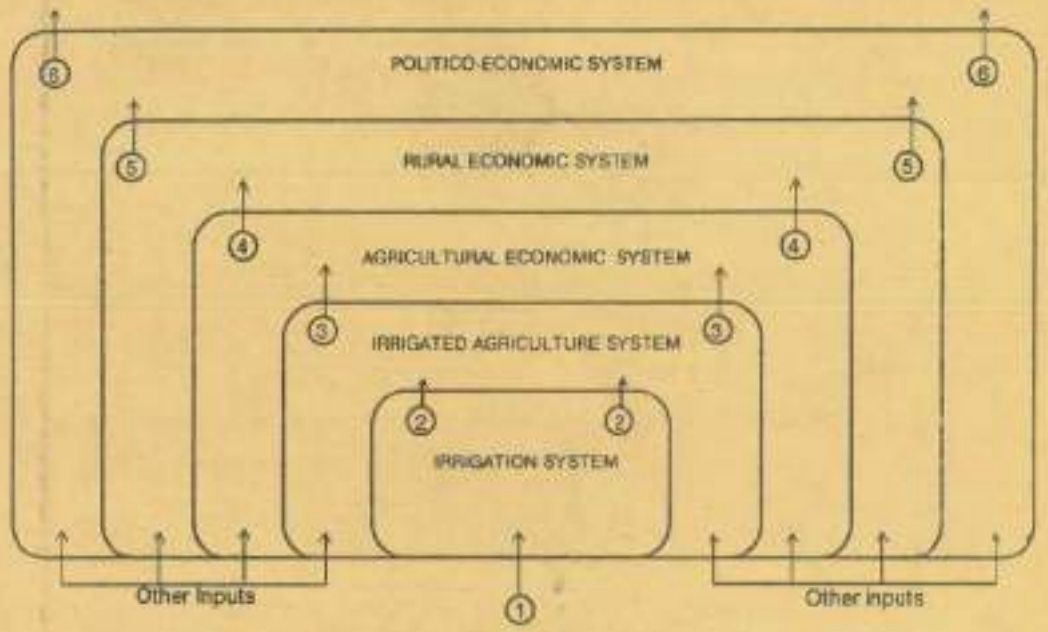
GUIDE FOR PREPARATION OF PLANS OF OPERATION AND MAINTENANCE OF IRRIGATION SYSTEMS IN INDIA



Key to Inputs/Outputs:

① Operation of irrigation facilities
② Supply of water to crops
③ Agricultural production
④ Incomes in rural sector
⑤ Rural economic development
⑥ National development

इनसिड
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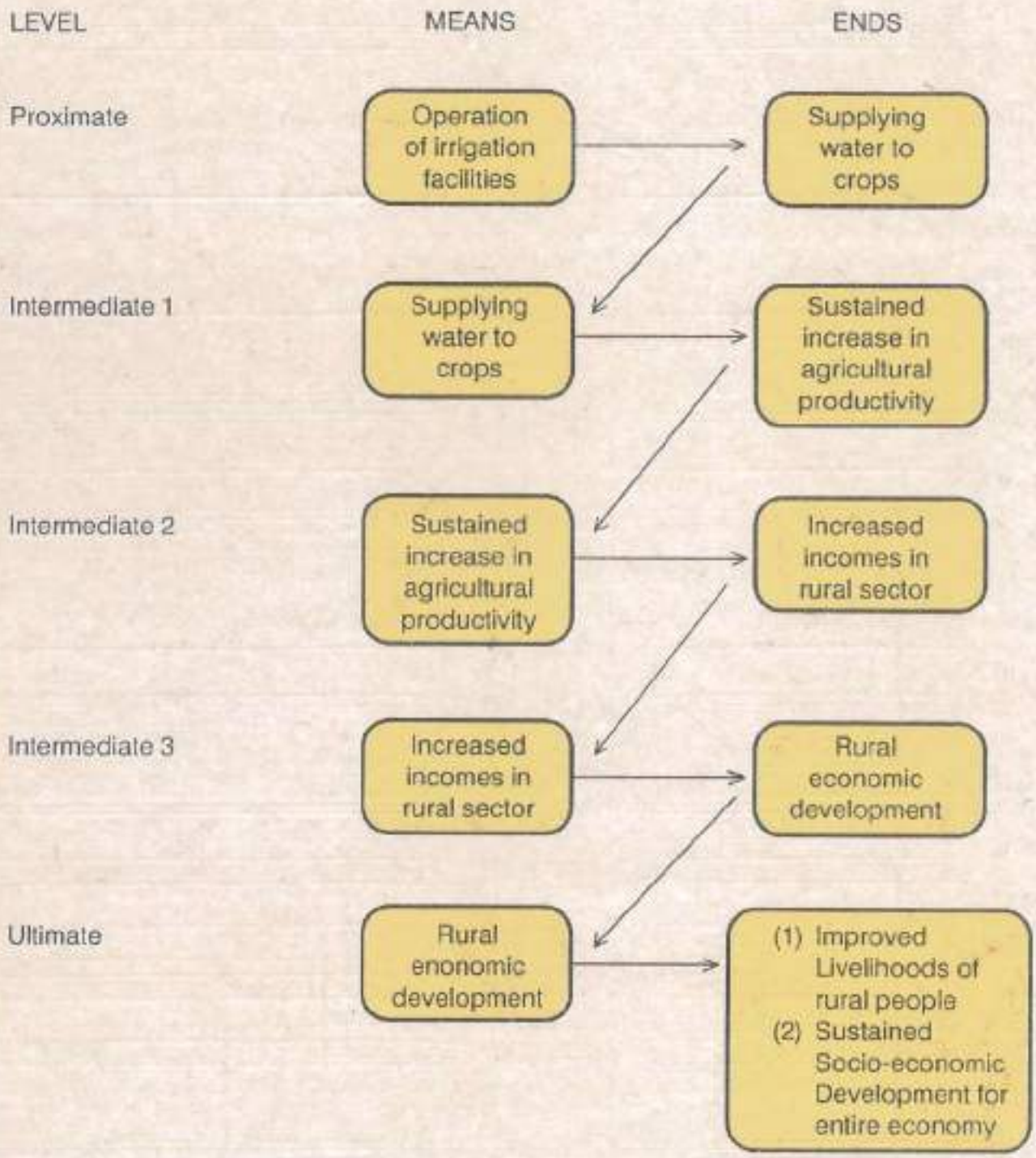
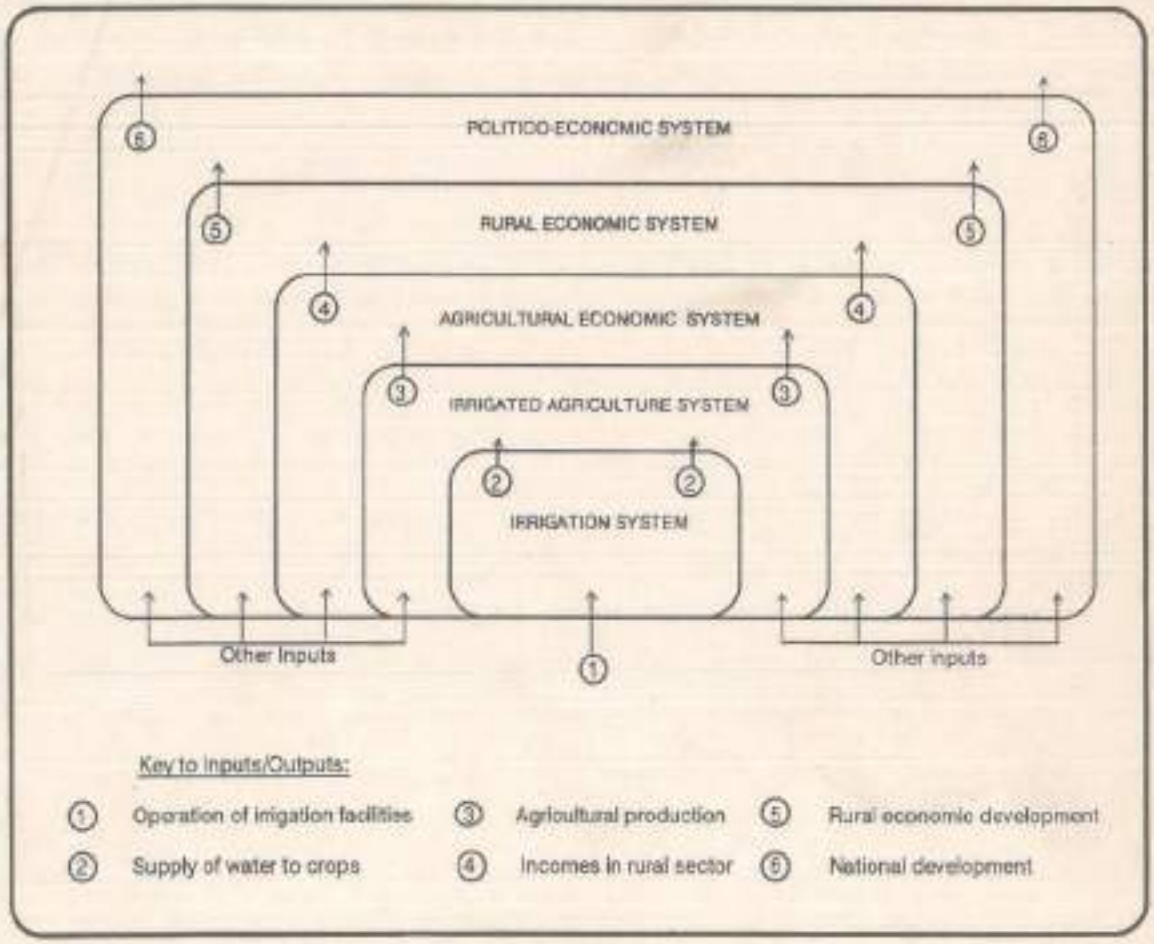
भारतीय राष्ट्रीय सिंचाई एवं जल निकास समिति
(जल संसाधन मंत्रालय, भारत सरकार द्वारा गठित)
INDIAN NATIONAL COMMITTEE ON IRRIGATION AND DRAINAGE
(Constituted by Ministry of Water Resources, Govt. of India)



Irrigation purposes as nested means and ends
Front cover; Inputs and Outputs : Irrigation in the context of nested systems
(Source : IFPRI 1992)

GUIDE FOR PREPARATION OF PLANS OF OPERATION AND MAINTENANCE OF IRRIGATION SYSTEMS IN INDIA



इनसिड

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(Constituted by Ministry of Water Resources, Govt. of India)

NEW DELHI
MARCH, 1994

PREAMBLE

ICID and World Bank jointly prepared a "Guide for the Preparation of Strategies and Manuals on Planning the Management, Operation, and Maintenance of Irrigation and Drainage Systems" (The World Bank, Technical Paper No.99) through a small Working Group of ICID with the assistance of World Bank. This Guide based on several case studies of various countries (English Speaking), was circulated by the ICID to various National Committees in 1991 requesting them to hold National Level Workshops for indepth discussion and adoption by their respective Countries. The National Committees of Canada and Hungary are using this Guide and the Guide has even been translated into Chinese, Spanish, Italian and Arabic languages.

INCID Secretariat circulated in November, 1991 the ICID/World Bank Guide to various organisations besides individual experts and International Organisations like USAID, Ford Foundation, World Bank, etc. for their comments about its suitability for adoption in Indian conditions to be discussed in a National Level Workshop in February, 1992. Twenty Three Organisations and individual experts sent detailed comments on the document which were compiled as pre-workshop proceedings and discussed at the National Workshop held at New Delhi in February, 1992. Thirty Five eminent engineers from Central and State Governments, Consulting Firms, International Organisations such as Ford Foundation, ICID, World Bank and USAID, participated in the workshop and deliberated on the document in the light of O&M practices in vogue in different parts of the country. While adopting the document as a global guide, the workshop recommended that INCID should prepare a National Guide based on the Indian experiences, that may be easily understandable even by Junior Engineers and other lower level field functionaries engaged in O&M of Irrigation and Drainage Systems.

INCID Secretariat took up the work of preparing the draft Guide right earnestly, utilising the services of Dr. B.C. Garg, Ex-Secretary, ICID with the financial assistance of USAID under WRM&T Project. The draft National Guide was discussed by an Advisory Group consisting of select group of 17 experts drawn from Central Water Commission, State Irrigation Departments, WAPCOS and other Consultancy Organisations and of course, the Nodal Working Group on Operation, Maintenance and Management besides INCID Secretariat. The Advisory Group headed first by Shri R.S. Agarwal and later by Shri Ranveer Ahuja, Engineers-in-Chief, U.P. Irrigation Department discussed at length, all the Chapters in two meetings convened at Delhi and suggested modifications in various chapters. As per the recommendations of the Advisory Group, the modified draft was scrutinised later by an Editorial Group consisting of Shri A.S.Rao, Member-Secretary, INCID and Chief Consulting Engineer, WAPCOS; Shri M.K.Narasimiah, General Manager, Consulting Engineering Services Ltd.; Shri S.K. Kumar, Convenor of the INCID Working Group on OM&M & Chief Engineer, U.P. Irrigation; and Shri N.K. Dikshit, Consultant, WAPCOS (India) Limited. The present document is the culmination of the sustained efforts of the Editorial Group.

The World Bank Guide comprising 8 Chapters is based broadly on a review of world-wide practices while the National Guide comprising 13 Chapters aims at giving exhaustive guidelines for adoption taking into account the present practices in India. Many Chapters included in the World Bank Guide were enlarged and modified extensively restructuring them to suit Indian conditions. Some new Chapters have also been added which include Statutory Acts, Rules and Policies; Management Information Systems (MIS); Communication Network; Training; and Computerization which are vital to make any plan of operation and maintenance (POM) comprehensive.

S/Shri B.C. Garg, R.S. Agarwal and Ranveer Ahuja, M.K. Narasimiah, S.K. Kumar and all the Members of the Working Group on OM&M and Advisory Group have made valuable contribution towards this important and useful document. Shri A.S. Rao, Member-Secretary, his colleagues in INCID Secretariat and Shri N.K. Dikshit have indeed done a commendable job in bringing out this National Guide. Special thanks are due to Shri R. Rajappa, Chairman and Managing Director,

WAPCOS (India) Limited for his keen interest and valuable suggestions from time to time besides providing all the infrastructural facilities to the INCID Secretariat.

A large number of projects have already been executed and many others are under construction. But only a limited few are having systematic plans of Operation and Maintenance. It is very essential that all Projects, big or small should have proper POMs, which are essential for improving their performance to provide better serve to the water users for higher yields and sustained production. I am sure that various State Governments and project Operating Agencies will be greatly benefited by this publication in preparing the POMs for major and medium projects to achive efficient and optimal functioning of the irrigation systems.

M S Reddy

Date : 05.02.1994.

Place : NEW DELHI

(M.S. Reddy)
Secretary, MOWR &
Chairman, INCID & CWC

GUIDE FOR PREPARATION OF PLANS OF OPERATION AND MAINTENANCE (POM) OF IRRIGATION SYSTEMS IN INDIA.

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ABBREVIATIONS

1.	AA	-	Agriculture Assistants.
2.	AC	-	Advisory Committee.
3.	AD(Agr)	-	Assistant Director (Agriculture).
4.	AE	-	Assistant Engineer.
5.	AEE	-	Assistant Executive Engineer.
6.	ALGOL	-	Algorithmic Language.
7.	AAO	-	Assistant Agriculture Officer.
8.	AO	-	Agriculture Officer.
9.	B/c	-	Benefit/Cost Ratio.
10.	BASIC	-	Beginners All-Purpose Symbolic Instruction Code.
11.	CAC	-	Canal Advisory Committee.
12.	CADA	-	Command Area Development Authority.
13.	CCA	-	Culturable Command Area.
14.	CCS	-	Central Control Station.
15.	CEA	-	Central Electricity Authority.
16.	CI	-	Canal Inspector.
17.	CIOC	-	Central Irrigation Operation Control.
18.	COBOL	-	Common Business Oriented Language.
19.	CPM	-	Critical Path Method.
20.	CPU	-	Central Processing Unit.
21.	CR	-	Cross Regulator.
22.	CWC	-	Central Water Commission.
23.	d/s	-	down stream.
24.	DCP	-	Data Collection Platforms.
25.	DD(Agr)	-	Deputy Director (Agriculture).
26.	DOT	-	Department of Telecommunications.
27.	DRO	-	Deputy Revenue Officer.
28.	DSO	-	Dam Safety Organisation.
29.	DTP	-	Desk Top Publishing.
30.	DVC	-	Damodar Valley Corporation.
31.	EE	-	Executive Engineer.
32.	EPAX	-	Electronic Private Automatic Exchanges.
33.	EPBU	-	Evaluation, Planning and Budget Unit.
34.	ESM	-	Essential Structural Maintenance.
35.	ETA	-	Expected Time of Completion.
36.	FAX	-	Fascimile Transmission.
37.	FC	-	Field Channel.
38.	FD	-	Field Drains.
39.	FDC	-	Field Drainage Channels.
40.	FDD	-	Field Drainage Ditch.
41.	FEL	-	Front End Loader.
42.	FIC	-	Field Irrigation Channels.
43.	FORTRAN	-	Formula Translation.
44.	FRL	-	Full Reservoir Level.
45.	FSD	-	Full Supply Depth.
46.	GOI	-	Government of India.
47.	GOMP	-	Government of Madhya Pradesh.
48.	HF	-	High Frequency.
49.	I&D	-	Irrigation and Drainage.
50.	IARI	-	Indian Agriculture Research Institute.
51.	ICC	-	Irrigation Command Committee.
52.	ICID	-	International Commission on Irrigation and Drainage.

53.	ICOLD	-	International Commission on Large Dams.
54.	ID	-	Irrigation Department.
55.	IM	-	Irrigation Management.
56.	IMD	-	India Meteorological Department.
57.	INCOLD	-	Indian National Committee on Large Dams.
58.	JE	-	Junior Engineer.
59.	LAN	-	Local Area Network.
60.	LOC	-	Letter of Credit.
61.	M&I	-	Municipal and Industrial.
62.	M&R	-	Maintenance and Repairs.
63.	MART	-	Multi Access Radio Telephone.
64.	MC	-	Management Committee.
65.	MET	-	Meteorology.
66.	MIS	-	Management Information System.
67.	MOU	-	Memorandum of Understanding.
68.	MP	-	Madhya Pradesh.
69.	MPEB	-	Madhya Pradesh Electricity Board.
70.	MS-DOS	-	Micro Soft - Disk Operating System.
71.	NCA	-	Narmada Control Authority.
72.	NCB	-	Narmada Control Board.
73.	NGOs	-	Non-Governmental Organisation.
74.	NGT	-	Nominal Group Technique.
75.	NLBC	-	Narayanpur Left Bank Canal.
76.	NPA	-	Narmada Planning Agency.
77.	NSC	-	Narmada Sagar Complex.
78.	NVDA	-	Narmada Valley Development Authority.
79.	NVDD	-	Narmada Valley Development Department.
80.	NVOMO	-	Narmada Valley O&M Organisation.
81.	O&M	-	Operation and Maintenance.
82.	OC	-	Outlet Committee.
83.	OFD	-	On-farm Development.
84.	OS	-	Operating System.
85.	PAT	-	Patwari.
86.	PC	-	Personal Computer.
87.	PERT	-	Project Evaluation and Review Techniques.
88.	PDC	-	Probable Date of Completion.
89.	PLWMC	-	Project Level Water Management Committee.
90.	PMF	-	Probable Maximum Flood.
91.	POM	-	Plan of Operation and Maintenance.
92.	PRP	-	Project Review Panel.
93.	PTT	-	Press to Talk Switch.
94.	PWD	-	Public Works Department.
95.	RAM	-	Random Access Memory.
96.	ROM	-	Read Only Memory.
97.	RT	-	Radio Transmission Talk.
98.	RWS	-	Rotational Water Supply.
99.	SA	-	Service Area.
100.	SAIC	-	Service Area Irrigation Committee.
101.	SC	-	Supreme Court.
102.	SDO	-	Sub-Divisional Officer.
103.	SE	-	Superintending Engineer.
104.	SF	-	Short Frequency.
105.	SITREPS	-	Situation Reports.

106.	SITREP DGR	-	Situation Reports about Daily (Canal) Gauge.
107.	Stn	-	Station.
108.	T&V	-	Training and Visits.
109.	TNA	-	Training Needs and Assessment.
110.	u/s	-	Up-stream.
111.	UHF	-	Ultra High Frequency.
112.	UKP	-	Upper Krishna Project.
113.	UP	-	Uttar Pradesh.
114.	USAID	-	United States Agency for International Development.
115.	VHF	-	Very High Frequency.
116.	VIP	-	Very Important Person.
117.	VOX	-	Voice Operated & Carrier System.
118.	VSAC	-	Village Service Area Committee.
119.	WALMI	-	Water and Land Management Institute.
120.	WAPCOS	-	Water and Power Consultancy Services (India) Ltd.
121.	WC	-	Water Course.
122.	WCS	-	Water Cooperative Societies.
123.	WDS	-	Water Delivery Schedules.
124.	WMA	-	Water Management Association.
125.	WMC	-	Water Management Committee.
126.	WR	-	Water Resources.
127.	WRDTC	-	Water Resources Development Training Centre.
128.	WUA	-	Water Users Association.
129.	WUG	-	Water Users Group.

NAGARJUNA SAGAR DAM (ANDHRA PRADESH)

UMIUM DAM (ASSAM)

CHAPTER 1

SCOPE OF PLAN OF OPERATION AND MAINTENANCE (POM)

1.1 DEFINITION OF POM

The Plan of Operation and Maintenance (POM) is the management plan of an irrigation and drainage (I&D) system. It comprises a permanent set of documents and instructions, organization charts, work procedures and rules (including coordination with other disciplines), programmes and schedules. It is to be clearly understood that POM is NOT a rule book; it is a framework of broad guidelines. POM requires updating during project implementation (refer para 1.6). It may have to be revised in the post-implementation period of the project in the light of advances in science and technology, management techniques (such as computerization, automation, etc.) and the experience gained over the years in operation and maintenance of the system (refer para 1.7). The POM should have readily available complete information/statements for reference and guidance at every level in the project organization.

1.2 OBJECTIVES OF POM

These are :

* to achieve stipulated levels of project services including maintenance at minimum achievable cost; and optimum use of canal water.
* to provide detailed O&M guidelines during various anticipated scenarios of water availability, including equitable water distribution upto the tail end of the system.
* to effect efficient coordination of staff, equipment, physical and financial resources and related disciplines, active involvement of farmers, etc.
* to establish guidelines to achieve the set objectives,treating all project facilities as integral parts of the project.

1.3 PURPOSE OF POM

A large number of irrigation projects - major (Culturable Command Area more than 10,000 ha.), and medium (CCA 2000-10,000 ha) - have been undertaken and completed in the post-independence era at massive public capital investment. Performance analysis of projects reveals that the contemplated objectives and benefits have not been achieved in many cases for various reasons.

The purpose of POM is therefore to specify:

- the services to be rendered by the project.
- the responsibilities of the operating agency.
- the functions and responsibilities of the water users for their active involvement, and
- the set-up of the O&M organization.

1.4 NEED FOR COMPREHENSIVE POM AND PREREQUISITES FOR ITS PREPARATION

The river and stream flows are community assets. The irrigated agriculture - an assured means of food and fibre supply - consumes most of the water which is delivered to the fields by a capital intensive network of channels and works fed by a storage dam/weir/barrage of a major/medium scheme. Efficient utilization of water depends on the efficiency of the plan of operation and maintnenance of the system. To conserve natural and financial resources, it is necessary to formulate the plan in as comprehensive a manner as possible.

The delivery system should be capable of providing quantities of water on the principles of equality and reliability. The ideal object of supplying the right quantity of water at the right time would generally be aimed at; but adequacy and reliability in supply would also be desirable. The farmers should be fully involved in water management, particularly at the outlet level.

Various prerequisites to prepare the POM are :

a) Realistic determination of inflows, which largely depend on weather, into the source (e.g. reservoir) and matching irrigation delivery schedules.

b) Efficient conveyance system.

c) Proper determination of overall system losses and constraints and steps for minimizing them; drainage and conjunctive use.

d) Effective monitoring of deliveries and effective feed-back system.

e) Clear understanding of duties by functionaries and conscientious performance thereof.

f) Good rapport and regular interaction between system managers and beneficiaries.

g) Adequate channel maintenance and properly designed tamper-proof outlets.

h) Good communication system.

i) Suitable Management Information System (MIS).

j) Periodic review of hydrological data.

1.5 PROCEDURE TO FORMULATE POM FOR NEW/MODERNIZATION PROJECTS

The O&M unit or the designated agency charged with the formulation of POM must commence very early in the project planning phase for coordination of action programme, and should continue through the planning, design, construction, commissioning and operation phases. Procedure for various phases is given below :

1.5.1 PROJECT PLANNING PHASE

O&M aspects of a project must be addressed by knowledgeable O&M specialists in a comprehensive manner during project planning like other aspects, such as, selection of the conveyance system or determination of the agricultural activities in relation to their costs or training of personnel and farmers.

A trade-off analysis of future O&M cost/capital is of vital importance to indicate the extent of trade-offs for various planning options. This will help in reaching optimized final decisions as it would clearly indicate the extent of trade-off in future O&M costs in planning options before final decisions are made.

The long-term operation and maintenance function and its cost are directly affected by decisions pertaining to the farm services or system components and facilities.

The following points need consideration in the planning phase :

- the operational feasibility of the scheme relative to services intended and components and facilities selected.
- realistic costs of operation and maintenance to assure continued project integrity by keeping in good health.
- the specific O&M facilities such as automation, communication, equipment,spare parts and supplies.
- the advance staffing and training,and pre-transfer preparatory work of O&M that must be completed before the project is commissioned. Adequate capital budget provision for O&M during construction phase and sufficient revenue budget provision thereafter must be carefully estimated. In planning O&M staff, the existing norms for sections, sub-divisions, divisions, circles, etc., would need to be reviewed in the context of actual requirements, keeping in view that the establishment cost is kept to minimum required.

The O&M matters that must be addressed during project planning and be fully reflected in the project feasibility report include:

- Irrigation, drainage and flood control services to farmers, villages and municipal and industrial (M&I) users.

- water allocations to individual farmers under turn schedule (warabandi) and other users and any interim modifications to utilize surplus water during project build-up with appropriate rules for running minimum discharge and notifications to prevent conferring unintended rights to use of such surplus water by the beneficiaries with necessary backing from the legal framework.

- role of farmers in determining specifics of irrigation scheduling and system operation and maintenance within statutory framework.

- organizational structure of the O&M unit including geographical bounds of the functional sub-units.

- data collection needs for purposes of O&M, extent of remote monitoring and control, and basic communication needs.

- configuration and location of offices, inspection houses/rest houses, shops, storage areas and housing.

- the complement of fixed and mobile equipment including back-up supplies and spare parts.

- schedule for completion of O&M components and facilities, procurement of equipment and supplies, and placing and training staff to meet scheduled start-up of operations.

- cost estimates of O&M components and facilities,equipment and back-up.

- cost estimates of initial staffing and final stage of commissioning.

- cost estimates of annual operations including salaries, supplies, utilities, vehicles and allowance for staff replacement and training.

- cost estimates of annual replacement and maintenance of system facilities, equipment and buildings.

1.5.2 DESIGN PHASE

Aspects of project O&M that are addressed during planning must be finalized during the design phase. These relate to :

- detailing the scheme of operation (i. e., regulated supply, canal storage requirement, unregulated supply, remote/on-site control, etc.).

- design of the overall conveyance/delivery system.

- the control, monitoring and communications system.

- the specific O&M offices, inspection houses/rest houses, shops, yards and related features.

Preparation of procurement documents for the O&M equipment will have to be completed. At the same time, new tasks must be started. The specific O&M matters that must be addressed during the design phase include:

- procurement documents for the initial complement of O&M equipment, supplies and spare parts.
- detailed schedule for placing the system into O&M status and related actions.
- detailed cost estimates for annual O&M costs.
- staffing of initial project O&M personnel.

1.5.3 CONSTRUCTION PHASE

Several aspects of project O&M must be pursued during the construction phase. In addition to those noted under the design phase, the dominant areas will be :

- installing the O&M organization in the field.
- commissioning of project facilities.
- transferring responsibility from construction to O&M.

Due to typical staging and/or phasing of the project completion, construction could be in progress in some areas, while full O&M could be in force in other areas.

The specific matters that need to be addressed include :

- finalizing POM and distributing the same together with other documents to various levels of personnel.
- recruiting, placing and training O&M staff prior to start-up in accordance with schedules.
- farmer groups, if such are to be encouraged/established, and elected designated officers for Farmers Organisations at the outlet/sub-minor/ minor level etc.
- orientation and procedural meetings with farmer organisations.
- trial operations for performance testing including communication system internal and jointly with farmers' organisations, O&M staff and CADA staff.
- trial maintenance - internal and jointly with farmers organisations - O&M Staff and CADA Staff.

1.5.4 PROJECT COMMISSIONING PROCEDURES

Following commissioning of a new project, the O&M unit should accept full responsibility for the operation, maintenance and management of the completed project components and facilities. However, it is necessary that the O&M unit is involved in considerable preparatory work which would be considered in the formulation of the POM.

Besides the preparatory work by the O&M unit, several documents are to be prepared by other units in the irrigation agencies. The documents include :

- Project Feasibility Plan
- Designer's Criteria
- Designer's Instructions to O&M
- Land acquisition instructions for O&M
- Details of rehabilitation activities carried out
- Construction/Supply Contract Documents
- Details of environmental liabilities to be met
- As-built Drawings and Manufacturers' Instructions
- Facilities and Commissioning Procedures and a report on the construction problems faced and solutions adopted therefor.
- Initial Complement of Equipment and Supplies
- Initial Complement of Staff
- Training of Staff and Farmers
- Project completion report.

Inputs to these documents will be required from O&M perspective by the initial O&M unit staff entrusted with that responsibility.

Further details of these documents are set out in Annex-I to Chapter 2 : Guide to Auxiliary Documents - Project O&M.

1.5.5 OPERATIONAL PHASE

Implementation Action Programme : A clear description, including timing is necessary for activities required for the phasing-in of O&M of the project.

The issues to be included are :

- completion of system components and facilities
- commissioning of components and facilities

- transfer from construction to O&M
- commencement of services to each area
- preparatory O&M tasks, including :
  * detailed work plan
  * completion of O&M components and facilities
  * equipment procurement
  * staffing and training
  * start-up procedures for services
- ongoing programme

The matters to be resolved are discussed in Chapters 2 to 13 of the Guide.

1.5.6 POM FOR FULLY/PARTLY IMPLEMENTED PROJECTS

Many a time, the preparation of POM is undertaken after implementation, for example, of the first stage in case of a major project or may be undertaken after full implementation of a medium or major project. In such cases more information and data may be available from (a) the study and analysis of the original project proposals, (b) additional field data collected and (c) performance of the system since its commissioning. Preparation of POM for such cases is to be viewed as preparation of POM for new projects. The POM in such cases will have to be very detailed one requiring thorough update in the light of advances and new innovations in respect of all O&M aspects and recommendations thereon after discussing their advantages and disadvantages.

1.5.7 SOME PROBLEMS FOR CONSIDERATION DURING PREPARATION OF POM FOR PARTLY IMPLEMENTED PROJECTS

Irrigation projects generally involve long gestation period and this is particularly true of major irrigation projects (CCA more than 10,000 ha). All problems faced or likely to be encountered during investigation, planning, designing, construction, commissioning and operational phases should be stated in the POM in as comprehensive a manner as possible for future reference by project authorities and by others designated to prepare POM of the project.

It would be useful and important to give the expected tangible benefits accruing from the project alongwith their economic value and also to list the project benefits (environmental, social, etc.).

The problems as faced or to be encountered include, but are not limited to, the following :

Changes in project features and scope due to inadequate investigations or change of technology, changes in project personnel including the experienced ones, shortage of funds, lack of training to staff and users, arbitrary delivery of water by (construction) staff leading to indisciplined water use and shortage at tail end incomplete portions of the system transferred to O&M staff in case

of an on-going project, introduction of new innovations and advanced techniques and methods without examining their suitability and long-term effects, examination of extensive and intensive irrigation aspects, not treating entire system as one network but as individual delivery channels, inequitable water distribution in time and space, indisciplined water use and inappropriate delivery programme, inflexibility in operation to cope up future changes in cropping pattern, inappropriate O&M organization with unreliable and ineffective communication system and lack of infrastructure facilities, etc. etc.

POM should clearly indicate the improvements to be carried out in the system to implement the POM effectively.

1.6 UPDATE FOR SUBSEQUENT PROJECT STAGES

Often a major project has to be completed in stages owing to resource constraints. Also a considerable period may elapse between the commissioning of one stage, and the commencement of planning of the next stage(s).

The experience of actual operation of the initial stage (or stages) is invaluable in planning and implementing the later stages.

All the preliminary activities outlined in para 1.5 should be completed in the sequence listed for the components and facilities involved in the additional stage by updating the existing POM.

1.7 REVISION OF POM

Irrigation projects are dynamic in nature. With the passage of time, crop types, cropping pattern, crop needs, irrigation methods & techniques, construction materials & techniques and water availability may change. Advances in science & technology, management techniques, research innovations and sometimes natural phenomena are the contributing factors. The guidelines given in the existing POM may have to be systematically upgraded, revised and supplemented from time to time particularly in light of the changes in water resources (quantity and quality), water allocation procedures and social and other factors - according to the requirements, capability, competence and the experience gained in the O&M of the project.

1.8 SCOPE OF GUIDE

This document is the national guide for preparation of plan of operation and maintenance (POM) of irrigation and drainage (I&D) systems. To meet that end, the scope of the Guide has been arranged in thirteen chapters to facilitate systematic preparation of POM of I&D systems.

The subjects covered in 13 chapters are :

Chapter 1 : Scope of Plan of Operation and Maintenance (POM)

This chapter presents POM definition; objectives of POM; purpose of POM; need for comprehensive POM and prerequisites to its preparation; procedure to formulate POM for new/modernization projects; update for subsequent project stages;revision of POM.

Chapter 2 : Project Description

Chapter 2 presents general project features and service area; maps of general and specific features; project components and facilities - water sources, conveyance and distribution system and its sub-systems; protection and other structures and related communication facilities; command area; drainage system; flood production works; disaster management facilities; supporting infrastructure; existing operation practices in the command; prevalent water management; irrigated cropped area and collection of irrigation charges; O&M charges; supporting services.

Chapter 3 : Statutory Acts, Rules and Policies

Chapter 3 gives general; constitutional provisions; national water policy; priorities for water use; State Irrigation Acts and Rules; model Irrigation Bill 1976 of GOI; adequacy of statutes.

Chapter 4 : System Operation

Chapter 4 contains general; detailed operational policy, rules and sepcifications; irrigation plan - seasonal and annual plan; operational procedures (of water sources, water distribution, system scheduling); operating of the canal and distribution system, safeguarding and security of canal banks, etc; emergency procedures; operation below outlets - responsibility of; supporting services; communication; waterlogging, salinity, drainage facilities; groundwater potential and conjunctive use of water.

Chapter 5 : System Maintenance and Repairs

Chapter 5 presents need for maintenance; Development of maintenance work plans; maintenance of record plans and drawings; specific maintenance procedures; specific features needing special attention; engineering problems; budgeting and funding; landscaping; formats and inspection/compliance.

Chapter 6 : Organization, Management and Responsibilities

This chapter presents general; essential purpose of the organization; management issues; detailed organizational structure; relationship with other public and private organizations; public relations; administration.

Chapter 7 : Management Information System (MIS)

Chapter 7 presents introduction - general; system definition & information needs; content, timing and frequency of reports; computer based MIS; Manual MIS.

Chapter 8 : Communication Network

This chapter gives need; types of communication; locations, networks and sub-networks; combination of different communication systems; operation of wireless system; wireless manual; advanced technology.

Chapter 9 : Involvement of Beneficiary Farmers

This chapter contains background; present status; need of farmers involvement; relationship between project and beneficiary farmers; rights and obligations of farmers; farmers involvement in financing and construction of irrigation systems; offences and penalties; other services.

Chapter 10 : Training

This chapter presents objectives of training; present status; international perspective; training for whom; need for systematic training; training of farmers; training needs and assessment (TNA); mass training programmes and other methods; training centre; effective training model.

Chapter 11 : Budgeting and Financing

Chapter 11 presents general; preparation of budget proposals; financing reliability; special funds; foreign exchange; water service charges.

Chapter 12 : Computerization

Chapter 12 gives introduction; need for computerization; plan of computerization; micro computer system; selecting a computer (PC); computer models; computer formats.

Chapter 13 : Monitoring and Evaluation

Chapter 13 gives general, monitoring and inspection visits; evaluations; performing evaluations; monitoring formats; record of evaluation reports and lessons for the future.

MAITHON DAM (BIHAR)

KOSI BARRAGE (BIHAR & NEPAL)

CHAPTER 2

PROJECT DESCRIPTION

2.1 GENERAL PROJECT FEATURES AND SERVICE AREA

It is essential for the project manager and all those involved with the operation and maintenance to be acquainted with the I&D system. The general features and service area may be described to acquaint all concerned with the project, including the following:

* physical-geographical location, service area, roads, railways, air links, utility lines (power, communications), districts, cities, towns, villages, etc.
* project category - major or medium
* stages of implementation and phases of construction
* historical aspects and irrigation development
* socio-economic details to establish bench marks
* Topography and soils
* waterlogged and salt affected areas and other environmental aspects
* climate and rainfall, dry spells and drought, relevant meteorological parameters and gauging facilities
* river basin
* water resources-surface and ground water (quantity and quality)
* water source and canal network lay-out
* cropping pattern and farming activities
* water requirements of crops and irrigation scheduling on the system
* farmers' input for operation plan
* acts and rules in brief (with details in a separate chapter).
* operation and maintenance status in vogue.
* project organization (existing and proposed)
* population resettlement and rehabilitation
* communication status
* project cost
* any other general project area features that will be important for operation and maintenance of the system

2.2 MAPS OF PROJECT FEATURES

2.2.1 MAPS OF GENERAL FEATURES

A series of maps as may be necessary for general features should be included to indicate :

* project location in the State on the country map.
* topographic features of catchment and cammand areas
* natural drainage lines
* soil types (moisture holding capacities)
* isohyets
* ground water details
* roads, railways, airlinks, navigation routes, etc.
* utility links e.g.power transmission lines, communication lines,
* location of cities, towns, villages
* climate classification
* raingauge stations
* weather reporting stations
* any other general project area features that will be important for O&M operations

2.2.2 MAPS OF SPECIFC FEATURES

Location maps of specific project features should also be incorporated. Lay-out of the irrigation and drainage system should be placed on these maps with details of:

* water sources
* offtaking canals, branches, distributaries, minors, sub-minors, etc
* distribution points (Canal regulators, outlets)
* water measurement facilities (flumes, cross regulators, falls, v-notches, etc.)
* cross drainage works (aqueducts, siphons, superpassage, level crossing)
* escapes
* pumping stations

* lift points
* maintenance shops, workshops, offices
* any other pertinent details

2.3 PROJECT COMPONENTS AND FACILITIES

It is necessary to provide details of all project components that will be operated and maintained by the organization. The related project facilities that may affect O&M should also be described, the information available therefrom will add to efficiency and effectiveness of work. The details required for O&M of the project components and facilities include :

* specific location, access/approach
* main design features
* capacities, sections, flow-charts, etc
* operating ranges (including whether for multiple use and if so, then priority assigned to different uses)
* sizes
* unique features
* materials
* construction problems faced and how solved
* any other pertinent description

Detailed design criteria, geologic reports, as-built drawings etc should be referenced to readily lay hand on specific details when necessary. (see Guide to auxiliary documents given at Annex-I).

Broadly, the project components/facilities can be distinguished as : water source; conveyance and distribution system; command area, drainage system; flood protection works; disaster management system; supporting infrastructure.

The 'heart' of any irrigation system is the command area or farm sub-system performing the primary function of crop production.

Some of the specific features of these facilities are listed below:

2.3.1 WATER SOURCES

* storage dam
* direct diversion (e.g. run-of-the-river scheme) or pumping from rivers (e.g. floating barge)
* pumping from groundwater aquifers (dugwells, tubewells, filter points, etc.)
* facilities for mixing drain water for re-use
* recycled waste water with or without treatment from various processing plants and municipalities

These project features should be described in detail in the context of O&M aspects, covering the details as given under 2.3.

2.3.1.1 Storage Dam

A broad list of items for a storage dam, which effects regulated releases, is given below, for example :-

Location; access/approach; catchment; yields including 75% dependable yield; storage (PMF, FRL, gross storage, dead storage, minimum draw down level, crest level); waterspread area and population displacement with number of villages affected; main design features covering-spillway (gated, ungated), earth dam, power dam section, design flood, river sluices, energy dissipating devices, head regulators/water intake structures, dam sections, capacity and rating curves of the dam, capacity of feeder channel, if any, etc., etc.

2.3.1.2 Weir/Barrage

The fluctuating river flow supplies water to the irrigation system as per discharge in the river. In case of run-of-the-river schemes (weir/barrage), regular and timely release of water is not always possible. The items for a weir/barrage in an alluvial tract will include, for example :

Assumed river discharge at the site, Lacey's waterway and looseness factor, weir width, sill levels of undersluice bays and weir bays, number of bays, length and height of divide walls, piers, fish ladder, length and thickness of upstream and down stream floors, silt excluder, energy dissipating devices, falling shutters and their operation, head regulator(s) - crest level, breast wall, discharge tables for different gate opening under various hydraulic conditions, flood protection works, weir/barrage regulation, gate operation schedule, etc. etc.

2.3.1.3 Other Water Sources

Floating barge, ground water aquifer supply, mixing drain water and use of waste water

These water sources may be described according to the details given in para 2.3, adding special and unique features in each case as required.

2.3.2 CONVEYANCE AND DISTRIBUTION SYSTEM

The conveyance system carries water from the source to the distributing channels. This system can be divided into three sub-systems and the important features thereof are :

2.3.2.1 Primary Sub-system

* Head regulator at the uppermost point to release regulated supplies-capacities and operating levels need to be mentioned
* Main canal or a feeder canal taking off from the head regulator at the source
* Branch canal(s) taking off from the main canal

2.3.2.2 Secondary Sub-system

* Distributaries taking off from main/branch canals (give capacity at FSD levels)
* Minors and sub-minors (laterals) take off from distributaries (150-700 lps discharge capacity), the smaller capacity minors are called sub-minors. Outlets are usually provided to deliver water to water courses. Outlet is the last government control point, normally serving 40 ha block. The capacity of an outlet may vary from 30-60 lps.

Some outlets may take off from distributaries or even from a branch, etc. which are called direct outlets.

2.3.2.3 Tertiary Sub-system/Micro System

Water courses and field channels supplying water to the command are called tertiary sub-system or micro system. These are usually built and maintained by the farmers themselves. The Government of India has lately directed that water courses and field channels be built by State Government upto 5-8 ha sub-blocks at the project cost to be maintained by the farmers. These are lined in many cases to reduce seepage losses (here description may be given in terms of para 2.3).

2.3.3 CONTROL AND OTHER STRUCTURES

* head regulators
* cross regulators
* silt excluders/ejectors
* drops/falls

* escapes
* level crossings
* super passages
* aqueducts
* tunnels
* syphons (drainage/canal)
* measuring structures
* pump stations
* pipe lines
* turnouts (outlets)
* bridges
* miscellaneous structures like bathing ghats, cattle ghats, silt traps, etc.

These and other pertinent structures may be described in terms of para 2.3.

2.3.3.1 Related transmission and communication facilities

The adequacy of communication facilities has to be indicated alongwith the proposed measures to improve the facilities. Automation/Semi-automation, if introduced,should be mentioned too.

2.3.4 COMMAND AREA

* Soils and their irrigability data and classification :
* Gross Command Area
* Culturable Command Area, Irrigation Intensity, etc.

2.3.5 DRAINAGE SYSTEM

* surface drainage
* sub-surface drainage (horizontal drainage)
* tubewells (vertical drainage)
* biological drainage (growing high water consuming plants)
* water entry structures along drains
* outfall facilities
* pump stations
* main drains, lateral drains, field drains

These and other pertinent features may be described in terms of para 2.3.

