consultant study team would have the advice and opinions of the participants to assist it in formulating its conclusions on the most appropriate form of management model for the GAP region.

There were 86 participants from Government agencies, academic institutions and other interested organisations together with a further 22 from the consultant.

The philosophy of the Workshop was to place before the participants the findings of the study team in terms of objectives, issues and potential models for development. The Workshop process was adopted as an appropriate means of exposing these findings to the widely representative expertise and then obtaining views and ideas on a collective basis.

The main business sessions were conducted over two days in the following form:

(a) Presentations by various members of the study team on the major findings of the study followed by a limited period of questions and discussion from the floor.

(b) The participants gathered into six discussion groups for detailed study of particular matters raised in the presentations. Each group was asked to consider a different item and then report its views and findings to a plenary session. There was an average of 18 persons representing several organisations in each group with the discussions structured so as to provide opportunity for a wide range of views to be expressed.

Details of topics and group responses are set out in the following attachments:

- List of topics discussed in each workshop group session.
- Responses by groups to the topics.
- A diagram relating these responses to the project objectives and model selection criteria.

- The concluding speech which summarised the workshop discussions and set out guidelines for future action.

2 TOPICS AND DISCUSSIONS, WORKING GROUP SESSIONS NOS 2 AND 3

2.1 Full List of Topics

The list of topics for discussion by working groups was as follows:

(1) How does one best mobilise the full spectrum of manpower resources at all levels?

(2) How does one best encourage an integrated and comprehensive (holistic) approach to the planning, operation and maintenance of irrigation development?

(3) What policy and strategy should be adopted for the setting of water and drainage charges, their collection and enforcement?

(4) Is the concept of a bottom-up approach to planning, design and management valid?

(5) How can the concept of accountability, and its corollary monitoring and evaluation, best be promoted?

(6) What is the optimal size and composition of:

(a) an irrigation group?

(b) an irrigation zone?

(7) What form of contract should be established between different layers in a management structure?

(8) Who should be responsible for and who should pay for monitoring and evaluation?

(9) Who can provide the range of services required most efficiently and with least social discord/

(10) How may farmers most effectively involved in implementation and O&M of drainage works?

(11) What is the appropriate timescale for the transition from the present situation to the longer term goal taking consideration of legal, cultural and skill/experience constraints?

(12) How may existing organisations best be mobilised to provide farmer training?

(13) How may the GAP MOM objectives best be met within the existing legal framework constraints?

(14) What are appropriate criteria for selecting demonstration areas and the

timescales involved?

In Session No 2 the working groups discussed the following topics:

Working Group No	Topic No
1	1
2	2
3	9
4	7
5	5
6	6

2.2 Responses, Session 2

The responses from the working groups to these topics are summarised in relation to the major objectives and evaluation criteria in the following table.

REQUIREMENTS FOR A SUCCESSFUL MOM MODEL IDENTIFIED BY WORKSHOP PARTICIPANTS (DEC.93) RELATED TO THE MAJOR AND KEY EVALUATION CRITERIA.