2.3.6 FLOOD PROTECTION WORKS

* bank groynes
* spurs
* revetments, etc.
* marginal embankments with adequate drainage arrangement.

Description of their and other pertinent features may be given in terms of para 2.3.

2.3.7 DISASTER MANAGEMENT FACILITIES

* breach control arrangements
* flood warning system
* cyclone warning system in coastal regions

Their description may be given in terms of para 2.3.

2.3.8 SUPPORTING INFRASTRUCTURE

* roads, railways, airlinks, etc.
* borrow pit area details
* utility lines
* maintenance and repairs' shops
* material storage areas and warehouses
* offices
* equipment yards
* weather reporting stations
* hydromet system
* spare parts depots, etc.
* agriculture support services and markets (support services include, e.g., electrical and mechanical repair shops, fertilizer, seed, pesticide, authorised selling agents, banking facilities).
* processing centres for produce (e.g.,crops, oilseeds, cotton, etc.)

These may be described in relation to O&M aspects

2.3.9 EXISTING OPERATION AND MAINTENANCE PRACTICES IN THE COMMAND

- Planning/design/construction stage - proposed practices in brief.
- Commissioning stage - status and proposed practices in brief
- Operating stage - status and detailed guidelines

2.3.10 PREVALENT WATER MANAGEMENT

* Staffing pattern for O&M, its adequacy
* procedure of taking over of irrigation management by O&M wing from the construction wing.
* notification for irrigation
* closures
* irrigation scheduling (water releases)
* research functions of O&M staff
* training including farmer's training and education.
* monitoring and evaluation

2.3.11 IRRIGATED CROPPED AREA AND ASSESSMENT/COLLECTION OF IRRIGATION CHARGES

2.3.12 O&M CHARGES - APPROVED RATE, ACTUAL RATE AS WORKED OUT, ETC.

2.3.13 SUPPORTING SERVICES

* CADA
* Other organizations and departments including farmers organizations, if set up or proposed to be set up.

2.3.14 ANY OTHER DETAILS - which will assist the project manager in knowing the system better from O&M view point.

Add relevant description for each item under paras 2.3.10 to 2.3.14 from the view point of O&M of the project.

KADANA DAM (GUJARAT)

JAWAHARLAL NEHRU LIFT CANAL (HARYANA)

CHAPTER 3

STATUTORY ACTS, RULES AND POLICIES

3.1 GENERAL

(i) It is useful and important to have knowledge of the statutory provisions in the acts, rules and policies framed thereunder for operation/water distribution in an I&D system.

(ii) Planning, design, construction, operation and maintenance of major and medium irrigation projects are carried out by State Governments who undertake such projects after clearance by the Planning Commission and the Central Government including clearance from Ministry of Environment and Forests which is now mandatory. All Central loan assistance is subject to these requirements and this enables the Central Government to coordinate and guide the pattern of irrigation development in the country, keeping in view the inter-state allocations of river waters etc.

(iii) To regulate the use of water, policies & procedures, rules & statutes/Acts are necessary. These are effected through enactment of Laws and Acts by the Central/State Governments. Guidelines and manuals are issued describing functions, duties and responsibilities of various agencies, departments, officers and the beneficiaries.

3.2 CONSTITUTIONAL PROVISIONS

(i) Promotion of welfare of all with a declared bias in favour of neglected and weaker sections of the society is stipulated in the Constitution of India.

(ii) Water resources development for irrigation, flood control, etc. is the responsibility of the States as it is included as a State subject in the Constitution.

(iii) For inter-state rivers, the union government can legislate, with the agreement of the concerned States, on their water resources development (Art.252).

(iv) The Central Government has been charged with the responsibility of regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest (Entry 56 of list I).

(v) Right of a State in water : (i) The only right of the State is the right to use water; (ii) This right is sovereign in character; (iii) The right is subject to the right of riparian to get the customary quantity of water; (iv) State is required to notify regarding its desire to use river water for public

purpose; (v) Ownership of groundwater rests with the State and the right thereto cannot be acquired by prescription.

3.3 NATIONAL WATER POLICY, 1987

For orderly development of water resources to meet the growing needs of food and fibre for the fast increasing population and to be in harmony with the integrated development of natural resources, environmental quality and ecological balance, the Union Government has formulated a National Policy in 1987. This policy lays down some important provisions for improvement of O&M of irrigation and drainage systems. (See Annex-II for relevant extracts of National Water Policy, 1987).

3.4 PRIORITIES FOR WATER USE

(i) The State Government should decide priorities in water use, irrigation is the biggest user of water (70-80% of diverted water). The various types of demands on water (with generally assigned priorities) are :

* drinking/domestic
* agriculture (Irrigation)
* municipal and Industrial (M&I)
* power generation
* pisciculture
* environmental
* silt extrusion
* flood moderation, etc.
* downstream statutory releases

These requirements except for irrigation may be worked out and accounted for in the total available supply in the order of priority to determine the quantity available for irrigation purpose.

(ii) Water for non-agricultural uses : A legal agreement should be entered into with the concerned agency, spelling out the obligation and responsibilities of the concerned agency.

3.5 STATE IRRIGATION ACTS, RULES AND POLICIES

(i) Irrigation Acts and Rules exist in various States. An available list of Acts/Rules relating to water management in different regions, & the

States in which these are prevalent (with some modifications) is given in Annex-III

N.B. THE STATE GOVERNMENTS MAY SEND THE INFORMATION TO HELP INCID TO UPDATE THE LIST

(ii) Some States have constituted Water Distribution and Maintenance Committees [viz. Village Service Area Committees (VSAC), Project Level Water Management Committees (PLWMC), Water Management Associations (WMA), Canal Advisory Committees (CAC), Water Users Associations (WUA), Water Cooperative Societies (WCS)]. These Committees decide water distribution programme, cropping pattern and intensity for the particular season as well as undertake maintenance of on-farm development (O.F.D.) works.

(iii) Relevant details of O&M aspects may be presented from the Acts and Rules while preparing POM of a project.

3.6 MODEL IRRIGATION BILL 1976, GOVERNMENT OF INDIA

The Irrigation Commission 1972 noted multiplicity of statutes covering various aspects of irrigation management and administration and recommended unification and simplification of laws relating to irrigation.

The draft Model Irrigation Bill 1976 is in pursuant to the above recommendation and was commended to the State Governments by the then Ministry of Irrigation for consideration (Model Bill is at Annex - IV). The main provisions of the Bill relate to :

(a) Application of water for public purposes

(b) Construction and maintenance of irrigation works including water courses, field channels and drains

(c) Regulation of Irrigation Supplies

(d) Levy of water rates and betterment contribution

(e) Requisition of labour and materials in emergency

(f) Settlement of disputes

(g) drainage, and

(h) protection of irrigation water including offences and penalties.

N.B. STATE GOVERNMENTS MAY CONSIDER ENACTMENT ON THE BASIS OF THE MODEL IRRIGATION BILL 1976 IN THEIR STATES TO UPDATE THE EXISTING ACTS WITH SUITABLE AMENDMENTS IN THE INTEREST OF IMPROVING WATER MANAGEMENT.

3.7 ADEQUACY OF STATUTES

(i) There should be an adequate provision in the statutes for protection of irrigation works against unauthorised use or damages, enforcement of discipline among beneficiaries and immunization of officers against legal proceedings for their actions taken in public interest to protect irrigation works and ensure planned water supply. Details of clause 430 of the Indian Penal Code regarding punishment for damaging and obstructing the canal system may be included.

(ii) The existing statutes should be examined for their adequacy to enable efficient and effective O&M of the system; suitable recommendations may be made for modification thereto and included after appropriate approval.

(iii) Environmental policies relating to irrigation and drainage may be included.

SALAL DAM (JAMMU & KASHMIR)

K.R. SAGAR DAM (KARNATAKA)

CHAPTER 4

SYSTEM OPERATION

4.1 GENERAL

(i) This chapter will provide specific, concise but detailed instructions for the operation of the irrigation system as it is to be used predominantly by operators in the field, and their supervisors and managers.

(ii) It will provide a formal documentation of operational procedures to assist in effective day-to-day operation, as well as providing a basis for long-term review and evaluation of policy and operational practices in the light of operational experience.

(iii) Two fundamental factors will influence the content of these instructions:

- the method of water allocation and distribution adopted for the system;
- the technology adopted for water control within the distribution system.

(iv) As mentioned in Chapter 1, para 1.5-Procedure to formulate POM...., essential features of project operation would have been addressed during the planning, design and construction phases.

(v) It follows therefore that the detailed instructions in this chapter should be compatible with the design features of the project facilities.

(vi) There are a number of activities to be addressed in the formulation of System Operation rules, which could be grouped under the following headings :

* Detailed Operational Policy, Rules and Specifications;
* Irrigation Plan (Seasonal and Annual Operating Plan);
* Operational Procedures
* Emergency Procedures
* Operations below Farm Outlets

4.2 DETAILED OPERATIONAL POLICY, RULES AND SPECIFICATIONS

The essential specific policy guidelines and general operating criteria which system operators must take into account in determining detailed operational procedures should be included.

These aspects should be detailed, where necessary, for operation purposes from the relevant information contained in Chapter 2 : Project Description; Chapter 3 : Statutory Acts, Rules and Policies; and Chapter 6 : Organization, Management and Responsibilities.

These should include such matters as :

* Water Sources
  - any legal limits to water availability for the project purposes
  - any water sharing agreement(s) with riparian state(s), international joint river commissions or international agreements/treaties/ arrangements
* Priorities for delivery during
  - normal availability from sources
  - restricted availability from sources
* Categories of demand to be met
  - project requirements
  - pisciculture
  - power generation
  - silt extrusion
  - flood moderation, wherever provision is made in the reservoir for regulation.
  - rural, municipal and industrial requirements
  - environmental requirement
  - recreation requirement
* Requirements for 'passed-down-river' flows to meet riparian entitlements (downstream committed uses), or entitlement of downstream projects or water users,in terms of either flow rate or water levels and quality to be maintained.

As an example, general operating rules alongwith an operational policy as framed by WAPCOS are given in Annex V.

4.3 IRRIGATION PLAN - SEASONAL AND ANNUAL

(i) This section of the POM should provide specific instructions for preparing seasonal/annual irrigation plan including mid-plan corrections, operation of canal system (main, branch, distributaries and minors/sub-minors)

and adjustment for discharges in main/branch canal. Initially, water requirements for each month of the crop season are worked out on an assumed cropping pattern. The channel design capacity is determined giving due weightage to the climatic conditions and watering depths for the crops. These capacities are listed in terms of percentage of the peak requirement termed capacity factors, which form the basis to run the channels. Duration of running a channel is, however, variable. Due to these capacity factors, the canal rotation becomes essential. The channels should attain the governing levels so that outlets can draw their share of water. The objective of the exercise is to match the water demand with the supply as closely as possible. This exercise is generally complex. The use of computers would be helpful. The complexity of the process varies from case to case depending on the scope for adjusting and matching water supplies to meet the demand. The plan should contain measures to mitigate drought conditions by maximizing production per unit of available water and also adopting agricultural policy to emphasize growing of drought-tolerant crops.

(ii) The preparation of the irrigation plan includes the following main steps:

* Estimation of water supply
  - kharif season
  - rabi season
  - hot weather
  - two seasons for two seasonal crops
  - perennial
* Estimation of water demand of the users (derived from cropping or demand pattern)
* Application of appropriate water allocation criteria and procedures; farmers' involvement
* Matching supply and demand

(iii) Estimation of water supply has to be realistic for determining the water availability; the hydrology of the area has to be properly analyzed to arrive at a reliable estimate of inflows. For major storage schemes or diversion works, hydrological studies are carried out based on long-term historical data.

For medium projects on smaller streams for which data are often not available or if available are scanty, empirical formulae are used such as:

* Binnie's percentages (Madhya Pradesh)
* Barlow's tables (Uttar Pradesh)

* Inglis and De-Souza formulae (Maharashtra)

* Strange's tables (Maharashtra)

The annual/seasonal water yields are worked out from rainfall data for a number of years. These computations can be arranged in descending order to determine the dependability (75%, or more or less than 75%). For erratic rainfall pattern the commonly adopted design criterion is based on mean flows (50%) for better carryover of water for lean years, particularly for drought prone areas.

(iv) The water demand is essentially determined either by the expected cropping pattern, or allocation criteria and procedures in water shortage situations. Of various options to compute water requirements(Cropping-pattern based, crop-water requirement based, growth-stage based, depth based), the most common method practised in the country is cropping-pattern based method. This means supplying water as per parameters adopted at the time of formulation of the system. It may be at variance with realities for which efforts should be made to improve the system so that to some extent crop water requirement is also realised.

(v) Allocation criteria such as allocation of water for social justice and equality (equitable water supply), promotion of optimal cropping pattern and irrigation intensity, maximum production per unit volume of water or per unit area etc, may be clearly mentioned.

It is necessary to seek farmers' participation to arrive at an acceptable implementation plan. There are variety of practices in the country. In some States, beneficiaries are required to apply for water indicating area and crops proposed. Applications are considered in accordance with the overall policies for sanction. In some States, execution of 'contracts' for long periods exist and such practices have been in vogue for a long time. The principles governing releases of water, however, remain the same under these practices (Shejpali or others). Preparation of irrigation plan should take into consideration such established practices also.

The project manager should -

* know farmers' need and crop preferences

* know their capabilities and preparedness

* ensure farmers' commitment and acceptance, and

* earn credibility with them.

Stress is, however, generally laid on framing an operation plan to ensure maximum production per unit area.

This chapter should clearly define the rules to be adopted in matching supply with the demand. The government has no control over the cropping pattern. The rules for sharing water deficits should be well defined.

(vi) In matching supply and demand, four situations could arise:

a) supply in excess or matching the demand.

b) supply moderately less than the demand (shortage 10-20% of the design)-by appropriately scheduling/rotating canal supplies.

c) much less supply than the demand (shortage more than 50% of the design) - requiring mandatory scheduling/rotating canal supplies.

d) far less supply than the demand. Such canal scheduling is known as "Distress regulation" or "Crisis management".

(vii) Measures to match supply and demand : The measures to reduce the gap between supply and demand, are mostly applicable to (b) and (c) above and are related to :

* cropping pattern
* water distribution practices
* adjusting water rates

Measures related to the cropping pattern

* shifting or staggering planting dates to reduce peak demand
* changing the existing crops for others consistent with crop calendar and soil-capability (limited application)
* reducing irrigation area (CCA of small and marginal farmers to be kept full, as far as possible).

Measures related to water distribution practices

* reducing water allocation but keeping the same distribution method
* extending the interval between irrigations - reduced waterings. (considering critical stages of waterings of predominant crops).
* decreasing the amount of water per irrigation proportionately to reflect minimum effect on crop production.
* allocation of water to preferential crops in terms of Govt.policy.
* exploring in detail the possibility of changing the water distribution method to a more efficient one.

Adjusting Water Rates

- This measure should be exercised with great care and only where the preconditions for its adjustment exist, such as installation of water measuring devices at the farm level, and supply is on volumetric basis.

(viii) A variety of well-known formulae exist for the calculation of crop water requirements which take into account effective rainfall, climatological factors, crop growth coefficients etc. (See para 4.3). A critical factor in the derivation of net irrigation requirements is the overall water use efficiency. This factor is often largely over-estimated at the planning stage and therefore, monitoring of operation activities is very important to assess the actual values of conveyance, operation and distribution, and on-farm efficiencies. (See Chapter 13 : Monitoring and Evaluation).

4.4 OPERATIONAL PROCEDURES

A specific set of written procedures and instructions will be required for each operating feature or item (or class) of work/plant, as indicated in the following sections.

4.4.1 WATER SOURCES AND STORAGES (RESERVOIRS)

The sources of water would have been determined during planning phase and documented. The quantity available would have been determined (real time and generated including carry over storage) on a seasonal basis so that supplies are known and plans can be made by the supplier and the user.

Many irrigation systems utilize a reservoir, often a part of a multi-purpose scheme, to store water during periods of high river flow for subsequent use during periods of low flow. The dam which forms the reservoir is often a major structure and must be operated under specific reservoir operation rules and procedures. In the case of a series of reservoirs in the basin, integrated operation should be a part of the procedure. These rules are usually formulated during the planning, design and operation phases.

The reservoir operation plan is prepared commensurate with the pattern of releases. Water availability is worked out each month (or on ten daily basis) from which losses and canal releases are deducted. From reservoir capacity chart (with water levels and dates), reservoir operation schedules are to be worked out. Guidelines for operation and maintenance of dams including Gate operation schedule are also to be prepared (Annex - VI).

As dam and reservoir assume importance to the success of providing adequate and reliable water supply, specific rules should be documented and implemented. Provisions for periodic inspection would need to be incorporated. In this

regard, integrated operation based on long-time historic data (as a guideline) would be helpful for real time operation.

Since planning, design, operation and maintenance of large dams are highly specialized subject matter, irrigation agencies responsible for such activities should refer to procedures developed by the International Commission on Large Dams (ICOLD) and their National Committee/INCOLD/Dam Safety Organisation (DSO) of CWC. Particular attention should be given to instrumentation, monitoring and performance requirements in the context of dam safety.

4.4.2 DISTRIBUTION OF WATER

Operation of water delivery network may vary considerably depending on a number of water management factors, including but not limited to the :

* soils types
* cropping pattern
* climatic conditions, particularly the rainfall pattern
* degree of regulation of the sources of water
* quality of the water, particularly the silt content
* size of project
* number and type of farms
* number and category of other users
* type of conveyance and distribution facilities (open channels and/or buried pipes, etc)
* method of water distribution, such as, on-demand, continuous delivery, and rotational system,

Water distribution includes two distinct steps :

* the preparation of the irrigation system scheduling (indenting, ordering) at an interval to be determined;
* the operation of the distribution system.

Procedures for these two activities should be clearly and carefully defined in the POM, since they are vital for the quality of service to the water users and will involve specific field staff.

4.4.3 SYSTEM SCHEDULING, INDENTING, ORDERING

It is a major management activity for determining when irrigation supply is required and in what quantity. This exercise is required to distribute the

available water in an organized and equitable manner. Three methods of irrigation scheduling are based on :

(i) Allowable soil water depletion
(ii) Allowable soil water tension, and
(iii) Allowable plant water stress which only indicates that an irrigation is needed and not the irrigation quantity.

Preparation of a system scheduling depends on the method of water distribution and on the type of facitlities. The water indent for an individual farm or group of cultivators or other users can be placed by each farmer or group or other users or decided unilaterally by the agency supplying water according to a pre-established scheduling. The preparation of the water delivery schedule can be simplified or even eliminated when part of the system is operated on demand/or is equipped with advanced water control faciilities such as downstream control or centralized remote control. Difficult areas in preparing a delivery schedule are the estimation of water propagation time, water use efficiencies and effect of rain interruptions. Knowledge gained from prior operational experience should be a guide in refining estimates.

Standard Forms should be prepared to facilitate the preparation of the system scheduling. Usual forms are :

* individual demand at lower reaches of canals;

* aggregating water demand from tail reaches to headworks incorporating efficiency, quantity required at each control point of the system. Instructions to deal with rapid variations of demand due to rainfall prepared jointly with the users should also be included.

4.4.4 OPERATION OF DELIVERY SYSTEM

4.4.4.1 Delivery on Demand System

The farmers apply for water for different crops, as prescribed by the department, showing the proposed area. The department sanctions applications within an overall policy. This system requires gated control for all offtakes including outlets alongwith the measuring devices. Prerequisites, problems, advantages and disadvantages in the context of the project cost and management would need to be considered.

4.4.4.2 Continuous Delivery System

This method envisages continuous flow of water from main canal to outlet for the entire season with variable discharge, according to crop water requirements.

4.4.4.3 Rotational Delivery

This method envisages canal running full in turns with full supply discharge

and the duration of flow is regulated. There are two types of rotational delivery system in vogue :

(i) Flexible rotational system : It has again two options.
   (a) to meet variable demand with constant stream size but delivery period is varied or adjusted.
   (b) to meet variable demand with constant period but varying stream size.

(ii) Rigid rotational delivery : It stipulates water delivery to all farmers within an outlet on the basis of the holding size only. It is suitable for water scarce areas. In the rotational operation of channels, grouping of channels, rotational running period and operation of channel groups in rotation should be considered.

Rotation possibilities : These are :

   (a) rotation of branches and distributaries
   (b) rotation of distributaries,
   (c) rotation of laterals (minors/sub-minors) on distributaries. This pre-supposes control arrangement at the head regulator of lateral, and
   (d) rotation amongst a group of farmers under specified outlet - generally termed as 'Tatil'.

(iii) Rotational Delivery and Warabandi : There is general agreement in the country that in the present context the rotational water delivery system upto the outlet level and warabandi/osrabandi below the outlet level is the most suitable method. However, the situation may change with the introduction of automation of an irrigation system. Rotational water delivery system is designed to ensure, adequate and equitable distribution on a fixed time basis within available supply.

The operation practices above the outlet and below the outlet as being followed in different regions are briefly given below :

Operation Above The Outlet

Northern Region

Water distribution as per predetermined schedule by rotation and capacity factors; canal scheduling decided by water distribution committee for each system to match the available supply.

Central Region

Schedule is prepared on the basis of sanctioned area to be irrigated on each channel; Canal Advisory Committee decides on sanction of area for irrigation to match the available supply.

Eastern Region

'On' and 'Off' pattern for various channels, running programme finalised by S.E. and E.E. after judging the available supply (Tatil system).

Southern Region

Land is identified for 'dry' or 'wet' crops; wet crops are given continuous supply while dry crops are given 'off' and 'on' supply. Programme of channel running is finalized by the Collector of the district assisted by Irrigation and Agriculture departments and for major projects by the government; farmers manage through 'Neerkatti' (No Warabandi is involved).

Operation Below The Outlet

Northern Region

Warabandi or Osrabandi; Outlets are open pipes or APM.

Central Region

As per water required on each outlet by turns (Shejpali). As per pre-determined time on each outlet by turns (rigid Shejpali); outlets are generally gated.

Eastern Region

Outlets are fed in turn when channels run; 'Sattedar' or 'Lambardar' assists in water distribution (no warabandi is involved); outlets are open pipes.

Southern region

Cultivators manage through 'Neerkatti' (no warabandi is involved); outlets are open pipes.

4.5 OPERATING A CANAL SYSTEM

The methodology for water distribution and water allocation to farmer groups for different seasons, etc, should be mentioned.

Instructions should be formulated regarding :

* system start-up and shut-down;
* range of discharges in each canal (minimum and maximum values)
* water measurements including channel losses.
* authorized rate of change of discharge

* water level fluctuations at critical points of each canal (minimum, maximum, rate of fluctuation - normal and emergency)

* operation during rainy season

* operation of all water control structures (cross-regulators, offtakes, escapes, pumps, etc.)

If part of the system is operated under remote control, detailed instructions for system scheduling and operating should be prepared.

Depending upon the type of water control technology (manual, hydrodynamical, electrical, or electronically controlled flow), forms Registers should be prepared for recording flow and water levels at critical points of the irrigation system. This information is important for :

* calculation of actual water use; and

* determination of actual water use efficiencies

* providing data for improvements in the system;

* volumetric water charges where applicable;

* long-term review and evaluation of policy and operational practices.

In view of the enormous volume of information on canal operation and water delivery which needs to be recorded, stored, monitored and analyzed, the use of computer-based management information system (MIS) is proving advantageous. Such systems need to be carefully developed to ensure that all the information needs arising from the water distribution function for other units in the organization can be met without the need for multiple data bases. Careful attention should be given in the development of the computer programmes to these other needs, as well as to provide for effective operation management including monitoring system at pertinent delivery points at field and policy making levels including groundwater status and conjunctive water use (also refer to Chapter 13 : Monitoring and Evaluation).

4.6 SAFEGUARDING OF CANAL BANKS, STRUCTURES AND PROPERTY

Issues to be addressed are :

* canal breaches

* operation of structures.

* use of canal property

* damage to communication lines and felling trees

* security of canal staff

The POM should discuss measures to be taken for preventing/ minimizing the breaches due to piping, overtopping of canal, etc. and also vigilance (watch and ward) for preventing farmers from unauthorized use or tampering with the structures, etc.

4.7 EMERGENCY PROCEDURES

4.7.1 EMERGENCY PREPAREDNESS PLAN

An Emergency Preparedness Plan (referred to also as a Disaster Management Plan) should be developed for all components and facilities for which failure or malfunction could cause -

* danger to human life
* substantial property damage
* loss of production
* disruption to other community activities

Essential complementary parts of an emergency plan are:

* establishment of emergency depots with immediately available stockpiles of materials for rapid repairs;
* schedules of mechanized plant and equipment which would be available from an agency, or agencies in relevant areas; and
* procurement of labour.

4.7.1.1 Dams and Major Structures

Keeping in view hazards involved in structural failure or malfunctioning, and the specialized technology involved in these structures, reference should be made to ICOLD or INCOLD/Dam Safety Organization (DSO) of CWC for relevant instructions in preparing the emergency plan, including inundation maps (Annex - VII : Emergency Preparedness).

4.7.1.2 Other Facilities

For other facilities, a number of situations need to be addressed, such as

* excessive rainfall, flood routing;
* blockage or malfunctioning of gate;
* breaches or overtopping of banks;
* breaches or overtopping of flood embankments;

* obstruction of drainage;
* chemical spills and pollution of waterways.

The Plan should indicate :

* action to be taken to minimize damage or risk to structures;
* action to minimize danger to life and property;
* internal reporting processes to be followed;
* external communication and notification processes;
* liaison requirements with relevant authorities;
  - civilian protection or evacuation-co-ordination with Voluntary agencies, Panchayats etc.
  - traffic control and diversion
  - flood routing procedures
  - water quality and health issues

4.8 OPERATION BELOW OUTLETS – RESPONSIBILITY OF

Operation below outlets is the responsibility of individual farmers. However, when farms are small, it is common that the projects deliver water in bulk at group level to outlet committees. In that case the cooperation and active participation of farmers is essential for efficient use of water. These require organization, skill and discipline. The responsibility for organizing Water User Groups (WUG) should be clearly defined. These WUG could be organized in a formal or informal way. The overall responsibility is to distribute water among the farmer members within the area and also to maintain on-farm facilities. The organization and responsibility of each WUG and the rights and obligations of each member, should be clearly defined separately (for more details see Chapter 9).

The distribution of water by the WUG is dependent on the supply of water in the main canal, branches, distributaries and laterals which are being operated by the irrigation agency. It is, therefore, necessary for the agency to take responsibility for, and an active interest in, activating the farmers within the WUG.

4.9 SUPPORTING SERVICES

Operation above the outlet is with the Irrigation or Command Area Development department and below the outlet is with the farmers. A Command Area Development Authority (CADA) has been established for a number of projects

in almost all States. CADA's multi-disciplinary programme envisages sustainable development of water, crops and land in the command area to improve utilization of the created potential and to enhance agricultural production/ productivity. The proposed main strategies during the VIII Five- Year Plan (1992-97) are:

(i) to ensure reliability of irrigation water supply through unified control and adoption of management approach.

(ii) to intensify implementation of software activities such as adaptive trials, demonstration, training, wireless communication, warabandi, farmers' participation in irrigation water management and maintenance, etc.

Core activities of CADA are :

(a) integrated water management.

(b) On-farm development (OFD) works-land levelling/shaping, field channels and drains, etc. (laser technology included wherever feasible and economical).

(c) agricultural inputs and extension services. In addition to the above, other activities of CADA relate to roads in the command, storage/ warehousing, marketing centres, processing units, credit, irrigation societies, farmers training, agricultural research, extension training and visits (T&V), distribution of certified seeds, fertilizers and pesticides. establishment of electrical and mechanical repair shops etc.

The operating agency should have cooperative/collaborative links with CADA to improve overall efficiency and effectiveness of the I&D system.

4.10 COMMUNICATION

To make possible the flow of information required for operation within the system and between the project and the users, an efficient system of communication is necessary, e.g. transmission of MIS data, severe and normal floods, operation and data collection. (Refer Chapter 8).

A full management information system (MIS) is usually desirable, and this can be used by other authorities (such as CADA) responsible for different aspects of an irrigation management, such as extent and rate of planting and harvesting, and occurrence of pests and diseases (Refer Chapter 7).

Clear instructions should be provided to operating staff on timing and nature of data to be exchanged and about business rules.

4.11 DRAINAGE

Drainage though a complement of irrigation, is deferred sometimes. It shall have to be provided at the earliest before the canal is put to operation. Drainage divisions and circles exist separately alongwith irrigation counterparts in many States under the irrigation departments. In some States both irrigation and drainage are the responsibility of the irrigation engineers. Surface drainage is predominantly practised in the country for which design principles have been developed in the States. Use of drainage coefficients (i.e. discharge per unit area) is quite common.

The Operating agency should be genuinely concerned with, and fully apprised of, the drainage problems in the project area. Surveys should be conducted of waterlogging, salinity of land and water, drainage inadequacies, groundwater potential and conjunctive use of water in the project area. Such surveys should normally have been done at the planning stage itself. The agency should be fully responsible for efficient functioning of the drainage system.

4.11.1 WATERLOGGING

The areas suffering from waterlogging should be delineated on maps with hydro-isobaths of 1.5 m and 3.0 m marked on them. The waterlogged areas are generally classified as below :

- fully waterlogged zone i.e. water table at ground level
- slightly waterlogged zone i.e. water table at 1.5 m below the ground level
- alarming zone (area prone to waterlogging)-water table between 1.5 m and 3.0 m from the ground level

The operating agency should monitor the ground water levels in the command through existing wells and observation wells before rains, after rains and midway (June, November and February) to initiate appropriate action. Other parameters to monitor are : area of waterlogging, damage to crops, period of waterlogging, water quality with respect to salt content etc.

4.11.2 SALINITY

The salt affected areas should be identified by visual inspection and local inquiry and marked on the maps with the following descriptions, for example:

- fully salt affected areas i. e. salt encrustation on the surface and no crops seen/grown thereon
- slightly salt affected areas i.e. marginal salt encrustation and poor crop growth

The Ec and pH values of the soils should be collected to classify soils to delineate salinity/alkalinity status. Alkaline soils with pH>9 usually require soil treatment (use of chemical amendments). Acidic soils should be treated

with known reclamation methods. Action research may be necessary for location specific problems.

Pre-monsoon and post-monsoon surveys of the soils are to be conducted to determine their salinity status, quality of surface and sub-surface water, soil classification, etc.

4.11.3 DRAINAGE FACILITIES

The drainage facilities operated in the command area i.e., surface, sub-surface, vertical drainage (tubewells, etc), biological drainage (through thick plantation) should be well monitored and maintained. Information on soils and water parameters and functioning of the drainage system should be collected on regular basis so that remedial measures for the anticipated problems may be arranged in time by the operating agency.

4.12 GROUND WATER POTENTIAL AND CONJUNCTIVE USE OF WATER

Ground water resources greatly differ in quantity from alluvial tracts in northern States to hard rock and delta areas in southern States. The exploitable ground water potential in the Command area should be assessed by the operating agency. Systematic ground water survey should be undertaken with regard to quality and quantity of groundwater in different seasons on a regular basis. This will enable the operating agency to plan conjunctive use of surface water and ground water especially during lean surface supplies. There should be adequate legislative provision to enable conjunctive use of water. The rise of water table in the command can also be kept under control to improve environmental and ecological conditions. Depending upon the quality of ground water, the latter can either be used fully or partly for irrigation. To assess potential waterlogged areas as well as saline areas, mathematical ground water modelling is coming up in a big way. This technique can be utilised for planning conjunctive use, sub-surface drainage, vertical drainage, etc. and even integrated with surface water operation model for optimizing available surface water resources. Action research may have to be undertaken in projects under operation to plan conjunctive use particularly in water scarce areas.

TUNGABHADRA DAM (KARNATAKA)

IDDUKI DAM (KERALA)

CHAPTER 5

SYSTEM MAINTENANCE AND REPAIRS

5.1 MAINTENANCE NEED

Proper maintenance of an irrigation and drainage system is imperative because

(a) the conveyance and delivery system of the irrigation project should be in a good condition for effective water management and to retain system's operation efficiency;

(b) reliable, predictable and equitable deliveries to the outlets will increase crop productivity from the existing irrigation systems and such deliveries can be assured by timely rectification of maintenance deficiencies;

(c) conservation of precious water resource for irrigation is essential. Economically viable project sites are shrinking and exploitation of sites in difficult terrain for future development with available technology is capital intensive and requires massive public investments.

The National Water Policy (1987) supports the foregoing as it stipulates "Structures and systems created through massive investments should be properly maintained in good health. Appropriate annual provisions should be made for this purpose in the budgets."

5.2 SOME MAINTNENANCE TERMS AND CONCEPTS

Maintenance : It refers to operations performed in preserving system and facilities in good or near-original condition without increasing their capital costs. Repairs are part of maintenance.

Normal or Routine Maintenance : It refers to the usual maintenance activities that are conducted annually for an irrigation system. It includes those activities which are done (rather than "should be done") every year.

Emergency Maintenance : It is undertaken because of urgent need to take immediate action under unusual conditions jeopardizing the safety of the source (dam, weir, etc.) or the irrigation channels, etc.

Essential Structural Maintenance (ESM) is the required maintenance for flow control structures that will allow them to be used for discharge measurement after calibration.

Deferred Maintenance is the accumulation of maintenance being accrued under the routine or normal maintenance programme - most likely because of shortage of funds and other reasons.

Catch-up Maintenance refers to the programme that takes care of the accumulated deferred maintenance needed to up-grade the hydraulic performance of the system.

Preventive Maintenance refers to the programme that takes care of the causes creating the maintenance needs when they are only a minor problem, rather than allowing such maintenance needs to go unattended until they become a major expensive problem.

Rehabilitation (or Restoration) is the process of renovating on existing system whose performance is failing to meet original project objectives, due to accumulation of deferred maintenance needs. If an effective preventive maintenance programme has been followed, then rehabilitation should only be required to replace ageing structures.

Modernization (or Remodelling) is the process of updating, and improving the existing project facilities in order to meet enhanced technical, social, economic objectives.

Diagnostic 'Walk-thru' Maintenance Survey : It is a detailed field survey that lists all maintenance needs along each canal, branch, distributary or minor, including the outlet structures to each tertiary (water course) system. This survey requires two or three individuals, walking along each irrigation channel, taking notes on maintenance need of each.

Special Repairs may be needed due to unforeseen mishaps such as breaches, large collapses or blowouts of lining, washing away of structures, floods, etc. Large investment for unforeseen mishaps or accumulated normal repairs over the years for want of funds are entitled to special repairs, and expenditure over them is met from the reserved O&M grant and allotted at the discretion of the competent authority.

There is some difference between repair (maintenance) and rehabilitation & modernization in so far as the source of funding for implementation. Maintenance is funded from revenue budget which is also called non-plan budget. Rehabilitation and modernization are carried out from Plan Budget i.e., capital expenditure. Receipt of funds for these two activities is comparatively assured once these are considered together in preparing the plan budget, since neglected maintenance will lead to costly rehabilitation later.

5.3 MAINTENANCE FUNCTIONS, POLICIES AND PROCEDURES

(I) The most visible function of an irrigation agency is the conveyance and delivery of water to the fields. However, sustained success in this function depends not only on the effective planning and execution of water distribution operations, but also on a well planned and executed programme of maintenance for all components and facilities, including drainage and flood control facitlities.

(ii) The chapter may contain a discussion of the approach to maintenance policy. In particular this may include a discussion and directions on the-

* degree to which preventive maintenance as opposed to maintenance on an ad-hoc basis is to be relied upon;
* appropriateness of deferring maintenance of components and facilities for which plans have been approved for rehabilitation or modernization;
* approach to modernization of works during performance of maintenance activities, including the degree to which it is intended to continually modernize the system, and the criteria for such decisions;
* the relationship between system maintenance, rehabilitation and modernization.
* approach to improvement of technology for maintenance including Action Research
* identification of deficiencies in the existing system by diagnostic analysis and the position reviewed periodically.
* transparency of maintenance including the degree to which it is intended to involve water users in the programme and execution of maintenance work.

(iii) The maintenance programme depends on well-developed technical and institutional support procedures. The procedures in this chapter, therefore, must be compatible with the general administrative instructions contained in Chapter 6 : Organization, Management and Responsibilities; and with the System Operation instructions contained in Chapter 4.

(iv) Effective procedures, for example, for the acquisition, handling and issuing of stores and spare parts for plant and equipment are vital to success. Effective planning for maintenance, on the other hand, must also recognize the inescapable lead time involved in store acquisition, particularly if overseas purchasing is involved.

(v) For these matters this chapter may include general directions as well as assignment of responsibilities within, as well as external to, the Operation and Maintenance Organization.

5.4 DEVELOPMENT OF MAINTENANCE WORK PLANS

5.4.1 MAINTENANCE WORK :

Normal or Routine maintenance which includes all work necessary to keep the irrigation system operating satisfactorily should be documented and detailed in work plans which should include the work to be accomplished

for all elements of the system. In addition to the normal/routine work plan, the other workplans which should be prepared are - essential structural maintenance plan, catch-up maintenance plan and preventive maintenance plan. These are described later as examples.

The maintenance work may :

* be performed on a periodic (i.e. seasonal) basis;
* be identified annually to be included in the work plan of the following year
* originate through an application of the above two plans.

5.4.2 SOURCE OF MAINTENANCE DATA :

Data to be used in developing maintenance work plans may originate from:

* reports from field personnel;
* inspection reports from Superior Officers;
* performance measurement data as outlined in Chapter 13 : Monitoring and Evaluation;
* research reports on improved technology in the field of maintenance, such as research on materials, equipment, and other sources.

5.4.3 WORK PLAN PREPARATION :

Detailed instructions covering the formulation, completion, timing, and contents of work plans will be included in this chapter. Matters to be included, but not limited to, are :

* contents and format of work plans;
* class of maintenance (periodical, special, emergency, improvement)
* period for which plan is prepared (i.e. one year or longer);
* definition and extent of work;
* estimates of cost;
* timing of work (during running, closure, rotation offdays), schedules of programmes;
* method of execution - departmental with workcharged labour, departmental with labour contract, labour and material contract with departmental supervision, etc.
* assignment of responsibilities for execution of work;
* priorities assigned having regard to maintenance policies;

* maintenance of services during work programmes;
* deadlines for receipt of information and data;
* submission of work plans, approval process;
* notification and liaison - where work may affect activities of other authorities and individuals.

5.4.4 **ASSIGNMENT OF RESPONSIBILITIES,** as indicated above, should be reflected in job descriptions and assignments of responsibilities and delegation of authority as contained in Chapter 6 : Organization, Management and Responsibilities.

5.4.5 **WORK PLAN PERIOD :**

The Work Plans may cover a one-year period as well as longer periods.

The planning periods to be covered in work plans should be stipulated and be consistent with the general budgeting and financing approach outlined in Chapter 11.

5.4.6 **EXAMPLES OF WORK PLANS**

5.4.6.1 **Essential Structural Maintenance (ESM) Plan .**

This ESM plan is prepared after completing the maintenance survey of flow control structures. The following information is required to prepare ESM plan.

* physical description of the irrigation system.
* proposed flow measurement programme to distribute water equitably.
* proposed programme for evaluating channel losses.
* essential structural maintenance (in-place, workshop repairs, replacements).
* costs of ESM
* implementation schedule of ESM (time schedule, problems, etc)
* field notes and sketches to be appended with the ESM plan.

5.4.6.2 **Normal or Routine Maintenance Plan**

The State department/ organization responsible for irrigation activities allocates funds for each irrigation system annually for routine maintenance. This type of maintenance should be documented for activities that are done annually.

The Executive Engineer would be the officer responsible to prepare document for routine maintenance programme and the suggested outline for this document would be :

(a) General description of the system

(b) Available maintenance equipment and manpower

(c) present maintenance activities relating to all elements of the project; Dam/weir, canal headworks, regulating as well as cross-drainage structures, irrigation channel network, drainage network, communication system, flood control, ancillary works (inspection/rest houses, residences, etc.)

Major maintenance difficulties e.g. physical, manpower, equipment, budget and administrative should be documented.

5.4.6.3 Catch-up Maintenance Plan

A catch-up maintenance plan should document proposed programme for catching-up on deferred maintnenance, so that the irrigation system can function on a preventive maintenance programme.

The catch-up maintenance plan should include :

(a) Physical description of the irrigation system

(b) Essential Structural Maintenance (ESM)

(c) Status and costs of ESM Plan

(d) Inventory of required maintenance

(e) maintenance costs

(f) priority maintenance needs and costs

(g) maintenance equipment and manpower requirements

(h) maintenance plan -

* maintenance issues - issues like channel regime,sediment sources, seepage losses, lining deterioration, etc. should be addressed.
* method of implementation
* implementation schedule
* any other points relevant to the plan

(i) field notes and sketches

5.4.6.4 Preventive Maintenance Plan

The preventive maintenance represents a minimized form of routine maintenance for proper upkeep of the system.

The preventive maintenance plan should present and discuss -

(a) physical causes of maintenance problems

(b) anticipated extent of maintenance problems

(c) maintenance equipment and manpower requirements

(d) maintenance requirements for farmers

(e) estimated annual maintenance costs

(f) preventive maintenance plan -

- maintenance issues
- preventive maintenance activities
- any other points relevant to the plan

5.5 BUDGETING AND FUNDING

5.5.1 GENERAL PROVISIONS

Maintenance and operation budget estimates may be prepared (according to the existing norms) for site specific conditions according to the work plans, separately for drains, laterals, distributaries, branches, main canal and headworks by the sub-division, showing class of work (periodical, special M&R, improvement, emergency) and break-up under staff charges (establishment), maintenance and operation, repairs and improvements. The budget estimates may be submitted in time in the preceding year, for the current year to the appropriate authorities for approval and sanction of funds. These estimates should show cost/ha, as grants are allocated on this basis and should be adequately justified for any increase in the cost/ha sanctioned for the previous year.

Budget sanctions are received after the State budget is approved. Allocation of funds for M&R and release of funds out of budget allocations take generally quite a long time and, therefore, the present procedure has a number of difficulties to face. A smooth procedure should be evolved by the State Governments so that effective and timely maintanece is assured. For details refer Chapter 11 : Budgeting and Financing.

5.5.2 CONTINGENCY FUNDS OR SPECIAL RESERVE FUNDS

It may be appropriate to include in the budget, a special reserve fund to be accessed to repair or maintain the system in the major event of unforeseen needs. This may include damage caused by major disasters, such as floods, earthquakes, cyclones in coastal regions, or structural failures and major breaches. This chapter should state the criteria under which such a fund may be accessed and by which authority. (In case of such calamities, the Central Ministry of Agriculture provides funds on the basis of recommendations of the Finance Commission.)

5.6 MAINTENANCE OF RECORDS, PLANS AND DRAWINGS

(I) A general policy on the storage and maintenance of as-built drawings, completion report with history of construction problems, right-of-way plans and the updating of these drawings as they are modified during maintenance activities should be included in this Chapter. The policy should include procedures as well as assignment of responsibilities. The responsibilities for storage and updating of design engineer's instructions for operation and maintenance should be assigned. These instructions may contain a general strategy for inspection and maintenance of particular structures or facilities. If not included in the design engineer's instructions the general strategy for maintenance of particular structures should be completed and updated by assigned maintenance personnel and included in para 5.7 of this Chapter alongwith design engineer's instructions.

(II) At the time of handing over the system for operation and maintenance, all records including completion drawings, reports containing dimensions and functional properties of structures, drainage system, completion certificates, test reports and operating instructions should be furnished by the construction wing to the O&M wing.

5.7 SPECIFIC MAINTENANCE PROCEDURES

This section should contain details of strategies, policies, standards, procedures, record management provisions, and other information specific to the maintenance of each system element or group of elements. The listing contained herein is for guidance purposes only and is not exhaustive. Other categorization may be more appropriate for specific projects.

Given below is a summary of some of the more important maintenance aspects of various features that will help to obtain additional information and details. For a broader and more thorough inclusion, the project engineers should look into appropriate references especially those dealing with site specific conditions of the project from ICOLD and CWC.