MAJOR OBJECTIVES	MAJOR EVALUATION CRITERIA	KEY	REQUIREMENT
MAXIMISE NET BENEFITS	Maximise Water Use Efficiency and Returns	(1)	WATER CHARGING TO BE ON A VOLUMETRIC BASIS.
		(●)	LATEST TECHNOLOGY REQUIRED TO CONTROL WATER.
		(3)	THE ENFORCMENT OF SANCTIONS IS PROVIDED FOR.
		(4)	TOTAL SET OF SERVICES FOR THE FARMER WITH THE EMPHASIS ON TRAINING, MARKETING, PRODUCTION PATTERNS.
	Minimise Management, Operation and Maintenance Costs	(5)	DEVELOPMENT OF SKILLS THROUGH TRAINING PARTICULARLY AT THE FARMER LEVEL.
		(6)	ACCOUNTABILITY IN PUBLIC SECTOR TO BE PROMOTED.
ENSURES SUSTAINABILITY	Political Acceptability		
	Minimise Adverse Environmental Impact		
	Promote Financial Viability	(10)	O&M COSTS TO BE COVERED BY USER.
	Socially Acceptable	(12) & (14)	SIZE AND FORM OF FARMER GROUPS TO BE FLEXIBLE AND RESPONSIVE TO ACTUAL SOCIO-ECONOMIC AND CULTURAL CONDITION
	Physical Performance	(16)	FARMERS TO BE MOTIVATED.
	Institutional Effectiveness	(17)	MONITORING AND EVALUATION IN GOVERNMENT TO BE STRENGTHENED
		(18)	GAP TO ACT AS TRAINING COORDINATOR. GOVERNMENT TO TAKE AN ACTIVE ROLE IN COORDINATION (DSI et al). COORDINATION NEEDS TO BE STRENGTHENED.
		(20)	DEVOLVEMENT IS PROMOTED AND FARMER PARTICIPATION IS ENCOURA
IMPLEMENTABLE AND FLEXIBLE	Early Implementation	(21)	EXISTING LEGISLATION IS RESTRICTIVE BUT THIS SHOULD NOT BE A CONSTRAINT ON SETTING GOALS.
		(22)	THE TRANSITION PERIOD FROM EXISTING TO TARGET MUST BE CAREFULLY PLANNED TO ENSURE A SMOOTH AND EFFICIENT TRANSITION (LEGALLY AND INSTITUTIONALLY).
	Flexibility to Change		

KEY :	(●) : 'COMMON' REQUIREMENT OR CRITERION	(4) : REFERENCE TO RELEVANT SPECIFIC KEY CRITERIA

2.3 Responses, Session 3

In Session No 3 the working groups considered topics from the same list as for Session 2. The topics discussed by each group were as follows:

Working Group No	Topic No
1	11
2	13
3	10
4	5 & 8
5	3
6	12

In some aspects the subject matter of these topics overlapped and the responses of the working groups reflected this fact. The requirements for a successful MOM model identified by the working group participants in this session are summarised as follows:

(a) Farmer Participation

- Motivation can be increased by more dissemination of information.
- Actual ownership of infrastructure should be passed to users as soon as the law allows.
- Participation to be encouraged from the beginning and to be sustained.

(b) Training

- Co-ordination is required.
- Existing capability to be fully utilised.
- Training should start as soon as possible.
- Training is a continuous process not simply "one off".
- A central training co-ordination institution should be considered.
- Initial concentration should be on trainers and lead farmers.
- Demonstrations in pilot areas are important. The areas must reflect the full range of conditions in the GAP area.

(c) Water Charges

- Drainage charges should be included as part of water charge. Prices to be set on an individual project basis.

- Sanctions should be available. Fines to be applied for late payment.

- At least part of the water charge to be paid before the start of the irrigation season.

- A volumetric basis of charging is preferred but it must be practicable.

(d) Monitoring and Evaluation

- Items to be monitored and evaluated should include:

  (a) Levels of service and observance of the obligations of both parties (supplier and customer).

  (b) Physical performance in relation to objectives.

  (c) Quality and quantity of resources.

  (d) Social, cultural and economic trends.

- Monitoring and evaluation should be implemented by an impartial organisation.

- Financing of monitoring and evaluation from a central government source is preferred.

- Supplier and user should also monitor their own performance.

(e) Legal Provisions

- Existing laws should be used to the best effect possible.

- Where existing laws require amendment this should be carried out for early implementation.

- The longer term goal is to have well drafted, practicable and implementable new laws.

- Legal sanctions are required and loopholes should be plugged.

- Legal provisions are required to cover the needs of monitoring and evaluation.

3 TOPICS AND DISCUSSIONS, WORKING GROUP SESSION NO 4

3.1 Topics Discussed

Up to three topics to be selected by each Working Group from the following:

(1) To ensure that:

- Water is used efficiently
- Cost recovery is facilitated and seen to be equitable
- Financial sustainability

water measurement should be implemented at all levels.