5.7.1 DAM AND RESERVOIR

Since the planning, design, operation, maintenance and safety of dams and other large structures is a highly specialized activity, irrigation agencies responsible for such facilities should refer to procedures and directions developed by ICOLD and its National Committees, and Dam Safety Organization (DSO) of Central Water Commission. The document prepared by DSO of CWC titled "Guidelines for Safety Inspection of Dams (Revised 1987)" provides guidelines for inspection and evaluation to determine the safety of dams and allied structures. The use of Dam Safety Panel of Experts for the State/Project is necessary for external review at stipulated intervals (not exceeding five years) to support "in-house" activity.

The following listing of problems and hazards and remedies thereof which must be addressed in the maintenance of storage reservoirs is included to assist in the preparation of work plan :

* sedimentation and siltation;
* water quality;
* bank erosion and slope instability;
* vegetation and weed control; and
* recreational hazards.

Work plans will also include programmes for -

- monitoring
- watershed management
- control of pollution
- bank protection
- acquisition of land

Dams are usually of different types, viz. concrete, masonary, earth, and rockfill or a combination of these. They should be inspected periodically for evidence of :

* stress and strain;
* instability;
* abnormal seepage;
* erosion;
* piping;
* aging;
* cracks;
* uplift;
* internal movement;
* settlement;
* instrumentation;
* gates and hoists;
* freeboard;
* possible undermining of the downstream toe;

* foundation damage;
* component material (e.g. plain concrete) deterioration; and
* other possible endangerments.

Work plans will also include programmes for -

- Component material (e.g. concrete) repair/replacement
- gate maintenance
- seepage control
- foundation grouting
- rip-rap replacement
- maintenance of control facilities
- resectioning earthen dam to make up for soil loss
- new instrumentation as appropriate/replacement of old ones

Adequate monitoring should be included in the work plan to determine the extent, the cause, the rate of deterioration, and the short and long-term effects of the problem. In addition, dam safety policies developed and approved by the organization should be included. The provisions of the policy should be applied to each structure systematically.

5.7.2 Open Canals

Canals are generally excavated in earth or soft rock and may be either lined or unlined. Items to be considered in their maintenance are :

* erosion of bed and banks;
* damage of banks from human and animal activities;
* special maintenance needs of banks if used as highway link road;
* settlement and sloughing;
* silting;
* vegetation and weed clearance (manual, mechanical, chemical, biological);
* seepage;
* lining/free board;
* sealants;
* under drainage;
* surface drainage;

* inflow of untreated industrial pollutants and municipal sewage
* flow and silt deposition measurements
* plantation along canals
* stability of slopes of deep cutting reaches
* communication

Work plans will also include programmes of -

- monitoring
- closing and strengthening of cuts and breaches
- providing regulators at the offtake of distributaries and minors with proportionate silt drawal devices. (This would reduce silt deposit in the tail reaches of channels).
- canal straightening, realignment
- bank protection including repairs to and strengthening of ghats (for drinking by animals, washing, bathing, etc.)
- dredging, silt removal/clearance
- Jungle clearance of banks
- lining/joint repair

The operation of maintenance work should be so planned that the maintenance cost and the wastage of water through cuts and breaches are minimum. This requires provision of escapes at suitable places. Machinery should be stationed at suitable points.

5.7.3 STRUCTURES

Most structures associated with irrigation projects are used for conveyance, regulation and control of water. They contain both structural and hydraulic features and are generally constructed of concrete, stone masonary, brick work, timber, metal, rock and rock gabions.

Structures associated with dams and reservoirs are :

* spillways;
* weirs;
* sluiceways;
* tunnels;
* riparian outlet works;
* power outlets;

* irrigation canal outlets and headworks;
* fishways/fish passes, fish ladder
* reservoir pumping stations.

Structures associated with open channels or drains may include

* head gates/offtake regulators/intake structures/head regulators
* cross regulators/check structures
* outlets/farm turnouts, modules
* syphons
* falls/drops
* navigation locks
* tail cluster
* ford crossings (cattle crossing, cart crossing)
* flumes
* road crossing (culverts, bridges)
* silt traps, silt excluder, silt ejector;
* escapes
* pumping stations;
* cross drainage structures (level crossings, aqueducts, super passages)
* drain inlets; and
* water measurement structures.

Structures associated with pipe systems or buried pipe drains may include

* inlets;
* outfall;
* silt and sand traps;
* standpipes
* pressure relief/air inlet valves;
* manholes
* crossing; and
* pumping stations.

Problems associated with these structures and their maintenance and repair requirements are generally similar. General maintenance due to age, natural attrition and design or construction inadequacies are important.

5.7.4 PIPE SYSTEMS

Mechanised irrigation system using pipes is prevalent in hilly terrains (e.g. Himachal Pradesh, where alphalpha valve is used for control). In pipe distribution systems the maintenance of not only the conduits must be considered, but also of other appurtenant works such as, gates, valves, metering devices, etc. The maintenance of pumps, motors, electrical controls and automation are discussed later. The Problems relate to -

* damage to linings and coating
* corrosion;
* separation of pipe joints; and
* build-up of material in pipe and appurtenances (encrustation, clogging, etc.)

Work plans will include programmes for -

- monitoring
- cathodic protection
- cleaning
- joint repair
- lining repair/replacement

5.7.5 OPEN DRAINS

Drains generally suffer rapid deterioration in their physical condition affecting performance and require comprehensive maintenance programmes. Problems may include -

* erosion;
* settlement;
* sloughing;
* silting:
* vegetation and weed growth;
* seepage
* Outfall condition

* straightening and realignment of drains

* removal of obstruction to flow

5.7.6 BURIED DRAINS

The major problems requiring maintenance include -

* physical blockages;

* organic or biological blockages;

* chemical or mineral sealing and outlet restrictions.

Work plan will include -

- monitoring;

- cleaning;

- root removal;

- cleaning and repair of inlet/outlet grills.

5.7.7 FLOOD PROTECTION EMBANKMENTS

Flood protection embankments are facilities not normally required to perform their function on a day-to-day basis. However, there is generally little opportunity to carry out routine maintenance during periods of flooding.

In these circumstances maintenance programmes should be implemented to ensure that the facilities are fully serviceable prior to flood season. Items to be considered include -

* erosion and slumping of banks and spurs;

* rip-rap and apron protection;

* damage to banks from human and animal traffic;

* damage to banks by burrowing animals;

* vegetation and tree-growth on banks;

* bank cracking and seepage at structures;

* approach roadways;

* flood warning systems;

* cyclone warning system in coastal regions;

5.7.8 ROADS

Roads located within an irrigation project and usually adjacent to a canal require maintenance to allow access to project features by operation and maintenance equipment and the personnel. Types of roads associated with irrigation systems include :

* all-weather paved or metalled roads;
* unsurfaced or gravelled (macadam) roads; and
* earthen roads along canals and drains.

Work plans will include -

- grading, and repairs to cuts;
- gravelling, macadaming the surface;
- slope protection;
- culvert and bridge maintenance;
- surface drain maintenance.

5.7.9 PUMPING STATIONS AND ELECTRIC POWER FACILITIES

Pumps, motors, pumping stations, and electric power facilities including diesel generators are used in irrigation and drainage projects in areas such as :

* motorized operation and automation of flow control devices;
* sprinkler irrigation systems and other mechanised irrigation systems;
* computerized management facilities
* pumping stations for pipeline distribution systems;
* pumped drainage;
* pumpwells; and
* transformers, switchgear (often maintained by the power utility Department).

The equipment is generally specialized and comprehensive instructions on care and maintenance are required, together with specialized training for maintenance personnel.

Specific care and maintenance procedures for each piece of equipment are usually described in the manuals, and maintenance instructions furnished by the manufacturer. These should be included in the manual. An adequate

supply of commonly used spare parts (including standby batteries/diesel generators) should always be kept on hand to ensure continuous operation.

5.7.10 TUBEWELLS

Maintenance of tubewells is primarily concerned with alleviating deposit build-up in and around the well screen and pump (encrustation) and preventing or slowing the rate of corrosion, deterioration of the pump, screen, and well casing.

After installation, regular maintenance of the tubewell is required to obtain satisfactory performance and extended life. Monitoring of the tubewell discharge rate, draw-down rate and the water quality is very important in detecting problems before they progress to a point where the tubewell is required to be abandoned.

In addition to monitoring, work plans will include programmes for -

- hydraulic flushing;
- chemical treatment;
- pump maintenance.

5.7.11 CATHODIC PROTECTION AND PROTECTIVE COATINGS

The protection from corrosion of buried pipelines and appurtenances, and exposed metal work generally is a highly specialized activity.

However, the direct financial losses and loss in operational effectiveness caused by shortened service lives of fixtures and equipment due to corrosion and cathodic attack are significant.

They are significant enough in most projects to warrant a specialist officer, or unit, to be assigned the responsibility for developing relevant maintenance and preventive programmes for the project works and components likely to be affected.

These programmes should be incorporated in the relevant Work Plans of the organization.

5.7.12 COMMUNICATION AND SENSING EQUIPMENT, RADIO LINKS, REMOTE MONITORS

The maintenance of equipment of these categories is also a highly specialized activity, generally requiring a specialist officer or unit to be established to have responsibility for developing maintenance programmes in the organization.

Where the opportunity exists, it is generally advantageous to enter into period service contracts with specialist firms or suppliers.

Routine maintenance procedures to be carried out by internal personnel should be developed from the manufacturer's manuals, and incorporated in the Work Plans for the relevant units.

5.7.13 ON-FARM IRRIGATION SYSTEMS

Organizations responsible for irrigation do not have responsibilities for maintenance of on-farm systems viz, field channels and water courses. CADA and farmers are responsible to look after the on-farm systems. While CADA may help initially in installing the system, mainly farmers are to be motivated to take up maintenance through suitable water user's organisations (see Chapter 9).

Various types of on-farm irrigation practices have vastly different maintenance problems. Sprinkler and Localized Systems (drip/ trickle) offer special maintenance problems.

5.7.14.1 Sewage Effluent Irrigation Systems

The design of irrigation systems for disposal of sewage effluent requires special considerations. However, even properly designed systems may have additional or increased maintenance problems as compared to conventional systems. Because of the higher content of organic and inorganic chemicals, sewage can be quite corrosive. In addition, sewage effluent may contain suspended solids which would build up in pipelines and clog valves, emitters, and sprinkler nozzles.

5.7.14.2 Municipal and Industrial Sewage

The Municipal and Industrial (M&I) sewage causes environmental and health hazards. Specific maintenance procedures for M&I sewage irrigation should be evolved taking into consideration the nature and sources of sewage, permissible degree of mixing it with the canal water with/without treatment and the location of entry points into the canal system. Entry of untreated effluents into the canals and drains should be prohibited through statutory Acts.

5.7.15 EQUIPMENT, BUILDINGS AND OTHER FACILITIES

An Organization may require a wide range of equipment and facilities from computers to buildings which need to be maintained efficiently and effectively. Each type of equipment and facility will have different problems and would need to be addressed in the maintenance work plan.

5.8 SPECIFIC FEATURES NEEDING SPECIAL ATTENTION

Some specific features of an irrigation project need special attention as their well-planned operation and maintenance is of vital and crucial importance to the success of the project.

Annex-VIII gives details from O&M viewpoint of water control equipment at a head regulator. The control equipment includes gates, gate grooves and seals, roller trains and fixed rollers, stop logs, hoist/winches, steel wire ropes and electrical installations.

5.9 CONFRONTING ENGINEERING PROBLEMS

The maintenance aspects listed in this chapter are indicative only. Actual problems and solutions depend upon site conditions, resource availability, demands that have to be catered to, etc. The engineer-in-charge of the O&M will be the best judge to adopt any measure/actions to cope up with the situation.

5.10 LANDSCAPING IN PROJECT AREA

Irrigation projects involve acquisition of large areas for borrow pits, spoil banks, construction yards, stores, housing colonies, etc. After completion of projects these lands are left unutilized. Such lands near the impressive structures should be developed for aesthetic reuse to provide attraction for visitors and tourists. It will improve the environment. Formal creation of landscaping will require large funds which should be considered by the Govts. for allocation of funds under Tourism Development Funding. Informal landscaping from O&M funds specifically allocated for this purpose will go a long way in improving the environment and enhancing the maintenance standard of the project facilities.

5.11 FORMATS FOR INSPECTION/COMPLIANCE REPORTS

Formats for inspection and compliance reports are very valuable records for study and reference in the O&M work. Inspection formats and compliance reports are formulated according to the need and experience gained in O&M.

Compliance reports should be monitored regularly and made readily available to the inspecting officers.

A sample each of inspection report and compliance report in respect of a dam and reservoir are annexed (Annex-IX and Annex-X).

5.12 ACTIVITIES FOR IMPROVING IRRIGATION SYSTEM MAINTENANCE PRACTICES

These include :

1. Compiling of (a) maps, reports and registers of channels and structures; (b) identification of flow control structures for discharge measurement;
2. Conducting operation control maintenance survey of each flow control and water measurement structure

3. Developing (a) Essential Structural Maintenance (ESM) Plan of flow control structures; (b) Implement ESM plan.

4. Conducting (a) hydraulic survey of structures and channels; (b) develop discharge ratings for flow control structures; and (c) collect water measurements and channel losses data.

5. Obtaining maintenance information from farmers.

6. Preparing report on routine or normal maintenance programme.

7. Conducting diagnostic 'Walk-thru' maintenance survey.

8. Developing 'catch-up' maintenance plan.

9. Continuing routine or normal maintenance programme.

10. Preparing (a) annual priority maintenance needs work plan from prioritized deferred maintenance needs and seek approval thereof; and (b) implement priority needs as funds permit.

11. Preparing and submitting annual maintenance completion report by the Executive Engineer.

12. Revising maintenance Plan, i.e. preparing preventive maintenance Plan which would be the basis for continued maintenance activities after completion of the priority maintenance needs.

13. Completing priority maintenance needs.

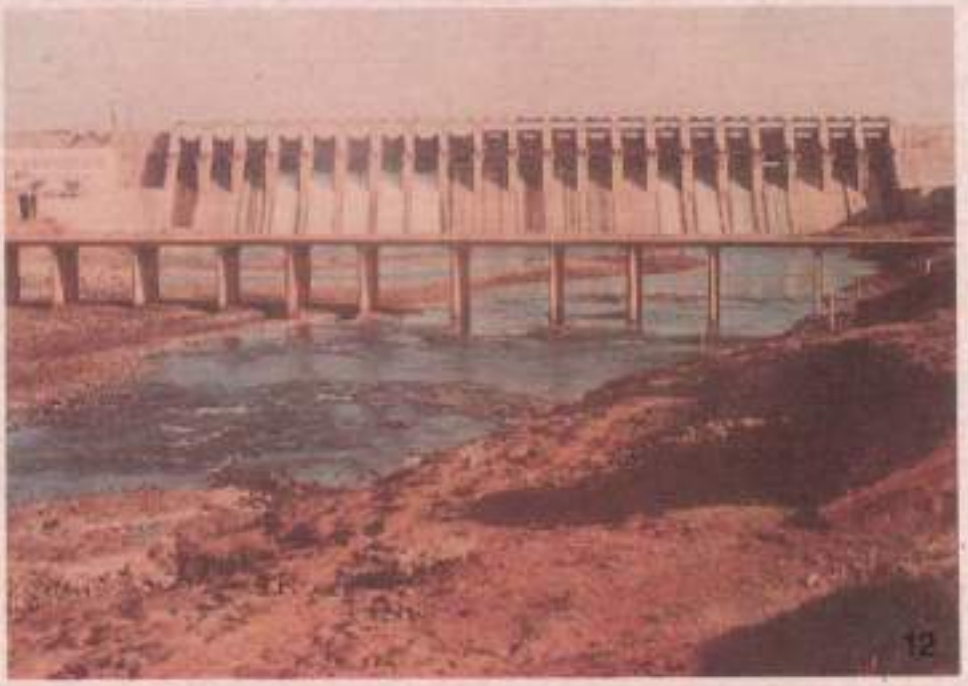
14. Implementing preventive maintenance programme.

15. Continuing preventive maintenance programme.

5.13 JURISDICTIONS OF CANAL OFFICERS FOR O&M

See para 6.6.4 of Chapter 6 : Organization, Management and Responsibilities.

PEECHI DAM (KERALA)



BARGI DAM (MADHYA PRADESH)

CHAPTER 6

ORGANIZATION, MANAGEMENT AND RESPONSIBILITIES

6.1 GENERAL

(i) The organizational set-up for irrigation differs from one State to another. The department responsible for irrigation in some States is Irrigation Department and in others it is Public Works Department (Irrigation Branch) or Water Resources Department or some other Department.

(ii) Apart from irrigation, the State Irrigation Department (or equivalent) is also the responsible authority for the development and regulation of all water sources and all works relating to drainage, river training and flood control.

(iii) In all States, major and medium projects are planned, executed, maintained and operated by the State Irrigation Department (or equivalent).

(iv) The Organization for operation and maintenance may be (a) one in itself for O&M and irrigation management (IM) in a State; or (b) part of the overall project organization, especially created by an Act of State Assembly in which case relationship and hierarchical dependencies between the O&M organization and the project organization need to be described (See 6.2. (iii) below).

6.2 SPECIAL ORGANIZATIONS

(i) The Damodar Valley Corporation (DVC) was created in 1948 by an Act of the Parliament (duly authorized by Legislatures of the concerned States for unified development of the Damodar Valley). The capital investment of the DVC was shared amongst the participating governments. The maintenance and control of irrigation works is now with the concerned State Government; however, the reservoir operation is with the DVC.

(ii) Control Boards have been constituted as executive organizations on the authority of identical resolutions passed by the Central Government and the State Government or Governments concerned, primarily for construction of major and medium projects. These are set up to ensure speedy, efficient execution of projects economically and coordination between the concerned governments, when necessary.

Control Boards are either single State or inter-state depending on the concern of one or more than one state. In case of a single-State Control Board, the Board representatives are from different Departments of that State only and the Government of India. In case of inter-state Control Boards, the representatives are from the States concerned, the Central Ministries and the CWC and/or CEA. Some examples of single-State and inter-State Control boards are :

Single State Control Boards : Rihand, Ramganga, Kosi, Hirakud, Farakka Barrage, Srisailam, Nagarjunasagar, major projects in Karnataka, Koyna, Tawa, Ukai, and

Inter-State Control Boards : Bhakra-Nangal, Beas Dam and Beas-Sutlej Link, Gandak, Chambal, Rajasthan Canal, Balimela Dam.

The Control Construction Boards are abolished after the construction work is over or are replaced, where necessary, by Management Boards/ Committees.

(iii) In Madhya Pradesh (MP), the Narmada Valley Development Department (NVDD) is a separate entity from the State Water Resources Department. The Narmada Valley Development Authority (NVDA) of the NVDD is for the development and management of the Narmada River basin water resources including, inter alia, flood control, irrigation, operation and maintenance of project facilities. The responsibility of direction of NVDA is vested in the Narmada Control Board (NCB). Both the NVDA and NCB were created by an Act of State Legislature. The Chief Minister of Madhya Pradesh is the Chairman and the Minister-in-charge is the Vice-Chairman of NCB.

(iv) Tehri Hydro Development Corporation is yet another example of Joint venture of the Central Government and U.P. Government for the development of the Ganga river water resources.

(v) With the adoption of multi-disciplinary* approach in irrigation to increase production, the supporting agencies representing other disciplines, enter mostly at field level i.e. below the government's outlet point. Functions of other disciplines should be clearly stated. The coordination mechanism and linkages with other disciplines at respective levels should be described for day to day operations.

(vi) The purpose of this Chapter is to specify, for the irrigation unit responsible for operation and maintenance of the whole or part of a physical system above the outlet and the management framework within which it will perform the functions assigned to it. Annexes XI A and XI B contain examples of Upper Krishna (Karnataka) and Narmada River Development (Madhya Pradesh) projects dealing with these aspects in the country.

6.3 ESSENTIAL PURPOSE OF ORGANIZATION

The essential purpose of the organization should be clearly stated emphasizing-

- the thrust of organization's effort and
- the legitimate functions of the organization.

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* *The multi-disciplinary concept is to be recognized as "interdisciplinary concept" for efficient management.*

For example, the essential purpose of an organization managing an irrigation system to supply irrigation water to farms in the command might read as follows:

"To operate and maintain the project facilities to supply crop water to farms within the command in an equitable and reliable manner at the required time."

In case of change of emphasis in the management effort, such as modernizing the system, changing the cropping pattern etc., the essential purpose may be reviewed to meet the perceived need.

6.4 MANAGEMENT ISSUES

The following issues need to be addressed :

* Pertinent Project Policies, within which the O&M function is to be exercised.
* Functions (refer 6.4.2)
* Objectives and Goals (refer 6.5)
* Functional units and responsibilities (refer 6.6)
* Detailed organizational structure (refer 6.7)
* Relationship with other public and private organizations (refer 6.8)
* Public Relations (refer 6.9)

6.4.1 Pertinent Project Policies under which O&M Function is Exercised

(i) The policies governing the access to water resources, the conveyance and distribution of water (inter-State and within departmental units), the disposal of excess water, the relationship of the organization with the farmers, environmental control, check excessive use of water, etc. should be reflected briefly (refer Chapter 3 : Statutory Acts, Rules, ..., and the Annexes thereto, and Chapter 9 : Involvement of beneficiary farmers).

(ii) Three elements may be embodied in the provision of an irrigation supply/ disposal of excess water :

* Access to or allocation of water after estimation of supplies (made by the highest competent authority)
* Receipt, conveyance and distribution of water to farm boundaries, in accordance with agreed/approved rates of supply and delivery periods.
* Conveyance & disposal of rain water and excess irrigation water from farms to maintain their health through a drainage network into a natural stream/sea.

(iii) The set of State policies should cover, but are not limited to, the following main issues :

* The provision governing the access to water by individuals and the organization by agreement or by customs.
* The main criteria that will govern the water allocation and distribution for different uses. Drinking water requirement for settlements enroute an irrigation channel should be a priority consideration and should be provided at design stage itself. Particular attention should be paid to the measures to be adopted during emergency and droughts (Chapter 4 : System Operation), the priorities to be accorded in case of storage of water in more normal circumstances of water availability and equitable water distribution in time and space.
* The water share for the project in case of inter-state agreement(s), and international water treaty(ies), if any.
* The responsibility of the organization to dispose of excess drainage water in the Project Command.
* Handling of emergent situations in regard to labour, material, etc. with magisterial powers given to canal officers.
* The criteria to be used in the maintenance programmes such as induction of contractors, casual labour, or machinery.
* The main criteria that will govern the relations with the water users. (Farmers, municipal and industrial users).
* The criteria for sharing the maintenance expenditure in case of inter-state projects.
* Regulatory provisions and disciplinary measures.

6.4.2 MANAGEMENT FUNCTIONS

(i) The functions for which the O&M organization will have sole or major responsibility should be mentioned. Generally, the following functions are to be covered :

* Establishment of policies relating to O&M
* Management - overall direction and coordination
* Water resources - making available the supply
* Water distribution - including protection and security of source.
* Maintenance of facilities
* Planning improvements and rehabilitation/modernization works and their design to be prepared for funding from appropriate sources, to improve the efficiency of water delivery.

* Administration - personnel, equipment and stores
* Observation of ground water levels
* Prevention of excessive use of water and maintaining equity
* Continuing training programme of staff
* Training of farmers
* Drainage of Irrigation Command
* Budgeting and financing
* Monitoring and evaluation
* Management Information System (see Chapter 7)
* Communication Network (see Chapter 8)
* Safety

Additional Functions

* Flood Control
* Navigation
* Recreation
* Power generation
* Fishery, forest and wildlife enhancement
* Environmental pollution control
* Water supply for rural, municipal and industrial uses
* Assistance to farmers on irrigation practices and on-farm development
* Remedy for offences committed against water management and distribution
* Assessment and collection of charges
* Any other special functions assigned.

(ii) The meaning and extent of the functions should be mentioned. For instance, it may be necessary to specify that -

* some of the above-mentioned functions are carried out by other entities or units outside the O&M organization (as could be the case with auditing that is carried out by external agency).
* certain functions will be carried out on contract.

(iii) How these functions are carried out, and by whom, is specific to every project. For instance, in public (State) irrigation projects the policies sometimes originate at higher level in official hierarchy or special committees or in consultation with water users organizations.

(iv) However, it will be important to specify which of the above functions will be carried out by the O&M organization and which farmers are expected to perform.

6.5 GOALS AND OBJECTIVES

(i) The goals and objectives, as to be referred herein, should be those of the organization that deal specifically with the operation and maintenance of the physical system (irrigation, drainage, etc.).

(ii) The objectives should be described in as much detail as possible classifying them in short and long-term, where possible. Typical long-term objectives of an O&M organization are :

* To provide a "satisfactory" operation and maintenance of the physical facilities of the project;

* To prepare operation schedule to suit crop water requirements based on seasonal and natural conditions;

* To maintain on permanent basis the system in "satisfactory" operational condition, in conformity with original design or approved design modifications;

  The term "satisfactory" operation and maintenance is synonymous with approved level of service.

* To provide "satisfactory" service at minimum achievable cost and conforming to State/National policies;

* To recover as far as possible costs of operation and maintenance from beneficiaries.

(iii) Depending on local circumstances and the actual range of functions, other objectives may be noted in addition to the 'Additional Functions' given under para 6.4.2 (i), viz.:

* allocating available water resources to different users within the project boundaries

* control of groundwater abstractions

* establishing priorities for water use

* assessing/collecting fees and water charges.

(iv) The short-term objectives should be described as specifically as possible, together with a relevant time-frame for their achievement. These will refer to discrete activities directed towards the achievement of long-term objectives.

6.6 RESPONSIBILITIES OF IRRIGATION ORGANIZATION AND ITS UNITS

The responsibilities of the Organization/ Department, job-related units including the revenue wing, and other agencies assisting the irrigation organization are to be delineated. Unit jurisdictions are also to be defined.

6.6.1 RESPONSIBILITIES OF IRRIGATION ORGANIZATION

The main objective of irrigation department or any major/medium irrigation project organization is to supply water to the water users. Broadly, the O&M related responsibilities of the organization are : planning, distribution and regulation of water deliveries; maintenance of irrigation and drainage facilities and communication network and roads; assessment and/or collection of water charges; monitoring ground water table, salinity and water quality; remaining in contact with water users.

For carrying out these responsibilities, the organization requires an adequate administrative arrangement. This arrangement can generally be sub-divided into four heads.

* Policy-making
* Administration and decision-making
* Implemention
* Field Operations

(a) Policy making body/committee is an apex body with representation of all concerned departments, agencies, etc. Its function is to formulate overall policy for O&M, approval of water distribution plans and overall performance of the project review.

(b) Administrative and decision-making units, like the Chief Engineer and Superintending Engineers take major decisions and exercise administrative control and supervise the work of implementation units.

(c) Implemention Units, comprising irrigation divisions organize day to day operations and maintenance work of water distribution, warabandi, assessment and/or collection of irrigation revenue, maintenance of accounts, etc.

(d) Field units comprising sub-divisions, sections and field level workers carry out maintenance, water distribution, warabandi implementation, measurement of irrigated cropped area, revenue assessment/collection.

The organizational set up for major and medium projects in most of the States is as below :

Organization Component	Project Category	
	Major	Medium
Policy-making	* State Govt. * CADA Canal Advisory Committee * Canal Consultative Committee	* State Govt. * Chief Engr.(CE) * Suptdg.Engr.(SE) * Canal Advisory Committee * Consultative Committee
Administration & Decision-making	CE/SE	CE/SE
Implementation	SE/EE/AE	EE/AE
Field Operations	AE/JE & Field Staff	JE & Field Staff

CE = Chief Engineer; SE = Superintending Engineer; EE = Executive Engineer; AE = Assistant Engineer; JE = Junior Engineer.

6.6.2 JOB RELATED FUNCTIONS OF IRRIGATION PERSONNEL

Irrigation Officers have to perform several functions which can be classified into four major categories.

* Administration
* Operation and Maintenance
* Implementation/Exeuction
* Monitoring and evaluation

The administrative function is related to controlling, directing and governing the work of the subordinate officer and is specified in detail in the Irrigation Act, Rules, manuals and guidelines issued by the State Governments, Financial powers are delegated to officers under Civil Services Rules and Financial Hand Books.

Chief Engineer is the administrative and professional head of a branch/wing/ region/part or full project. Chief Engineers in some States are Level - I and Level - II. Senior Chief Engineer becomes Engineer-in-chief/Head of Department. In many States there are several Chief Engineers and Engineers-in-chief. : In some States, a Chief Engineer is Secretary to Government in respect of his charge; in some other States Chief Engineers are Additional or Joint Secretaries.

Superintending Engineer (SE) is in charge of a Circle which is an administrative unit of irrigation department in each State. He is responsible to the Chief Engineer.

Chief Engineers and Superintending Engineers have more administrative responsibilities and their job-related function is more or less similar. Their responsibilities in respect of O&M, implementation and monitoring should be described in detail.

Duties and responsibilities should be clearly specified after reviewing the existing norms in regard to inspection, regulation, operation, maintenance, execution, monitoring, evaluation and irrigation management. Annex - XII gives specific duties of irrigation staff in Maharashtra.

6.6.3 FUNCTIONS SPECIALLY RELATED TO SYSTEM OPERATION

The job-related functions for operation and maintenance,execution/ implementation, monitoring & evaluation differ considerably for Executive Engineer and below, from region to region, according to the practice in water distribution, assessment/recovery of irrigation charges, etc. The functions should therefore be described in detail for Executive-Engineer (Incharge of a Division), Assistant Engineer/AEE (Incharge of a Sub-Division), Junior Engineer/ Section Officer (Incharge of a section).

Other field functionaries whose functions need to be described are; Revenue Staff, Canal Inspector, Supervisors/ mistries; Signallers/telephone/telegraph operators, Gauge Readers; Mate/ Mundu, Beldars/Chowkidars, etc.

In northern States, a separate revenue unit works under the control of the Executive Engineer for assessment of and/or collection of irrigation charges, etc. A Deputy Revenue Officer (DRO)/Deputy Collector is assisted by Ziledars, Amin, Sinchpals at field level. Their responsibilities and jurisdictions should be described.

6.6.4 JURISDICTIONS OF IRRIGATION PERSONNEL

The jurisdictions of officers are fixed according to the workload. The criteria for computation of work load are derived from :

- Length of Channels - following a computation procedure to account for length of main, branch, distributaries, drains, escape channels lined v/s unlined length.
- Irrigation works - dam, reservoir, canal headworks.
- Command area

Practices of computing workload, however, differ from State to State and these need to be reviewed.

6.6.5 FACILITIES TO PERSONNEL

The O&M personnel should be provided with facilities and amenities so as to enable them to perform functions efficiently, such as residential accommodation, closely located offices, well furnished inspection houses/rest houses, modernized office equipment including Personal Computer (PC), office furniture, ready reckoners, calculators, guide books, manuals, medical aid, protection for legitimate discharge of duties, reward for good work as well as for new and innovative ideas, travelling facilities (government vehicles, training, O&M equipment, etc).

6.7 DETAILED ORGANIZATIONAL STRUCTURE

(I) It is necessary to describe how the above functions and responsibilities are discharged by organizational units and how the dependence and lines of authority are established. The most effective way of presenting this information is by an organizational chart with the necessary annotations. (See Annex - XII).

(II) An irrigation and drainage (I&D) system has great importance in terms of food and fibre production, income of rural people, public investment, recurrent public expenditure.

A few suggestions appear relevant in this context.

(a) establishment/strengthening of evaluation and monitoring units.

(b) splitting of O&M grants into (i) grant for operation, (ii) grant for maintenance and (iii) grant for establishment.

(c) segregating O&M Units and establishment units.

6.8 RELATIONSHIP WITH OTHER ORGANIZATIONS

Irrigated agriculture is a multi-disciplinary activity and requires active involvement of other departments such as Agriculture, Revenue, Co-operatives, Forest and CADA. Interaction with these departments is of great importance and should be a regular feature. Links with these departments should be described, indicating the levels, the extent of information, cooperation or services required as well as the channels of communication between the respective organizations. The departments/ organizations to be associated are :

* Revenue
* Agriculture
* Extension Services
* CADA

* Research
* Forest
* Universities
* Hydrological organization
* Cooperatives and marketing (mandis)
* Credit/Banking
* Animal Husbandry
* Fisheries
* Agro-Industries
* Storage/Warehousing
* Health
* Transport, etc.
* Environmental and recreational agencies
* NGOs for formation of farmers organizations
* PWD (Road and Bridges Wing)
* State Electricity Boards

6.9 PUBLIC RELATIONS

Good public relations involve good communication between organization, water users and the public. There are two aspects of communication which need attention.

Communication Between Organization and Water Users : The communication channels between the two are to be mentioned. Particular attention should be paid to the need of reaching all the water users and giving them the possibility of addressing the O&M organization when necessary. This will help in maintaining cordial relations with farmers and will add to O&M efficiency.

Communication Between Organization and Public : This implies the use of mass media and other means to promote efforts in the farming community or to pass relevant information in a rapid and effective way.

Visits of tourists and VIPs to the Project Area : Necessary facilities should be provided for this purpose.

Watch and Ward : Vulnerable points should be protected from miscreants and anti-social elements.

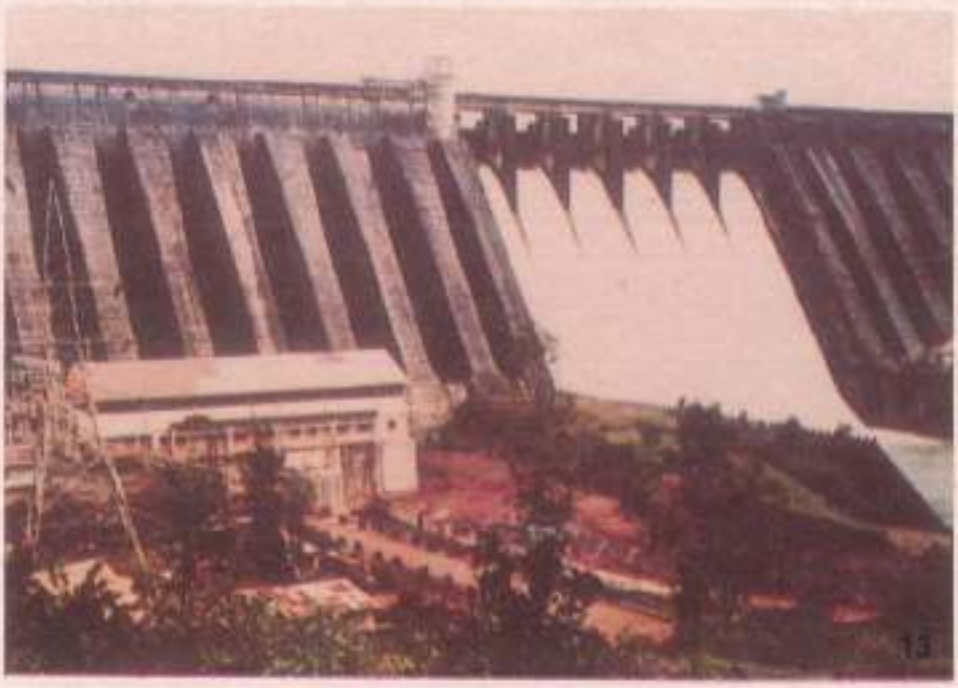
6.10 ADMINISTRATION

(i) Project management entails the application, direction and control of project resources to achieve the objectives of the entity. Obviously, the effectiveness and efficiency of project management depends on :

* quality of staff (with training background)
* adequacy of facilities
* equipment
* funds
* institutional arrangements
* timely flow of management information

(ii) The administration function provides the essential support to project management and the dominant project functions - operation and maintenance. Stores procurement, financial procedures, staff recruitment and administrative support procedures are given in departmental rules, irrigation manuals and financial hand books. The following elements of administration should be addressed:

* Personnel functions and responsibilities
* Stores procurement and inventory control
* Financial procedures
* Administrative support procedures (for travel,communication, typing services, records, files, office maintenance, media, liaison, etc.)
* Management Information System (see Chapter 7)
* Communication Network (see Chapter 8)



KOYANA DAM (MAHARASHTRA)

HIRAKUD DAM (ORISSA)

CHAPTER 7

MANAGEMENT INFORMATION SYSTEMS (MIS)

7.1 GENERAL

(I) A Management Information System (MIS) is a management tool for planning, monitoring and evaluating any activity in a comprehensive manner. In doing so, it brings to fore the areas of weakness and concern to enable the management to initiate timely corrective measures. Project planning phase is dealt in Chapter 1 (para 1.5.1), and monitoring and evaluation in Chapter 13. The MIS could be manual or computerized.

(II) For overall efficient management including corrective measures, timely flow of management data and information is necessary. This will assist to -

- control day to day operations, monitoring and evaluation activities.
- facilitate long-term review and evaluation of performance, and
- provide quicker response to project needs

(III) The existing system of reporting information, as in the case of most of the major and medium projects, by canal divisions to Superintending Engineer and Chief Engineer's Office results in considerable time lag between reporting information/data and receiving published report. A computerized MIS is the answer to this delay. Large data for a number of years can be stored, processed, retrieved and made available quickly. Time-saving, voluminous record keeping and cost effectiveness are other advantages. Use of satellite remote sensing techniques for collection of data and information is being made in the country, as in the case of Bhadra reservoir project in Karnataka.

(Iv) The design of MIS for an organization must involve the officers who need the information and who would use it in the discharge of their management responsibilities.

7.2 SYSTEM DEFINITION - INFORMATION NEEDS

(I) The information needs for an O&M unit of an irrigation and drainage organization are generally specific and must be clearly identified. However, the likely requirements of information needs can be broadly included in one of the following categories of reports.

* Management Reports
* Statistical Reports
* Annual Reports
* Other Information Reports

(II) Each of the above categories would again contain a number of reports for numerous different related functions, such as, the management reports which contain reports concerned with management aspects, i.e. financial, expenditure against budget, costing reports; physical system reports i.e. water availability, monitoring gauge/discharge, regulation of channels, allocation of water between different parts of the canal system, channel rostering programme, maintenance programme, stores inventory control, equipment/plant availability, etc; statistical reports such as cropwise irrigated area, crop failures, revenue assessment for each division, districtwise area irrigated and cropwise revenue assessment, etc.; annual reports, such as administrative report and other reports on monitoring of groundwater table, areas prone to waterlogging & salinity, etc.

(III) For various information needs, suitable procedures need to be established and adopted covering :

* Details of data to be collected, their sources, frequency of collection
* Frequency and method of compilation of data
* Content, timing and frequency of reports
* Supply of information to various management offices.
* Staff participation and responsibilities

7.3 CONTENT, TIMING AND FREQUENCY OF REPORTS

(I) The content, timing and frequency of report will vary -

* according to the function of the report, e.g. water control information report will be required on a continuous basis, sometimes in a 'real-time' mode, whereas some financial reports will be on a periodic basis.
* according to level of authority involved, i.e. a Control Board, or a Chief Engineer may only be interested in water deliveries on a weekly basis,whereas the Executive Engineer/Assistant Engineer will be concerned to monitor activities on daily basis or at shorter intervals.

(II) The criteria for timing, content and frequency of management reports should be that there should be adequate time for the manager to take corrective action. If such response is not possible, then the reports are to be classified as Information or Statistical Reports only.

(III) The report should also include feedback information regarding -

(i) corrective action taken on the earlier report, and

(ii) the results achieved therefrom.

7.4 COMPUTER BASED MIS

(i) With the advent of mini and micro-computers of increased capacity, it is possible to achieve significant improvements in storing and processing MIS data resulting in saving of time and cost.

(ii) Where communication facilities exist to provide data transmission links at low cost, it is possible -

* to link a network of such computers throughout the organization, including regional and local offices;

* to avail of the possibility of managed, integrated data bases, and of greatly improved internal communication processes.

(iii) Many of the design principles for a computer-based MIS remain similar to those for a manually compiled system. However, many procedures necessarily will be different. When converting from a manual system, care should be taken in system design to take advantages of all possibilities offered by the new technology, and not simply computerize the existing manual processes.

(iv) A computer specialist firm could be employed for detailed study of the system for preparing computer oriented MIS. The firm could be asked to prepare detailed formats for collection of one time data, recurring input data and output reports. (Annex - XIII gives an example).

(v) When the project is under construction, the MIS may have to be developed in separate modules for construction and for O&M activities.

(vi) In maintaining the system, it will be necessary to develop procedures for :

* Updating system description and facilities

  - hardware
  - software
  - data storage
  - printers and communication links

* Controlling development of new or modified systems

* Approval process for additional equipment

* Cost sharing of services between internal client units.

Note : A computer-based MIS offers great flexibility and scope. However, the absence of computer facilities should not deter development of an effective MIS for adoption manually, as it is vital for achieving efficient O&M functions.

BHAKRA DAM (PUNJAB & HIMACHAL PRADESH)

KOTA BARRAGE (RAJASTHAN)

CHAPTER 8

COMMUNICATION NETWORK

8.1 NEED

(I) A good communication system, preferably a modern one, is *sine-qua-non* for all irrigation personnel concerned with operation, maintenance and monitoring activities of an irrigation and drainage system. The field conditions and field needs are required to be communicated to the senior officers for timely operational instructions for implementation. The communication system should cater to the communication needs at any time (day or night).

(II) Accurate planning, monitoring and regulation of water releases would warrant;

- collection of meteorological data from stations in the command/catchment and transmitting the same to India Meteorological Department (IMD) to provide forecasts for small areas, which IMD undertakes now.
- collection of weather forecasts from IMD
- collection of information about crops, cropped area, sowing dates and age of crops from command.
- position of water availability.
- Data on consumptive use of crops
- delivery schedule and communicating the same to the operating staff and beneficiaries.
- water release information as per schedule
- happenings on the system related to water use.
- direction/implementation of instructions and transmitting information.

(III) Communication System is essential for :

* operation and maintenance of dam, reservoir, weir/barrage, headworks
* flood regulation and emergencies
* warning to flood prone areas for organizing rescue operations.
* operation and maintenance of canal networks, in regard to
  - quick appraisal of water requirement and optimum utilization.
  - daily monitoring of regulation orders.

- diverting likely wastage to needy areas.
- avoiding overtopping/breaches of canal banks in case of sudden heavy rainfall, by operating escapes or adopting other suitable measures.
- effecting quick operational modification to an endangered structure.
- minimizing breach/damage from other causes through fast communication.
- expediting measures required to handle emergent situations.

* organizing effective and timely support services to help farmers.
* other administrative requirements.

8.2 TYPES OF COMMUNICATION

8.2.1 MESSENGER SERVICE

This old system is still in use for transmittal of routine and ordinary messages.

In some remote places canal and river gauges are still communicated through messengers called 'dak runners'. The dak runner system involves a large number of messengers. The communication is slow and takes long time in communication for action and reporting compliance thereof.

8.2.2. TELEGRAPH/TELEPHONE SYSTEM

In India, by about 1900 A.D., telegraphic communication or canal wires were introduced on some major and medium irrigation projects. These are still in use.

Later, the telephones (magneto system) were introduced for better and quick communication through direct talk. The telegraph/ telephone is under the monopoly control of the Central Ministry of Communications. The systems are installed by that Ministry as per specific indents of Irrigation Department. The system is owned, maintained and repaired by the Ministry and leased out to the user department on yearly rent per km length of the lines installed. The operators are employed and paid by the user department.

Both the telegraph and telephone are installed either with single wire-earth return or double-wire systems. Double wire system is comparatively costly, but communication is better and not affected by climatological changes.

8.2.3 WIRELESS SYSTEM

Wireless communications are in short wave (SF), high frequency (HF), very high frequency (VHF) or Ultra high frequency (UHF) categories depending upon the wave length used. Wireless system eliminates transmission by wires and poles. It is free from a number of disruptions and damages particularly

in remote areas. The installations can be done quickly. The operation/ maintenance cost is less than the rental charges of telephone/telegraph lines.

8.2.3.1 High Frequency Wireless (HF)

The system can be installed and owned by the Irrigation Department after necessary permission and licence to use frequency from the wireless Advisor, Ministry of Communications, GOI. The Ministry also installs and leases out such networks for exclusive use of the Irrigation department.