(2) In order to ensure that water is delivered at the right time to the right place in the right amount designs must be based on a clear perception of how the system must be operated.

(3) In order to maximise system efficiency and minimise costs

- Investment in plant & equipment must be used to best effect.
- Manpower skills and capacity must be fully mobilised.

(4) In order to ensure that farmers operate efficiently as producers training in both technical and business subjects must be provided. Training is required in:

- commercial (being a business - market awareness - cash flow)
- modern technique
- water use efficiency.
- optimal returns to water.
- crop protection.
- land management.

(5) In order to ensure sustainability both at the regional level and the farm group level, a water charging policy/strategy is required which:

- promotes water use efficiency
- minimises return water/drainage & salinity problems
- encourages farmers objectives to match system objectives (sends the right signals)
- provides the supplying authority with a means to influence demand patterns
- affordable and perceived to be reasonable (in relation to level of service)
- charges must be adequate to cover all costs.
- subsidies must be clearly defined and linked to specific objectives.

(6) Infrastructure (irrigation and drainage system) must be compatible with social characteristics such as:

- land ownership pattern
- village boundaries
- requirements for safety.

Even though this implies sub-optimal canal layouts in term of cost/ha.

(7) Legal provisions must be fully compatible with overall strategy eg. standards must be realistic/appropriate/enforceable without adverse impact on regional economy.

(8) Communication and coordination must be promoted

- between govt agencies
- between farmer groups and the supplying agency
- farmer group and system designers.

For each topic it was suggested that the discussion should follow the following pattern:

(a) Is the statement accepted as correct?
(b) How may the objective be best achieved and what agency?

The actual topics discussed by each working group during this session were as follows:

Working Group No.	Topic No	
1	1	Water measurement
2	4	Farmer training
3	3	Maximising system efficiency
4	5	Water charging policy
5	6	Compatibility of infrastructure with social structure
6	2	System design to be based on operating rules

Further details of these topics and the response by each working group are given below.

3.2 Working Group Responses, Session No 4

Group 1, Topic 1 - Water Measurement

- Measurement to cover all levels from resource to point of use.
- Particular emphasis to be given to the measurement of water at the user end.
- The most appropriate method of measurement wil vary with the irrigation system.
- Consideration should be given to the measurement of (surface) return water.
- farmers in the pilot areas to be made aware of the need for and benefits of good water measurement.

Group 2, Topic 4 - Training in a Wide Range of Subjects

- The objectives of training are seen as: increasing production through better water utilisation, plant protection and land utilisation.
- The process should be: identify the requirements and skill gaps and then train to meet these specific needs.
- There has to be a dynamic two relationship between research and training. This may be fostered through a central institution responsible for co-ordinating both functions.
- Information dissemination is very important and organisational arrangements to promote this need to be strengthened.
- Training should not be confined to technological issues but cover the full range of skills and knowledge required for agricultural and system operation and maintenance.
- Farmers' organisations should become more involved in extension activities through direct participation.
- Literacy has to be improved, particularly among women.
- More efficient and effective methods are required for the analysis of the results of studies.

Group 3, Topic 3 - Maximising System Efficiency

- Government plant and equipment should be transferred to the private sector (contractors) with the objective of improving utilisation levels.
- The introduction of more efficient distribution systems, such as low

pressure pipes, needs to be promoted in areas where it is technically appropriate and favoured by the farmers.

- It is perceived that farmers are receptive to training when they can see the advantages to them.

Group 4, Topic 5 - Appropriate Water Charging Policy

- The principle that has to be explained to the farmers is that the Government is not so much selling water but the service of delivering the water to the point of supply.

- The objective of the water charging structure should be the encouragement of water use efficiency as well as cost recovery. Incentives should be included to encourage good practices.

- The recovery of cost should be made at the same time as the outlay or investment is incurred (i.e. not devalued by inflation).

- The chairman of a co-operative, or an equivalent water user group leader, should be the point of contact for the collection of water charges by the supplier.

- Users should be fully informed as to the make-up of the charges.

- Distribution of water should be free of Government intervention.

- The water price structure (tariff) may reflect demand level and possible variations, eg for supply at night.

On another subject it was suggested that land fragmentation is not always the direct result of the Heritage law; it may be voluntary.

Group 5, Topic 6 - Compatibility of Infrastructure with Social Structure

- Surveys should be carried out to ensure that social factors are taken into consideration, even if this entails an additional cost at the planning and design stage.

- Farmers generally favour land consolidation but the time required for implementation in practice is a constraint.

- The heritage law leads to land fragmentation, small holding sizes and inefficient production. The minimum holding sizes set by the law may be too low and should be reviewed.

Group 6, Topic 2 - Distribution System Design to be based on Operating Rules

- Studies should be carried out at the outset of the scheme planning to determine realistic irrigation requirements and scheduling.

- Provision to be made for water measurement.
- Co-ordination between the users, government agencies and scheme designers needs to be strengthened.
- The irrigation system design should be as simple as practicable while providing the necessary degree of control.

4 REMARKS BY EXPERT PANEL MEMBER MR D J CONSTABLE TO CONCLUDING SESSION

As you know the Panel of Experts has been standing somewhat apart from the detailed project activities; in an overview and support role as it were.

During the workshop we have joined with you in listening to the consultant's team explain the model methodology and we have listened with great interest to your discussions on the relevance of the key issues and criteria.

We have listened to Mr Browne demonstrate the evaluation process just a few minutes ago.

There is still much to do in finalising the deliberations on issues and criteria, and each one of you will be providing further input by responding to the questionnaire.

Now let me go back to Mr Suter's comments yesterday - the development of the model options and their evaluation is not a mechanistic process. We do not just plug all these issues into a matrix and uncritically accept the answer that pops out. The final stage is the stand back and take an objective overview of the process and its outcome and perhaps test some of the criteria and weighting of individual elements on the outcome - the sensitivity analysis.

The Expert Panel would like to draw on its international experience and offer some comments which may assist you in that final process.

Firstly let me say that in our deliberations we have been focussing on management options for one set of elements in a complex institutional framework. We need to remind ourselves of the whole set on institutions in the national context - not only in the water/agriculture sector but also energy production, transport, communications, health and so on. Their collective purpose is to facilitate the Turkish people reaching their national aspirations in their political, social and economic development.

It is a process in which individual and community aspirations and expectations are continually changing and developing - reaching out for progress - a very dynamic process.

During the workshop we have heard terms like democratisation, empowerment and participation raised as key issues in management on community facilities.

Communities now expect to be involved in the decision making process by which these facilities are managed to supply services to them - even though they delegated the care and custody of these facilities, for the time being at least, to particular institutions and organisations through the political process.

Communities now expect the institutions to respond to these dynamic processes and indeed they seek ways to reassure themselves that each institution its obligations of accountability.

There is a danger that public sector organisations, in a well meaning pursuit of excellence and efficiency, sometimes develop an unconscious response and reaction to change in that their first reaction is:

> "How will this affect this organisation?"

The first question should be this I believe:

> "How can or should this organisation adapt and change to meet these changing circumstances?"

I can claim some personal experience in this process.

Now let us come back to our specific task.

Even though the objective of this workshop is to explore the methodology by which the most appropriate GAP MOM model might be chosen, I detect that there has emerged a fair deal of consensus about likely final outcomes at least at the upstream and downstream ends of our irrigation system. I believe that most people are comfortable that the function of bulk supply, ie. headworks management, should remain where it currently rests, with the very busy DSİ.

I also detect that people are comfortable with, and indeed would promote, a model which provides for farmers to be responsible for MOM of the tertiary system. However there is clearly much to do to develop the processes with the relevant communities and the enabling processes to bring this about.

That leaves the bit in the middle as it were, the management of the primary and secondary canals in the distribution system.