The HF wireless transmission propagates through space in omni directions, and can cover longer distances. The power required is high and so the operating costs are also high. The HF system is susceptible to jamming or interference from other networks in the vicinity. The audibility is poor or weak during inclement weather and high temperatures. There are periods when the communications are totally blank, particularly in summer during mid-days and mid-nights.

8.2.3.2 Very High Frequency Wireless Network (VHF)

The transmission is in straight line like light ray beam which can be intercepted by an opaque body, structures or even the curvature of the earth. But, if the transmitters and receivers (through high antenna or higher altitude locations) are provided to avoid these obstructions, the reception is clear and audibility very good to excellent, not susceptible to weather or high temperatures or interference by other nearby wireless networks.

For large and extensive command areas intercepted by hills, auto repeator (transmitting/receiving) stations are required. The VHF transmitters/receivers work on relatively low power ranging from 2 to 20 watts, which reduces installation, maintenance and operation costs.

VHF system is fast and reliable and is suitable for operation of irrigation projects. It is being installed by a large number of projects in the country. Refer para 8.4 (ii) for installation of VHF networks in stages.

8.2.3.3 Ultra High Frequency Communication System (UHF)

The propagation is through electromagnetic waves which travel straight and have lesser bending effect in comparison to the VHF. As a result it has less coverage of communication between two points in comparison to VHF, and is restricted to purely line-of-sight communication due to earth's curvature. For a long distance communication UHF system will need more repeaters than VHF.

The most significant advantage over VHF is that it has a multi-channel facility extending from 12 to 60, while the VHF has only one channel facility. Better directive antennae can be designed. Although for taking advantage of multichannel facility, it is necessary to have multi-plexing equipment in addition to wireless trans-receiver sets. The modernized system will have radio relay system, Multi-

Access Radio Telephone (MART) system and Electronic Private Automatic Exchanges (EPAX)and mobile Radio sets including walkie-talkie sets. The repeaters in UHF are much less prone to noise and more number of repeaters in tandem can be possible. Although UHF has the advantage of multichannel facility the installation cost would be high but in the long run it could be economical.

Ultra High frequencies, however, have a high potential use in remote areas for measurements and control of water flows in the system. This system is necessary when sophisticated remote control gates are installed on the systems.

8.3 LOCATIONS, NETWORKS AND SUB-NETWORKS AND FREQUENCY REQUIREMENTS

8.3.1 LOCATION

In order to have smooth and fast flow of information/instructions to the operating personnel or strategic control points, the wireless stations need to be installed at the location of all key functionaries deployed on water/flood management, administrative hierarchy upto policy decision making level.

Some wireless sets should be mobile and installed on vehicles of field level officers.

8.3.2 NETWORKS AND SUB-NETWORKS

It is generally not necessary for all the stations to communicate with all other stations regularly. Generally about 8 to 10 stations can communicate efficiently on one network. The system should, therefore, be organized in suitable networks of primary, secondary and tertiary networks according to the administrative convenience and importance of work.

8.3.3 FREQUENCY REQUIREMENTS

The primary network may have two independent frequencies, one for water management and the other for flood management. For every autorepeater station in the command, two additional frequencies may be essential.

Providing independent frequencies for secondary and tertiary networks may not be possible being limited by the divisions/sub-divisions located at long distances. Same frequencies can, however, be used on regional basis. If the traffic is less, adjacent divisions/sub-divisions can use the same frequency on time sharing basis.

Communication system is an important tool for management. Its erection and installation alone may not ensure its effectiveness. It is the planning and orderly sustained operation and maintenance that would lead to better and efficient management. Preparing detailed procedures for operations, manuals, traffic rules, assigning appropriate priorities for different messages, setting up time

schedules for collecting important information, issuing instructions/executive orders from higher authorities and periodical monitoring are other essential activities which would ensure effectiveness in water management.

8.4 COMBINATION OF DIFFERENT COMMUNICATION SYSTEMS

(i) In most of the existing major/medium irrigation projects, some kind of communication system, such as telegraph (canal wire) or telephone is in existence and may be working satisfactorily although maintenance and repair by Ministry of Communication (DoT) may not be prompt. In the long run, the VHF wireless communication is suitable and economical for better water/flood management, though immediate replacement may call for additional budgetary provisions. Since this may be difficult to obtain, especially on completed projects, it may be advisable to continue the existing system and use it in combination with VHF wireless which may be installed on the missing links. Later, when it is possible to get funds, the same could be replaced by VHF network.
However, preliminary/feasibility survey, GOI approval and allotment of frequencies could be organized for the complete network, as it would be difficult later to get adjacent frequencies.

(ii) Different situations may be prevailing in respect of communication systems in the commissioned projects. Where there may be telegraph system (canal wire) or telegraph/telephone or wireless sets on lease from police or Telecommunication Department, these may be used while improving the system.

The installation of VHF networks could be arranged in stages.

- Installation of VHF, secondary and primary networks in phase-I, replacement of tertiary network in phase II.

- Installation of VHF tertiary network in phase I and secondary/primary in phase II.

- Installation of secondary/tertiary VHF wireless network in phase I and replacing HF network by VHF in phase II.

8.5 OPERATION OF WIRELESS SYSTEM

(i) Wireless transmission works on Press To Talk (PTT) Switching. Transmission starts and the message reaches the receiving side where the operator listens and writes the message. After the end of each sentence, the operator on the transmitting side has to say 'OVER' and the operator of the receiving side who notes down (or writes) the message has to say "ROGER". After the message is transmitted, the receiving operator repeats it for confirmation.

The message is written according to a methodology, e.g. the short message is written in narrative form using small sentences separated by stops. Long messages are broken into paragraphs 1,2,3,.... or A,B,C,.....

(ii) The messages are assigned priorities according to the objectives of the message. Most of the O&M messages in O&M work relate to water measurements, i.e., gauges and discharges of channels and rivers. This information is vital for regulation and therefore needs to be given special status and specific time slot for communication. Such messages are designated Situation Reports (SITREPS). The messages are classified according to certain priorities :

(a) "CRASH" messages are for immediate attention/action, prompt help or situation of alarming emergencies, such as, heavy flood warnings, heavy releases from reservoirs expected to submerge downstream valleys, major breaches and remedial measures therefor, VIP programmes.

(b) "PRIORITY" messages seek prompt attention and compliance, in situations such as unscheduled increase or decrease in water flows, express reminders, higher floods, etc.

(c) "IMMEDIATE" or "MOST IMMEDIATE" messages where the receiving side is expected to suspend their normal work and respond to the calling side.

(d) "SITREPS" (Situation Reports) would include daily gauges, rainfall, evaporation, temperature, etc., instructions for changing the discharges of canals and gate opening, settings daily flood bulletins.

(iii) Abbreviations and code words are used to save time in wireless communication as it involves repetition for correctness, copying and forwarding to the concerned officers. For example : AE = Assistant Engineer, EE = Executive Engineer, SITREP OGR = Situation Report about daily (Canal) Gauge, CR = Cross Regulator, Stn = Station, u/s = Upstream, d/s = Downstream, ETA = Expected Time of completion, PDC = Probable Date of Completion, WDS = Water Delivery Schedules.

8.5.1 STANDARD MESSAGES

To enhance communication efficiency by way of handling more traffic, the SITREPS should be on standard message formats. This saves time in transmission/receiving, writing and copying the messages. Standard message formats are evolved to indicate or suggest all possible information desired to be reported and also the further steps or actions to be taken in a particular situation.

8.5.2 WIRELESS MEETING -

A meeting usually of senior officers through wireless can also be arranged by providing suitable equipment. This saves time to expedite action.

8.6 WIRELESS MANUAL

(I) A manual for the use of wireless communication may be prepared for all the irrigation projects, especially for the major and medium projects in the state. The manual may cover -

(a) Scope and objective of installation and use of the system, such as water management, flood regulation, construction facilities, monitoring irrigation deliveries and health of soil and water in the command and collecting vital statistical information.

(b) Detailed methodology in carrying out preliminary survey, feasibility studies, obtaining approval, licence and allotment of frequencies from GOI.

(c) Types of wireless communications installed in the State viz. HF, VHF, UHF, etc.

(d) Officers/field staff authorized to use the communication networks, and officers authorized to have direct Radio Transmission Talk (RT Talk).

(e) Qualifications for the operators of wireless sets, and radio technicians for repairs.

(f) Rules of operation and traffic discipline.

(g) Functions, duties and responsibilities of Central Control Station (CCS) for the project and control stations (CS) of individual network.

(h) Method and language to be used in initiating/writing messages, transmitting/receiving on wireless and forwarding the messages to the concerned officers.

(i) Priorities for different messages according to the purpose, contents and urgency.

(j) Standard messages for common situations like flood warnings, breaches in canals, canal/river gauges, MET Reports.

(k) Monitoring of communication traffic by CSS and CS.

(l) Daily/Periodical maintenance, inspections of installations.

(m) Officers authorized to use/operate 'mobile' 'Hand held' sets or sets installed in cars/jeeps.

(n) Centralized training facilities,syllabii for the operating staff and officers entitled to use the system.

(ii) A Telecommunications Consultant could be appointed to formulate proposal for modernizing the existing system and preparing communication plan for the project.

8.7 ADVANCED TECHNOLOGY

With the rapid advancement in electronics and electronically operated devices, there is a tremendous scope to use wireless network for precision and accurate operation and monitoring water delivery or regulating floods. Some of them expected to be used in near future are ;

i) Telemetry

Electronic devices are now available in market, which can continuously record the canal/river gauges at designed intervals. Equipment is also available which can record the gauge installed as measuring devices, and can transmit the same through auto-transmitters periodically.

ii) Remote Control

The gates of cross regulator, head regulator, escape of canals or flood gates of the dam can be remotely operated from the control station, through servo motor operated hoists installed at the gates whose switch can be activated by wireless signals.

iii) Computer Controlled Information System

Computers can be used alongwith wireless network to store information about crops, cropped area, age of crops, climatological data required for working out crop water requirements. This can be brought on the computer screen, analyzed for taking appropriate decisions in releasing water (Chapter 12).

Written communication facilities are also available. These devices can be attached to the wireless trans/receiving sets. The messages can be transmitted through fascimile transmission (FAX) accurately without mutilating the information with preambles such as time, date, message number to whom and by when initiated etc. Secrecy of the messages can be maintained since they are transmitted at a high speed in a digital communication code.

iv) Extension and Telephonic Transmission

In the present systems, the officers are required to go to the static wireless set installed at their location. Senior officer may not get time to go for transmitting/receiving messages. Similarly for urgent talks the conventional

one way communication may be time consuming. Radio telephone exchange equipment working on duplex by voice operated carrier system (VOX switching) in place of Press to Talk Switch (PTT) can be installed to facilitate senior officers like CE, SE, and EEs who can then talk on VHF wireless similar to Telephone system.

v) A new technology which enables data to be stored in the Indian languages, has been developed by the Centre for Development of Advanced Computing" Pune. It has potential for better communication with field staff and water users.

vi) Remote Sensing techniques are being used for mapping, monitoring and evaluation

VIDUR DAM (TAMIL NADU)

SARAYU BARRAGE (UTTAR PRADESH)

CHAPTER 9

INVOLVEMENT OF BENEFICIARY FARMERS

9.1 BACKGROUND

(i) Before the British Raj, the traditional practice of irrigation management in India was self governance and self management, except that the Governments in those days used to help, promote or at the most construct such systems. Phad System in Maharashtra; Vijayanagar Canals in Karnataka are classic examples. Subsequently the concept of Government Control came into existence and during the British Raj in some of the States. Irrigation Departments/Public Works Departments came into being to control large number of irrigation works constructed as protective irrigation schemes to cope with famine like situation.

(ii) Since the First Five-Year Plan (1951-56), a good number of major and medium irrigation projects have been built and are controlled/ managed by the State Irrigation and Public Works Departments. Over the years, the irrigation potential created has not been fully utilized. The gap in utilization of potential has been widening, ever since 1950-51 and was about 4.0 million ha in 1979-80 and 8.5 million ha in 1989-90. Lack of involvement of farmers is one of the important reasons for slow utilization of the created irrigation potential.

9.2 PRESENT STATUS

(i) Farmers are the principal beneficiaries of an irrigation project. Though they use most of the available water for production of food and fibre, yet they constitute the weakest link in irrigation management. They are not effectively and functionally involved in management. There is no legal backing to hand over management of water distribution at the outlet to beneficiaries. In some States efforts have been made to form Co-operative Societies of beneficiaries to hand over outlet discharge on agreement basis.

(ii) Due to lack of education, the farmers may not be able to perceive the complications of intricate planning of major and medium irrigation projects. However, their participation in planning, design and construction of micro level systems would improve system efficiency and consequently help in greater production. By creating a sense of involvement and ownership, they would get to know the project objectives better and the Department would know the expectations of the beneficiaries. Construction quality of water course/field channel lining and works thereon would also improve. The main objective to involve the farmers in the entire functioning and working is to make

them partners in the irrigation management. Some problems are experienced in organizing farmers into groups. This requires strong motivation through local bodies/NGOs, providing incentives and giving recognition for their involvement in O&M work, expression of concern for their betterment, and adoption of partnership approach.

(iii) Participation of farmers in water management and maintenance of irrigation system at micro level has been talked about since early eighties. The Ministry of Water Resources (WR), Government of India requested the States in October, 1985 to introduce farmers participation by way of involving them in the distribution and management of water and maintenance in one minor (about 1000-2000 ha of area) in each CADA project. The Ministry of Water Resources also supplied guidelines on the subject which, *inter alia*, included information on participation, experiences abroad and at home, objectives of participation, area of operation of associations and methodology, advantages to the farmers, duties and responsibilities of the department, incentives to farmers, training and monitoring. This programme was overwhelmingly endorsed by the Parliamentary Consultative Committee attached to the Water Resources Ministry.

(iv) The National Water Policy (1987) stipulates making efforts to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates.

(v) Several experiments are in progress in different States for improving irrigation management through farmers involvement. (Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu are examples). These experiments demonstrate the feasibility and how farmers involvement can be achieved in irrigation projects. NGOs and women farmers have made significant contribution in this regard.

(vi) The Second National Water Convention held in New Delhi, in January, 1991 recommended operationalisation of farmers participation by way of adopting a three-tier system with the Canal Advisory Committee at the Canal level, a duly registered water users association at the minor level and informal groups at the outlet level, for sustained and improved performance in irrigation management. Adequate financial incentives and legal support, if required, should be extended by the State Governments for the formation and sustenance of water users associations. Advantage may be taken of the incentives provided under centrally sponsored CAD programme operated by Ministry of Water Resources in this respect.

(vii) The National Workshop on Farmers Management in Indian Irrigation Systems held at ASCI, Hyderabad, in February, 1992 also recommended effective management of major and medium irrigation systems by

creating functional partnership between Government agencies and farmers' Water Management Associations (WMA).

9.3 NEED OF FARMERS INVOLVEMENT

Farmers involvement in irrigation management is considered necessary as it is likely to :

- reduce water distribution costs
- develop cordial relations between farmers and the irrigation agency.
- facilitates prompt recovery of irrigation dues.
- improve/achieve maintenance of micro level system.
- motivate economic use of water by infusing ownership among farmers.
- bring about uniformity in irrigation practices.
- improve effectiveness of the system.
- assure reliability of water supply to result into higher productivity.
- effect equitable water supply to protect weaker sections and tailenders.
- provide stability to O&M of the system.

9.4 RELATIONSHIP BETWEEN PROJECT AGENCY AND BENEFICIARY FARMERS

The relationship between irrigation agency and the beneficiary farmers should be clearly dealt with clarifying the rights and obligations of each party. All major and medium irrigation works are under the control of State Irrigation Departments (or equivalent). Different Irrigation Acts are in force in different States : these Acts and Rules thereunder differ widely in their scope, in powers and privileges of Government and rights and obligations of the Irrigators. In Andhra Pradesh, Tamil Nadu, Karnataka and Orissa, the rivers and natural streams are regarded as public property, while in other States, the government has to declare that the waters of a river/stream would be used for irrigation. To obviate the above difficulty the Central Government prepared the Model Irrigation Bill in 1976 and commended to the States (Annex IV). This model is required to be adopted uniformly throughout the country through appropriate legislation.

9.5 RIGHTS AND OBLIGATIONS OF FARMERS

9.5.1 EXISTING PRACTICES

The existing statutory rights and obligations of beneficiary farmers to the use of water from a government irrigation work are:

RIGHTS

* in north-west India, (Punjab, Rajasthan and Uttar Pradesh) by the inclusion of their area within CCA of a canal.

* in Tamil Nadu, Andhra Pradesh and karnataka by usage, in which case the right to irrigate a field from a particular source is entered in the settlement records and by inclusion of specified areas in a 'localisation scheme' approved by the Collector.

* in Maharashtra and Madhya Pradesh by entering into agreement with government for a specified period under terms and conditions defined in the agreement, and

* in all other States by special permission on application for specified periods or for single crop season waterings.

Whereas every field irrigable from a canal in north-west India is entitled to receive its due share of waters available in the canal (free-will system), every field irrigable from a canal in Gujarat, Maharashtra and Madhya Pradesh would be entitled to receive irrigation water through application and will acquire the right to get irrigation supplies (pass system), for the period approved. But this practice is not vogue in Andhra Pradesh, Tamil Nadu and Karnataka where fields are not entitled for getting irrigation water (even though they may be commanded from the irrigation system). If water is available, they are included in the 'localization scheme' of supply as a second priority.

OBLIGATIONS

* irrigators except in Assam and some parts of Bihar, are required to pay water rates as may be levied by the State Government from time to time.

* maintain water courses in proper state of repairs. In north-west India, irrigators can be required to pay penalty, in western Maharashtra, the application for water supply may not be sanctioned if water course is not properly maintained.

* irrigators are required to provide labour for ordinary or emergent repairs. Full wages are, however, paid for such repairs.

9.5.2. PRACTICES UNDER EVOLUTION

With the introduction of the concept of command area development in 1973-74, various models for farmers involvement in management of major and medium irrigation projects have been evolved and experimented on various projects in several States (Maharashtra, Gujarat, etc.)

9.5.2.1 Project Level Management Committee (PLMC)

These were constituted to advise the irrigation project authority in overall

water management including deciding canal operation schedules. These include State department officials, elected representatives of the project command and some nominated representatives. The PLMC as a single tier committee has not been much effective. Hence in Gujarat a three-tier farmers organisation has been advocated:

(a) Village Service Area Committee (VSAC)

(b) Water Management Committee (WMC)

(c) Project Level Water Management Committee (PLWMC)

9.5.2.2 Outlet Committees

An outlet is the last government control point and the interface between the irrigation staff and the beneficiary farmers. An Outlet Committee is also called as 'Pipe Committee' or 'Kolaba Samiti' and has been promoted by CADA as a CADA activity in several projects in many States. It is an informal organization, reconized by CADA. It is not effective as a single tier PLMC in large projects.

9.5.2.3 Water Users Cooperatives/Water management Associations (WUC/WMA)

The WMA are based on minor/sub-minor and have come up on several projects in Gujarat and Maharashtra States. Mohini Water Distribution Cooperative Society, Ryma Water Users Cooperative Society and Saras Water users Cooperatives Society in Gujarat and Shri Datta Cooperative Water Management Society in Maharashtra and single tier minor based formal organization (registered under Cooperative Societies Act) are examples. WMA purchase water in bulk at negotiated water rates, collect water charges and pay to the irrigation department, resolve conflicts, receive maintenance grant for the minor to carry out maintenance work and also collect service charge for office expenses from the farmers. A memorandum of understainding (MOU)/agreement between the WMA and the Irrigation Department should be entered into, to safeguard the interests of both. Their rights and obligations are given below.

9.5.2.4 Rights and Obligations of WMA and the Irrigation Department

9.5.2.4.1 *WMA*

Rights of the WMA should include

i) information from Irrigation Department regarding water availability and delivery.

ii) the right to make contracts and earn profits.

iii) legal support to establish linkages with other agencies.

iv) autonomy in management and financial administration.

v) the right to elect their own leaders.

vi) the right to establish and enforce internal rules.

vii) the right to engage their own technical staff.

viii) recourse to redressal of grievances with Irrigation Department through mutually agreed arbitration.

ix) participation in planning and implementaiton from the minor level to water courses.

x) representation in distributary and system level operation.

xi) joint inspection by the ID/WMA before taking over, during repairs and modifications; constructing measuring devices and deciding frequency of discharge observations ; handing over completion drawings to WMA; guidelines on the turn over of the system from ID to WMA after carrying out the updating works etc. and conducting hydraulic tests of canals; to ensure channel capacities as per design, recording seepage losses and efficiency of minors and micro system.

xii) distribution of water supply among members and non-members.

xiii) management of ground water within their respective command areas.

xiv) information regarding financial allocation from minors upto outlets.

Obligations of the WMA should include :

i) maintenance of minors for equitable water distribution taking bulk supply from the irrigation agency

ii) enforcement of discipline among the member farmers to prevent canal offences

iii) routine maintenance of minors and outlets.

iv) timely payment for water delivery

v) communication of relevant information to Irrigation Deptt.

vi) collection of water charges

vii) environmental maintenance and improvement

viii) resolving disputes amongst member farmers

ix) adhering to specific cropping pattern or choice of cropping pattern with the allocated water

9.5.2.4.2 *Irrigation Department*

Rights of the ID should include :

i) Partial and proportionate recovery of capital costs of the irrigation system on mutually agreed terms as and when the farmers are

assured of high returns on their produce, keeping in view the standing Government instructions.

ii) inspection of the physical system

iii) Recourse to redressal of grievances with the WMA through mutually agreed arbitration

iv) Information regarding the WMA and equity aspects

v) Recovery of contract amount for the supply of water to WMA

Obligations of the ID should include :

i) main system operation to deliver reliable irrigation supply to the WMA at the minor level at appropriate time.

ii) provision of funds and technical advice to the WMA for special repairs of the minors and outlets

iii) granting repair and rehabilitation contracts to the WMA on a priority basis.

iv) grant of subsidies, incentives, etc. from time to time to meet management costs of WMA in the first few years, and grants for repairs of minors, etc.

9.5.2.5 Size of Water Management Associations (WMA)

The size of WMA as mentioned under para 9.2 (ii), is about 1000-2000 ha. The size, however, depends on project size, number of outlets, financial viability, maintenance problems and the possible cooperation/cohesion among farmers. It would generally be advisable that WMA is set up for :

- each minor (lateral), with separate gated control and discharge measuring device, irrigating 400-1000 ha.
- sub-minors should be clubbed to have an area of 400-500 ha and 100-200 farmers for financial viability.
- direct outlets, if any, should be clubbed with adjacent minors.

9.5.2.6 Formation of Water Management Association

While forming a WMA, its scope, duties, structure and functions should be mentioned. Guiding principles for formation of associations are given in Annex-XIV, as an example.

Model bye-laws of associations in a major project are at Annex-XV.

Proposed draft legislation for water users cooperatives under Northern India Canal and Drainage Act 1873 is at Annex-XVI.

9.5.2.7 Training of Associations, Office Bearers

The organizers and farmers, especially the office bearers of the Associations should be trained in project-specific aspects (for details see Chapter 10 on Training).

9.6 FARMERS' INVOLVEMENT IN CONSTRUCTION OF IRRIGATION SYSTEMS

Peoples' involvement has not remained limited only to operation, maintenance and management (OMM) of irrigation works, but has also extended to financing and construction of irrigation systems. Bala Raja Dam in Maharashtra is a Society owned and controlled project and Chikapadasalagi Banaje in Karnataka is another example of people's involvement in financing and construction of an irrigation project.

9.7 OFFENCES AND PENALTIES

As discussed in para 9.5.2.4, it is important that beneficiary farmers and project employees comply with their respective obligations. The most frequent offences by the water users and the penalties for such offences should be spelt out and made known to the water users to reduce such occurrences. The offences and penalties are also dealt within Model Irrigation Bill in Annex-IV to Chapter 3.

9.8 OTHER SERVICES

Besides delivery of water from the project, farmers may benefit from other services provided by the project agency, e.g. :

* technical assistance for on-farm water management and other activities such as construction of field channels land levelling/shaping, field drainage, other OFD structures, crop water requirements, critical watering for crops etc.
* delivery of inputs through extension services (fertilizer, pesticides, certified seeds, etc.).
* execution of farming activities (ploughing, fertilizer dose treatment for salt affected lands, tackling waterlogging problem etc.).
* financial assistance.

9.9 FARMERS' TRAINING

Refer to Chapter 10 : Training (para 10.6).

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CHAPTER 10

TRAINING

10.1 OBJECTIVES OF TRAINING

(i) The objectives of training are to improve performance of I&D systems, for sustained increase in crop production in quantity and quality, without detrimental effects on environment, soil deterioration in particular. The training contents should have an overall view of principles of irrigation water management, diagnostic analysis of farm irrigation systems and specific skills of irrigation personnel and farmers.

The training should help the trainees :

- to keep the service personnel abreast with the latest development in their respective field of activity.
- to appreciate benefits of improved water use practices.
- to determine the existing deficiencies in O&M and develop solutions therefor.
- to infuse discipline and team skills and to further improve monitoring skill to evaluation approaches.
- to understand principles, processes and specific field problems.
- to gain field training experience in multi-disciplinary responsibilities and actions. (The multidisciplinary concept has come to be recognized as "inter-disciplinary concept").
- to appreciate positive side of involving farmers in decision-making.
- to have a comprehensive view of all project management aspects including strategies to ensure equity and reliability of water delivery upto the outlet and technological advancement in water management having socio-political impact.

(ii) There is a need to understand the meaning of irrigation water management. The latter may be viewed as the process by which the available water is used for maximum good for the production of food and fibre. It is the judicious conservation and optimum utilization of available water in all intended spheres of its utility.

Water management warrants the following prerequisites for improvement and better performance :

(a) Precise water control and reliability of supplies at the farm level.

(b) Increased productivity of water.

(c) Equity in water distribution among all classes of farmers.

(d) Sustained maintenance of project facilities including health of command area.

(e) Increased participation of farmers in the O&M of the system.

(f) Analysis of precise cost effectiveness of the system.

To achieve the above, the project should have professionals trained in comprehensive irrigation water management.

10.2 PRESENT STATUS

(i) A review made in 1985 of Country's status in irrigation training shows that in the past four decades investigation planning, design, construction and O&M of irrigation projects have been deficient, primarily due to inadequately trained staff. There were some 1,60,000 irrigation engineers in the country, most of whom had received little or no in-service training since entering the departments.

(ii) Of the total estimated irrigation potential (113.5 million ha), some 83 million ha was created upto 1991-92, but the utilized potential was only 75.70 million ha. leaving a gap of 7.30 m.ha. of potential to be utilised yet. There is an urgent need to fully utilize the created potential to sustain crop productivity - in terms of intensity and yield consistent with the cropping pattern with available water supply and to operate and maintain the irrigation systems in a more effective and efficient manner.

(iii) Sustained productivity of irrigation projects depends on the capacity of the irrigation departments/organizations, ability of technical personnel and the use of improved/modern practices by the farmers. This calls for effective human resources development on regular basis to achieve production goals, to safeguard the public investment and the environmental quality.

The human resource development programmes for most of the large irrigation organizations should also include training in.

* Planning (organizational, financial).
* Assessment of cost/benefit and performance
* Leadership and management skills; and
* Information management.

(iv) A rough estimate was drawn up by an Expert Committee in 1985, of the personnel to be trained in the country upto 2000 AD for major and medium projects. The requirement is as below :

Senior Level Managers (Chief Engineers + SE)	500
Middle Level Managers (EE + AE)	6,200
Junior Level including non-engineering disciplines	20,000

(v) National Water Policy (1987) states that a perspective plan for standardized training should form an integral part of water resource department. It should cover training in system operation, physical infrastructure and the management of water distribution system. The training should extend to all the categories of personnel involved in these activities as well as the farmers.

(vi) In the preparation of POM of a project, the current status of irrigation training in the concerned State and the facilities existing or planned may be presented.

10.3 INTERNATIONAL PERSPECTIVE

(i) The 13th International Congress of the International Commission on Irrigation and Drainage (ICID) discussed in 1987 a full Question on Irrigation training. Conclusions reached at the Congress being relevant in this context, are given below :

* Training programmes should be based on an assessment of the need for training and should be developed in line with the organizational objectives;
* Training programmes should be comprehensive and systematic and enhance the skills needed by the management and operation & maintenance staff;
* Initial training of projects' operating and maintenance staff should be completed before new works are commissioned;
* Water users and their associations should be taken into consideration when developing training strategies. This may require complementary training programmes on their behalf; and
* Training programmes should be conducted as close to the farmers groups as possible.

(ii) The World Bank and the United States Agency for International Development (USAID) brought out in 1989 "Irrigation Training in the Public Sector : Guidelines for preparing strategies and programs."

It is a companion volume to World Bank Paper 99 (See list of references at the end). This document presents: 1. Irrigation Development and Human Resources Development Strategy; 2. Developing a training strategy; 3. Systematic Training, and 4. Strategic decisions in planning for training. For details see Annex - XVII.

10.4 TRAINING FOR WHOM

Training is to be imparted to :

* Irrigation department and project staff responsible for designing, operating and maintaining the system i.e., officers and field functionaries.
* Staff of other departments connected with irrigation, such as Agriculture, Forests, Cooperatives, CADA, Extension Services, etc.
* Farmers who are responsible for water management at the farm level.

The above should be motivated for training. Training in foreign countries should be project need based including for senior officers. There should be training in automation to catch up with the modern developments.

10.5 NEED FOR SYSTEMATIC TRAINING

Staff training is now universally accepted as an essential element of organizational management.

Training for irrigation normally includes : Pre-service for technical staff who are recruited by the department; post-graduate courses on special aspects of irrigation; staff college training; orientation for newly inducted staff; short-term refresher course; specialized courses; training linked to specific project or system; on-the-job training; international short courses; seminars and conferences, study tours within or outside the country.

10.5.1 CATEGORIES OF STAFF TRAINING

A systematic training plan should generally include three categories of training that would strengthen the performance of managers and staff. These categories and their relevance to different situations are given below. Distinctions among these categories are subtle.

10.5.1.1 In-Service (and maintenance) Training

This category of training is intended to meet short-term improvements generally focussed on specific and current needs. It may be called short-term, routine, continuing, in-house, or on-the-job training for existing or

new staff members. It may be used to certify continuing or increased staff proficiency within the same career path.

10.5.1.2 Adjustment or Reorientation Training

This category of training is required following changes in policy or technology when irrigation staff may be called upon to undertake new jobs for which they are not adequately prepared. The training must be redefined to bring staff capabilities in line with new departmental objectives. For example, adjustment training would be needed if the farmers are to be advised about agricultural matters by the irrigation personnel. This type of training may be further sub-divided into three formats :

(a) Specialist Training : It is a short-term training and may be carried out through special courses at local institutions. If needed, regional/ international experts may be brought in to supplement the local experience. For example, study tours within and outside the country.

(b) Refresher Training : It is short duration course of study in one's field of basic qualifications that will introduce concepts and reinforce earlier training. This could be different for different disciplines and also could be different for officers and field workers.

(c) Retraining : It is needed when a staff member is moved from one type of job or career stream to another. This frequently happens when there is a significant shift in the mandate of the department, or when certain phases or organization developments are complete or permanent slowdown in new construction is anticipated e.g. design staff after completion of the project may be retrained to operate the irrigation system.

10.5.1.3 Project and Task Force Training

It is a special category of in-service training that is particularly appropriate for pre-commissioning training of the staff not yet in place for new projects.

Task Force Training is a form of project training in which the key staff to be involved in an aspect of the project receive training as a team before that aspect of the project begins.

10.5.2 STAGES OF STAFF TRAINING

There could be many models for training programmes. The most common pattern of training is :

* Induction training (at entry level).
* In-service training (middle level).
* Appreciation/Management training (at Senior-level).

10.5.2.1 Induction Training

It should include basic training to acquaint a new entrant with the administrative processes, responsibilities and duties of various positions, organizational set-up, modern theories and practices of management, etc. It should also include technical training both academic and practice-oriented, to bridge the gap in the academic education provided at the university or poly-technique. Advanced post-graduate training in selected subjects could also be included for officers with appropriate aptitude and background.

10.5.2.2 In-Service Training

The in-service training (para 10.5.1.1) in the context of irrigation water management has received much attention in the last decade. There has been an all-round awareness in the recent years that significant efforts are required to increase the efficiency and productivity of irrigation water at the farm level. It is also recognized that the educational background of civil engineers of the irrigation departments is not adequate to realize the vital need for the development of the irrigated areas below the outlet, which are at present left to be done mainly by the farmers with the assistance of other state-level departments, such as CADA, Agriculture, Soil Conservation, Revenue, etc.

Significant efforts are being made in irrigation departments for large- scale training programmes, primarily with the objective of improving the O&M of irrigation systems at the macro and micro levels. The institutions catering to the needs of water management training are :

Departmental Institutions	* Staff Training Colleges, Water and * Land Management Institutes (WALMI)
Educational Institutions	* Agricultural Universities, * Engineering Universities/Colleges, Management Institutes

In the recent past, a number of States have set up Water and Land Management Institutes (WALMI) to promote innovative concepts in improved water management (Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh). Water and Land Management Institutes (WALMI) have been playing increasing role in training irrigation professionals and farmers.

The Universities equipped with training facilities are : Centre for Water Resources, Anna University; Inter-Faculty Department of Irrigation Water Management (MPAK); Irrigation Management & Training Programme, Rajasthan Agricultural University; Water Resources Engineering and Management Institute, Vadodara, Centre for Water Resources Studies, Bihar College of Engineering; Indian Institute of Management, Ahmedabad and Bangalore; Water technology Centre, IARI, New Delhi; College of Technology, Pantnagar; WRDTC, Roorkee. The institutes to mention a

few, provide training to in-service personnel in irrigation management and also to the farmers by organizing training courses both on short-term and long-term basis. There is also a proposal to set up a National Irrigation Management Institute to impart training and conduct research.

Some Institutes have started induction training for new entrants. They also carry out action research programmes in operational irrigation projects for optimization of irrigated agricultural production. Such training programmes at WALMI have helped in giving a new direction in improved water management practices on one side and the general increase of overall irrigation efficiency on the other.

10.5.2.3 Appreciation/Management Training

Senior Officers at policy-making level need to develop better appreciation/ management of situation, long-range and short-term effects of decisions, management and personnel planning, human relations, multi-disciplinary work, socio-economic and political influences, etc.

10.5.3 RECOMMENDATIONS OF THE EXPERT COMMITTEE

The recommendations of the Expert Committee relating to training of Irrigation Engineers in respect of (i) nature of training, (ii) stage in service when the training be given to an officer, (iii) duration of training, and (iv) objective of training, are given in the Table. It is only indicative and may have to be augmented/modified particularly to include training of subordinate staff and farmers.

10.5.4 Salient Features of Training

The most effective training in irrigation water management should be action-oriented, should emphasize the management aspects and should be conducted on actual operating systems, with identified problems in water use in the farmers fields.

The training needs for the involved in-service professional personnel are different in content and duration at different levels of responsibility. The training programme for different levels is given below. However, more emphasis on all levels is to be given to use of computers, farmers involvement, environmental control and sustainable development.

10.5.4.1 For Junior and entry-level personnel.

The training programmes of longer-term of 6 to 8 months should cover:

Table - Recommended Scheme for Training of Engineer Officers of Irrigation Department.

Nature of Training	Stage in Service	Duration of Trg. (months)	Objectives of Training
A. Induction Training (Basic & Technical)	On Entry to Service	12	**Basic** : Procedures, Rules & Organization of Irrigation Deptt. **Technical** : Academic & Practical-oriented
B. In-Service Training			
(i) Refresher/ Specialist Courses	After 3rd year of Service	¼ - 3	Input of modern technology not covered under 'A' or during college education.
(ii) Specialized Training	Between 8th to 12th year of Service	6 to 12	Develop special skills for planning, design, operation or management
(iii) Advanced Specialist Training	3 to 5 years after (ii)	1	Add on to specialized skill
(iv) Refresher Course in Field of Specialization	3 to 5 years after (iii)	½ - 1	Refresh sepcialized skill
C. (i) Appreciation Training	Between 15th to 20th year of Service	¼ - 1	Give inter-disciplinary background and appreciation of modern technology.
(ii)Management Training for Senior Executives	After 20th year of Service	¼ - ½	For operating in a specialized field for considerable time, based on individual competence.

- Rudiments of surface and ground water Hydrology and Irrigation, agronomical linkages.
- Surveying and levelling with special reference to laying out water courses, field channels, and operation and maintenance of canal systems.
- Design of control structures and discharge measurement techniques.

- Plant Science, Agro-techniques, Soil Science, On-farm land development, land consolidation.
- Irrigation and Drainage Engineering, including Hydraulics.
- Elements of Rural Sociology, Farmers' involvement, Water-users associations and farmer organizations.
- On-farm training for one full crop season and hands-on training working with inter-disciplinary group.

10.5.4.2 For Middle Level Officials

The programmes not exceeding 8 to 10 weeks should cover :

- Design of irrigation system including below the outlet control structures, discharge measuring devices.
- Elements of hydrology with special reference to role of rainfall in the crop development and groundwater hydrology.
- Elements of plant science, agricultural practices, soil science, land development and land consolidation and drainage engineering.
- Modernization concepts of the old irrigation systems, monitoring and diagnostic analysis.
- Water distribution systems with particular reference to warabandi type water distribution.
- Organizational aspects and inter-departmental coordination at various levels in the administrative and professional hierarchy.
- Performance Appraisal - quantitative methods and economic assessment.
- Rural Sociology and its application to irrigation system operation.
- Field visits and hands-on training at the farmers' fields and demonstration projects.
- Farm-management and economics.

For Middle level officials also, it is necessary to organize seminars, workshops and study tours in small and manageable groups.

10.5.4.3 For Senior Officials

The programme not exceeding 4 - 6 weeks should cover :

System analysis of the proposed utilization of the created potential which should include socio-economic-agricultural and environmental

aspects. This should also cover the basic needs of personnel management of line institutions.

- Methods of collection of irrigation data, storage, processing and analysis.
- Performance criteria and evaluation methods, both on the main canals, distributaries and also below the outlet;
- Benefit-cost analysis.
- Rural sociology aspects and their application to irrigation systems.
- Irrigation Water Acts, responsibilities of various involved water-use institutions.
- Importance of communications, motivation and leadership with reference to farmers' involvement in the water management.
- Financial analysis of on-farm irrigation management.
- Management techniques for efficient development and water utilization.
- Formulation of Operation plans for large irrigation networks.

Since smaller groups of government personnel at senior levels are involved, many of the subjects should be organized as short-term seminars, workshops and tour programmes.

10.5.5 Training Topics for Field Functionaries

The senior officers are normally expected to train/guide the field functionaries. An organized effort is required in this direction to improve the performance. Field functionaries include signallers, gauge readers, gate operators, canal inspectors, measurers, Ziledars, Patwaris, etc. They should be apprised of their job requirements. The topics of training should be selected according to the needs of the trainees.

For example, a Gauge Reader's job requirements and topics for training should include :

(a) Job Requirements

- to read gauges accurately.
- to neatly enter readings in the register
- to report punctually to the JE
- to adjust control gates to all authorized discharges.
- to report variations in levels/discharges in main and/or off-taking channels to the JE.

(b) Topics for Training

- types of gauges-vertical, slanting with magnification, least counts, etc.
- purpose of still wells for gauging, keeping inlet pipes clean.
- reading gauges accurately, eliminating parallax error
- maintenance of various registers prescribed for recording gauges of outlets, minors, distributaries, branches, main Canal and accuracy needed in their recording.
- free flow and submerged flow characteristics in Parshall flumes, orifices, etc. and their relationship to discharges.
- reading discharge corresponding to a gauge, discharge rating curves, statements, graphs.
- time fixed for recording and reporting gauges and discharges
- standard format for reporting
- authorized discharges in different canals
- setting gates to permit authorized discharge.

10.6 TRAINING OF FARMERS

10.6.1 TRAINING CONTENT

(i) Farmers are the principal users of water and are the weakest link in irrigation water management. It is important that the farmers know their rights and responsibilities in water management.

Farmers are required to be trained particularly on the community based approach, their responsibilities (not to encroach upon the share of downstream farmers) in the public delivery system and the science of irrigation.

Training should include :

* importance of land levelling,
* O&M of micro network,
* correct sowing periods,
* crop water requirements,
* advanced methods of irrigation.

* land preparation

* land shaping

* improved methods of on-farm water applications

* crops, cropping pattern and sequence.

* water distribution procedures below the outlet, economic and disciplined use of water.

* maintenance of water courses, field channels and drains.

* visit to successful field trial areas to instil confidence among farmers.

The training for farmers should be arranged at training centres and at farms, preferably in the local language.

10.6.2 WATER USERS' ASSOCIATIONS

The farmers should be organized in Water Users Associations (WUA) set up for each minor; and WUA should be effectively involved in land and water management for which Irrigation Departments have to include the representatives of WUA in the Canal Advisory Committees if not already done. The training of Water Management Associations (formed at minor level) should be arranged in stages as follows :

* reading gauges at minor, and using Parshall flumes or V-Notches at the outlets, calculating discharge in litre/sec using working tables for gauge versus discharge.

* calculating quantity of water by multiplying discharge in litres and time in secs.

* cost of water per thousand litres or thousand cubic metres as laid down by the project.

* water rates on volumetric or bulk supply water rates as per area basis as per the prevailing practices.

* crop water requirements with due adjustments at the field level, outlet level and minor level depending upon the seepage losses in the system.

* irrigation layout for preparing field to receive water, methods of irrigation, improvement in application efficiency by controlling stream size and cut-off time.

* calculation of water used for irrigation and total quantity of water required and used for the crop.

10.7 TRAINING NEEDS ASSESSMENT (TNA)

10.7.1 GENERAL

(I) Identification of deficiences of the system which can be remedied by staff training.

Training need is to cover the gap between actual and the expected performance of the trainee. The gap could be in terms of knowledge, skills and attitudes.

(ii) All the problems of system performance cannot be solved by training O&M staff. For example, when the system is in bad physical condition or where the staff morale is poor, training will have little effect on improving the performance.

The training needs could be at individual, group and organizational levels and have to be assessed in terms of knowledge, skills and attitudes. A systematic approach should be followed to assess the needs.

(III) For conducting a TNA, two types of data are required

(a) Information that identifies the nature and extent of irrigation performance, shortcomings, which may be available from the monitoring unit.
(b) Accurate and complete personnel records to assess the skill levels of all critical personnel categories of staff.

The training needs could be assessed through job analysis, interviews, questionnaires, performance reports, scrutiny of reports, meeting with staff/farmers, visits to project area, introduction of innovative techniques for improved performance, manpower development etc.

10.7.2 CONDUCTING A TNA PROGRAMME

There are seven steps for conducting a TNA programme (refer Annex - XVII for details).

(i) define performance shortcomings

(ii) define asessors for the TNA

(iii) select assessors for the TNA

(iv) set performance and skill proficiency for key managers and staff.

(v) draw profiles of skill proficiency of key managers and staff.

(vi) define gaps in skills of key personnel, and

(vii) determine which personnel is to be trained and on what subjects.

An example of a questionnaire for assessment of training needs is at Annex - XVIII.

10.8 MASS TRAINING PROGRAMMES AND OTHER METHODS

Besides formal training programmes, there are other ways and means for training the masses as well as groups of staff that would disseminate the information quickly.

* seminars/workshops
* kisan Melas, Shivirs (Camps) - using audio-visuals slide/film shows, video cassettes, live demonstrations, exhibitions.
* live demonstrations for action research
* television and radio announcements.

10.9 TRAINING CENTRE

10.9.1 GENERAL

A suitably located training centre, preferably at the centre of the command with faculty support from the department/ State WALMI/University in addition to its own, may be set up. . The Centre should have well equipped in-house testing laboratories for soil, water measuring devices etc. field laboratories, library, supporting staff, transport arrangements for trainees.

10.9.2 COMPUTER ORIENTATION/APPLICATION TRAINING

The concerned staff may be trained in computer applications. The Senior staff may be given a computer appreciation course to enable them to provide encouragement to the computer staff.