There is such an intimate hydraulic integration between these two elements that it seems that the most effective outcome is, at this stage of development at least, that these be managed conjointly by one organisation. Indeed some working groups cautioned against a model which introduces another level of management.

However the legislation which establishes the legitimacy of this organisation should ensure that future devolvement of management responsibility for appropriate parts of the system to farmers' organisations, as they develop and mature, can take place in a natural and orderly process.

Now, how might we evaluate options for this body?

Let us be very clear about its functions and purpose, its very mission in life.

We expect this body to manage the canal system, to operate and maintain this system, in a way to provide cost-effective water supplies and drainage services to farmers groups so as to foster a viable irrigate agriculture system within the GAP project area. This is a very clear and sharp focus. Farmers would expect this, and have a right to expect this, in return for meeting the costs of the system.

These are some significant criteria which readily come to mind in making this evaluation:

	CRITERIA
ORGANISATIONAL AUTONOMY	• No conflicting objectives at the top organisational level. • Capacity to make all management decisions and be fully responsible for them.
FINANCIAL AUTONOMY	• Ability to develop its budget and recover revenue to cover its programmed activities.
CONSUMER ORIENTATION	• There is a critical interdependence between this agency and the farmer groups. It needs special sociological and communication skills. Its identification is with the area rather than "head office".
COMMERCIAL APPROACH TO ITS OPERATIONS IN WHICH GIVING VALUE FOR MONEY IS A PRIMARY THRUST	• Not generally highly developed in central agencies within a government budgetary system.
TECHNICAL COMPETENCE	• Ability to develop and retain specific skills.

And finally

ABILITY TO DISCHARGE ACCOUNTABILITY	• To farmers - difficult for a central government agency. • To government - would appear easier to correct deficiencies as a regional body.

On balance this evaluation might be seen to suggest that this organisation is one which should be autonomous at the regional level rather than a unit of a central government agency, i.e of either DSİ or GDRS. This will be a matter for you to resolve.

However, the central agencies, particularly DSİ and GDRS, will have expanding roles in their existing key functions in the rest of Turkey, as well as playing a significant role in the development of the farmer groups and the training of farmers. In particular the development of the enabling legislation will require inputs from many disciplines other than lawyers - I recall one or two groups suggesting that review of legislation should be left to the legal people.

I hope that our legal colleagues will not take this as a reflection on their capability when I suggest that disciplines of agronomy, hydrology, engineering, economics and financial management specialists will be needed in developing comprehensive water resources legislation for the longer term.

From my own experience, your conclusion that this is a longer term process is absolutely correct. In my country it took more than six years to complete this review and we had a good body of law to start with.

Mr Chairman, one last comment on legal provisions. I have some slight reservations about the use of the words "contract" and "sanctions" in developing the arrangements between agencies at the operational level. There is no question that we need strong legislation to control wilful damage and other unlawful acts, for cost recovery and so on. However the operational issues associated with the delivery of water are somewhat different - there are unpredictabilities associated with climate variations in both water supply and agronomic conditions at the farm level. I prefer the term "level of service agreement" which indicates a co-operative approach, which involves a readiness to continually review and modify these arrangements in accordance with the dynamic changes in the agriculture production system.

If farmers are paying the whole cost of the distribution system then the costs of legal action will be part of the operating costs.

Finally, Mr Chairman, let me commend to you the conceptual approach put forward by the project team, for a co-ordinating committee at the regional level to assist the GAP Administration to bring the diverse interests involved in irrigated agriculture into a productive partnership.

We have enjoyed participating with you in this important workshop. We wish you every success for the future.

APPENDIX 3

RESPONSIBILITIES AND FUNCTIONS OF GAP CO-ORDINATION AND ADVISORY COUNCIL ON IRRIGATION DEVELOPMENT

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RESPONSIBILITIES AND FUNCTIONS OF THE GAP COORDINATION AND ADVISORY COUNCIL FOR IRRIGATION DEVELOPMENT

RESPONSIBILITIES

The GAPCACID will be a Council responsible to the GAP Regional Directorate in Şanlıurfa. GAP RDA would report on the Council's recommendations and advice to GAP RDA HQ.