10.10 TRAINING MODEL

An effective training model should be evolved if the training is to be made useful and cost effective. The components of such a model will include.

(i) I&D Sponsoring Agency.

(ii) Trainees

(iii) Training institutions, and

(iv) Trainers.

The success of the training will depend on the contribution/input by each of the four components, design of training courses and the methods to be followed to bring out the desired behavioural changes among the trainees. Cooperation of the sponsoring agency with training institutions, continuous assessment of training requirements to design improved training modules and the working inter-relationships between the four components will help evolve an affective conceptual model.

The following figure presents a suggestive model.

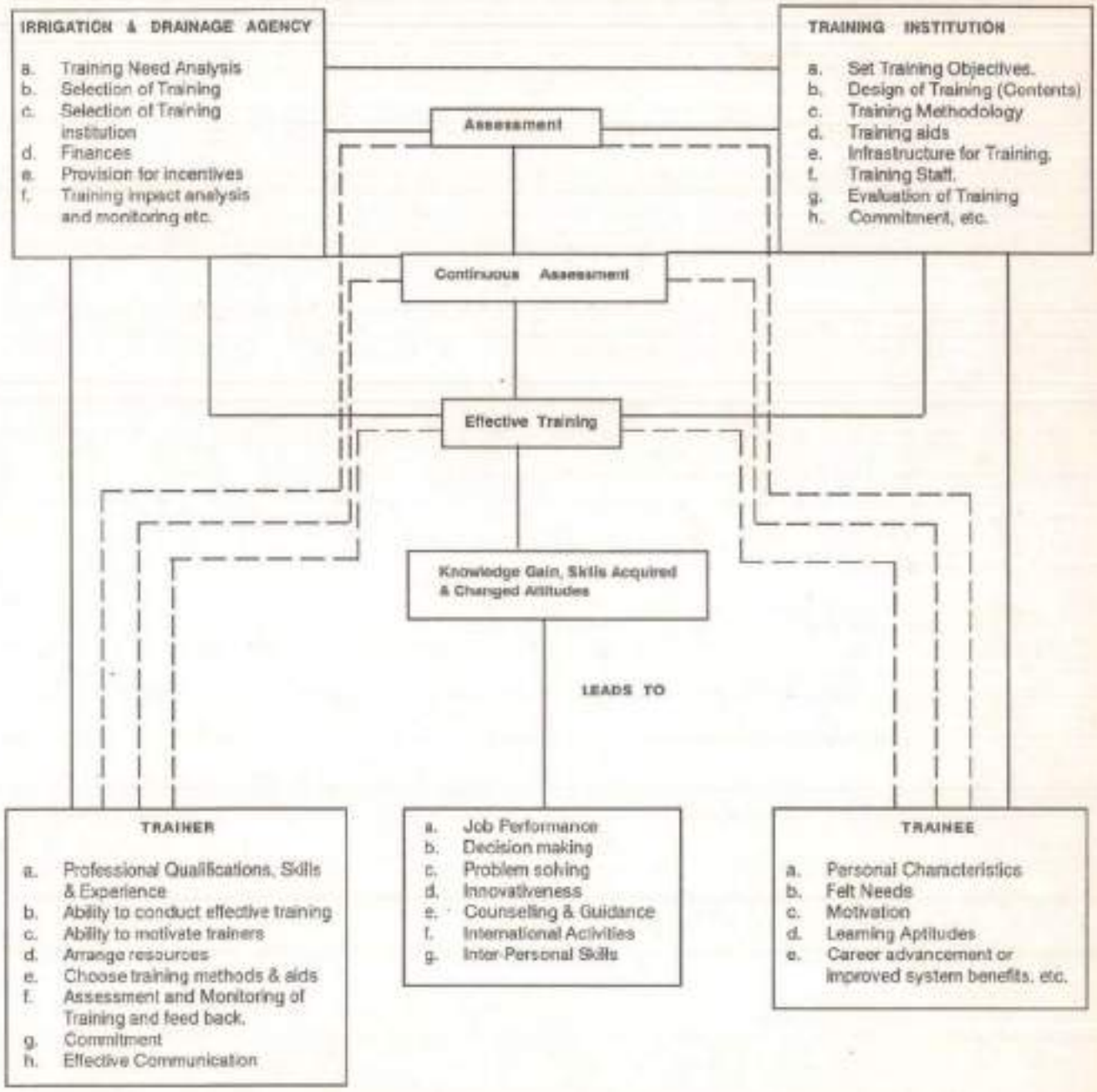

FIGURE 10.1 : EFFECTIVE TRAINING MODEL IN O&M OF IRRIGATION & DRAINAGE SYSTEMS

Note : This is only a suggested model by a professor which may be modified to suit location specific needs and capabilities.

BUDGETING AND FINANCING

CHAPTER 11

BUDGETING AND FINANCING

11.1 GENERAL

The following general aspects of budgeting and financing may be kept in view-

(i) Estimation of irrigation revenue and expenditure on programmes and works and activities of O&M, in advance, for the ensuing (Budget) year (April-March) is referred to as budgeting. Such an estimation for the future year(s) beyond the budget year will be termed as 'forecast' in this Chapter.

(ii) Budgeting for O&M is a mandatory requirement as per the Budget Manual in each State, to ensure timely receipt of formal authorization/allotment of funds in the beginning of the year under consideration. Allocation should be distinguished from allotment, the latter is the formal authorization for incurring expenditure, while the allocation signifies approval of funds and not the authorization to spend.

Procedure for receipt of firm allotment in the beginning of the year, say by April end, needs to be evolved. So far as O&M activity is concerned if the system of LOC (Letter of Credit) is followed, at least the credit should hold good for six months.

Budget allocation should be periodically reviewed in tune with the escalation in labour and material prices and submitted to appropriate authority intimating the revised need of budget allocation and fund allotment accordingly for proper maintenance of the I&D Systems.

(iii) Any work that is carried out to create an asset is a 'plan work'. In the O&M programmes, rehabilitation and modernization works are considered as "Plan Works" and are accordingly classified under 'Capital budget' or 'Plan expenditure.'

(iv) Capital cost of a major/medium project includes cost of construction of project components and facilities and construction of water courses upto 5-8 ha blocks.

O&M costs during the construction period are generally met from the capital budget for the completed portion of works yielding partial benefits.

(v) O&M funds include establishment (staff) charges and are generally allotted on adhoc basis based on per ha of potential created/C.C.A. Alternatively, per km basis of channel length (length standardized for channel size) could also be considered for allotment of funds. Physical condition of works also need consideration. There is need for rationalisation in this respect.

(b) Due to uncertainty of allotment from the revenue (or non-plan) budget for O&M, the overall resources available for capital and revenue expenditure of the department/organization may be considered together for O&M so that a considered view may be taken about the availability of resources for O&M.

An adequate allotment needs to be made for proper upkeep of the existing systems rather than creating new irrigation potential in order to get better returns from the investment already made. This calls for a balanced view of deployment of available funds for plan projects and for meeting O&M costs of existing works.

Establishment charges (a part of O&M charges) have been mounting particularly to continue the work-charged staff even after completion of a project according to the Supreme Court (SC) directive (Staff costs for medium and major projects for 1991-92 in J&K was 76.67%). Suitable measures need to be evolved to limit staff costs e.g., transferring surplus staff to new investigation work or to construction site.

(vi) The productive and non-productive criteria of irrigation projects is no more in existence. Benefit-Cost (B/C) ratio concept has been introduced since 1964. For a project to be economically viable and acceptable, the B/C ratio should be more than 1.5. Projects with, B/C ratio less than 1.5 are not accepted for implementation under the Five-Year Plans. However, in the case of drought affected areas, B/C ratio is relaxed to 1 in respect of projects serving such areas. Benefit is the net value of agricultural production (with irrigation - without irrigation), and cost comprises interest and depreciation on capital plus O&M charges.

(vii) Cost Allocation in Multi-Purpose Projects : Different methods have been applied for allocation of costs and revenues. The question of cost allocation in case of the project serving one State only is not relevant as the expenditure is met from the State revenue. In cases where the project serves more than one State and the Central Government contributes to one of the project purposes, the question has to be resolved by the concerned parties.

(viii) A clear and concise presentation of budget contents will assist consideration by the relevant authorities, and enhance the chances of a positive outcome for the organization. In this connection, it is absolutely imperative that the Budget request in any year is framed to meet the agreed objectives for the organization and in accordance with its policies and priorities. Moreover, many of the budget proposals will have financial implications which extend beyond one financial year, and individual forecasts need to be framed in the context of the organization's longer-term Financial Plan in tune with the relevant Five Year Plan.

11.2 PREPARATION OF BUDGET PROPOSALS

Procedure for budget preparation is laid down in the State Government Budget Manual. Rules and procedures are also contained in irrigation manuals/ financial hand books.

11.2.1 FORMAT AND TIMING

(i) The budget cycle extends over the following time periods :

* formulation and approval processes must be completed prior to the financial year to which they apply.
* implementation of the approved budget during the financial year.
* final review and evaluation of budget performance (variation statement) at the end of the year of implementation.

The formulation and approval period has fixed deadlines as given in the Budget Manual. Accordingly, the organization units will need to have a disciplined approach to this activity.

11.2.2 AN EXAMPLE OF BUDGET PREPARATION

Irrigation Revenue

Most of the receipts come from the irrigation charges which are estimated separately for Rabi and Kharif seasons. Small portion of revenue comes from sale of water to cities and towns for domestic and industrial purposes and receipts on account of cultivation of canal lands, water mills, plantation, etc.

Dates for submission of budget estimates by EE to SE are prescribed. For example, in one of the northern States the dates are :

- estimate for the ensuing year	01 October
- revised estimate for current year	15 October
- final revised estimate	15 December

Revised estimate would include actual receipts for Rabi and forecast for kharif.

Final revised estimate would include actual receipts for both the crop seasons - Rabi and Kharif. Revenue receipts are collected from the office of the Board of Revenue in each State.

All the estimates are consolidated and submitted to the government through the Chief Engineer/Engineer-in-chief.

It is suggested that the revenue assessment should be simplified by evolving a flat rate system for kharif and rabi seasons and collection at outlet head. It would spare revenue staff for watching and supervision of the system thereby reducing O&M expenditure.

Expenditure

Expenditure is worked out for the works for which authorization has been issued.

Dates for submission of estimates for expenditure by EE to SE similarly are:

- expenditure for the ensuing year	15 September
- preliminary forecast of expenditure for current year	15 October
- final forecast of expenditure	15 December
- supplementary forecast (demand)	01 February

The expenditure will include ordinary repairs, special repairs (including reserves for SE and CE) for emergency repairs and improvements, depreciation reserve for distress conditions (small percentage, say 1% of capital cost to O&M), tools and plants, provision for stores, establishment charges including salaries, allowances, contingency, collection charges paid to the Revenue Department. After consolidation, the estimates are submitted by the Chief Engineer/Engineer-in-chief to the government.

Presentation of Budget Proposals

The budget proposals submitted to the government by the Chief Engineer/ Engineer-in-chief are scrutinized and finalized by the State Finance Department for presentation to the Legislature, which usually passes -

- supplementary budget for current year	in February
- budget for the ensuing year (1st April)	in March

Allocations under different heads are communicated to the Head of the Department (Chief Engineer/Engineer-in-chief) and are followed by formal allotment/ authorization of funds. The Head of Department makes allocations soon there after to the various irrigation Divisions.

11.2.3 STANDARDIZED BUDGET FORMS

(I) There is a need of standardized forms and documents to be developed, both to facilitate their original formulation within the individual units and the subsequent consolidation by the Budget Section at the Chief Engineer/ Engineer-in-Chief's Office. All the budget estimates of revenue and expenditure are submitted to the government. The Budget Section should prepare the budget forms, and related instructions and specifications in consultation with the appropriate functional managers, and arrange for their distribution.

(II) The specifications and instructions should cover :

* description of activity or programmes

* justification for activity e.g.:

* relationship to objectives for particular functional responsibility
* commitment by organization or government
* effect on service being provided
* economic justification (if appropriate)
* priority
* whether a continuing or new activity

(iii) Scheduling of associated resource commitment is expressed ultimately in financial cost. Typical items are :

* personnel
  - numbers and classification
  - wages and salary costs
  - related allowances and expenses
* equipment and plant hire
* supplies and materials
* energy, fuel costs
* pumping costs
* technical service costs - internal, external
* contract services
* training
* travel, within-country and external
* administrative and general expenses
* any other item of project expenditure

(iv) The instructions should also provide advice on standardized costs, recurring and non-recurring, to be used in estimating e.g.:

* salary and wage rates
* fuel, energy costs/unit
* plant hire, hourly or daily rate
* particular materials and supplies
* contingency in budget estimates and inflation element in forecasts (if applicable).

The estimates of costs and resource commitment will be drawn from the estimates set out in the various elements of the POM and associated work plans.

If the estimate applies to a system or parts of the system commissioned, though the entire project is yet to be completed, then the estimates will be made for O&M of the commissioned portion of works chargeable to 'Plan/Capital Budget.'

11.2.4 IMPLEMENTATION OF APPROVED BUDGET - BUDGETARY CONTROL

(I) Once the budget has been approved the following will occur :

* Budget Section at the Chief Engineer/Engineer-in-Chief's Office will advise organization units (divisions) of the approved budgetary allocations in each case.

* Unit Managers will adjust if necessary, their work plans and programmes in accordance with approved allocation of funds.

* Unit Managers will prepare and forward revised estimates for approval by the competent authority depending upon their financial powers for sanctioning estimates.

* Budget Section will monitor and provide periodic reports on implementation.

(II) The reports and reviews by the Budget Section should conform to the specifications set out for the Management Information System (MIS) (Refer Chapter 7).

11.3 FINANCING

The operation and maintenance charges of irrigation and drainage projects are met out of the general revenue of the State, which includes the irrigation revenue realized from the irrigation projects. Besides the share of the State from the Central revenues is disbursed by the Central Government as per the award of the Finance Commission, for meeting O&M of State Irrigation projects and other sectors of development. The recommendations of the Ninth Finance Commission in this regard are at Annex - XIX.

The annual expenditure incurred on O&M of major and medium projects in nearly all States has been very low. The O&M grants should be enhanced in tune with the need of proper upkeep based on per ha rate approved by Finance Commission from time to time.

11.4 RELIABILITY

The costs associated with operation and maintenance of an irrigation system have fixed (salaries, etc.) and variable cost elements. Frequently, costs are incurred on droughts and floods over which management has no control. The need for maintenance effort can vary over the life of a project, depending on

the age of the components relative to the anticipated service life. The type of construction, texture and structure of soils and meteorological factors also affect maintenance effort.

On the other hand, the anticipated revenue may vary from the "normal". The revenue is based on the supply of water. The occurrence of a drought reduces supply, higher than normal rainfall reduces demand, and both these situations will result in lower than normal revenue even though actual operating costs may be higher because of these abnormal circumstances.

The budget process requires forward estimates based on 'normal' conditions, unless it is known otherwise with some certainty.

The requirements of O&M functions do not have the same order of possible fluctuations as revenue sources. Any drastic cut in O&M costs would adversely affect the system performance, thereby reducing revenue/benefit in the future.

11.5 SPECIAL FUNDS

There may be circumstances for the establishment of Special Funds, or special arrangements to access additional funds in particular situations

11.5.1 RESERVES

To provide for unexpected operation or maintenance cost during the course of a financial year, e.g. floods, droughts etc. Funds for meeting such expenditure are available with the State as 'Margin Money' on the basis of Finance Commission award for gratuitous relief for calamities. For funds requirement in excess of 'margin money', states will approach Union Ministry of Agriculture on the occurrence of natural calamities like floods, cyclones, drought etc.

11.5.2 REPLACEMENT FUNDS/DEPRECIATION RESERVE

If significant expenditures are anticipated in future to replace project facilities, it may be appropriate to include depreciation components in current charges or revenue, and place these amounts in a "Replacement" /Depreciation Reserve account subject to established procedures. However, rehabilitation and modernisation of existing projects can be implemented from plan funds (refer para 11.1 (iii) of this Chapter).

11.6 FOREIGN EXCHANGE

Foreign exchange may be required for purchase of equipment, materials, spare parts, for training or other activities.

It is important to identify foreign exchange requirements well in advance of the actual procurement so that stores and other items can be replenished

without creating shortages that adversely affect the timing and effectiveness of O&M activities.

11.7 WATER SERVICE CHARGES

(i) Charges for the supply of water generally take the form of a water rate, which varies with the crop grown and is levied on the basis of the area irrigated and matured. The water rate has no relation to the cost of supplying water but is fixed by each State Government, from time to time, taking into consideration a number of factors.

The Irrigation Commission (1972) recommended the following principles as guidelines to fix water rates :

(a) Water rates should be levied on a 'crop basis', except in the case of tubewell irrigation.

(b) The rate should be related to the gross income from the crop and not to the cost of the project. It should range between 5% and 12% of gross income, the upper limit of percentage being applicable to cash crop.

(c) The rates should be within the paying capacity of irrigators and should aim at ensuring full utilization of available supplies.

(d) There should be minimum disparity, in the rates charged between regions with a similar class of supply.

(e) The rates should be fixed on the basis of quantity and timeliness of supply : lower rates for less demand due to good rainfall or where the supply is inadequate and uncertain.

(f) The general level of rates in a State should be such that, taken as a whole, the irrigation schemes do not impose any burden on the general revenue.

(ii) In some States, an annual charge or cost is levied for every hectare of the area irrigable from a project whether water is taken for irrigation or not, which is called 'irrigation cess'. This is distinct from water rates which are charged on crop-wise basis generally.

In Assam, and on some minor irrigation works in Bihar, no charge is made for supply of irrigation water.

The water rates may be charged separately or as part of a consolidated assessment as in southern India. In north-west India, water rates are levied on crops matured (each crop being charged only once), in Maharashtra and Gujarat, water rates are levied on area irrigated in each season, Kharif, Rabi and Hot weather and not by crops.

There is thus considerable variation in the methods followed in different States for assessing water charges.

(iii) An Irrigation Pricing Committee of Planning Commission is engaged at present in examining this issue in all its aspects and its recommendations when available will help States to review the existing rates.

COMPUTERIZATION

CHAPTER 12

COMPUTERIZATION

12.1 INTRODUCTION

(I) Computerization refers to making use of low cost micro-computers, also known as Personal Computers (PCs), for management of water resources relating to O&M of irrigation and drainage systems. The important information to be stored and processed relate to data on water availability, monitoring gauge/discharge regulation of channels, allocation of water between different canal systems, channel rostering programme, maintenance programme, etc. These computers are being used in hydrology for primary processing in field offices or for dedicated applications such as on-line, real-time forecasting for hydrodynamical control, and for computer orientation.

(II) Besides low cost, the micro-computers have an adequate memory, occupy small space, consume low power, and withstand wide climatic changes. Data/information can be acquired/fed, processed, stored and transmitted via the available communication system in short time. At unattended remote sites, Data Collection Platforms (DCP) linked to Satellite telemetry transmit compatible data (in frequency, format, timing) for water management needs.

12.2 NEED FOR COMPUTERIZATION

(I) The need for computerization is obvious in the context of improving efficiency and effectiveness of O&M of irrigation and drainage systems in a cost-effective and expeditious manner.

(II) Computerization will provide invaluable support to :

(a) Irrigation Management : The various activities of operation, maintenance and management of project components and facilities need to be coordinated for their efficient and effective working. It is a gigantic task in case of major and medium projects. For example, planning of irrigation supply in an optimal way for channel network, gate opening/closing and flood management to avoid damages, conservation of water, etc. are some of the functions which can be processed through computers.

(b) Hydrological data processing, particularly for real-time data as proposed in the case of Narmada Projects.

(c) Preparation of hydrological and mathematical models

(d) Monitoring of project activities and performance

(e) Managerial tasks of daily routine, decision-making etc.

(f) Communication

(g) Financial Management

(h) Monitoring and evaluation.

(i) Inventory control of stores, etc.

12.3 PLAN OF COMPUTERIZATION

Computerization of an irrigation unit/project should be planned after making study of the problems such as reservoir operation, canals operation,data storage and processing. The computerization should be taken up in stages according to the need and availability of funds. The computer load will increase with the usage. larger and faster computers may then be required and the existing computer may work as a slave unit.

12.4 MICRO COMPUTER SYSTEM

(i) The discovery of the CHIP (Integrated Printed Circuit) in 1959 revolutionized the development of micro-computers. The chips contain, photographically placed, diodes, transistors, resistors, condensers and integrators. In 1970, a chip contained hundreds of thousands of transistors per square cm. Since then the computer technology has made rapid advancement and has resulted in smaller, cheaper and reliable computers.

(ii) The computer perlorms with speed the following functions :

* acquisition of data and information.
* storage of data/information.
* processing
* presenting results (output).

(iii) A computer has two parts : Hardware and Software.

(a) Hardware

The hardware comprises the computer and the peripherals (disk drive, key board, mouse, screen, printer).

A computer has three major parts :

* Central Processing Unit (CPU) - the micro processor

* Internal Memory(ies) to store information. It is of two types RAM (Random Access Memory) for temporary storage and its contents are lost on turning off the computer; and ROM (Read Only Memory) from which information can be read and its contents are retained on turning off the computer.

* Communication system with external devices such as keyboard, mouse, display screen, disk drive, printer, plotter, modem, scanner, diskettes.

Diskettes (3 ½ " or 5 ¼ " diameter) are magnetic storage devices. Information on diskettes is read by a disk drive which rotates the diskette and has a "read-write" head for discerning the contents; have memory from 360 KB to 1 MB.

Hard Disk is built into a Computer and is rotated by the Disk Drive having a "read-write" head. It has a memory upto 100 MB or more.

Printers are of three types : Dot Matrix, Daisy Wheel, Laser. Desk Top Publishing (DTP) can be used with PC/AT or PC/XT and could be used for quality report production.

Scanner digitizes an illustration and stores the resulting information as coordinates.

Networking facilitates communication between several desks within an office (such as local area network - LAN) or several offices of the organization, by telephone, telex, fax, and computer - either using land lines, radio or satellite or a combination of all three. Communication between computers is done through 'Modem'.

(b) Software

These are computer programmes. There are four types of programmes:

* Operating System (OS) programmes, or frequently called DOS (Disk Operating System).

* Utility programmes

* General use programmes, and

* Speciality programmes.

OS Programmes manage the internal working of a computer including reading and writing information to diskettes/hard disk. IBM and IBM compatible computers can use one of the several operating systems. Micro-Soft - Disk Operating System (MS-DOS) is more common and now is in fifth version. Other operating systems are : UNIX, XENIX, POSIX, AMOS, etc. UNIX is particularly useful for networking.

Utility Programmes are short programmes to speed up an operation or improve the use of other programmes, e.g., changing the function of keys on key board.

General Use Programmmes are used most often and are of four types. The commonly used softwares are mentioned alongwith them.

* Word Processor - WORD STAR, WORD PERFECT, MS-WORD

* Data bases - dBASE, FOXBASE

* Spreadsheets - LOTUS 1-2-3, SUPERCALC, VISICALC

* Graphics - SURFER, STATGRAF, HG

Speciality Programmes range from simple game programmes to highly complex engineering model simulation programmes.

Programming Languages : One is never required to use a programming language. These are tools to write all other types of programmes. There are several languages. Important procedure-oriented languages in common use are :

FORTRAN	(FORmula TRANslation)
ALGOL	(ALGOrithmic Language)
COBOL	(COmmon Business Oriented Language)
BASIC	(Beginners All-purpose Symbolic Instruction Code)
PL/1	(Programming Language 1)
PASCAL	(Named after French Mathematician Blaise Pascal)

Tool Kits or Programming Tools are additional programmes to help the programmers.

(c) Generic Micro-Computers (PC)

These are :	PC (Personal Computer 8088),without hard disk
PC/XT	(PC - Extended Technology), with hard disk
PC/AT 286	(PC - Advanced Technology), with hard disk
PC/AT 386	(PC - Advanced Technology), with hard disk
PC/AT 486	(PC - Advanced Technology), with hard disk

More powerful computers such as Mini and Super Mini are used to handle very large data/information.

12.5 SELECTING A COMPUTER

(i) Selection of a computer for an irrigation unit (starting with a Division) should be based on the requirements of the problem(s) to be solved. It is therefore necessary to :

(a) define the current and future problems

(b) select computer programmes that would be most useful to solve the problems, and then

(c) select the computer that would run the programmes and would meet, as far as possible, the future needs.

(II) For selecting a small computer, one should be aware of the computer characteristics :

(a) Modules of Computers : The computer design should be modular, i.e. each part such as key board, screen, memories, disk drives should be replaceable.

Other characteristics are - speed of operation, number of bits (8,16,32), diskette/floppy type the computer can read, size of bytes of RAM and size in bytes of hard disk, data and programme sharing with other computers with LAN.

(b) Expandability of memory and programmes

(c) Compatibility with regard to programmes, operating systems and languages.

(d) Maintenance of hardware; and maintenance of software and data backup, archiving, reformatting, etc; availability of consumables (floppies, paper, ribbons, ink).

(e) Quality of Manuals

(f) Cost

(g) Training for use of the Computer

A comparison of all these aspects may be made before purchase of the computer.

12.6 COMPUTER MODELS

(I) A large number of computer software and models have been developed for problems of irrigation, drainage and flood control. Some of the models are available in the country. Most of the models are written in FORTRAN and can be run on any PC/XT or PC/AT Computer.

(II) Suitable models may be procured depending on the needs and the availability of computer facilities. Models can be developed locally, but it is a long process.

The computer centre should maintain a list of models of their use and the source of availability for procurement.

12.7 COMPUTER FORMATS

Design of formats for data input and output is an important part of computerization. It would be advisable to prepare these formats in consultation with a computer specialist. A sample list of formats has been given at Annex - XIII to Chapter 7 : Management Information System (MIS). A specimen of a computer format for input for water allocation for a canal system taking off from a river is at Annex - XX. The formats should be easily followed by field level functionaries. The Pune based Centre for Development of Advanced Computing has developed technology which enables data storage in Indian languages. This would be helpful to the field functionaries.

MONITORING AND EVALUATION

CHAPTER 13

MONITORING AND EVALUATION

13.1 GENERAL

(i) In essence, monitoring is a process of data collection and compilation for use in the review of performance status at regular intervals and comparing it with the targets set. This would highlight performance weakness and reasons/causes therefor. Evaluation, i.e. concurrent review analysis of the collected data under monitoring, is carried out to know how the targets could be achieved. A carefully planned and specifically designed MIS with common MIS base can ensure effective coordination for monitoring and evaluation activities.

(ii) The monitoring and evaluation should be conducted by an internal unit on a continuing basis (regular irrigation audit), and also by the independent agency which is separate from field units, say, once in five years. Necessary Guidelines to this effect should be developed and incorporated in the POM for the two cases.

(iii) The monitoring and evaluation details required for irrigation projects and drainage projects vary considerably. These details are critical in setting priorities for O&M and adjusting seasonal and yearly operational requirements.

(iv) Data are the observed attributes, and information results from processing the data in a meaningful form. The information supplied by a lower office in the hierarchy to the higher office is treated as data for further processing.

13.2 MONITORING AND INSPECTION VISITS

(i) Items to be monitored must be specifically noted. The organizational unit responsible for each monitoring activity must be identified. Items to be monitored at middle level and at top level should be clearly identified. It is important to transmit the monitored information to the appropriate authority. The reporting level of information should be carefully determined to be effective. Reporting of grass root level information such as filling of village ponds, visit of VIPs, etc. is meaningless.

Details required in a monitoring plan include, but are not limited to :

* daily monitoring and reporting of head and tail gauges of distributaries and minors;
* precipitation and temperatures;

* evaporation;
* crop production (area, yields, types of crops, age of crops);
* water quality;
* water use - irrigation, municipal and industrial, others;
* groundwater quality and levels;
* return flows and quality;
* drainage water quantity and quality;
* soil salinity;
* progress of irrigation development;
* adherence of roster of running of canals under rotational schedule;
* revenue assessment;
* daily/fortnightly monitoring of reservoir inflow, gauge and discharge observations at head and tail through proper measuring devices.
* feed back from implementation of past evaluation reports.
* communication system
* operating costs of major components such as :

  - individual pumping plants
  - main water supply
  - distribution blocks (secondary, tertiary).

* maintenance activities, schedule and costs for major components - headworks, lining, service roads, structures, breaches.
* environmental concerns are reflected in some of the items noted above. A fuller list of these concerns is given hereunder : pollution of surface and ground waters, waterlogging, erosion, hydrological changes, climatic changes, changes in aquatic life and fisheries, wet lands, pests, resettlement, health, socio-economic conditions.

Data to be collected for each monitored item should specify.

* monitoring locations for each activity.
* methods and procedures for each monitoring activity.
* timing of monitoring actions.
* data presentation, format, detail and storage.
* distribution of information.

(II) Tours and inspection visits by officers in their jurisdictions of physical system network cannot be substituted by monitoring. Officers issue corrective instructions on-the-spot to the field staff and keep the latter alert and vigilant in the discharge of their duties. The officers get first hand information from the staff and the farmers about the performance of the system.

Surprise checking is another tool for monitoring and management.

13.3 EVALUATION

Evaluation of information gathered in the monitoring process must also be systematically performed. The organization units responsible for evaluating data must be identified and assigned specific evaluation areas. General information which is needed for each type of evaluation will include :

* data sources (for monitoring and other areas);
* timing of evaluations
* methods to be used in making evaluation for each purpose;
* format for the evaluation to be distributed including reports to be prepared reflecting the evaluation. The evaluation reports should bring out the priorities for implementation of short-term and long-term remedial measures.
* who will receive the reports and when?

13.4 PERFORMING EVALUATION

To manage a system properly the physical effectiveness of past operations must be considered against the original criteria set forth for the project, or as subsequently amended following modification of the facilities. Procedures for acting on the indicators uncovered in evaluation are critical to the financial and operational efficiencies of a system. Priorities for adjustments in the system and scheduling the needed maintenance can best be made by using inputs for timely and proper evaluation reports. Some of the diagnostic analyses that can be considered are :

(i) Farmers operation performance

- adequacy of crop production techniques for irrigated farming including adequacy of supply of inputs such as credit, certified seeds, fertilizers, pesticides, etc.
- adequacy of irrigation methods.
- farm management and economic results.
- soil management and erosion control.
- on-farm efficiency of water use.

(ii) Delivery operational performance

- water use efficiency in distribution
- water losses (physical including evaporation)
- project overall water use efficiency.
- deep percolation
- canal seepage
- spillage from canals
- dam and foundation seepage
- water operational losses (such as leakage from gates,etc.)
- adequacy of delivery scheduling.
- energy use.

(iii) Drainage operational performance

- drainage requirement area-wise.
- water table fluctuations by season and years.
- water quality changes by reach-wise for drain effluents.
- soil salinity changes area-wise.

(iv) Maintenance of individual components

- civil works
(1) Canals
(2) hydraulic structures
(3) drains
(4) buildings and roads

- equipment degradation and prediction of replacement schedule :
(1) fixed (pumps, hoists, etc.)
(2) moveable (earthmovers, transport vehicles, truck, loaders, etc.)
(3) computers and office equipment
(4) communication equipment, measuring devices installed, gates, etc.

(v) Overall Project Review : Efficiency and Effectiveness. The procedures outlined in paragraphs (i) to (iv) above will facilitate evaluation of the relative performance of various project components and activities, and should show whether poor performance is a technical or managerial problem which could be resolved by internal management processes.

It may be necessary, from time to time, to carry out a more wide-ranging evaluation of the total project, for example, if poor performance is a result of inadequate flow of funds for O&M because of inadequate generation of benefits, or from external economic, social or environmental effects.

Some of the matters which should be highlighted in such a review are :

documentation of project costs and revenues

- adequacy of revenue sources to meet O&M needs
- benefit flows from project to farmers; governments; others
- comparison of benefits generated to revenue required
- relevant agricultural and engineering issues
- social and environmental changes and concerns and resulting implications
- institutional effectiveness in providing efficient and effective system operation and services to water users.

13.5 MONITORING FORMATS

The monitoring data should be collected in prescribed formats to facilitate their processing for evaluation.

The formats should be designed so as to ultimately fit in the computerized management information system.

A list of formats for a manually monitored large irrigation system is at Annex - XXI.

13.6 RECORD OF EVALUATION REPORTS AND LESSONS FOR FUTURE

The evaluation reports should be easily accessible for future use. It is easy to have them if a computerized MIS is used in the project.

13.7 TRAINING NEEDS

Training needs for monitoring and evaluation should be assessed and a plan be drawn to train the personnel for effective contribution by them. Advantage may be taken of the training programmes conducted by WALMIS (Water and Land Management Institutes) in different States for the purpose.

ANNEXURES

ANNEX I
(to Chapter 2)

GUIDE TO AUXILIARY DOCUMENTS : PROJECT OPERATION AND MAINTENANCE

GENERAL

The Plan of Operation and Maintenance (POM) constitutes the comprehensive guide, detailed instructions, background information and documentation for operation and maintenance of a project. The scope of POM is provided in Chapter 1 of the Guide.

Besides the preparatory work by the O&M unit, several documents are to be prepared by other units in the irrigation agencies prior to commencing operation. These are to convey instructions and/or information to be incorporated into the POM with the complete documents serving as reference on the subject items. The documents include :

a. **Project Feasibility Plan** : The Project Planning document forms an important part of the O&M reference material. Of particular importance in addition to the report are the policies, rules, regulations and legislation bearing on O&M. Water allocations are an example. And, of course, the details of the adopted project services, farmer obligations, cost allocation, water charges, agency/farmer O&M responsibilities and all other project commitments are essential to this POM.

b. **Designers' Criteria** : The design unit is to prepare a comprehensive report stating criteria used in design of the facilities. These are to cover such matters as material characteristics, allowable stresses, allowable loadings, allowable loading conditions on and adjacent to structures,protective measures to be maintained effectively and surface drainage removal.

c. **Designers' Instructions to O&M** : The design unit is to prepare a comprehensive report clarifying the permissible operating conditions including start-up and shut down of each individual facility, system sub-component and system, permissible rates of filling and emptying specific canal reaches, siphons and pipelines are obvious examples Rate of operation of gates and valves are another. Required compaction and shape of canal prisms to be maintained including cross-slope of road sub-grade and road surfacing; inspection and performance of toe drains and bridge supports; and cautions when finding dampness at aqueduct abutments, concerns with surface drains and canal lining are yet other examples. This is an important document that the people who design, must complete at the time plans and specifications for construction are readied, since others cannot reconstitute these guides nor are O&M staff capable or responsible for developing them.

d. **Instructions for acquisition of land for O&M** : Maps of acquired land and conditions for relocation of utilities are to be documented. Specific provision of access or other factors affecting O&M are to be stated.

e. **Construction/Supply Contract Documents** : Sets of drawings and specifications for all works should be furnished to the O&M unit at the time of tender. Subsequently, copies of change orders shall be sent when issued. These will form the initial basis for preparation of O&M manuals to be further refined using as-built drawings.

f. **As-built Drawings and Manufacturers' Instructions** : As built drawings should be completed by the design unit and forwarded to O&M within six months of acceptance of a project component from the contractor. These are essential for completing POM and their receipt should not be delayed until contract completion for large contracts nor until all components are completed. Likewise, manufacturers/ suppliers warranties and instructions on equipment and materials should be provided as received. Completion report highlighting the construction problems faced and solved should also be supplied to O & M unit.

g. **Facilities Commissioning Procedures** : Specific procedures for commissioning individual facilities, system sub-components and systems are to be stated. These are to include a description of acceptance tests, start-up procedures, measurements and remedy of deficiencies. The participation of representatives from the design, construction and O&M units are to be identified with responsibilities clearly stated. The Construction Unit should take the lead in preparing these with assistance from the other two-design and O&M.

h. **Initial complement of Equipment and Supplies** : Though a part of POM, a seperate document is required to be prepared by the Project O&M Unit together with the State O&M Office describing the necessary complement of fixed and moveable equipment and stock of supplies required at project start-up and at each subsequent stage of project development. This is required to allow timely budgeting, procurement and commissioning before the project services are to commence. Equipment is to include office, shop and field. Supplies are to meet like uses including one year's spare parts, replacement components (filters, belts, etc.), lubricants etc. Usually, the project O&M unit is not staffed early enough to do this alone nor does it have funds to carry these start-up expenditures. It is a necessary part of the initial project investment and must be acknowledged and treated as such. It is assumed that offices, buildings, yards and lands are provided as a part of the usual project construction activity.

i. **Initial Complement of Staff** : Though a component of the POM, the initial two-years complement of staff noting specific numbers and qualifications are to be presented in a separate document. Required training courses and method of presentation are to be included. An essential part is the schedule showing recruitment, evaluation, placement, orientation and specific training activities. This must assure a fully capable staff in place at start-up that knows operation and maintenance of equipment, facilities and the systems. Funding and capability constraints necessitate that this also be a part of the intial project activity and investment. This document should be prepared by the Project O&M Office.

ANNEX II
(to Chapter 3)

RELEVANT EXTRACTS FROM THE NATIONAL WATER POLICY, 1987

i. In the planning, implementation and operation of projects, the preservation of the quality of environment and the ecological balance should be a primary consideration. The adverse impact, if any, on the environment should be minimized and should be off-set by adequate compensatory measures.

ii. There should be integrated and multidisciplinary approach to the planning, formulation, clearance and implementation of projects, including catchment treatment and management, environmental and ecological aspects, rehabilitation of affected people and Command Area Development.

iii. Structures and systems created through massive investments should be properly maintained in a good health. Appropriate annual provisions should be made for this purpose in the budget.

iv. There should be proper organisation arrangements at the national and state levels for ensuring the safety of storage dams and other water-related structures.

The central guidelines on the subject should be kept under constant review and periodically updated and reformulated. There should be a system of continuous surveillance and regular visits by experts.

v. Irrigation planning either in an individual project or in a basin as a whole should take into account the irrigability from all available sources of water and appropriate irrigation techniques. The irrigation intensity should be such as to extend the benefits of irrigation to as many number of farm families as possible, keeping in view of need to maximize production.

vi. There should be a close integration of water use and land-use policies.

vii. Water allocation in an irrigation system should be done with due regard to equity and social justice. Disparities in the availability of water between head reach and tail end farms and between large and small farms should be obviated by adoption of a rotational water distribution system or Warabandi, supply of water on a volumetric basis subject to certain ceilings.

viii. Concerted efforts should be made to ensure that the irrigation potential created is fully utilized and the gap between the potential created and its utilization is removed. For this purpose the Command Area Development approach should be adopted in all irrigation projects.

ix. Water rates should be such as to convey the scarcity value of the resource to the users and to foster the motivation for economy in water use. They should

be adequate to cover the annual maintenance and operation charges and a part of the fixed costs. Efforts should be made to reach this ideal over a period, while ensuring the assured timely supplies of irrigation water. The water rate for surface water and ground water should be rationalised with due regard to the interest of small and mariginal farmers.

x. Efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating the farmers in efficient water use and water management.

xi The efficiency of utilization in all the diverse uses of water should be improved and an awareness of water as a scarce resource should be fostered. Conservation consciousness should be promoted through education, regulation, incentives and disincentives.

There should be a master plan for flood control and management for each flood prone area. Sound watershed management through extensive soil conservation, catchment area treatment, preservation of forests, increasing the forest area and the construction of check-dams should be promoted to reduce the intensity of floods. Adequate flood-cushion should be provided in water storage projects, wherever feasible to facilitate better flood management. An extensive network for flood forecasting should be established for timely warning to the settlements in the flood plains, alongwith the regulation of settlements and economic activity in the flood plain zones, to minimize the loss of life and property on account of floods. While physical flood protection works are necessary, the emphasis should be on non-structural measures for the minimization of losses, such as flood forecasting, warning and flood plain zoning, so as to reduce the recurring expenditure on flood relief.

xii. A perspective plan for standardized training should form an integral part of water resource development. It should cover training in system operation, physical infrastructure and the management of water distribution system. The training should extend to all the categories of personnel involved in these activities as well as the farmers.

ANNEX III
(to Chapter 3)

REGION-WISE IRRIGATION ACTS AND RULES

N.B. 1 THE INFORMATION ABOUT ACTS AND RULES IS INCOMPLETE. THE STATES ARE REQUESTED TO UPDATE THE INFORMATION IN RESPECT OF THEIR IRRIGATION ACTS AND RULES AND FURNISH INFORMATION TO INCID.

2 RELEVANT DETAILS OF O&M ASPECTS MAY BE ADDED FROM THE ACTS AND RULES.

NORTHERN REGION

* Indian Easements Act 1882 : Delhi, Uttar Pradesh
* Punjab Minor Canals Act 1905 : Punjab
* Uttar Pradesh Irrigation (Emergency Powers) Act 1950
* Rajasthan Irrigation and Drainage Act 1954 and Rajasthan Irrigation and Drainage Rules 1955 : Rajasthan
* Northern India Canal and Drainage Act 1873 : Haryana,Punjab. Uttar Pradesh, Rajasthan. Each State has issued a set of rules/executive orders to be followed in respect of irrigation water management.

CENTRAL REGION

* Bombay Irrigation Act 1879 (slightly modified); Gujarat (Called Gujarat Irrigation Act and Gujarat Canal Rules).
* Indian Easement Act 1882 : Maharashtra, Madhya Pradesh
* Madhya Pradesh Act 1931 (amended 1960);
* Maharashtra Irrigation Act 1976 and Bombay Canal Rules : Maharashtra.

SOUTHERN REGION

* Madras Irrigation Act 1865
* Indian Easements Act 1882
* Madras River Conservancy Act 1885
* Madras Land Encroachment Act 1905
* Madras Irrigation Tanks (Improvement) Act 1949

* Karnataka Irrigation (Levy and betterment contribution and water rates) Act 1957.
* Karnataka Land Improvement Act 1961
* Karnataka Irrigation (Levy of Water rates) rules 1965.
* Karnataka Irrigation Act and Irrigation Rules 1965 and various statutory notifications vesting officers with powers.
* Karnataka Command Area Development Act and Rules 1980.

EASTERN REGION

* Bengal Canal Act V 1864
* Bengal Embankment Act VI 1873
* Bengal Irrigation Act VI 1880
* Bengal Embankment Act II 1882
* Bengal Cooperative Society Act 1940

Under the above acts the following rules have been framed and promulgated in Bihar.

* Drainage Rules
* Navigation Rules 1893
* Embankment Rules 1916
* Sone,Champaran, Saran, Kamla Canals Irrigation Rules
* Bihar Public Irrigation and Drainage Works Rules 1949
* Sakri Canals Irrigation Rules 1952
* Damodar Valley Corporation Rules
* Bihar Private Irrigation Act (1922 as amended 1950)

ANNEX IV
(to Chapter 3)

THE MODEL IRRIGATION BILL 1976*
STATEMENT OF OBJECTS AND REASONS

1. There is considerable variation in irrigation practices in different parts of the country. Not only are there different irrigation statutes for different States, but in most States there is a multiplicity of laws covering various aspects of irrigation management and administration. The result is a plethora of statutes and rules which have to be mastered by irrigation officials, if they are to function efficiently. The multiplicity of laws providing for multiple lines of authority and diversification of control for operation and management of irrigation works diffuses responsibility and is against the interests of the State as well as of the irrigators. Further, linguistic reorganisation of States after Independence has resulted in material adjustment of their boundaries. In the process, some new States and Union territories have been created, others adjusted, while some have lost their old separate entity. The upshot is that irrigation works in a region continue to be administered under the laws applicable to them in their parent States prior to reorganisation. This circumstance complicates matters in that irrigation laws differ not only from State to State but even from one region of a State to another and different acts are applicable to works similar in nature within a State itself.

2. The Irrigation Commission, which submitted its report to the Government of India in March 1972, also recommended that the irrigation laws in each State should be consolidated into a single statute applicable uniformly to all regions within the State. The Commission in its report gave guidelines for the enactment of such a statute.

3. The present Bill seeks to provide for use and control by the State for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes and other natural collections of still water and to that end, to amend, and consolidate the law relating to irrigation and drainage and ground water and flood control in so far they relate to such irrigation and drainage and levy and assessment of water rates and betterment contribution.

4. The main provisions of the Bill fall under the following heads :-

   a. application of water for public purposes;

   b. construction of irrigation works including water courses, field channels and field drains;

   c. regulation of irrigation supplies;

   d. levy of betterment contribution and water rates;

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*Government of India, Ministry of Agriculture & Irrigation (Department of Irrigation), New Delhi, 1976

e. requisition of labour and materails in emergency;

f. settlement of disputes;

g. drainage; and

h. protection of irrigation works including offences and penalties.

5. The Bill seeks to simplify the administrative machinery eliminating multiple lines of authority and diversification of control for operation and management of irrigation works. The primary responsibility for the administration of the provisions of the Bill lies with the officials of Irrigation Department and the reverue officials come into picture only at the stage of realisation of any sum due under the Bill from any person as arrears of land revenue. So also the jurisdiction of civil courts is barred to a great extent.

6. The provisions relating to regulation of water supply in the Bill are not intended to be exhaustive as it has been considered that the provisions of different laws and practices appear to be justified by the special circumstances of various States.

7. The constitution of India empowers the States to enact legislation regarding water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power excepting the regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest. Hence this Model Bill for the guidance of the States.

THE MODEL IRRIGATION BILL 1976

An Act to amend and consolidate the law relating to irrigation and drainage and levy and assessment of water rates and betterment contribution and matters connected herewith.

Be it enacted by the Legislature of the State of _____ in the _____ year of Republic of India as follows:

CHAPTER I

1. (i) This Act may be called the Irrigation Act, 19.

(ii) It extends to the whole of the State.

(iii) It shall come into force on such date as the State Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different areas of the State.

2. In this Act, unless the context otherwise requires, -

a. "betterment contribution" means contribution levied under chapter VI of this Act;

b. "Betterment levy Officer" means such officer as the State Government may appoint to be the betterment levy officer in respect of any area of an irrigation work, or portion of an irrigation work;

c. "Canal Officer" means an officer exercising control over a sub-division of an irrigation work or portion of an irrigation work;

d. "Canal revenue" includes water rate, betterment contribution, water cess, crop cess, licence fee for fishing, navigation, sale of grass, trees and other produce from the land belonging to irrigation work, proceeds from lease of land belonging to irrigation work and from water mills;

e. "Collector" means the head revenue officer of a district and includes a Deputy Commissioner or other officers appointed under this Act to exercise all or any of the powers of a Collector;

f. "Culturable commanded area" means all lands which are fit for cultivation under irrigable command of an irrigation work;

g. "Divisional Canal Officer" means an officer exercising control over a division of an irrigation work, or portion of an irrigation work;

h. "drainage work" includes -

   i. channels, either natural or artificial for the discharge of waste or surplus water, and all works connected with or auxiliary to such channels;
   ii. escape channels from an irrigation work, dams, weirs, embankments, flood embankments, sluices, groynes and other works connected therewith but does not include works for the removal of sewage;
   iii. any work in connection with a system of reclamation made or improved by State Government for the purpose of drainage of an area; and
   iv. all field drains;

l. "field channel" means a channel constructed by owners or occupiers or constructed by the State Government on their behalf and at their cost to serve the various fields within a block of 40 hectares or as may be prescribed and maintained by such owners or occupiers and includes existing water courses constructed or maintained by the owners or occupiers;

Explanation:- Existing means existing at the time of the coming into force of this Act.

j. "field drains" include drains, escape channels and other similar works constructed and maintained by the owners or occupiers, or by the State Government on behalf and at the cost of the owners or occupiers;

k. "flood embankment" means any embankment constructed or maintained by the State Government in connection with any system of irrigation or reclamation works for the protection of lands from inundation or which may be declared by the State Government to be maintained in connection with any such system, and includes all groynes, spurs, dams and other protective works connected with such embankment;

l. "Irrigation work" includes -

i. all reservoirs, tanks, dams, weirs, canals, barrages, channels, domestic water supply works, pipes, ponds, spring ponds, spring channels, aqueducts, sluices, pumping installations constructed, maintained or controlled by the State Government for the supply or storage of water;

ii. all works, embankments, structures, control structures including outlets, supply and escape channels connected with such reservoirs, tanks, dams, weirs, canals, barrages, channels, domestic water supply works, pipes, ponds, spring ponds, spring channels, aqueducts, sluices, pumping installations, and all roads constructed for facilitating the construction or maintenance of such reservoirs, tanks, dams, weirs, canals, barrages, channels, domestic water supply works, pipes, ponds, spring ponds, spring channels, aqueducts, sluices and pumping installations;

iii. all drainage works, flood embankments, wells, water courses and field channels;

iv. any part of a river, stream, lake or natural collection of water or natural drainage channel and ground waters to which the State Government has applied the provisions of Chapter II of this Act; and

v. all lands held by the State Government for the purpose of such reservoirs, tanks, dams, weirs, canals, barrages, channels domestic water supply works, pipes, ponds, spring ponds, spring channels, aqueducts, sluices, pumping installations and all buildings, machinery, fences, gates and other erection upon such lands.

m. "lands under irrigable command" means such lands as are irrigated or capable of being irrigated by flow or lift from an irrigation work being under its command and shall include also such cultivated land which receive, in the opinion of the Divisional Canal Officer, by percolation or otherwise from an irrigation work or by indirect flow, percolation or drainage from or through adjoining land, an advantage beneficial to the crop;

n. "notification" means a notification published in the Official Gazette;

o. "Occupier" includes an occupier of land or property who cultivates or possesses the same for the time being;

p. "on-farm development" includes any of the following works-

i. land-levelling and land-shaping, including realignment of field boundaries;

ii. providing of falls, culverts, and farm roads in the fields;

iii. land reclamation by use of engineering, biological and chemical measures, including leaching;

iv. contour bunding and nala bunding;

v. such other works as may be necessary or incidental to development of land or ground or flow water potential and for optimising the utilisation of land and water resources;

q. "outlets" include an opening, constructed by the State Government in an irrigation work through which water is delivered into a water course or field channel or directly on to any land;

r. "owner" includes every person having interest in the ownership of land or property, and all rights and obligations which attach to an owner under the provisions of this Act shall attach jointly and severally to every person having such joint interest in the ownership;

s. "prescribed" means prescribed by rules made under this Act;

t. "sewage effluent" means effluent from any sewerage system or sewage disposal works and includes sullage from open drains;

u. "Superintending Canal Officer" means an officer exercising general control over an irrigation work or portion of an irrigation work;

v. "trade effluent" includes any liquid, gaseous or solid substance which is discharged from any premises used for carrying on any trade or industry, other than domestic sewage;

w. "Water course" means the length of a channel between an outlet and a field channel, built at the cost of the State Government and maintained by the owners or occupiers to carry water from an outlet to any block of land or as may be prescribed;

x. "water rate" means water rate levied under chapter V of this Act;

y. "well" means a well sunk for search or extraction of ground water and includes an open well, dug well, bored well, dug-cum-bored well, tubewell and filter point;

z. "vessel" includes boats, rafts, timber and other floating bodies.

CHAPTER II

CONSTRUCTION AND MAINTENANCE OF IRRIGATION WORKS

THE APPLICATION OF WATER FOR PUBLIC PURPOSES OF IRRIGATION WORKS

3. (1) Whenever it appears expedient to the State Government that the water of any river (including its tributaries) or stream flowing in a natural channel or of any lake or any other natural collection of still water or ground water or water flowing in a channel where such water or part thereof, is received from any irrigation work constructed by the State Government, whether by percolation, regeneration release or otherwise should be applied or used by the State Government for the purpose of any existing or projected irrigation work, or for the regulation, supply or storage of water, the State Government may by notification declare that the said water will be so applied or used after a day to be named in the said notification, not being earlier than three months from the date thereof.

(2) As soon as practicable after the issue of a notification under sub-section (1), the Divisional Canal Officer or any officer duly empowered under this Act shall cause public notice to be given at convenient places, stating that the State Government intends to apply or use the water referred to in that sub-section.

(3) The application or use of the said water of any irrigation work under the management or control of the State Government shall be regulated according to the provisions of this Act.

(4) Where the State Government is of the opinion that in the interests of proper irrigation from any irrigation work constructed or proposed to be constructed it is necessary to control the construction of well for any purpose other than exclusively domestic use, either on personal or community basis, in any area or areas, and thereupon no person shall within such areas or areas construct any such well except with the previous sanction of the State Government or other authority authorised by the State Government in this behalf, and subject to such conditions as the State Government or such authority may impose.

(5) Where the State Government is of the opinion that in the interests of proper irrigation from any irrigation work constructed or proposed to be constructed

it is necessary to regulate the operation of the existing works for any purpose other than exclusively domestic use, either on personal or community basis, in any area or areas, the State Government may by notification specify such area or areas and impose such conditions as it may deem fit with regard to extraction of water therefrom. Thereupon no person shall within such area or areas extract water from such well except according to conditions which the State Government may impose.

(6) When the State Government is of the opinion that in the interest of proper irrigation a block of land under any existing or proposed irrigation work is to be transferred to another proposed or existing work or completely excluded from any existing work, the State Government may by notification specify such areas and such works to take effect from a date specified in the notification, not being earlier than six months from the date thereof.

(7) When the State Government is of the opinion that in the interest of proper utilisation of available water resources, it is necessary to subject a block of land for temporary submersion without damage to crops, the State Government may by notification specify such areas and period of such submersion on a date specified in the notification, not being earlier than six months from the date thereof.

POWERS OF ENTRY ON LAND ETC.

4. At any time after the day named in the notification under sub-section (1) of section 3, any Canal Officer duly empowered in this behalf may enter on any land, remove any obstruction, close any channel and do any other thing necessary for such application or use of the said water and for such purpose may take with him, or depute or employ such subordinates and other persons as he thinks fit.

5. Whenever it shall be necessary to make an enquiry or examination in connection with proposed irrigation work or its construction or with the maintenance of an existing irrigation work or with the application or use of the water of any irrigation work for the purpose of regulation, supply or storage of water, any Canal Officer duly empowered in this behalf may -

a. enter upon such land and structure or anything attached to land as he may think necessary for the purpose;

b. undertake surveys or take levels thereon;

c. dig and bore into the sub-soil;

d. where otherwise such inquiry cannot be completed, cut down and clear away any part of any standing crop,fence or jungle;

e. exercise all powers and do all things in respect of such land as he might exercise and do if the State Government had issued a notification under

the provisions of section 4 of the Land Acquisition Act, 1894, to the effect that land in that locality is likely to be needed for a public purpose; and

f. set up and maintain gauge discharge and silt measurement stations and do all other things necessary for purposes of such inquiry and examination.

6. Any Canal Officer duly empowered in this behalf may enter upon any land, building, water course or field-channel on account of which any water rate is chargeable, for the purpose of inspecting or regulating the use of the water supplied, or of measuring the land irrigated thereby or chargeable with a canal revenue and doing all things necessary for the proper regulation and management of the irrigation work from which such water is supplied.

7. (1) In case of any accident being apprehended or happening to an irrigation work, any Canal Officer empowered in this behalf may enter upon or into any immovable property in the neighbourhood of such irrigation work, or such other immovable property as may be necessary for the purpose, and take trees and other materials, and such other steps as may be necessary, and execute all work which may be necessary for the purpose of preventing such accident or repairing any damage done.

(2) In determining compensation for taking trees and other materials the principles laid down in section 60 shall be followed.

8. Where any irrigation work is being damaged or damage to any irrigation work is apprehended due to floods, any Canal Officer duly empowered in this behalf may, in the interest of the safety of the irrigation work regulate the floods by operating gates or gated waste weir on the irrigation work or regulate the Canal as the case may be.

9. Where a Canal Officer proposes under the provisions of section 5, 6 or 7 to enter into any building or enclosed court or garden attached to a dwelling house, not supplied with water from an irrigation work, and not adjacent to a flood embankment, he shall give to the occupier of such building, court or garden such reasonable prior notice as the urgency of the case will allow.

10. Canal Crossings

(1) There shall be provided at the cost of the State Government suitable means of crossing canals constructed or maintained at the cost of the State Government at such places as the State Government thinks necessary for the reasonable convenience of the inhabitants of the adjacent lands.

(2) No suit shall lie in a civil court against the State Government to enforce the construction of a crossing of a canal, or to enforce the altering of a crossing or for compensation for damage arising from the absence or inadequacy of any crossing, or to modify or set aside any scheme framed or order passed under this section.

Explanation: Suitable means of crossing canals include means for the passage of traffic and of water.

ACQUISITION OF LAND

11. If the State Government is satisfied that any land for the construction of an irrigation work, excluding water courses, field channels and field drains or for the maintenance, improvement or extension of an existing irrigation work excluding water courses, field channels and field drains, is needed, the State Government may acquire the land by following the provisions of the Land Acquisition Act, 1894 except to the extent specifically stated to the contrary in this chapter.

12. (1) Notwithstanding anything to the contrary in the Land Acquisition Act, 1894, the Collector may, after holding such enquiry as he deems necessary, make an estimate of the amount of compensation payable in respect of the land, needed, the purposes specified in section 11 of this Act, for which declaration under Section 6 of the aforesaid Act has been made, including compensation for the standing crops, trees and structures, if any, on such land and for any physical damage caused to them, within three months of the declaration.

(2) The Collector may take possession of the land after tendering the estimated amount of compensation, as stated in sub-clause (1), to the person having an interest in the land and the land shall thereupon vest absolutely in the Government free from all encumbrances.

(3) If any person having an interest in the land acquired by the State Government does not agree with the estimated amount of compensation, he may require that the matter be referred by the Collector for determination by the court in accordance with section 18 of the Land Acquisition Act, 1894.

(4) In all other matters relating to compensation including principles for determining compensation, the provisions of the Land Acquisition Act, 1894, shall be applicable.

Note : - Adoption of provisions for acquisition of land is subject to concurrence of Ministry of Agriculture and Irrigation (Department of Agriculture), Government of India.

CHAPTER III

WATER COURSES AND FIELD CHANNELS

13. (1) Notwithstanding anything contained to the contrary in this Act and subject to the rules prescribed by the State Government in this behalf, the Divisional Canal Officer may, on his own motion or on the application

of an owner or occupier, prepare a draft scheme to provide for all or any of the matters, namely :-

a. the construction, alteration, extension and realignment of any water course, or existing water course constructed or maintained by the owners or occupiers;

b. reallotment of areas served by one water course to another;

c. the lining of any water course;

d. the occupation of land for the deposit of soil from water course clearances;

e. any other matter which is necessary for the proper maintenance and distribution of supply of water from a water course.

(2) Every scheme prepared under sub-section (1) shall, amongst other matters, set out the estimated cost thereof, the realignment of any water course or existing water course, as the case may be, the site of the outlet, the particulars of the owners or occupiers to be benefited and other persons who may be affected thereby, and a sketch plan of the area proposed to be covered by the scheme.

14. (1) Every scheme shall as soon as may be after its preparation, be published in such form and manner as may be prescribed inviting objections and suggestions with respect thereof within twenty-one days of the publication.

(2) After consideration of such objections and suggestions, if any, the Divisional Canal Officer shall approve the scheme either as it was originally published or in such modified form as he may consider fit and publish the same.

(3) The Superintending Canal Officer may, on his own motion at any time, or on an application by any person aggrieved by the approved scheme made within a period of thirty days from the date of publication of the particulars of the scheme under sub-section (2), revise the scheme approved by the Divisional Canal Officer:

Provided that such revision shall not be made without affording the person affected an opportunity of being heard.

(4) An owner or occupier aggrieved by the order of the Divisional Canal Officer in respect of a scheme, which has not been approved, may prefer an appeal, within thirty days of the passing of the order, to the Superintending Canal officer whose decision shall be final.

15. (1) After a scheme has been approved by the Divisional Canal officer, or, where an appeal is pending before the Superintending Canal Officer, after it has been disposed of by him, the Divisional Canal Officer shall acquire the land by agreement with the owners thereof, or the Divisional Canal

Officer shall publish in the manner prescribed a notice of his intention to acquire the land required for implementation of the scheme.

(2) Any person interested in the land notified under sub-section (1) may, within fifteen days from the publication thereof, apply to the Divisional Canal Officer by petition stating his objections to the proposed acquisition.

(3) After considering the objections, the Divisional Canal Officer may make an order for acquisition of the land.

(4) After fifteen days of the order made under-sub-section 3, the Divisional Canal Officer may take possession of the land, and the said land shall vest absolutely in the State Government free from all encumbrances.

(5) The Divisional Canal Officer shall make an award of compensation, including compensation for standing crops, trees and structures, if any, on such land and for any physical damage caused to them, within six months of the making of the order under sub-section 3.

(6) In determining the amount of compensation the Divisional Canal Officer shall give a reasonable opportunity of being heard to the person having an interest in the land.

(7) The principles to be followed in awarding the compensation shall be the market value at the time of publication of the notice under sub-section (1).

(8) The amount of compensation shall be paid within thirty days of the award by the Divisional Canal Officer.

(9) A person aggrieved by the order of the Divisional Canal Officer in respect of compensation may prefer an appeal within thirty days of the passing of the order to the Superintending Canal Officer who shall decide the same and no further appeal shall lie from such a decision.

16. (1) The Divisional Canal Officer shall, after getting the occupation of the land under sub-section (4) of section 15, take steps to implement the scheme at the cost of the State Government.

(2) Any water course constructed under sub-section (1) shall be the property of the State Government.

(3) Unless ordered by the State Government to the contrary, any extension, alteration or realignment of water courses at the instance of the owners or occupiers shall be done at the cost of the owners or occupiers.

17. On execution of the scheme, the Divisional Canal Officer shall by requisition in writing, direct the owners or occupiers to take over and maintain the water course and on failure of any owners or occupiers to comply with this direction,

he shall make arrangements for maintenance of the water course at the cost of such owners or occupiers in proportion to the culturable commanded area under the scheme held by them.

18. (1) The Divisional Canal Officer may issue an order to the persons using any field channel to construct suitable bridges, culverts or other works as approved by the Divisional Canal Officer for the passage of the water of such field channel across any public road, canal or drainage channel in use before the said field channel was made, or to repair any such works.

(2) Such order shall specify a reasonable period within which such construction or repairs shall be completed.

(3) If, after the receipt of such order, the persons to whom it is addressed do not within the said period, construct or repair such works to the satisfaction of the said Divisional Canal Officer, he may with the previous approval of the Superintending Canal Officer, himself construct or repair the same, and demand the cost of such construction or repairs.

19. (1) If a person demolishes, alters, enlarges, obstructs or encroaches upon a water course or field channel or causes any damage thereto, any persons affected thereby may apply to the Divisional Canal Officer for directing the restoration of the water course or field channel to its original condition.

(2) The Divisional Canal Officer may, on his own motion, or on receiving an application under sub-section (1), after making such enquiry as he may deem fit, require, by a notice, in writing served on the persons found to be responsible for so demolishing, altering, enlarging, obstructing encroaching or causing damage to restore, at his own cost, the water course or field channel to its original condition within such period as may be specified in the notice.

(3) If such person fails, to the satisfaction of the Divisional Canal Officer, to restore the water course or field channel to its original condition within the period specified in the notice served on him under sub-section (2), the Divisional Canal Officer may cause the water course of field channel to be restored to its original condition and recover the cost incurred in respect of such restoration from the defaulting person.

(4) Any person aggrieved by the order of the Divisional Canal Officer may prefer an appeal, within thirty days of the passing such order, to the Superintending Canal Officer, whose decision on such appeal shall be final.

20. (1) If any person, jointly responsible with others for the maintenance of water course or field channel, or jointly making use of a water course with others, neglects or refuses to pay his share of the maintenance or to execute his share of any work necessary for such maintenance, the Divisional

Canal Officer, on receiving an application in writing from any person injured by such neglect or refusal, shall serve notice on all the parties concerned that on the expiration of fifteen days from the service, he shall investigate the case, and shall, on the expiration of that period, investigate the case accordingly, and make such order thereon as he deems fit.

(2) Such order shall be appealable to the Superintending Canal Officer, whose order thereon shall be final.

(3) Any sum directed by such order shall be paid within a specified period.

21. (1) Whenever application is made to a Divisional Canal Officer for supply of water from an irrigation work, and it appears to him expedient that such supply should be given and that it should be conveyed through some field channel, he shall give notice to the persons responsible for the maintenance of such field channel to show cause, on a day not less than fourteen days from the days of such notice, why the said supply should not be so conveyed, and, after making enquiry on such day, the Divisional Canal Officer shall determine whether and on what conditions the said supply shall be conveyed through such field channel;

Provided that such application is made for lands already included in the irrigation work.

(2) Any person, aggrieved by the determination of the Divisional Canal Officer, may prefer an appeal to the Superintending Canal Officer within thirty days of such determination.

(3) When the Divisional Canal Officer determines that supply of water of an irrigation work may be conveyed through any field channel as aforesaid, his decision shall when confirmed or modified by the Superintending Canal Officer on appeal, be binding on the applicant and also on the persons responsible for the maintenance of the said field channel.

(4) Such applicant shall not be entitled to use such field channel until he has paid the expense of any alteration of such field channel necessary in order to his being supplied through it, and also such share of the first cost of such field channel as the Divisional Canal Officer or, as the case may be, Superintending Canal Officer may determine.

(5) Such applicant shall also be liable for his share of the cost of maintenance of such field channel so long as he uses it.

22. (1) Any person desiring that a field channel should be transferred from its present owner to himself may apply in writing to the Canal Officer, stating;

(a) that he has endeavoured unsuccessfully to procure such transfer from the owner of such field channel;

(b) that he desires the said Canal Officer, in his behalf and at his cost, to do all things necessary for procuring such transfer;

(c) that he is able to defray the cost of such transfer.

(2) If the Divisional Canal Officer considers -

(a) that the said transfer is necessary for the better management of the irrigation from such field channel; and

(b) that the statements in the application are true, he shall call upon the applicant to make such deposit as he considers necessary to defray the cost of the preliminary proceedings, and the amount of any compensation that may become due under the provisions of section 27 in respect of such transfer, and upon such deposit being made, he shall publish a notice of the application in every village, and shall send a copy of the notice to the Collector of every district through which such field channel passes.

23. (1) Within twenty-one days of the publication of a notice under section 22, any person interested in the field channel to which the notice refers may apply to the Divisional Canal officer by petition stating his objections to the transfer for which application has been made.

(2) The Divisional Canal Officer may either reject the petition or may proceed to enquire into the validity of the objections, giving previous notice to persons concerned stating the place and time at which such enquiry will be held.

Provided that such notice shall also be given to the Collector of the district through which field channel passes.

(3) The Divisional Canal Officer shall record in writing all orders passed by him under this section and the grounds thereof.

24. If no such objection is made, or where such objection is made and the Divisional Canal Officer overrules it, he shall intimate the Collector to that effect, and shall transfer the field-channel from the present owner to the applicant.

25. If the Divisional Canal Officer considers any objection made as aforesaid to be valid he shall inform the Collector accordingly.

26. (1) If the Collector disagrees with the Divisional Canal Officer, the matter shall be referred for decision to the Superintending Canal Officer.

(2) The decision of the Superintending Canal Officer shall be final, and the Divisional Canal Officer, if he is so directed by such decision shall subject to the provisions of section 27, cause to transfer the field channel from the present owner to the applicant.

27. (1) No such decision shall be made until the applicant has paid to the person named by the Divisional Canal officer such amount as the Divisional Canal Officer determines to be paid as compensation for field channel so transferred, together with all expenses incidental to such transfer.

(2) In determining the compensation to be paid under this section, the Divisional Canal Officer shall follow the provisions of the Land Acquisition Act, 1894, but he may, if the person to be compensated so desires, award such compensation in the form of a rent charge payable in respect of the field channel transferred.

(3) Any person aggrieved by the order of the Divisional Canal Officer regarding compensation may prefer an appeal to the Superintending Canal Officer within thirty days of the order. The order of the Super-intending Canal officer on such appeal shall be final.

28. (1) When a field channel is transferred to the applicant the following rules and conditions shall be binding on him and his representative in interest, namely:-

a. All works necessary for the passage across such field channel, existing previous to its construction and of the drainage intercepted by it, and for affording proper communications across it for the convenience of the neighbouring lands shall be constructed by the applicant, and be maintained by him or his representative in interest to the satisfaction of the Divisional Canal Officer.

b. In case in which a field channel is transferred on the terms of a rent charge, the applicant or his representative in interest shall, so long as he occupies such field channel, pay rent for the same at such rate and on such days as are determined by the Divisional Canal Officer when the applicant is placed in occupation.

c. The Divisional Canal Officer may, on the application of the person entitled to receive such rent or compensation, determine the amount of rent due or assess the amount of such compensation.

(2) If any field channel transferred under this Act is disused for three years continuously, the right of the applicant or of his representative in interest, to occupy such field channel shall cease absolutely.

29. (1) Whenever it appears expedient to the Divisional Canal Officer either on his own motion or on the application of an owner or occupier that with a view to utilising irrigation potential created by an irrigation work, field channels should be constructed in any area, he may cause to be served on the owner or occupier concerned a notice in the prescribed form, containing the exact location of sluices or outlets on the irrigation works and specifying the area of irrigable land to be served by the same and direct them to construct such field channels at their own cost within a

specified time which shall not be more than six months from the date of issue of the notice.

(2) If the owner or occupier fails to construct the field channels in his land as directed by the Divisional Canal Officer within the time prescribed under sub-section (1), the Divisional Canal Officer may, after giving the owner or occupier a reasonable opportunity of being heard, make an order excluding such land from the culturable commanded area.

(3) Any person aggrieved by an order of the Divisional Canal Officer under Sub-section (2) may, within a period of thirty days from the date on which the order was served on him, appeal against such order to the Superintending Canal Officer.

Provided that the Superintending Canal Officer may admit an appeal presented after the expiry of the period of thirty days, if he is satisfied that the applicant had a sufficient cause for not presenting the appeal within the said period.

(4) In disposing of an appeal, the Superintending Canal Officer may after giving the appellant a reasonable opportunity of being heard, pass such order on the appeal as he deems fit. The order of the Superintending Canal Officer on such appeal shall be final.

(5) The Divisional Canal Officer may construct the field channels at the cost of the State Government and recover the cost pro-rata from the owners or occupiers.

30. (1) It shall be the duty of owners or occupiers to maintain the field channels in a proper state of repairs at their own cost.

(2) If the Divisional Canal Officer is satisfied that any field channel is not being properly maintained, he shall, after providing an opportunity to the owner or occupier concerned to take such action as may be directed by him, proceed to have such repairs made as he may consider to be suitable at the cost of the owners or occupiers.

31. (1) When there is any dispute between the owners or occupiers for the construction of a field channel, the Divisional Canal Officer shall acquire the land required for such construction.

(2) The provisions relating to acquisition of land for the construction of water courses mentioned in section 15 shall apply for acquisition of land for the construction of field channels with the modification that the compensation payable shall be paid by the owners or occupiers.

32. No land acquired under this Act for the construction of water courses and field channels shall be used for any other purpose without the order of the Divisional Canal Officer.

33. (1) Notwithstanding anything contained to the contrary in this Act and subject to the rules, that may be made by the State Government in this behalf, an officer designated by the State Government in this behalf may, on his own motion or on the application of not less than fifty percent of the owners or occupiers of lands in the culturable commanded area, prepare a draft scheme to provide for on-farm development on a group or block of fields.

(2) Every scheme prepared under sub-section (1) shall among other matters, set out the cost of the on-farm development works, a sketch plan of the area proposed to be covered by the said scheme, and particulars of the owners or occupiers to be benefited by the said scheme.

(3) Every scheme shall, as soon as may be after its preparation, be published in such form and manner as may be prescribed inviting objections and suggestions with respect thereof within twenty-one days of the publication.

(4) After consideration of such objections and suggestions, if any, the said officer shall approve the scheme either as it was originally published or in such modified form as he may consider fit and publish the same.

(5) The officer designated by the State Government in this behalf may, at any time, or on an application by any person aggrieved by the approved scheme made within a period of thirty days from the date of publication of the particulars of the scheme under sub-section (4), revise the scheme approved by the said officer :

Provided that such revision shall not be made without affording the person affected an opportunity of being heard.

(6) An owner or occupier aggrieved by the order of the said officer in respect of a scheme, which has not been approved, may prefer an appeal, within thirty days of the passing of the order to such officer designated by the State Government in this behalf whose decision shall be final.

(7) After a scheme has been approved by the said officer under sub-section (4) or where an appeal is pending before an officer under sub-section (6), after it has been disposed of by him, the scheme shall be published in such manner as may be prescribed and upon such publication, it shall be executed or got executed by the owners or occupiers in the group or block of fields at their cost, within such period of time as may be specified by the said officer.

(8) In the event of the failure of any or all of the said owners or occupiers to execute the works within the said period of time specified by the said officer or in the event of any or all of the owners or occupiers informing in writing the said officer prior to the expiry of the said period of time that they are unable to execute or get executed the works as required, the works may be carried out by the State Government or by an agency determined by the State Government in that behalf, and the cost of the

works so executed by the State Government or by the said agency, as the case may be, shall be recoverable by the State Government or the said agency, as the case may be, from the owners or occupiers who fail or indicate their inability, to execute or get executed the works as required.

(9) The share of the individual owners or occupiers of the cost of the works executed in the said group or block of fields by the State Government or by the said agency, as the case may be.

34. Notwithstanding anything contained in this Act or any other law for the time being in force, no civil court shall have jurisdiction to entertain or decide any question relating to matter falling within this Chapter.

CHAPTER IV

REGULATION OF IRRIGATION SUPPLIES

35. The provisions of this Chapter shall apply in respect of water from an irrigation work supplied under sections 37, 38 & 43.

36. Water from an irrigation work may be supplied -

a. as provided in section 37;

b. on an application for irrigation or non-irrigation purposes as provided in section 38; or

c. under a scheme in accordance with the provisions of section 43.

37. A Divisional Canal Officer duly empowered by the State Government by a notification in respect of any irrigation work or class of irrigation works may, after such inquiry as he deems fit regulate in respect of any irrigation work for each year or part thereof or for a specified term of years at a time, as circumstances may require -

i. the time for letting out water for irrigation;

ii. the period of supply;

iii. the quantity of supply; and

iv. the areas to be supplied at different times.

Explanation : A land shall be deemed to have been supplied with water notwithstanding that the water is not utilised for irrigation provided that such non-utilisation is due solely to the action or inaction on the part of the owners or occupiers interested in such land.

Note : See Exhibit A for alternative to section 37 as model in appropriate cases.

38. (1) Any person, desiring to have supply of water from an irrigation work for irrigating land not included in any area to which supply of water is regulated under section 37, shall make a written application to that effect to the Divisional Canal Officer. Subject to any general or special order made by the State Government determining the extent of lands for which water can be made available from such irrigation work, such officer may, if in his opinion such supply can be made without detriment to the supply of water is regulated under section 37, order the supply of water and for such period not exceeding six years subject to such conditions as may be specified in such order.

(2) If after a period of six successive years of supply of water made to any land referred to in sub-section (1), the occupier of such land applies for the supply of water being made permanent, such application, with the opinion of the Divisional Canal Officer, shall be forwarded to the Superintending Canal Officer concerned who shall take steps to include the land in the area to which supply of water is regulated by section 37.

(3) The water rate leviable for the use of water for temporary cultivation under sub-section (1) shall be the normal water rate.

(4) With the sanction of, and subject to such conditions, payments, and restrictions, as may be imposed by the State Government or such officer as may be authorised by the State Government in this behalf, the Divisional Canal Officer, may, without detriment to the supply of water is regulated under section 37 give permission for water to be taken from an irrigation work, for purposes other than those of agriculture.

(5) If any person uses water from an irrigation work without obtaining the permission required under this section he shall in addition to any penalty he incurs under this Act for such unauthorised use of water, be liable to pay water rate at such rate as may be determined by the prescribed officer not being less than ten times and not exceeding thirty times the normal rate he would otherwise have been required to pay, had he applied for and obtained the permission.

39. (1) The supply of water to any water course or field channel or to any person who is entitled to such supply shall not be stopped, except,

a. Whenever and so long as it is necessary to stop such supply for the purpose of maintenance of an irrigation work or execution of any work ordered by the competent authority;

b. whenever and so long as any field channel by which such supply is received is not maintained in such repair as to prevent the wasteful escape of water thereof;

c. whenever and so long as it is necessary to do so in order to supply in rotation the legitimate demand of other persons entitled to water;

d. whenever and so long as it may be necessary to do so in order to prevent the wastage or misuse of water;

e. within the periods fixed from time to time by the Divisional Canal Officer of which due notice shall be given;

f. whenever there is diminution in the supply of water in the irrigation work due to any natural or seasonal causes and so long as it is necessary to do so.

g. for any reasons beyond the control of the Divisional Canal Officer.

(2) No claim shall be made against the State Government for compensation in respect of loss caused by the failure or stoppage of water from an irrigation work;

Provided that the person suffering such loss may claim such remission of the charges payable for the use of the water as is specified by the State Government.

40. (1) Except with the permission of the Superintending Canal Officer, no person entitled to use the water of any irrigation work shall sell or sub-let or otherwise transfer his right to such use or use it for unauthorised purposes.

Provided that no permission shall be necessary for use of water for authorised purposes by a cultivating tenant of water supplied by the owner of a field channel for the irrigation of the land held by such tenant.

(2) Every right to the supply of water for agricultural purposes to any land or other immovable property shall be attached thereto and shall be presumed to have been so transferred whenever a transfer of such land or immovable property takes place.

41. When water from an irrigation work is supplied for the irrigation of one or more crops only, the right to use such water shall be deemed to continue only until such crop or crops shall come into maturity, and to apply only to such crop or crops.

42. (1) Where the State Government is satisfied that, for the better cultivation of lands, and production of crops and due preservation and proper utilisation of water resources of any irrigation work, or in the public interest, it is expedient to regulate the kind of crops that should be sown, planted or grown on lands under the irrigable command of an irrigation work or any part thereof, and the period during which such crops should be

sown, planted or grown on such lands, the State Government may, having regarding to the soil characteristics, climate, rainfall and water available, by order in writing, make a declaration to that effect. Such a declaration shall be given wide publicity in such manner by the Canal Officer authorised by the State Government as he may think fit.

(2) On such a declaration, the Canal Officer with the approval of the superior officer authorised by the State Government, may specify by notice published in such manner as may be determined by him, the kind of crops that shall be sown, planted or grown on the lands under the irrigable command of the irrigation work or any part thereof, the area of crops, and the periods during which such crops shall be sown, planted or grown. The Canal Officer shall subject to the provisions of sections 39(1) and 40 (2), thereupon by order regulate the supply of water from the irrigation work for sowing, planting and growing such crops during the periods specified in the order.

(3) The State Government may, by notification in the Official Gazette, make rules for determining the crops, and the periods during which such crops may be sown, planted or grown and for regulating supply of water for the purpose. Such rules may provide for fixing the extent of irrigation for sowing, planting or growing different crops on the lands under the irrigable command of an irrigation work.

(4) On the publication of the notice under sub-section (2), no person shall sow, plant or grow or allow any crop, other than the crop or crops specified in such notice, to be sown, planted or grown on any land under the irrigable command of the irrigation work or any part thereof, specified in such notice and during the periods specified therein.

(5) Any person aggrieved by any notice given under sub-section (2), may, within thirty days from the date of publication of such notice, file an appeal before such officer not below the rank of Superintending Canal Officer as the State Government may appoint. The appellate officer may on hearing the parties pass such order as he thinks fit; and thereupon, the notice shall stand modified to such extent as may be specified in the order.

(6) The person, who has sown, planted or grown any unauthorised crop, or allowed any land to be sown, planted or grown with such unauthorised crop, shall -

a. be liable for contravening the provisions of this section; and

b. also be liable to pay such water rate, as may be prescribed by the State Government, not being less than five times and not exceeding ten times the water rates which he would otherwise have been required to pay in addition to any penalty he may incur under the Act for such unauthorised crop.

Provided that if no water is utilised either directly or indirectly from the irrigation work for growing any crop, the provisions of sub-sections(4) and (6) shall not be applicable.

Note : See Exhibit B for alternative section as model in appropriate case.

43. (1) Where in the opinion of the State Government an irrigation work is likely to irrigate lands not exceeding 200 hectares in an area or as may be prescribed, the State Government may, in the public interest by notification prepare a draft scheme for supply of water from such irrigation work to such lands. The draft scheme shall provide for handing over the management of the irrigation work and distribution of water therefrom to the Water Committee appointed under section 45.

(2) The draft scheme shall contain the following particulars, that is to say:-

a. the area to which the scheme applied;

b. the survey numbers of lands included in such area and the names of owners and occupiers thereof;

c. the period or periods during which water will be supplied to such lands;

d. the crop or crops which will be permitted to be grown thereon;

e. the water rate at which water may be supplied to such land included in the scheme;

f. the amount to be paid by the State Government for the management of irrigation work to the Water Committee; and

g. fixing a period of not less than three months from the date of publication of such notification, for submission of objection or suggestions to such scheme.

(3) After the publication of such notification, it shall also be published by the Canal Officer duly empowered in this behalf as soon as practicable in the language of the residents of the area through which the irrigation work passes in such place or places and in such manner as he thinks fit for the information of the owners and occupiers who are likely to be affected by such notification.

(4) After considering such objection and suggestion, if any, as may have been received within the period fixed as aforesaid, the State Government may, after making due inquiries, sanction the draft scheme with or without any modifications or may reject it.

(5) The scheme as sanctioned under sub-section (4) shall be published in the Official gazette, and in the village and at the headquarters of the taluk and of the district in which the lands included in the scheme are situated, in such manner as the State Government deems fit, and shall, on such publication, be final.

44. (1) The scheme shall come into force on such date as the State Government may, by notification appoint.

(2) The scheme may at any time be varied by a subsequent scheme made, published and sanctioned in accordance with the provisions of section 43.

(3) The scheme may at any time be cancelled by the State Government by a notification.

45. (1) After a scheme has come into force under sub-section(1) of section 44, the State Government shall appoint a Water Committee to execute the scheme, subject to the superintendence, direction and control of the Canal Officer appointed by the State Government for the purpose.

(2) The Water Committee shall consist of five persons or as may be prescribed, appointed from amongst the owners and occupiers of lands included in the scheme.

(3) The Members may be appointed by the State Government or any officer thereof duly empowered by it in that behalf.

(4) The members of the Committee shall ordinarily hold office for a period of two years from the date of their appointment.

(5) The members of the Committee shall hold office at the pleasure of the State Government and the State Government may terminate the appointment of all or any of the members of the Committee at any time by an order in writing in that behalf.

(6) The Water Committee may meet from time to time, and may follow such procedure as it deems fit for the transaction of its business.

(7) The Water Committee shall :-

a. manage the irrigation work and ensure proper distribution of water to the lands included in the scheme;

b decide the crops to be grown during any period or periods according to the provision of the scheme;

c carry out day to day maintenance and repairs of the irrigation work;

d. maintain the irrigation system of the irrigation work beyond the outlet in a fit state of supply of water;

e. assist the Canal Officer -

i. in detecting and preventing encroachment on the irrigation work and on the lands appertaining thereto;

ii. for preventing damage to the irrigation work;

iii. for repairing any damage caused to the irrigation work;

f. have power to impose a penalty for unauthorised use of water, or use of water out of turn or for growing crops contrary to the provisions of the scheme;

g. maintain accounts of the amount paid to it in such manner as may be prescribed.

(8) The penalty may consist of a fine not exceeding two hundred rupees.

(9) Any person aggrieved by the decision of the Water Committee may within thirty days from the date of receipt of the decision of the Water Committee make an appeal to the Canal Officer or any officer duly empowered by the State Government for the purpose.

(10) The State Government may, not later than two years from the date of the order, call for and examine the record of any inquiry or proceeding underlying such order of the Water Committee, or of the officer appointed by it, for the purpose of satisfying itself as to the legality or propriety of any decision or order passed or as to the regularity of the proceeding, and it may pass any order upholding, annulling, modifying or reversing the order of the Water Committee or of any such officer :

Provided that, no order affecting any person shall be made unless such person is given a reasonable opportunity of being heard.

(11) If at any time the State Government is of opinion -

a. that the Water Committee has persistently made default in the performance of the functions imposed on it by or under this Act, or

b. that the circumstances exist which render it necessary in the public interest to do so, the State Government may by notification, supersede the Water Committee for such period, not exceeding two years as may be specified in the notification:

Provided that before issuing a notification under this sub-section for the reasons mentioned in clause (a) the State Government shall give a reasonable opportunity to the Water Committee to show cause why

it should not be superseded and shall consider the explanation and objections, if any, of the Water Committee.

(12) Upon the publication of a notification under sub-section (1) superseding the Water Committee -

a. all the members shall, as from the date of supersession, vacate their offices as such;

b. all the powers, functions and duties which may, by or under this Act be exercised, performed or discharged by the Water Committee shall, until the Water Committee is reconstituted under sub-section (13), be exercised, performed or discharged by the Canal Officer as the State Government may direct;

c. all property owned or controlled by the Water Committee shall until the Water Committee is reconstituted under sub-section (13) vest in the State Government.

(13) On the expiration of the period of supersession specified in the notification issued under sub-section (11), the State Government may :-

a. extend the period of supersession for such further term, not exceeding six months as it may consider necessary; or

b. reconstitute the Water Committee by fresh appointment, and in such case any person who vacated his office under clause (a) of sub-section (11) shall not be deemed to be disqualified for appointment:

Provided that the State Government may at any time before the expiration of the period of supersession, whether originally specified under sub-section (11) or as extended under this sub-section, take action under clause (b) of this sub-section.

CHAPTER V

LEVY OF WATER RATE

46. (1) Whenever

a. water is supplied, made available or used for purpose of irrigation or any other purpose from any irrigation work belonging to, or constructed by, or on behalf of the State Government; and

b. water from any such work, by direct flow or percolation or by indirect flow,percolation or drainage from or through adjoining land, irrigates any land under cultivation or flows into a reservoir and thereafter by direct flow percolation or by indirect flow, percolation or drainage

from or through adjoining land irrigates any land under cultivation and, in the opinion of the Divisional Canal Officer such irrigation is beneficial to crops on such land; the Government shall be entitled to levy a separate charge for such water hereinafter referred to as water rate and the Government may prescribe the rates at which such water rates shall be levied, which may be -

i. different in respect of water supplied, made available or used having regard to the costs of operation and maintenance of irrigation or drainage work;

ii. different in respect of water supplied made available or used for different purposes;

iii. different in respect of water supplied, made available or used for irrigation of any land with reference to the crop or crops grown or which may be grown on such lands;

iv. different in respect of the quantity and timeliness of supply of water or the number of waterings.

47. The Canal Officer shall prepare an assessment of the water charges for the lands in respect of which water was supplied, made available or used from an irrigation work, and serve the same on the owner or occupier.

48. An appeal against the assessment order of the Canal Officer shall be filed to the Divisional Canal Officer in the prescribed manner within twenty-one days of the passing of the order.

49. As soon as an assessment is made under section.47 or where an appeal has been preferred and disposed or under section 48, the Canal Officer shall serve a notice of demand in the prescribed manner for the amount of water charges assessed.

50. Any person on whom a notice of demand has been served under section 49 shall be liable to pay the same within the period fixed by the State Government in this behalf.

51. (1) If water supplied through any irrigation work is used in an unauthorised manner and if the person by whose act or neglect such use has occurred cannot be found after such enquiry as the Canal Officer may deem sufficient, the Canal Officer, after giving not less than one month's notice to the owners and occupiers of all lands benefited thereby and after hearing their representations, if any, make an order for the recovery of such charges as may be specified by the State Government not exceeding thirty times the water rates for such use from such owners and occupiers in such proportion as he may find just, in addition to any penalty he may incur under the Act for such unauthorised use.

(2) If water supplied through a water course and field channel be allowed to run to waste, and if, after enquiry, the person through whose act or neglect such water was suffered to run to waste cannot be discovered, the person or all the persons chargeable in respect of the water supplied through such water course or field channel shall in addition to any penalty he incurs under the Act for such waste of water, be liable or jointly liable, as the case may be for the charges, not exceeding three times the water rates as may be specified by the State Government.