FUNCTIONS

1. Provide advice and guidance to GAP Regional Director to enable better formulation of regional policy on irrigation development and associated services.

2. Provide advice and guidance to GAP Regional Director to enable the better direction of involved departments, directorates and authorities on irrigation and associated services.

3. Provide a formal channel for farmers' concerns and ideas on irrigation development to be heard and to take into account the needs and wishes of farmers in planning and design phases of future irrigation development in the region.

4. Build upon the information from and experience of group formation and implementation in the pilot areas for refinement of the process and wider application within the GAP region.

MEMBERSHIP

1. Representatives of the Secondary Canal Management Committees representing the interests of individual Water User Groups.

2. Representative of the Irrigation System Operating Body (Irrigation Authority).

3. Representative of the Supplier of Bulk Water (DSİ).

4. Representatives of Regional Directorates of DSİ, MARA (Extension and Research), GDRS, Forestry, and of other relevant regional directorates.

5. Representatives of Private Sector Bodies (e.g. Chamber of Agriculture, Agriculture Supply and Service sector).

6. Provincial Governors or their appointed Representatives.

7. Representatives of the Universities directly involved in research or other inputs for irrigation development.

APPENDIX 4

RESPONSIBILITIES AND FUNCTIONS OF PLANNING AND DESIGN WORKING GROUP FOR PILOT AREAS DEVELOPMENT

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RESPONSIBILITIES AND FUNCTIONS OF THE PLANNING AND DESIGN WORKING GROUP FOR PILOT AREAS DEVELOPMENT

RESPONSIBILITIES

The PDWG will be a body responsible for the coordination, planning, management of design, and implementation of the agricultural and engineering measures related to irrigation development in the pilot areas. The PDWG would be responsible through a GAP RDA Pilot Area Development Coordinator to the GAP Regional Director.

FUNCTIONS

1. To promote close coordination and consultation between the GAP MOM team, GDRS, GDAReF, DSİ and the Agricultural Extension Service of MARA.

2. To utilise all expertise and knowledge that exists within the various agencies and organisations involved in irrigation development to implement the pilot area development programme.

3. With the cooperation/coordination of all the concerned bodies represented on the working group to plan, design, and implement the works within the pilot areas.

4. To set design standards and specifications for secondary and tertiary distribution systems and for works at farm level.

5. Specify requirements for contract agreements and documentation for supply and construction contracts.

6. Prepare design drawings and documents.

7. Provide advice on appropriate practices and extension methods relating to on-farm activities and works.

8. To use the principle of participatory planning through full consultation and discussion with the farming community and through the established Water User Groups for the on-farm agricultural works to be carried out in the pilot areas.

9. To function as an integrated team at the project offices in Şanlıurfa.

10. GAP MOM to initiate and coordinate activities on a day-to-day basis.

11. Prepare a Preparation Report relating to on-farm works designs to form the basis for Planning and Design Guidelines for future projects with the assistance of the Project Agronomist and Agricultural Economist.

MEMBERSHIP

1. Pilot Area Development Coordinator (to be appointed by GAP RDA) as chairman of the PDWG.

2. GAP MOM Deputy Project Manager (responsible for overall development in the pilot areas).

3. Pilot Area Development Engineer (to supervise the planning, design and implementation of the engineering measures) to be appointed, assisted by two Irrigation Engineers from the GAP MOM team.

4. On-Farm Water Management Specialist (to plan and supervise the implementation of the agricultural measures) to be appointed.

5. One staff member from each DSI Regional Directorate involved in the Pilot Areas nominated to the PDWG.

6. One staff member from each GDRS Regional Directorate involved in the Pilot Areas nominated to the PDWG.

7. One Liaison Officer from each provincial directorate Extension Services Department involved with the Pilot Areas to be nominated.

8. One Liaison Officer from GDAReF to be nominated.

9. Short-term input from an Agricultural Economist and Agronomist (for function 11).