(3) All questions arising under this section shall be decided by the Canal Officer and any person aggrieved by the decision of Canal Officer may prefer an appeal to the Divisional Canal Officer within thirty days of the decision.

(4) The decision made by the Canal Officer under this section subject to any order passed by Divisional Canal Officer on appeal from such decision, if any, shall be final.

(5) All charges for the unauthorised use or waste of water may be recovered, as water rates, in addition to any penalties incurred on account of such use or waste.

CHAPTER VI

LEVY OF BETTERMENT CONTRIBUTION

52. (1) There shall be levied a tax called betterment contribution in accordance with the provisions of this Chapter from the owner who is benefited by the construction, expansion, improvement or alteration of any irrigation work by the State Government.

Explanation 1: A land shall be deemed to be benefited notwithstanding that the benefit is not enjoyed, provided such non enjoyment is due solely to the action or inaction on the part of the person or persons interested in such land.

Explanation 2: A land shall not be deemed to be benefited merely by reason of the execution of repairs and maintenance of an irrigation work wholly or partly at the expense of the State Government.

(2) For the purpose of levy of betterment contribution, the prescribed officer shall, by notification, specify the dates of commencement and completion of the construction, expansion, improvement or alteration of any irrigation work and different dates of commencement and completion of any irrigation work depending upon the date on which water is made available to such lands.

53. (1) The amount of betterment contribution payable in respect of any land referred to in section 52 shall be an amount equal to 1* of the total cost of the construction, expansion, improvement or alternation of the irrigation work;

Provided that the amount of betterment contribution payable in respect of any land shall not be more than 2* per hectare or as may be prescribed by the Government from time to time;

Provided that the Government may prescribe different fraction of the total cost of construction, expansion, improvement or alteration of the irrigation work and different rates per hectare for different lands covered by different projects for purposes of betterment contribution;

Provide further that no betterment contribution shall be leviable in respect of a land :-

a. not earlier than five years from the date on which water is made available.

b. which is unarable;

c. benefited by the construction, expansion, improvement or alteration of an irrigation work which is not capable of irrigating more than forty hectares of land.

(2) As soon as may be, after the publication of notification under sub-section (2) of section 52 in respect of any irrigation work, the Betterment Levy Officer shall prepare a statement showing the lands under the irrigable command of the irrigation work in respect of which the betterment contribution in accordance with the provisions of sub-section (1) is payable, and the nature and extent of irrigability of different lands.

(3) The statement so prepared alongwith a public notice shall be published in the village and the taluk office and in such other manner as may be prescribed and such notice shall require the owners of lands under the culturable commanded area of the irrigation work to appear before the Betterment Levy Officer either personally or by agent at a time and place therein mentioned, such time not being earlier than one month from the date of publication of the notice, and to state :-

a. their objections;

i. to the inclusion of lands in the statement as lands under the irrigable command of the irrigation work;

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1. A fraction of the total cost may be specified by the State.
2. Cost per hectare may be specified by the State.

ii. to the inclusion of the lands in the statement as lands of any specified nature and extent of irrigability; and,

b. in respect of payment of betterment contribution, the basis on which they claim that the amount of betterment contribution has to be computed and such statement shall be made in writing and signed by the party or his agent.

(4) The Betterment Levy Officer shall also serve notice to the same effect on the owner of such land or his agent authorised to receive service on his behalf, who resides within the revenue district in which the land is situated and in case any owner resides elsewhere and has no such agent, the notice shall be sent to him by registered post.

(5) On the date fixed under sub-section (3) or on such other date to which an inquiry may be adjourned, the Betterment Levy officer shall after holding an inquiry in the manner prescribed and after giving an opportunity of being heard to every person who has made a statement under sub-section (3), make an order specifying -

a. the amount of betterment contribution payable in respect of the said lands; and

b. the date from which such betterment contribution shall be payable.

(6) The State Government or any person aggrieved by an order made under sub-section (5) may, within sixty days from the date of the order, appeal to the prescribed authority and the authority may pass such orders on the appeal as it may deem fit.

(7) An order passed by the prescribed authority on an appeal preferred to it under sub-section (6) and subject to the orders of the authority the order of the Betterment Levy Officer under sub-section (5) shall be final.

(8) At the end of every four years from the year in which the betterment contribution is finally determined under sub-section (1) any future instalment of such contribution shall be liable to be revised on the same basis as provided in that sub-section.

(9) If, in the opinion of the State Government the enforcement of all or any of the provisions of this Chapter will cause hardship in any case or cases, the Government may, by notification, setting out the ground therefor, exempt either permanently or for a specified period such case or cases from all or any of the provisions of this chapter, subject to such conditions, if any, as the Government may deem fit to impose.

54. The contribution shall become payable under this chapter on a written notice of demand thereof issued by the Betterment Levy Officer being served on the owner:

Provided that no notice of demand shall be served on an owner until an order made under sub-section (5) of section 53 becomes final;

Provided further that where, before the commencement of this Act, five years or more have elapsed from the date of completion of the construction, expansion, improvement or alteration of the work such notice may be served at any time after such commencement.

55. (1) The owner of any land, in respect of which any contribution is payable, shall pay it in cash in such annual instalments not exceeding twenty as may be prescribed :

Provided that if, on or before the date on which the first instalment is payable, or at subsequent date within a period of two years from that date, the owner pays the entire contribution or the balance of contribution, as the case may be, he shall be entitled to a rebate as may be prescribed on such contribution or balance of contribution, as the case may be.

(2) Contribution payable under this Act in respect of any land shall be deemed to be revenue demand due upon the said land.

56. Any person having interest in a land may, notwithstanding that he is not the owner of such land, pay the contribution payable by the owner in respect of such land and shall, if such person, pays the entire contribution within a period of two years from the date on which the owner becomes liable to pay the contribution, be entitled to a rebate as may be prescribed.

57. No claim shall lie against the State Government for compensation or for the refund of betterment contribution on account of loss occasioned by any temporary failure or stoppage of water in an irrigation work or by any cause beyond the control of the Divisional Canal Officer or by any repairs, alterations or additions made to such work.

CHAPTER VII

OBTAINING LABOUR AND MATERIALS FOR IRRIGATION WORK IN EMERGENCY

58. (1) Whenever it appears to the Divisional Canal Officer or any Officer acting under his general or special orders in this behalf, that, unless some work or repair is immediately executed, such serious damage will happen to any irrigation work as to cause sudden and extensive public injury or serious interruption of the established course of irrigation and that labour necessary for the proper execution thereof cannot be obtained in the ordinary manner in time to prevent such injury or interruption or to remedy it within a reasonable time, the Divisional Canal Officer or any officer acting under the said orders, may, by public proclamation by beat of drum require any able bodied person, who resides or owns land in any village

within eight kilometers of the place where the work is to be executed and whose name appears in the list hereafter mentioned to attend in person at such place and to carry out such duties as he may allot to them in connection with the execution of the work necessary for the safety of the particular irrigation work.

(2) All persons so labouring shall be entitled to payment at rates which shall not be less than the highest rates for the time being paid in the neighbourhood for similar labour.

59. Subject to such rules as may be made in this behalf, the Divisional Canal Officer in consultation with the Collector shall prepare a list of persons liable to carry out the duties as aforesaid, and may from time to time add to or alter such list or any part thereof.

60. Whenever it appears to a Divisional Canal Officer or any officer acting under his general or special orders in this behalf, that it is essential for carrying out urgent works on any irrigation work to prevent public injury caused by damage to works, he may enter upon or into any immovable property in the neighbourhood of the irrigation work requiring immediate repair, or other work and take possession, appropriate, cut or remove any trees, timber, bamboos, mats, ropes, straw, earth, stone and other materials and prepare an inventory of the materials taken; such materials shall be paid for at the highest prices for which they are sold in the neighbourhood and in case damage is sustained by any person in consequence of the removal, seizure or cutting of any such material, compensation shall be paid for such damage by the Divisional Canal Officer in accordance with the procedure laid down in sections 68 and 69.

61. Any person aggrieved by fixation of wages under sub-section (2) section 58 may prefer an appeal within sixty days to the Superintending Canal Officer whose decision shall be final.

CHAPTER VIII

DRAINAGE AND PREVENTION OF WATERLOGGING

62. Whenever it appears to the State Government that injury to any land or public health or public convenience has arisen or may arise from the encroachment upon any irrigation work, the State Government may, by notification, prohibit within limits to be defined in such notification the formation of any encroachment, or may, within such limits order the removal or other modification of such encroachment.

63. (1) The Divisional Canal Officer, or other person authorised by the State Government in that behalf, may, after the notification under section 62 issue an order to the person causing or having control over any such encroachment to remove or modify the same within a time to be fixed in the order.

(2) If within the time so fixed such person does not comply with the order, the Divisional Canal Officer may remove or modify the encroachment and recover the expenses involved in such removal or modification from the person concerned:

Provided that the Divisional Canal Officer may, in cases of emergency, remove the encroachment before the publication of notification and the expenses incurred shall be recoverable from the person concerned.

64. (1) Whenever it appears to the State Government that any drainage work excluding field drain is necessary in the interest of public health, or for improvement of any lands, or for the proper cultivation or irrigation thereof or that protection from floods or other accumulation of water or injurious salts or from erosion by a river, is required for any lands, the State Government may by notification declare that the drainage work shall be constructed after a day to be named in the said notification, not being earlier than three months from the date thereof.

(2) As soon as practicable after the issue of a notification under sub-section (1), the Divisional Canal Officer or any officer duly empowered under this Act shall cause public notice to be given at convenient places, stating that the State Government intends to construct the drainage work excluding field drain referred to in sub-section (1).

(3) The provisions contained in Sections 11 and 12 regarding the acquisition of land for the construction of work shall apply, *mutatis mutandis*, to the construction of drainage work referred to in sub-section(1).

65. (1) Notwithstanding anything contained to the contrary in sub-section(1) of section 64, the Divisional Canal Officer may cause a scheme for field drains to be drawn up.

(2) Every scheme drawn up under sub-section (1) amongst other matters set out the estimated cost thereof, the alignment of the proposed field drain or realignment of the existing field drain, as the case may be, the particulars of the owners or occupiers to be benefited and other persons who may be affected thereby and sketch plan of the area proposed to be covered by the scheme.

(3) The provisions contained in sections 14, 15 and 17 to 20 shall apply *mutatis mutandis* to the scheme drawn up for field drains.

(4) The Divisional Canal Officer may construct the field drains on behalf of the owners or occupiers and recover the cost pro-rata from the owners or occupiers.

CHAPTER IX

AWARD OF COMPENSATION

66. Compensation may be awarded in the event of only substantial damage caused by the exercise of any of the powers conferred by this Act, which is capable of being ascertained :

Provided that no compensation shall be so awarded in respect of any damage arising from -

a. deterioration of climate or soil; or

b. stoppage of navigation or of the means of floating timber or of watering cattle; or

c. stoppage or diminution of the supply of water in consequence of the exercise of the power conferred by section 3, if no use has been made of such supply within five years immediately before the date of issue of the notification under section 3; or

d. failure or stoppage of any water in an irrigation work where such failure or stoppage is due to -

i. any cause beyond the control of the Divisional Canal Officer;

ii. the execution of any repairs, alterations or additions to the irrigation work;

iii. any measures considered necessary by the Divisional Canal Officer, for regulating the proper flow of water in the irrigation work for maintaining the established course or irrigation; or

iv. circumstances mentioned under clauses (a) to (g) of section 39:

Provided further that any person who suffers loss from any stoppage or diminution of water supply to his lands due to any of the cause named in clause (d) of the preceding provision shall be entitled to such remission of the water rate payable by him as may be authorised by the State Government.

67. No claim for compensation under this Act for any damage shall be entertained after the expiration of one year from the time when the damage complained of commenced, provided that the Divisional Canal Officer on sufficient cause shown to his satisfaction by the claimant for not making the claim within such period, may condone the delay, and entertain the claim.

68. (1) In every case of entry upon any land and building of the utilisation of materials under sections 4, 5, 6, 7 and 60 the Canal Officer or the person

making the entry shall ascertain and record the extent of the damage, if any, caused by the entry, or in the execution of any work, to any crop, tree, building or other property and the value of the materials taken or utilised and, within one month from the date of such entry, compensation shall be tendered by the Canal Officer to the owner or occupier of the property, as the case may be.

(2) If such a tender is not accepted within a week of the tender, the Canal Officer shall forthwith refer the matter for purpose of determining the amount of compensation to the Divisional Canal Officer who shall decide the matter with the previous approval of the Superintending Canal Officer.

(3) The Superintending Canal Officer either *suo motu* or on the application of the person concerned, when the matter has been referred to the Divisional Canal Officer, may revise the order of the Canal Officer within a period of two years from the date of the order.

69. (1) Unless otherwise provided, all claims for compensation under this Act other than claims of the nature provided for in section 68 shall be made to the Divisional Canal Officer concerned.

(2) The Divisional Canal Officer shall enquire into all such claims and determine the amount of compensation, if any, which should be awarded. In determining such amount, the Divisional Canal Officer shall be guided by the provisions of sections 23 and 24 of the Land Acquisition Act, 1894:

Provided that regard shall be had to the diminution in the market value, at the time of awarding compensation, of the property in respect of which compensation is claimed; and where such market value is not ascertainable, the amount of the diminution of the annual net profits of such property caused by the exercise of the powers conferred by this Act;

Provided further that no order determining the amount of compensation shall be made by the Divisional Canal Officer under this section without the previous approval of the Superintending Canal Officer.

70. Any person aggrieved by the order of the Superintending Canal Officer or the Divisional Canal Officer under section 68, or of the Divisional Canal Officer under section 69, may, within 90 days from the date of the communication of the order, prefer an appeal to the prescribed authority.

71. All sums of money payable for compensation awarded under this Chapter shall become due three months after the final award is made, and simple interest at the rate as may be prescribed but not less than five percent per annum shall be allowed on any such sum remaining unpaid after the said three months, except when the non-payment of such sum is caused by the neglect or refusal of the claimant to apply for or receive the same.

CHAPTER X

SETTLEMENT OF DISPUTES

72. (1) The Canal Officer may, if he considers necessary, pass an order as to the use of distribution of water from a water course or field channel amongst persons in any land or a group of lands or in any holding or group of holdings in such land or lands :

Provided that no such order shall be passed by the Canal officer without making any inquiry into the matter and without giving notice to all the persons interested that on a day to be named in such notice, he shall proceed to inquire into the said matter.

(2) Whenever a difference arises between two or more persons in regard to their mutual rights or liabilities in respect of the use or maintenance of a water course or field channel or field drain any such person may apply in writing to the Canal Officer stating in matter in dispute.

(3) On receipt of an application under sub-section (2), the Canal officer shall give notice to the other persons interested, and on a day to be named in such notice, he shall proceed to enquire into such matter and after the enquiry, he shall try to bring about a compromise between the parties.

(4) On the failure of the Canal Officer to bring about a compromise, he shall pass an interim order as regards the use or maintenance of a water course or field channel or field drain pending the disposal of the dispute and he shall forward the dispute to the Divisional Canal Officer along with his findings and the Divisional Canal Officer shall pass an order thereon after giving a hearing to the parties.

(5) The Superintending Canal Officer, within whose jurisdiction the water course or field channel or field drain is situated, may, on his own motion or on an application made in this behalf by an aggrieved person, revise an order passed by a Divisional Canal Officer under sub-section (4) :

Provided that no such application shall lie unless it is made within a period of thirty days from the date of such order.

(6) No order passed under this section shall be liable to be called in question in any civil court.

CHAPTER XI

SAFETY OF IRRIGATION WORK

73. Except as may be prescribed, no person other than the Canal Officer shall,

a. Interfere with or encroach upon an irrigation work; or

b. construct any earthen or masonry bund or weir on any channel or stream, flowing above or below any irrigation work.

74. The Canal Officer may issue an order to the person concerned interfering or encroaching upon any irrigation work to remove the same within a time to be fixed in the order; and if the person concerned does not comply with the order, the Canal Officer may remove the encroachment and take such other action as may be necessary and recover the expenses thereof from the person concerned :

Provided that the Canal Officer may, in case of an emergency remove the encroachment or take the necessary action before issuing the order, and recover the expenses thereof from the person concerned.

75. (1) Every owner whose tank, well, pond, spring pond or other reservoir is situated above any irrigation work shall maintain the bunds and surplussing arrangements of such tank, well, pond, spring pond, spring channels or reservoir in a safe and efficient condition.

(2) If, in the opinion of the Canal Officer, such bunds or surplussing arrangements, of the work referred to in sub-section (1) are not in a fit condition and are likely to endanger the irrigation works below, then the owner concerned shall be served with a notice to bring such bunds or surplussing arrangements to a reasonably fit condition, in such manner and within such time as may be specified in the notice.

(3) If the said owner fails to comply with the notice within the time specified or does repairs which in the opinion of the Canal Officer are unsatisfactory, the Canal Officer may carry out the necessary repairs and recover the cost from the said owner.

(4) From any order of the Canal Officer under this section an appeal shall lie within thirty days from the date of communication of the order, to the Divisional Canal Officer, whose decision thereon shall be final.

76. No person shall conduct mining or quarrying operations requiring the use of explosives within such distance as may be prescribed from the boundaries of an irrigation work without the written permission of the Canal Officer.

77. Notwithstanding anything contained to the contrary in sub-section (4) of section 3, no well exclusively for domestic use, either on personal or community basis, shall be excavated within such distance, as may be specified by the State Government from time to time, from the boundaries of an irrigation work without the previous sanction of the authority specified by the State Government and subject to such conditions as the authority may impose.

78. No person shall have the right to fish or ply, any vessel in a reservoir, pond or tank or across or along a canal or channel maintained or controlled by the Government without the permission in writing of the State Govenment or of

such officer as may be empowered in this behalf by the State Government, and except under such terms and conditions and subject to payment of such fees as may be prescribed.

79. No person other than the Canal Officer or any Officer duly empowered in this behalf shall let out water from a canal or channel by cutting the bund, constructing a sluice or outlet or any other similar contrivance.

80. (1) Save as provided in this Act, no person shall abstract water for any purpose by the installation of pump sets or other electrical or mechanical devices for pumping water from an irrigation work except with the permission of the Divisional Canal Officer within whose jurisdiction such pump sets or other devices for abstraction of water are installed and subject to such terms and conditions and subject to the payment of such fees, as may be prescribed.

(2) If any person abstracts water from an irrigation work in violation of sub-section (1), the Divisional Canal Officer or any person authorised by him in that behalf shall have the power to enter any property, place or premises in which construction is made or any pump set or other electrical or mechanical device is installed for the abstraction of the water and remove or cause to be removed such construction or pump set or other device.

(3) The Divisional Canal Officer or the person Authorised under sub-section (2) may also confiscate any pump set or other electrical or mechanical device if he is satisfied that such confiscation is necessary for the prevention of the abstraction of water.

81. No person shall deposit any produce of mines or earth or any other material in or near any channel or field drain or other work, whether natural or artificial, through which rain or other water flows into any irrigation work.

82. (1) No person shall without the permission of the Divisional Canal Officer pollute, or discharge sewage effluent or trade effluent in the water of any irrigation work which may cause injury to the irrigation work or may deteriorate the quality of water of the irrigation work or may give rise to the growth of any weeds in the irrigation work.

(2) The provisions of Water (Prevention and Control of Pollution) Act 1974 will apply with regard to matters in sub-section 1.

CHAPTER XII

OFFENCES AND PENALTIES

83. Whoever voluntarily or without proper authority :

(1) damages, alters, enlarges, obstructs or encroaches upon any irrigation work;

(2) interferes with, increases or decreases the level and supply of water in, or the flow of water from, through, over or under, any irrigation work;

(3) interferes with or alters the flow of water in any river or stream, so as to endanger, damage or render less useful any irrigation work;

(4) being responsible for the maintenance of a water course or field channel, or using a water course or field channel, neglects to take proper precautions for the prevention of waste of the water thereof, or interferes with the authorised distribution of water therefrom, or uses such water in an unauthorised manner;

(5) causes any vessel to enter or navigate on any irrigation work contrary to the rules for the time being prescribed by the State Government;

(6) while navigating on any irrigation work, neglects to take proper precautions for the safety of the irrigation work and of vessels thereon;

(7) neglects, without reasonable cause, to carry out or to continue to carry out duties in connection with the execution of any repair or work, when lawfully bound to do under section 58;

(8) destroys or moves any level-mark or water-gauge fixed by the authority of a public servant;

(9) opens, shuts or obstructs or attempts to open, shut or obstruct, any sluice or outlet or any other similar contrivance in any irrigation work;

(10) allows cattle to graze or be tethered on the irrigation work or pass any animal or vehicles on any irrigation work;

(11) grows or allows to grow any crop in contravention of a notification under sub-section (2) of section 42;

(12) uses water from an irrigation work without obtaining the permission required under sub-section (5) of section 38;

(13) contravenes any of the provisions of the Act or of any rules made thereunder/ shall be liable on conviction before a Magistrate, for offences mentioned in clause (1) to (6), (8) and (12) to a fine not exceeding rupees one thousand or to imprisonment not exceeding one year or with both and for offences mentioned in clauses (7), (9) to (11) and (13) to a fine not exceeding five hundred rupees or to imprisonment not exceeding two months or with both :

Provided that for a second or subsequent offence under clauses (1) to (6), (8) and (12) fine shall not be less than rupees two hundred and under clauses (7), (9) to (11) and (13) fine shall not be less than rupees fifty:

Provided further that in case of a continuing offence a daily fine of not less than rupees fifty during the period of continuance of the offence shall also be imposed.

84. The penalties and punishments mentioned in the Water (Prevention and Control of Pollution) Act, 1974 will be applicable for violating the provision of section 82.

85. (1) When any person is convicted of an offence under section 83, the Magistrate may order that the said person shall remove the obstruction or repair the damage or replace or repair the land mark, level mark, water gauge or apparatus in respect of which the conviction has taken place within a period to be fixed in such order.

(2) Without prejudice to the powers of the Canal Officer under section 74, if such person neglects or refuses to obey such order within the period so fixed, the Canal Officer may carry out the work in accordance with such order and the cost thereof shall be recoverable from such person.

86. Whoever abets any offence punishable under this Act, or attempts to commit any such offence shall be punished with the punishment provided in this Act for such offence.

87. Nothing contained in this Act shall prevent any person from being prosecuted under any other law for the time being in force for any act or omission made punishable by this Act.

88. Notwithstanding anything contained in the Code of Criminal Procedure, 1973, all offences punishable under this Act shall be cognizable and bailable.

89. Any person in charge of, or employed upon any irrigation work, may remove from the land or buildings belonging thereto, or may take into custody without a warrant, and without unnecessary delay take to a Magistrate or in the absence of the Magistrate take to the nearest police station, any person who within his view :-

a. wilfully damages, alters, enlarges or obstructs any irrigation work;

b. without proper authority interferes with the supply or flow of water, in or from any irrigation work so as to endanger, damage or render less useful such irrigation work.

90. (1) Whenever any person is fined for an offence under this Act, the court which imposes such fine, or which confirms in appeal or revision a sentence of such fine, or a sentence of which such fine may be paid by way of reward to any person who gave information leading to the detection of such offence or to the conviction of the offender.

(2) If the fine is ordered to be paid as a reward by a court whose decision is subject to appeal or revision, the amount ordered to be so paid, shall

not be paid until the period specified for presentation of the appeal has elapsed or if an appeal is preferred till after the decision of the appeal.

91. (1) If the person committing an offence under this Act is a company, the company as well as every person in charge of, and responsible to the company for the conduct of its business at the time of the commission of the offence shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this sub-section shall render any such person liable to any punishment if he proves that the offence was committed without his knowledge or that he exercised due diligence to prevent the commission of such offence.

(2) Notwithstanding anything contained in this sub-section (1) where an offence under this Act has been committed by a company and it is proved that the offence has been committed with the consent or connivance of, or that the commission of the offence is attributable to any neglect on the part of, any director, manager, secretary, or other officer of the company, such director, manager, secretary, or other officer shall also be deemed to be guilty of the offence and shall be liable to be proceeded against and punished accordingly.

Explanation : For the purposes of this section:-

a. "Company" means any body corporate and includes a firm or other association of individuals; and

b. "director" in relation to a firm means a partner in the firm.

92. Any Canal Officer duly empowered under this Act, may accept before the institution of a prosecution under this Act, from any person, against whom a reasonable belief exists that he has an offence punishable under this Act or the rules made thereunder, a sum of money as may be prescribed but not exceeding two hundred rupees, by way of composition for such offence.

CHAPTER XIII

MISCELLANEOUS

93. When the person causing any damage, alteration, enlargement or obstruction to any irrigation work without proper authority cannot, after such enquiry as the Divisional Canal Officer may deem sufficient, be ascertained or identified, the Divisional Canal Officer may, on requisition from the Canal Officer, after giving not less than one month's notice to the owners and occupiers of all lands benefited thereby, and after hearing their representations, if any, recover from them, in such proportion as he thinks fit, the cost of repairing such damage, or of removing such alteration, or obstruction.

94. (1) Whenever any sum is to be paid by any person under this Act and the sum has not been paid within the time prescribed for such payment, it shall be recoverable with interest not exceeding twelve percent per annum as may be prescribed.

(2) When any sum is recovered as above under sub-section (1) of section 27 and sub-section (1) of section 28, it shall be paid to the person who is entitled to receive the same.

95 (1) The State Government or, subject to such rules as may be made under this Act, any officer so empowered in this behalf, may :

a) appoint such officers with such designations, define the local limits of jurisdiction of such officers and assign to them respectively such powers and duties under this Act, as the State Government or such officer, may deem fit;

b. invest any government officer in any department, either personally or in right of his office, or any other persons, with such powers and impose upon him such duties, under this Act, as the State Government of such officer, may deem fit:

Provided that any assignment of, or investment with powers or duties made under this section may at any time be cancelled or varied by the State Government or such Officer.

(2) The State Government shall have the power to direct in the manner prescribed the annual inspection of and submission of reports on all irrigation works in respect of their proper maintenance and repair.

96. Any officer empowered under this Act to conduct any enquiry may exercise all such powers connected with summoning and examining the witnesses and the production of documents as are conferred on a civil court by the Code of Civil Procedure, 1908, and every such enquiry shall be deemed to be a judicial proceeding.

97. (1) No suit, prosecution or other proceedings shall lie against any officer or servant of the State Government, for any act done or purporting to be done under this Act, without the previous sanction of the State Government.

(2) No Officer or servant of the State Government shall be liable in respect of any such act in any civil or criminal proceeding if the act was done in good faith in the course of the execution of duties or the discharge of the functions imposed by or under this Act.

(3) Save as otherwise provided in this Act, no suit shall be instituted against the State Government in respect of any act done unless the suit is instituted within six months from the date of the act complained of.

98. (1) The State Government may, from time to time, empower the Village panchayats to discharge any of the functions entrusted to the Government under this Act.

(2) Without prejudice to the generality of the foregoing provision, the State Government may entrust the village panchayats with the responsibility of constructing and maintaining small irrigation works such as tanks, tubewells, water courses and field channel and regulate supply of water therefrom.

99. If the State Government is of the opinion that it is in the public interest to entrust distribution of water supply when given in bulk at the head regulator or outlet to farmer's cooperative societies, the State Government may by rules provide for the formation of such societies on such conditions as may be prescribed.

100. (1) The State Government may, by notification, make rules for the purpose of carrying into effect the provisions of this Act.

(2) Every rule made under this Act shall be laid as soon as may be, after it is made, before each House of the State Legislature while it is in session for a total period of thirty days which may be comprised in one session or in two successive sessions, and if, before the expiry of the session in which it is so laid or the session immediately following, both Houses agree in making any modification in the rule or both Houses agree that the rule should not be made, and notify such decisions, the rule shall from the date of publication of such notification have effect only in such modified form or be of no effect, as the case may be so however, that any such modification or annulment shall be without prejudice to the validity of anything previously done or omitted to be done under that rule.

EXHIBIT A

37. (1) Supply of water from any irrigation work shall be regulated according to rules made in that behalf, such rules may provide for calling for applications for supply, of water before the prescribed dates and for sanctioning supply, regard being had to the availability of water, the total area of the land for which water is to be supplied,the regularity in payment of water rates by the applicants, the crops to be grown on the lands from irrigation works and other relevant factors, if any, which may be prescribed.

(2) The sanctioned supply may either be on area basis as provided in sub-section (1) or on volumetric basis.

(3) Every person desiring to have a supply of water from an irrigation work shall submit a written application to that effect to a Canal Officer duly empowered in this behalf to receive such-applications in such form as may from time to time be prescribed.

(4) Where an application is made for a supply of water to be used for purposes other than those of irrigation, the Canal Officer may, with the sanction of the State Government, give permission for water to be taken for such purposes under such special conditions and restrictions, as to the limitation, control and measurement of the supply, as he may be empowered by the State Government to impose in each case.

(5) If any person uses water from an irrigation work without obtaining the permission required under this section, he shall in addition to any penalty he incurs under this Act for such unauthorised use of water be liable to pay water rate at such rate as may be determined by the prescribed officer not being less than ten times and not exceeding thirty times the rate he would otherwise have been required to pay, had he applied for and obtained the permission.

EXHIBIT B

42. (1) The areas for crops other than staple cereal crops may be delimited by the Divisional Canal Officer into blocks. Each such block shall have a period of rotation as may be prescribed by the State Government according to the crop pattern to be determined by the blocks by the persons having lands in the blocks by mutual agreements.

(2) In case of disagreement, the Divisional Canal Officer shall prepare a draft crop pattern for each block under his charge. It shall be published in a conspicuous place of the village in which the block is situated in the presence of two witnesses of the locality inviting objections and suggestions to be filed before the Divisional Canal Officer within fifteen days from the date of publication. The Divisional Canal Officer after the last date fixed for filing objections and suggestions, shall proceed to hear the objections and suggestions received by him after giving due notice to the parties concerned. As soon as the Divisional Canal Officer completes the hearing he shall finalise the crop pattern for each block and cause the same to be published in a conspicuous place of the village in the presence of two witnesses of the locality.

(3) Any person aggrieved with the order of the Divisional Canal Officer may file an appeal before the Superintending Canal Officer within thirty days from the date of publication of crop pattern. The decision of the Superintending Canal Officer shall be final.

(4) The crop pattern fixed for a block may be revised as may be prescribed by the State Government. In revising the crop pattern the same procedure as prescribed in the preceding sub-section shall be followed.

42-A (1) The Divisional Canal Officer shall prepare a draft irrigation chart for lands under such irrigation command for staple cereal crop and other crops showing the quantity of water to be supplied according to the time

schedule indicated therein. The draft chart shall be published in a conspicuous place of each village in which the lands under the irrigable command are situated in the presence of two witnesses of the locality inviting objections and suggestions, if any, to be filed before the Divisional Canal Officer within fifteen days from the date of publication. On expiry of the last date for filing objections and suggestions, the Divisional Canal Officer shall consider the objections and suggestions received and shall finalise the irrigation charts. The irrigation charts as finalised shall be got published by the Division Canal officer in the same manner as prescribed for draft publication of such charts.

(2) Any person aggrieved with the decision of the Divisional Canal Officer in preparing the final irrigation charts may file an appeal before the Superintending Canal Officer within thirty days from the date of publication of the final charts. The decision of the Superintending Canal Officer shall be final.

ANNEX V
(to Chapter-4)

AN EXAMPLE OF OPERATIONAL POLICY AND OPERATING RULES - WAPCOS

OPERATION POLICY

A. The system should be operated in the basic interest of the beneficiaries i.e. farmers.

B. The project management may frame appropriate rules, proceed with those activities for regulation and conservation of water and for the protection of quality of water.

C. The policy should conform to all the laws, ordinances of the State.

D. Operation within the project will be guided by the policy included i.e. rules and regulation to be adopted by the project management.

OPERATING RULES

It is necessary that all the personnel of the operating staff and the farmers should be provided with relevant policy statement and operating rules. The following operating rules suggested by WAPCOS, are given as an example :

i. The control of the system upto outlets lies with the irrigation department.

ii. Maximum water permissible, within the allocation, made by the State will be stored and diverted for irrigation.

iii. Water will be supplied to all farmers in the command equitably, proportionate to their holdings, as per availability.

iv. Water will be delivered as per rotational water supply and schedules communicated to all concerned in advance.

v. Water will not be delivered to, nor will be supplied to any land not included in the project, by the project authorities.

vi. Unexpected interruptions in service may occur due to breaches in canals etc., for which the users will not have any recourse for compensation.

vii. During normal years of water availability, the water will be supplied generally at 14 days frequency to the farmers.

viii. During scarcity years, the quantity of water supplied will be proportionate to availability. This will be done either by less number of turns or by reducing quantity supplied per turn or both. However, all beneficiaries in commissioned command area will be supplied with water.

ix. The distributaries will run on 7½ days 'on' and 7½ days 'off' basis, to ensure that all farmers get atleast one turn of irrigation during one 'on' period.

x. The farmers will take the water as per Warabandi schedules prepared on outlet basis. The period of water supply below outlet will be in proportion to the area of the holding bears to the total area under the outlet. The effect in period of 168 hours will be apportioned to each holding in the same ratio. These timings and the order of getting water will remain fixed during the year and will be changed by 12 hrs in the following year, in order to rotate the day and night irrigation supplies among farmers. The irrigation will have to be done round the clock.

xi. When the water runs through the outlets, the farmers having their turns on that date and at that time will start irrigation in the sequential order otherwise the defaulting farmer will lose the particular turn.

xii. The schedules for water delivery will be prepared taking into account the general cropping pattern, sowing times and crop water requirements, and will not consider the crops grown by individual farmers and the area irrigated.

xiii. The schedules thus prepared at the beginning of the season will be rigidly followed and nobody from the operating staff, nor the farmers will be authorised to change, modify or alter the same, except that in times of heavy rainfall the supplies may be suitably reduced during the 'on' period for which no additional supply will be made during the following 'off' period and further that in special circumstances with prior consultation of standing sub-committee of the ICC/ CADA board, the schedules may have to be changed.

xiv. In case of long dry spells in the command, efforts will be made by the management to supply more turns, if water is available in the reservoir and these will be communicated atleast 48 hrs. in advance.

xv. The farmers will be free to grow any crops(except those that are prohibited by the project authorities) and extend the irrigation to part or full area of their land within the water allocated to them.

xvi. Taking water unauthorizedly, out of turn and more in quantity by heading up the distributary, lateral, etc., will be considered as legal offence. No farmer will be authorized to tamper with the flows to distributaries/ laterals/FICs.

xvii. Additional outlets will be permitted only upon the written orders of the Chief Engineer (O&M).

xviii. Irrigation supplies will generally begin from 1st June and will continue upto 7th March, with Kharif season from 1 June to 15 October and rabi season from 16th October to 28th/29th February.

xix. During normal year, efforts will be made to provide 19 to 21 turns to all the farmers.

xx. Every watering will provide 17 mm/ha of water for the CCA of each farm.

ANNEX VI
(to Chapter-4)

GUIDELINES FOR OPERATION AND MAINTENANCE OF DAMS*

1. OPERATION AND MAINTENANCE

1.1 Even a well constructed dam may face problems and difficulties if it is not properly maintained. The maintenance budget of most of the structures, it is noticed, hardly covers the establishment charges, leaving very little funds for carrying out actual maintenance. The budget provisions for maintenance of hydraulic structures need to be upgraded and this should be on the basis of the prevailing cost of structures instead of the original cost. This should be upgraded once in ten years.

1.2 In case of remedial works necessary as a result of review, for existing dams, a detailed estimate has to be prepared and got sanctioned before the commencement of work. If such repairs are to be undertaken as a consequence of the panel's recommendation, the dam safety cell shall act as a catalyst to arrange for speedy sanction of the estimate. The estimate however, shall be prepared by the Chief Engineer, incharge of the project. In case of emergency repairs, the works will be commenced and the estimate submitted for ex-post-facto sanction.

1.3 Each river valley project/dam should have an operation and maintenance manual (POM) which should contain detailed instructions, procedures and rules for operation and maintenance of the dam and its appurtenant works. It should also include instructions regarding operation, maintenance and record of observations in respect of working of various facilities as well as the equipment/instruments embedded within the body of the dam and its appurtenant works.

1.4 A copy of the operation and maintenance manual (POM) should always be handed over to the new officer who joins the project and is charged with the responsibility of maintenance of dams.

1.5 Operation and maintenance manuals (POM) should be prepared by the design office in consultation with the construction and maintenance organization/ dam safety cell of the State. the procedure fomulation should also involve

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* Extracted from Chapter VII of the "Report on Dam Safety Procedures", Dam Safety Organization, Central Water Commission, Government of India, New Delhi, July 1986. The report was presented by the Standing Committee to review the existing practices of inspection/maintenance of dams and allied structures in various States and to evolve standard guidelines for the same, constituted by Government of India, 17 August, 1982.

administrative authorities and requirement of downstream riparian rights. Any modifications considered necessary as a result of field experience in following the instructions contained in the operation and maintenance manual (POM), shall be proposed by the field engineers to the design office. All amendments considered necesary by the design office shall be done after getting approval from the competent authority in consultation with the dam safety cell.

1.6 An adequate flood forecasting system with wireless communication needs to be established for reservoirs wherever such a system is likely to provide enough advance information of incoming flood volumes useful for reservoir operation.

1.7 In respect of major projects, the State Government may consider the formation of an Expert Committee consisting of experienced design and construction engineers of dams to advise on the various problems encountered during operation and maintenance stage. Annual memos may be prepared regarding the performance of dams and other important components of the project and seek the advice of the experts. Copies of these memos may be sent to Dam Safety Cell in the State as well as to Chief Engineer, Dam Safety Organization.

1.8 It would be necessary that before shifting the operation and maintenance staff from one project to another, it should be ensured that the staff posted in their place are properly trained and at no time all the staff is new at a project.

2. PRINCIPLES OF RESERVOIR OPERATION

2.1 The aim of reservoir operation is to reduce the risk of man-made floods to the area on the downstream through carefully prepared reservoir regulation schedules, release procedure and gate operation schedules aided by an accurate and reliable flood forecasting and warning system.

2.2 In case of ungated reservoirs the important parameters that need to be carefully decided are the design flood, adequacy of spillway capacity and the free board. These need to be periodically reviewed with the help of continuous short-term data collected during the course of operation.

2.3 In case of gated reservoirs while it is desirable to fill the reservoir early, the reservoir level should not be allowed to reach F.R.L., if late monsoon inflows are adequate to fill the reservoir.

2.4 In case of gated reservoir having flood control storage space, the operation could be flexible keeping the requirements of both conservation and flood control in view. The reservoir operation should be carefully co-ordinated between flood disposal and the building up of the conservation storage. This is achieved by preparing guide curves and gate operation schedules and efficient system of flood forecasting.

2.5 The Regulation Manual for Damodar Valley Reservoirs was prepared by the then CWPC in April, 1969 and this deals with integrated regulation of the four D.V.C.multipurpose reservoirs at Panchet, Maithon, Konar and Tilaiya for the

principal benefits of flood control, irrigation, industrial and domestic water supply and power. This can be referred to with benefit for developing integrated regulation manual for a system of reservoirs in a basin.

2.6 The Government of Maharashtra has brought out a Dam Safety Manual. Chapter 7 of the manual, entitled "Flood Forecasting, Reservoir Operation and Gate Operation" is for the general guidance of the field staff engaged on operation and maintenance of dams in the State. The manual contains guidelines relating to principles and techniques of flood forecasting, operation of flood forecasting systems, principles of reservoir operation, preparation of guide curves for reservoir filling and regulation, gate operation schedules for gated dams and flood disposal, flood fighting, constitution of flood coordination committees, flood-plain zoning and details of various data to be collected and registers to be maintained relating to reservoir operation and floods. The manual is quite exhaustive and other States may develop similar documents to meet the specific requirements of the State relating to reservoir operation, flood disposal and safety of dams and downstream property.

3. GATE OPERATION SCHEDULES

3.1 The gate operation schedules must be based on the site conditions, the results of model studies and the regulation schedule of the reservoir. The gate operation schedule should clearly indicate the complete sequence and stages of operation of various gates corresponding to various lake levels and flood situations.

3.2 Operating instructions for important structures should be displayed near the associated equipment. Each opeating device should be permanently and clearly marked for easy identification of equipment, and proper security arrangements should be made to ensure that unauthorised persons cannot operate or tamper with equipment.

3.3 All mechanical and electrical equipment should be maintained properly and inspected at regular intervals to avoid any mishap in case of emergency. The working of spillways, outlet gates and undersluices and low-level outlets should be especially checked before the onset of monsoon each year so as to ensure that these are not jammed and inoperative.

3.4 Proper measurement of short-period water levels during floods, short duration rainfall measurement in the catchment, outflow rating calculations and maintenance of gate operation records, etc, is very essential, for all existing reservoirs. Automatic water level recorders in the reservoir, to monitor drawdown effect caused by outflow, should be installed at all reservoirs at suitable places.

3.5 An efficient and reliable flood forecasting system should be established to formulate accurate forecasts of inflow and volume of floods and regulation of gates for efficient flood disposal.

4. SILT SURVEYS

4.1 Reservoir silt survey should be conducted at regular intervals and the area capacity curve of the reservoir should be accordingly revised. If some major slides/mishaps take place in the reservoir which considerably affect its capacity, silt surveys should be conducted immediately thereafter. These surveys should be more frequent in the initial years so as to know the trend of silting.

4.2 Flood carrying capacity of river channels downstream of the dam shall be reviewed at intervals of five years.

5. RECORD OF OPERATION

5.1 Proper measurement of water levels at short intervals during floods and short duration rainfall in the catchment, outflow rating calculations and maintenance of gate operation record, etc. are very essential for existing reservoirs. Automatic reservoir water level recorders should be installed at all reservoirs at suitable places.

6. MISCELLANEOUS

6.1 In Maharashtra State, regular workshops are conducted every year before the monsoon for training of dam operating staff in reservoir operation. The workshops are of a short duration of 4 to 5 days and are conducted at the regional training centre at Paithan dam through the Engineering Staff College, Nasik. The workshops are intended to acquaint the staff, engaged on actual operation of reservoirs in the State, with the techniques and methodology of reservoir operation and the related aspects. The trainees include mostly Assistant Engineers and Junior Engineers posted on maintenance and operation of important dams in the State. The training syllabus of workshops includes lake filling schedules, flood hydrology (a broad appraisal), flood forecasting, flood disposal, flood moderation and upstream and downstream safety, collection of hydrological data at dam sites and maintenance of records, maintenance and operational aspects of spillway gates, and vigilance of dams during monsoon. In addition to the lectures, the trainees are taken round the existing facilities at Paithan dam for practical demostrations and drills in various related aspects of the course.

6.2 The Committee recommends that such training programmes should also be organized in other States.

ANNEX VII
(to Chapter - 4)

EMERGENCY PREPAREDNESS*

1. NATURE OF DISASTER AND ITS EFFECTS

1.1 A situation of emergency arises in case of an impending disaster. The disaster itself may be natural or man-made. While natural disasters run through a definite known cycle of events and follow certain norms of localized scale, man-made disasters neither have known cycle of events nor are they necessarily spatially and temporarily restricted. In other words, natural disasters barring earthquakes, may be considered to be structured events while man-made disasters are unstructured.

1.2 Floods are one of the natural events, which often spell disaster. The existence of a dam upstream of the flood plain may either mitigate the extent of the calamity or accentuate it. As such, the disaster due to the existence of a dam may have the attribute of a natural disaster or attributes of both natural and man-made disasters. A disaster would be considered natural if the quantum of outflow from the dam is equal to the inflow flood. If however, due to the very existence of a dam the outflow exceeds the inflow, the disaster can be logically classified as man-made. In the event of dam break the disaster will be purely man-made.

2. PLANNING FOR EMERGENCY

2.1 The emergency preparedness plan should, however, be applicable both to natural and man-made disasters. The man-made disaster arising out of an outflow in excess of the inflow can be taken care of by developing operation rules with built-in factor of safety and an adequate and efficient warning system. Our greater concern is to evaluate the disaster consequent to dam break.

2.2 The aim of management cannot be the handling of the natural phenomenon itself, but rather to lessen or mitigate its impact upon human beings and natural environment. In order to carry out such measures it is necessary to have a proper plan and well defined measures which would help reduce the risk of disaster. Assessment of a country's vulnerability to disaster should be regarded as an essential element in the planning and implementation of measures which are designed to prevent or mitigate the disaster. If this basic element is ignored, disasters will keep occurring and take their toll; and a great deal of avoidable damage will continue to occur which will ultimately have a disastrous effect on the economy of the country.

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* Source : Chapter VIII of the "Report on Dam Safety Procedures", Dam Safety Organization, Central Water Commission, Government of India, New Delhi; July, 1986.

2.3 An integrated disaster plan would encompass both the disaster prevention and disaster preparedness, and these two aspects are like the two faces of the same coin. One part cannot be dealt exclusively without the other.

2.4 Disaster preparedenss can minimize loss of life and property by proper planning in advance so that measures are available to counteract the disaster. Visualising the challenges in advance and equipping accordingly to meet them effectively is the hall- mark of rational human thinking. Such planning would call for correct assessment of the following items :

- Evaluation of the disaster - advance knowledge of the likely occurrence of floods or cyclones.
- Identification of the likely effects; on property and human beings with a view to assessing the damage potential of the disaster.
- Vulnerability analysis and hazard area mapping to identify the most disaster prone areas.
- Review of organization and machinery for proper upkeep and maintenance of flood control works like dams,embankments,etc.
- Review of provisions for anti-disaster shelter such as adequacy of medical aid facility, transportation, food etc.
- Review of the existing method of flood and cyclone warning system with a view to rectify the missing links and gaps and modernizing the system in accordance with the latest state-of-art, if necessary.

3. PRIORITIZATION OF PROJECTS FOR EMERGENCY PREPAREDNESS

3.1 It would be ideal if emergency preparedness plans can be developed for all dams whose failure would endanger human life and property. However, due to financial and other constraints it may not be possible to prepare Emergency Preparedness Plan in a single stage for all projects in one go. In fact, emergency preparedness plans shall be prepared for certain priority situations to be decided on the basis of the following considerations :

(i) Dams in distress (dams whose level of safety has been adjudged low after review).

(ii) Projects with an earth dam component for which inadequacy of spillway has been identified during review and which even after adoption of engineering solutions, are susceptible to a remote possibility of overtopping while managing the reviewed design inflow flood.

(iii) Projects with an earth dam component for which the inadequacy of spillway has been identified, but engineering solution to manage the design inflow flood without overtopping would need considerable time and funds.

(iv) For dams constructed with masonry or concrete and without an element of an earth dam, the disaster preparedness here again shall be done for a possible outflow exceeding the capacity of the downstream channel, but the dam is saved in the process.

(v) For dams having a nuclear power plant on the downstream, studies will be conducted in consultation with the Atomic Energy Commission.

(vi) While fixing *inter se* priority, the hazard potential of the dam in question shall also be taken into account.

4. INPUTS FOR PREPARATION OF EMERGENCY PLAN

4.1 Planning of 'emergency preparedness plan' would get facilitated if the "flood plain zoning bill" has been enacted and is given effect to for the basin under consideration. Such an approach would lessen the effect of the disaster at a later stage.

4.2 Release of large quantity of water due to combination of flood coupled with dam break, disaster preparedness shall be done for the dams listed above (See 3.1) in the same order of priority.

4.3 An inundation map is the first input for planning an effective emergency preparedness plan. The following guidelines are suggested :

- Assess the safe carrying capacity of the downstream channel and the safe levels.

- Assess the inundation area for
  * 25-yaar flood
  * 50-year flood
  * for routed design flood
  * for PMF + dam break.

4.4 Inundation maps may be prepared for 25-year flood; 50-year flood and routed PMF in the order indicated above. The inundation map for flood coupled with dam break shall be prepared subsequently after conducting studies on dam break and collecting additional data etc.

4.5 Dam Break Studies

4.5.1 There are computer programme packages to evaluate inundation area due to dam break floods

Model Solution	Technique	Remarks
HEC I DB	Modified Pulse Kinematic wave	Well documented; easily applied; incorporates variation in breach geometry and time rate of breach formation (Presently limited to single dam application with dry downstream channels).
USIFLO (Corps of Engineers)	Explicit, staggered grid	Requires use of separate programme to calculate geometric elements (GEDA); designed for river routing; use for dam-break flood difficult; requires relatively small time steps and fixed distance steps.
DAMBRK (National Weather Service)	Four point, weighted difference implicit	Designed specifically for dam break floods; is easily applied and extremely versatile; handles variable breach and time rate of breach formation, using storage or dynamic routing in reservoir; will handle multiple (domino type) failures and will route super-critical or sub-critical flow.
MOC-LIF (United States Geological Survey)	MOC explicit method of characteristics, LIF-Four or Six point linear implicit	is not widely used; treats dam as internal node; propegates a single bore, sub-critical flow only; limited a single dam; requires trapezoidal cross sections, evenly spaced distance steps small time steps, relatively expensive computational cost.

4.5.2 The DAMBRK model is more versatile compared to other models. This model is available in the Dam Safety Organization, Nasik. The following minimum data are required for this model :

- Breach geometry (simplified to rectangular or trapezoidal shape parameters).
- Time rate of breach formation.
- Reservoir elevation - surface area points.
- Two or three valley cross-sections. The cross-sections should be chosen to accurately describe valley storage and conveyance. More sections generally improve the accuracy of computed peak stages.
- Valley roughness co-efficients.
- Boundary inflow hydrograph and lateral inflow hydrograph.

- Reservoir elevation at start of failure and initial water surface elevation at the downstream end of the channel.

- Description of downstream channel flow conditions i.e. sub-critical or super-critical.

5. PREPARATION OF INUNDATION MAPS

5.1 The population and property situated within the area prone to inundation and damage must be surveyed to identify the emergency potential.

5.2 Based on this survey, the index maps and detailed maps of likely inundation area due to dam break floods to be prepared by the Executive Engineer. The index maps and detailed maps of the dam break inundation area should ordinarily be prepared and handled as secret documents. These maps should also indicate location of safe high ground which can be used for evacuation and shelter purposes.

5.3 The inundation maps should be prepared to the scale 2 cm to 1 km or 1 : 50,000 or the scale of available topographical maps. A list of towns and villages, important public buildings and installations, railway lines, railway stations, Post and telegraph office and roads which may come under the flood line, should be prepared on the index map itself.

5.4 In respect of cities or towns and the villages falling in the likely inundation area of dam break floods, the detailed contour maps of the entire area showing contours at 0.5 m intervals should be prepared. The hypothetical dam break flood line, the 25-year return period outflow and the maximum spillway design discharge flood line (wherever relevant), the various populated sectors, streets and roads, public buildings, important installations and all prominent places must be marked on these plans. The detailed maps should be prepared on the available town planning or city survey or land record plans or village maps.

5.5 Normally such maps are avilable for the command area of irrigation projects having direct canals.. These maps with additional surveys covering the likely inundation area will also serve the purpose in majority of the cases.

6. ARRANGEMENTS FOR PUBLIC SAFETY

6.1 The Revenue Offices should be informed to select suitable higher locations where the people from flood prone area should be shifted in case of emergency. Details of such locations to be used for evacuation and shelters should be worked out and clearly marked on these detailed maps. The particulars of the railways and road bridges in the flood zone should be obtained and likely flood levels to which they might be subjected should be intimated to the revenue authorities and the authorities in charge of the bridges.

6.2 The above maps and details should be scrutinized and approved by competent officers of Irrigation Department as under:

Sr.No.	Category of Hazard Potential	Competent Authority
1.	High	Regional Chief Engineer
2.	Medium	Superintending Engineer
3.	Low	Executive Engineer

6.3 The approved plans of inundation area should be supplied to the following authorities:

- Chief Engineer (Irrigation Department)
- Commissioner of revenue Division
- Superintending Engineer
- Executive Engineer
- Collector (District Magistrate) of the District

6.4 Sufficient spare copies of the approved plans should also be kept ready to be supplied to any other officials concerned at short notice.

6.5 Location of readily available equipment, material, labour and engineering expertise which can be commanded need to be identified and properly planned. All emergency preparedness plans shall be reviewed after a period of 5 to 10 years depending upon the operations.

7. PUBLIC PARTICIPATION

7.1 Public participation to make emergency preparedness plan a success is an absolute must. Consequently, the MLAs, MPs in the disaster prone area, and all responsible persons of the locality shall be involved in the emergency preparedness plan. The help of volunatry orgnizations, like the Ramakrishna Mission and others shall be utilised. To chalk out the plan of action and fixing responsibility, a meeting shall be convened at the District Magistrate level before the flood season every year to assign responsibilities and indicate their duties in the likely event of disaster, so as to remain in readiness to encounter the emergent situation.

8. EFFICIENT COMMUNICATION SYSTEM

8.1 An efficient communication system to achieve success of emergency preparedness plan is absolutely essential and this has to be worked out in consultation with local authorities and administrative set-up. More often than not, the entire communication facility gets disrupted in a disaster situation. The wireless facility which is slightly free from the general encumbrances of

the communication system shall invariably be a part of the emergency preparedness plan. Department of Police invariably has wireless sets and there are standing instructions with them that they should convey disaster messages effectively and in time.

8.2 All departments who are to deal with the emergency preparedness plan shall be identified and the officer who is to be the nodal office in each department shall be identified and such officers will be provided residential telephone in addition to their office telephones. It is evident that the emergency preparedness plan is an integrated matter and requires technical expertise and specific administrative procedures if it is to be made practical, workable and successful.

8.3 The Government of Maharashtra has brought out a Dam Safety Manual. Chapter 8 of this manual, entitled "Preparedness for dealing with emergency situation on dams", is quite exhaustive and may be used by other States for developing similar plans to meet the specific requirement in their State.

ANNEX VIII
(to Chapter 5)

AN EXAMPLE OF MAINTENANCE ASPECTS OF A HEAD REGULATOR, GATES ETC. AT A DAM SITE

1. MAINTENANCE ASPECTS OF A HEAD REGULATOR

1.1 Approach channel

Sediment free maintenance of approach channel - methods such as reduction of sediment entry into the channel by judicious operation of river sluices during floods.

Frequency of silt clearance of approach channel and maintenance thereof to its original design.

Masonry protection works in the channel to be maintained in good condition.

1.2 Gauges

Gauges must be kept clean and painted regularly so as to remain clearly readable without ambiguity.

Approach to gauges to be maintained for all weather use.

1.3 Discharge Verification

The discharge passing through the head regulator is normally worked out from discharge rating curves (tables) prepared by model experiments, both for free-fall and drowned conditions. This needs verification at site by current meter, etc. Rating curves (tables) in case of significant variation need to be modified in consultation with the research unit.

1.4 Energy dissipating devices downstream of the Head Regulator

The performance of such devices should be monitored to check conformance with model results. In case of significant non-conformance, research unit should be consulted.

Bank and bed protection of exit channel should be carried out regularly. Routine repairs should be done during closures, and emergency repairs may be undertaken as called for.

2. OPERATION AND MAINTENANCE ASPECTS OF GATES

2.1 A chronological history of performance including repairs, replacements, and maintenance should be maintained. The engineer-in-charge shall test gates and appurtenant facilities annually and submit operability certificate to appropriate authorities.

2.2 Gates should be operated at suitable intervals to free the mechanism and wash out extraneous material.

2.3 Operation speed of gates should be limited to the speed prescribed by the manufacturer.

2.4 When more than one gate, the gates should be opened equally unless otherwise advised by the research unit on the basis of model studies.

2.5 Operation of gates and sequence of operation shall be decided by a higher authority (e.g. superintending engineer) and shall be based on model studies.

2.6 Model studies of river behaviour, shoal formation, sediment movement etc. are carried out for hydraulic efficiency and structural safety. The expenditure on studies is generally met from O&M funds.

2.7 In absence of such studies, wedge operation, i.e. commencing to open all gates equally on one side from the centre and then open gates on other side, should be resorted to.

2.8 Static head at any structural component should not exceed the prescribed safe limit and this may be ensured during gate operation.

2.9 The physical maintenance of gates includes -

- cleaning gates and removing debris, drift wood and silt from all cavities and angles/corners.
- keeping open all drainage holes and not allowing water to be entrapped.
- preventing (scrubbing) green stains formation on steel members at the backside (d/s) of gates.
- coating the mechanized and stainless steel, brass and bronze surfaces by a gasoline compound which is soluble, rust preventing and non-corrosive. These parts should not be allowed to be painted.
- painting according to specifications the u/s face of skin plates, which come in contact with water and other parts not coming in contact with water.

- painting should be done at least once in two years as a general schedule of maintenance.

Maintenance of appurtenant gate equipment, i.e. gate grooves and seals, roller train and rollers, stop logs, hoists and winches steelwire ropes and electrical installations should also be discussed in detail.

2.10 Gate Grooves and Seals

* grooves, in particular the machined faces should be cleaned specially to remove the sticky deposits and be well lubricated.

* the efficacy of seals should be tested initially after construction and at the time of closure or during dismantling of different portions for repairs.

* the leakage through the gate seals should not exceed one litre per minute per meter length of seal.

* the alignment of seal seats and wall plates shall be checked with spirit level.

* seal faces should be tested for uniform pressure by light test and by use of paper strip inserts.

* gate seals should be checked for wear and tear, deterioration and replaced in time.

* the screws fixing the seals shall also be checked, and damaged/worn out screws replaced.

2.11 Roller train and Rollers

* Roller trains should be examined at least once a year. Partially, jammed rollers should be cleaned, freed and greased. Totally jammed rollers should be replaced.

* Bolts of roller guards should be checked and tightened.

* Worn out pins should be replaced and suitably held against rotation by filling the empty space between the pin and side plates through welding or other approved means.

2.12 Stoplogs

* stoplogs shall be properly stored in idle bay provided for the purpose as per manufacturer's specification.

* care should be taken not to damage the structural members, seals and lifting logs.

* lifting beams, hooks and counter weight levers, which are prone to twisting and bending shall be handled with care.

* stoplogs should be tested before putting into operation.

* repairs/replacement of seals if necessary shall be done.

* lowering should be done in still water.

* while raising, the topmost unit shall be raised in unbalanced condition and others when water level has balanced.

* formation of scales and rusting on the surface should be prevented and painting of the members carried out as per specification or atleast once in two years.

* bolts/screws fixing the rubber seals shall be inspected frequently and invariably before lowering and set in order.

* sliding plates shall also be inspected for wear and tear and replacement done before use, wherever, necessary.

* drain holes shall be cleared of debris, clogging material or silt after every use.

2.13.1 Hoists and Winches

* all winches and lifting drums shall be examined once a year to ensure that all gears and axles are clean and properly lubricated.

* grease fed bearings should be cleaned of old grease and fresh grease applied/filled.

* alignment of shafts shall be checked and coupling bolts tightened.

* all grease caps shall be kept full of lubricant and covers tightened to ensure that the lubricant forms an effective seal against entry of dust into bearings.

* if working of any winch becomes hard, it shall be examined minutely, and defect rectified after it is used. Winch gear covers shall have felt or rubber washers to prevent entry of dust.

* winches shall be operated in correct direction. To ensure this, the direction of operations should be marked and limits of operation indicated.

2.13.2 Steelwire ropes

* steelwire ropes must be cleaned to remove all dust and lubricated atleast once a year.

* the portion of rope which is submerged in water shall be lubricated twice a year.

* inspection of wire clamps shall also be carried out.

* clamping devices shall be declamped and reclamped atleast once in three years.

2.14 Electrical Installations

All precautions shall be taken to ensure safe and fault - free operation of electric motors and switching devices connected with the hoists.

* insulation of all electrical wiring, motor armature windings shall be checked once a year.

* motor bearings and reducing gears shall be inspected and lubricated to ensure smooth functioning.

ANNEX IX
(to Chapter 5)

A SAMPLE INSPECTION FORMAT FOR DAM AND RESERVOIR

1. Name of Dam/Reservoir :

2. Completed on :

3. Date and Time of Inspection :

4. Operation Status at the time of Inspection :
   - Reservoir level
   - Reservoir releases

     (a) Spillway
     (b) River Sluices
     (c) Penstock(s)
     (d) Head Regulator
     (e) Pumping

   - Tail water elevation
   - Weather

5. Inspection Party :

6. Facilities/Units examined (Dam/Concrete, masonry, earth, etc. spillway gates, outlet works, power house, drainage gallery, reservoir, approach channel, exit channel,mechanical features, electrical features, roads and bridges, safety features, communication system, stop logs, pump house, etc.)

7. Report (for each facility/unit examined)

S. No.	Facility Unit	Date of previous inspection	Report on the unit inspected + Instructions issued therefor	Structural specifications of structures Excellent/ Good/Fair/ Poor	Operability of equipment Excellent/ Satisfactory/ Fair/Poor	Functional performance adequacy Satisfied/ Questionable/ Unsatisfactory	Remarks
1	2	3	4	5	6	7	8

ANNEX X
(to Chapter 5)

A SAMPLE OF COMPLIANCE REPORT OF DAM AND RESERVOIR

1. Name of Reservoir

2. Name and Designation of official submitting compliance report

3. Date of Compliance Report

S. No.	Facility Unit	Name and designation of inspecting official/ party	Date of report of inspection	Nature of repairs/ actions ordered/ Instruction issued	Steps taken for repairs/ compliance to instructions with actions	Date	Remarks
1	2	3	4	5	6	7	8

ANNEX XI A
(to Chapter 6)

MASTER PLAN FOR OPERATION AND MAINTENANCE (POM)OF THE UPPER KRISHNA PROJECT (UKP - STAGE-I)

[Summarised Version]

CHAPTER I

PURPOSE AND SCOPE OF O&M MASTER PLAN FOR UKP

The UKP Stage-I project is a major irrigation project in the State of Karnataka. It envisages irrigation of 425,439 ha out of the total potential of 833,000 ha of the Upper Krishna Project. The Project cost of UKP Stage-I is over Rs.1,300 million.

The Krishna Water Dispute Tribunal apportioned 19668 million cum (695 tmc) of the Krishna Waters of Karnataka (1976), out of which the State intends to utilize 4896 million cum.(173 tmc) in the single Upper Krishna Project. The UKP is proposed to be completed in two stages :

Stage I : Narayanpur Dam and Left Bank Canal with distribution system; Almatti Dam (partial height) and Left Bank Canal with distribution system. Stage I has two phases of construction.

Stage II : Completion of Almatti dam plus power house; Narayanpur and Almatti right Bank Canals and Lift Schemes.

The purpose of the O&M Plan (POM) is to optimally use the scarce water resource for maximization of returns by orchestrating land, water, farms and the skill of irrigation staff.

The scope of the O&M plan includes evolution of a suitable O&M policy; and recommend water delivery schedules/methods, staff training, effective communication system and suitable organisation for project management.

The aim of the project is to provide extensive irrigation with equitable water distribution to all farmers.

The Master Plan report is in four volumes plus the Executive Summary. There are eleven Chapters, which are briefly covered herein with salient features.

CHAPTER II

PROJECT DESCRIPTION

The project area is located in the arid northern maidan region in Bijapur and Gulbarga Districts. Of the 192,204 sq.miles (480,510 km^2) area of the Karnataka State, the

Krishna River basin accounts for about 60 per cent. The average annual yield from east flowing and west flowing river systems of the State is 97,352 million cum. of which 47,735 million cum. is assumed as utilizable potential for irrigation. The Krishna River system contributes 19,668 million cum. but only 4896 million cum. or 25 per cent will be utilized in the UKP.

Of the 12.6 million ha cultivable area the irrigation potential is 5.5 million ha. The Krishna basin has a potential of 3.4 million ha of which UKP accounts for 0.833 million ha.

The UKP envisages building of irrigation facilities - the dams and canal systems - in two stages. Stage-I will be completed in two or three phases :

Phase I of Stage I : Completion of Narayanpur dam and left bank canal for an irrigation potential of 409,239 ha; partial completion of Almatti dam and left bank canal for an irrigation potential of 16,200 ha; the total potential being 425,439 ha.

Cost (1978-84) : Rs.2443.4 million (With World Bank Assistance of US$117.6 million.

Phase II of Stage I: Project components posed to World Bank costing Rs.5500 million for completion during 1988-93 are :

Almatti dam, headworks of left Bank canal and six offshore schemes + Shahpur Branch (upto 76 km); Mudbal Branch (51 km) + Indi Branch (62 km) + disnet 146,000 ha + field channels 145,000 ha.

The left over work will be completed in Phase III.

Stage II : Completion of Almatti Dam and Narayanpur Right Bank Canal + Almatti Right Bank Canal + Lift Schemes.

Lining of the canal system upto farm gates, exclusion of high water consuming crops and closure during summer are the strategic objectives.

Of the CCA, 60% are deep black soils, 25% shallow/medium black soils and 15% are red soils. Average holding size is 5.9 ha. Yields are low. The area is dotted with villages.

Salient Features of the Two Dams

Almatti dam is a masonry-cum-earth dam with 48650 m concrete spillway. Seventy five percent (75%) dependable yield is 21057 million m^3 and average annual yield is 24071.17 million m^3. Gross storage in Stage-I is 1193.84 million m^3 inclusive of 353 million m^3 dead storage with crest gates at RL 509.016 to be heightened during Stage-II to 524.256 m.

Narayanpur dam is also a masonary-cum-earth dam and 548 m concrete spillway. The 75% dependable yield is 22,290 million m^3 and average annual yield is 26,122.4 million m^3. Gross storage is 1071 million m^3. The Left Bank Canal is of 283.45 cumecs

and serves a CCA of 409000 ha. The disnel is designed for a duty of 1766 ha/cumec (50 ha/cusec). One outlet serves 50-60 ha and its command varies from 19.7 ha to 49.3 ha. Estimated losses from main canal is 6%, distributaries 4% and operation losses are 10%. Conveyance efficiency is 85%, application efficiency is 80% and project efficiency is 50%.

Planned cropping pattern for the area is :

Kharif (47.5%)	: Jowar, Paddy, Maize, Groundnut
Two Seasonals (35%)	: Jowar, Cotton, Bajra, Vegetables.
Rabi (25%)	: Jowar, Wheat, Safflower, Gram

Water was first released in June 1982 and the CCA in 1987-88 was 68,862 ha.

The management system comprises Section Officers (each with jurisdiction 3000-5000 ha), Assistant Executive Engineers (AEE) heading a Sub-division (3-4 Sections), Executive Engineers (EE) heading a division (4-5 Sub-divisions). At present, the Superintending Engineers (SE) oversees 3-4 divisions or say 100,000 ha. A Section Officer is assisted by Canal Inspectors at field level.

The O&M unit takes over the canal network after joint inspection with the construction unit. The CADA is also associated. The construction unit is expected to hand over record plans and design details to the O&M unit.

The Canal is designed for a capacity of 57 l/ha/s. The outlets are designed with APM since 1985.

VHF wireless communication is installed at head regulators of NLBC, branches and cross regulators as well as in circle office, division, and sub-division offices.

SE, O&M, Narayanpur issues a notification 60 days in advance of letting out water.

The system is not properly maintained : there is an excess supply, tailenders suffer, dialogue with farmers is weak and waterlogging and salinity problems are appearing in the command.

The CADA for UKP was constituted in 1981 to orchestrate land, water and inputs and arrange credit and develop infrastructure. The master plan expenditure was estimated in 1985 at Rs.435.84 crore including the Central Sector Program of Rs.352.3 crore.

CHAPTER III

PERTINENT POLICIES, RULES AND REGULATIONS OF OPERATION

In view of water being a State subject in India, the responsibility of its development rests with the State. The use of water is however sovereign and not proprietary. The States enjoy riparian rights and thereby control and regulate irrigation supplies and have right to groundwater.

Provision of the National Water Policy (1987) are reiterated in regard to O&M of irrigation systems which interalia include preservation of environmental quality, ecological balance, appropriate O&M budget, equitable water allocation, farmers involvement in water management.

The Karnataka State lays stress on timely completion of projects, better resource utilization, efficient water management and conjunctive use of surface and ground waters.

The UKP aims at extensive irrigation to larger area and equitable water distribution to all farmers.

Acts, Rules and their Adequacy

The Karnataka State has the following Acts and rules in vogue pertaining to irrigation:

Karnataka Irrigation Levy and Betterment Act 1952, Rules 1965;
Karnataka Land Improvement Act 1961
Karnataka Irrigation Act 1965, Rules 1965;
Karnataka CADA Act 1980, Rules 1980; and

The Acts have adequate provisions for regulation and equitable distribution of water, crop regulation, stoppage of supply to defaulters, protection and maintenance of works; penal action against farmers for non-maintenance of field channels, out of turn supply, unauthorised obstruction to or diversion of flow and damage to works; immunity to officers acting in good faith.

WAPCOS procedure for water supply

- Time based, disciplined supply through predetermined schedules, rostering of distributaries and warabandi, equitable supply based on crop water requirements and soil type.
- Formation of Water Users Association (WUA) and involving them with water distribution and maintenance of micro level network.
- Supplying water in bulk on volumetric basis to WUA.

The procedure of water supply suggested by WAPCOS needs review of legal aspects of the time based RWS and warabandi, different periods of water supply to different soil groups and entrusting responsibilities of O&M of micro network supplied water in bulk and distribution thereof. Necessary statutory provisions need to be made for warabandi and WUA.

CHAPTER IV

ANALYSIS AND APPROACH

Presented in this Chapter is the approach evolved for effective O&M of the project. It is based on the study and analysis of the project data and performance. The various

components considered in the analysis and the recommendations thereon are :

Soils These are heterogeneous as regards the water holding capacity and the depth. Based on the latter criterion the soils have been divided into three major groups; deep black (60% water holding capacity; 210 mm/m); red/medium black (25%; 160 mm/m); red sand loam (15%; 120 mm/m).

Cropping Pattern The project envisages 108% irrigation intensity (against 85% in pre-project era) composed of 47.5% Kharif, 25.5% rabi, and 35.5% two seasonals. The recommended crops are :

Season	Deep Black Soils Crops	%	Red/Medium Soils Crops	%
Kharif	Hy.Jowar, Maize, Groundnut, Sunflower, etc.	47.5	Hy.Jowar, Maize, Groundnut, Sunflower, etc.	60.0
Rabi	Wheat Sunflower Safflower, etc.	25.0	Hy.Jowar, Hy. Sunflower, Groundnut	30.0
Two Seasonals	Onion, Cotton, Chillies	42.5	Bajra/Pigeonpea Chillies, Cotton	32.5
		115.0		122.5

The recommended cropping pattern increases irrigated area by nearly 10.75%.

Water Distribution Methods

The distribution of water is based on timely and equitable supply to two different soil groups with suitable periods and frequency to maximise production and to meet variable crop demands in different construction phases.

Consideration has been given to different distribution methods, which are : delivery on demand, continuous delivery system, and Rotational Water Supply (RWS) system. The RWS systems is of two types : Flexible RWS with constant/variable stream size, and rigid RWS system. The rigid RWS system is distribution proportionate to the holding size according to predetermined schedules based on general cropping pattern. Different levels of rotation are possible. The recommended method of water distribution is :

* Main canal, branches and very long distributaries to run continuously;
* Other distributaries to run as per 'on' and 'off' basis;
* All distributaries taking off from main canal/branches to have gated control and measuring devices;
* Other distributaries, all laterals would be ungated and provided with proportionate distributors;

* All outlets should be provided with APM.

In the UKP, rigid rotational method is being practised since 1986 - distributaries with two weeks 'on' and one week 'off'. The responsibility of supplying water below outlet is with the O&M wing of UKP after 1987 (and earlier it was with CADA). To effect warabandi schedule of 7 days (168 hrs), the recommended rostering of 7.5 days 'off' and 7.5 days 'on', a 14 - day frequency is ensured throughout the year. Warabandi system for water distribution amongst farmers below the outlet is in vogue in the project area.

WAPCOS recommended Central Irrigation Operation Control (CIOC) based on constant volume concept for UKP for operating main/branch canals. This system enables working out and ordering gate adjustments at pre-determined time in advance, through VHF network. This system can be computerised and made automatic, but can also work fairly well with pre-determined setting of gates of all cross-regulator and head regulators simultaneously.

Capacity of Canal System

Earlier the system was designed on a fixed duty concept, a duty coefficient of 0.57/ l/ha/s or a duty of 50 ha/cusec.

The coefficients for distributary and lateral were slightly increased to account for conveyance losses. After considering discharges at outlet, lateral head and distributary head, these work out as under :

		Outlet	Lateral	Distributary
Duty coefficient,	l/ha/s	0.57	0.58	0.60
Authorised discharge,	l/ha/s	0.42	0.44	0.46

For smooth transferring of irrigation system from construction to O&M Wing, a procedure has been recommended. It includes inter alia induction training, testing of system jointly by construction, O&M and CADA staff, testing of channels by farmers, O&M staff not to be transferred out of area before a number of years of completion. Additional cost for smooth handing over works out to Rs.16 per ha.

CHAPTER V

SCHEME OF OPERATION

The operation rules framed by the Irrigation Department are based on equitable water supply worked out on general cropping pattern and crop water requirements. 14-day frequency and about 20 waterings between 01 June and 07 March, with each watering to provide 17 mm/ha to CCA.

Reservoir Operation

The UKP project consists of two reservoirs - the partially completed Almatti dam (FRL 512.256) and Narayanpur dam completed in 1982 (FRL 492.252). The Narayanpur reservoir is to irrigate 409,000 ha and to supply cooling water to a thermal station.

The salient features of the dams are :

Features	Almatti Dam	Narayanpur Dam
Catchment	35925 km^2	47850 km^2
75% yield	21057 million m^3	22920 million m^3
PMF	31,007 m^3/s	37945 m^3/s
Life	122 years	228 years
Gross Storage upto FRL	1193 million m^3	1066 million ^{3}

The operation of the two reservoirs is guided by the following principles :

Almatti Dam : It is operated to meet the requirements of the Lower Narayanpur Dam, Left Bank Canal, and the power generation (however, UKP Stage - I does not contemplate power generation).

Narayanpur : It meets irrigation requirements of the Narayanpur left canal and the Raichur Thermal Power Project (for cooling).

Some carryover storage has to be maintained for pre-soaking irrigation of 100 mm in the first fortnight of June. Regime tables and curves for 75% and 90% dependable yields have been prepared. Reservoir level has to be watched at end of each month in years of dependable yield being below 90%.

Annual and seasonal plans for irrigation are drawn up based on expected river yields. Due to construction of Almatti dam and the canals, the storage and CCA change from year to year. Normally, delivery schedules for kharif crops do not change from the annual plan. Storage shortfall during Rabi irrigation results in cutting number of waterings and adjusting/cutting pre-soaking irrigation quota. All changes are communicated to farmers.

Operation of the Canal System : The main canal/branches/major distributaries (of > 5 m^3/s) are run continuously. Seven and a half days 'on' period discharge requirements for various groups are computed and gates are adjusted at predetermined time by CIOC in a period of 4 to 8 hours, priority to opening/closing of distributors. Distributions upto 5 m^3/s are operation with seven and a half day 'on' and 'off' period. Laterals and outlets are integrated and provided with proper distributors.

The Central Irrigation Operation Control (CIOC) is recommended to plan, control and monitor the changes to enable the system to operate in an integrated manner. The CIOC may also be equipped with computers and necessary softwares. Procedures of water measurement, irrigated area measurement, water accounting and detailed statement of revenue are reiterated.

Application efficiency, conveyance efficiency and project efficiency be computed; irrigation efficiency and irrigation deltas be worked out at division and circle levels.

Safety Programs : Timely warning against risks to life and property, appropriate measures to avoid health hazards, guarding at vital points, timely inspection of works, monitoring groundwater table, education/training, farmers participation and proper O&M would contribute to safety and enhance production.

Supporting service is provided by CADA which is responsible for physical and institutional infrastructure.

Guidelines for telecommunication system operation are given.

Drainage : A survey is to be conducted to delineate the areas affected by waterlogging and salinity on yearly basis. Groundwater levels are observed to prepare isobaths of 1.5 m and 3 m to work out fully/partially prone areas to waterlogging.

Quality of soils and groundwater is tested for Ec and pH values.

Ec mhos/cm	Soil
0 - 1	Non-saline
1 - 3	Slightly saline
> 3	Saline

Soils with pH more than 9 are alkaline and require chemical treatment.
Ground Potential - An exploitable potential of 79,000 ha m (or 790 million m^3) has been estimated from recharge.

Irrigable area for groundwater	185,130 ha
Groundwater and Canal Irrigation	485,212 ha
Irrigation intensity	158%
Cropping intensity	175.37%

CHAPTER VI

ORGANIZATION AND MANAGEMENT

The UKP is a major irrigation project and is to be completed in two stages. Stage-I consists of two or three phases of construction. Phase I will create facilities to irrigate 160,000 ha and phase II to irrigate 250,000 ha. The existing Narayanpur Circle will look after the O&M irrigation network with four divisions. The phase-wise executive posts (excluding attached ones) during construction and the suggested posts for irrigation management (O&M) for Stage-I are :

Unit	Construction		Suggested
	Phase I	Phase II	Stage I O & M
CE (O&M)	1	-	1
SE (Circle)	2	2	4
EE (Division)	7	10	15
AEE (Sub-Division)	24	32	55
AE/JE	95	127	210
Rev AO	3	4	9
Rev AAO	12	16	33
CI/PAT/AA	78	104	204

AO = Agriculture Officer; AAO = Assistant Agriculture Officer; CI = Canal Inspector; PAT = Patwari; AA = Agriculture Assistant

Unit-wise and phase-wise distribution of posts under main activities of Stage-I are :

Unit	Total	Head Works	Mech.	O&M	CIOC Central Control	VHF Commu-nication	Drainage
CE(O&M)	1	-	-	-	1	-	-
Circle	2+2	Partly	-	Partly	-	-	-
Division	16	1	0+1	3+4	1+1	1+1	1+2
Sub-Div.	56	4+4	0+4	12+16	3+3	1+1	4+4
Section	222	13+17	0+13	50+65	6+6	10+10	16+16
Rev.AO	7	-	3+4	-	-	-	-
Rev AAO	28	-	12+16	-	-	-	-
CI/PAT/AA	182	-	78+104	-	-	-	-

CIOC = Central Irrigation Operation Control

CADA : During construction, it has two main functions of land levelling and organising agriculture extension services. During O&M phase, CADA staff will be deployed to handle land erosion, waterlogging and salinity, soil fertility, on-farm works, supply of inputs, strengthen credit and organising farmers. Staff will not change.

The organising structure with details of functionaires and their duties, coordination and interaction amongst them and with other agencies, personnel management are dealt with in this Chapter.

CHAPTER VII

TRAINING

The chapter presents the training requirements for efficient water management. The personnel of irrigation, CADA and agriculture (related to irrigation) and the farmers need periodical training to develop better understanding, improve skills, introduce latest technologies for saving/conserving water and its use.

The training program can be organised into three major categories : long-term, short-term and farmers training. The long-term training is to be designed for O&M and CADA, extension and research who are expected to work continuously for 6 to 12 years. The training would enable these officers to introduce, practise and analyse the improved methods and furnish data to top level management for sound policy decisions. These courses would be organised through central institutes in the country and abroad. Officers identified for long-term training are EE, AEE, AE/JE, DD (Agric), AD (Agric), AO, AAO, Scientists and their number is over 600.

Short-term courses from 4-5 days to one month generally cover topics related to project specifics. Such courses are in the form of induction training, orientation course, refresher course, and on-the-job training. Officers of all levels join the training program depending on their need.

Farmer is the end user of irrigation water. He should have precise knowledge of crops, their sequence, sowing time vis-a-vis the soil type, irrigation methods and pre-soaking of black soils to increase cropping intensity.

WAPCOS have recommended setting up of Water Users Associations (WUA) to look after the training of farmers in various aspects of O&M. In stage-I, the number of farmers is about 1,40,000 plus 10% office bearers of the WUA. Project's training centres and field training programs in villages have to be organised. Seminars/ Workshops/Kisan Melas are also organised. The training programs have to be evaluated to monitor their impact.

CHAPTER VIII

FARMERS' INVOLVEMENT, THEIR RIGHTS & RESPONSIBILITIES

The farmers are the principal beneficiaries of irrigation projects. It is necessary to involve them effectively and functionally in O&M work, e.g. planning, designing (of micro disnet) and distribution of water through warabandi. A brief review is given of experiences regarding farmers role in O&M in India and abroad. Involvement of farmers in warabandi, maintenance of field channels, productivity increase is vital for successful operation of the project and maintenance of good relations with users.

The farmers rights as identified by WAPCOS are : Formation of associations and self management, receive services from different departments, receive information in regard to inputs and research and exploit ground water for use.

The responsibilities of the farmers are to abide by O&M regulations, to conserve water and use it efficiently, pay water charges regularly, resolve water disputes, adopt proper crop calendar, avoid damage to canals, etc. The recommended pattern of Water Users Associations (WUA) is to organise them according to lateral/independent distributary or group of laterals serving an area of 400-1000 ha. The functions and structure of WUA are stated. There should be a statutory provision in the Karnataka Irrigation Act for the smooth working of WUA.

An advisory distributary level committee has also been recommended to resolve disputes arising between WUA located on one major distributary and to deal with matters of common interest.

CHAPTER IX

MAINTENANCE AND REPAIRS

For proper upkeep of the irrigation system, maintenance and repairs (M&R) have to be undertaken soon after the commissioning of the system. The M&R could be of the following nature : periodical, special, emergency and remodelling to improve/ modify the functioning.

In case of UKP Stage-I, M&R works relate to dams and appurtenant works, canal systems, equipment, colonies and roads, etc. Brief mention is made of various system components alongwith items of M&R such as dams and other structures, water control equipment, irrigation distribution network, drainage equipment, etc. Allocation of funds for M&R are proposed to be linked to agricultural production. Landscaping and aesthetic considerations are for promotion of tourism.

CHAPTER X

COSTS

The estimated cost of irrigation facilities works out as high as Rs.50,000/ha. O&M grant @Rs.140/ha for the commissioned CCA is inadequate. The O&M cost includes items such as establishment charges, training centre and VHF network components; it does not include capital cost for accomodation and drainage construction. Escalation is provided for, non-recurring (capital) and recurring costs of O&M are estimated separately.

The annual recurring costs include establishment, repairs, data collection, maintenance of vehicles, plant and equipment and other costs like training, emergency repairs and hospitability. Detailed estimates are given in the report.

The overall O&M costs are :

	Irrigation Department (Rs. Million)	CADA (Rs. Million)
Non-recurring	563.10	16.70
Recurring Works - regular	43.83	5.44

The average cost works out to Rs.307.27 per ha with establishment and Rs.121/- per ha without establishment.

CHAPTER XI

DEVELOPMENT OF COMPUTER SOFTWARE FOR UPPER KRISHNA PROJECT

Computerization of project activities is being planned to make them efficient and effective. Micro Computer facilities are being planned for data entry/acquisition, storage, processing operation and monitoring facilities including flood warning.

Computerization has been planned in three stages :

In the first stage, Division 41 is to be equipped with main computing facilities where modelling and data processing will be carried out. At Divisions 11 and 13 special models for reservoir management and flood forecasting and at other divisions auxiliary facilities will be provided. A total budget of Rs.781,000/- was estimated for the purchase of PC/AT, PC/XT,printers,plotters,etc.

At the second stage, a super mini computer system will be installed at Division 41.

In the third stage the complete system will be linked through modems with the super mini computer.

Computer training is being planned for all UKP personnel. The officers will be given a short duration orientation/appreciation training and the computer personnel will be trained for specialised operations, applications and program development.

ANNEX XI B
(to Chapter 6)

NARMADA RIVER DEVELOPMENT - MADHYA PRADESH
NARMADA SAGAR DAM AND POWER COMPLEX*

INSTITUTIONS

GENERAL

1. The capacity of the institutions - organization, regulations, policies and most importantly, the capability of the people - determines the success of an undertaking by Government. The crucial role that the government institutions play in the success or failure of the development and management of the Narmada Basin resources was recognized early in the project formulation. An initial act was the creation of the Narmada Planning Agency (NPA) by GOMP. Assigned responsibility for planning the development of the basin, NPA concentrated on a basin-wide scheme of projects and the more detailed formulation of the Narmada Sagar Complex. Studies went forward on the dams and power plant at the three sites; Narmada Sagar, Omkareshwar and Maheshwar, as well as the irrigation projects associated with the first two. This unit directed field and office work and the preparation of construction documents for early work at the Narmada Sagar. However, as work progressed, the need for expansion and tailoring of the organization to undertake the ongoing planning and the execution of the plan became evident. After discussions on the subject in the context of the goals MP had established for the basin development and of the programs to reach those goals; a plan of action evolved and major institutional changes were effected.

2. As an important step, GOMP created a basin authority, the Narmada Valley Development Authority (NVDA) in August 1985, with the responsibility for the planning, development and management of MP's share of the water in the basin and the lands and related resources directly affected. Units have been established to perform the various specialized functions in meeting these responsibilities. The immediate focus of the Authority's activities, which is the basin planning and the execution of the Narmada Sagar Complex, has permitted detailing the organizational arrangements to carry out the component tasks. Staffing plans, position descriptions, staff training and the use of consultants have been formulated reflecting the work, the organization and the capability of the staff anticipated to be available at the onset. These institutional arrangements, as bearing on the project, will be described in detail in this annex.

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* **Source :** World Bank Technical Paper No.99: Planning the Operation, Maintenance & Management of Irrigation & Drainage Systems: A Guide for the Preparation of Strategies and manuals - World Bank and International Commission on Irrigation and Drainage ICID, the World Bank, Washington D.C.1989.)

Narmada Valley Development Authority

3. The Authority was created by government order in July 1985. Patterned on authorities elsewhere in India and on similar organizations in other countries, the entity has jurisdiction for all water resources and related development and management activities within the geographical bounds of the Narmada Basin in MP. To execute its assignment, the Authority has been granted administrative and financial powers somewhat larger than usually held by other departments in the government.

4. Overall responsibility for the basin activities and the direction of the Authority is vested in the Narmada Control Board (NCB) established by the same order. As a result, the Narmada Control Board will have close review and final approval for essentially all plans and action proposed by the Authority. This board is chaired by the Chief Minister with the Vice-Chairman being the Minister-In-charge of the Narmada Valley Development Department. Members include the Ministers and Secretaries of GOMP departments involved in activities in the basin such as irrigation, environment, energy, public works, agriculture, forestry, finance and revenue. Other members include the Chairman and Vice-Chairman of NVDA.

5. The NVDA management consists of a Chairman; Vice-Chairman; Members for planning, engineering, power and finance and ex-officio members which consist essentially of the various Secretaries of line departments involved in the basin. The Chairman of the NVDA will be either the Secretary of the Narmada Development Department or an officer of the state government not below the rank of Additional Chief Secretary. All Members will be appointed by and serve at the pleasure of the state government.

6. Initially, the Chairman of the now abolished Narmada Planning Authority will serve as Chairman of the NVDA. This will assure continuity as the Authority commences operation. Likewise, all staff, functions and assets of the Narmada Planning Authority will be absorbed by the Narmada Valley Development Authority effective immediately.

7. The order states a number of functions that the Authority will be responsible for. Some of the most pertinent are summarized :

   (a) to prepare a detailed plan for exploitation of water resources of the Narmada river and its tributaries and to undertake all necessary engineering works for the harnessing of basin waters for the purpose of irrigation, power and navigation and other development;

   (b) to undertake ancillary works for the distribution of water for irrigation, industrial, domestic and other purpose;

   (c) to undertake generation and sale of power in bulk of MPEB and provision of all necessary engineering works ancillary thereto;

(d) to acquire and manage land in the valley for purposes of carrying out engineering works and provide for human resettlements and other activities to meet the needs for irrigation, flood control and navigation;

(e) to shoulder responsibility for human resettlement and rehabilitation and to establish towns and villages and take all necessary measures to ensure planned settlement and rehabilitation;

(f) to advise on the proper conservation and development of forest, wild life and fisheries in the valley;

(g) to establish a design organization for the projects entrusted to it;

(h) to undertake operation and maintenance of the projects; and

(i) to undertake monitoring and evaluation.

Structure of NVDA

8. The organizational structure of NVDA is depicted in Figure 1. Offices are shown indicating the reporting responsibilities of the various functions. The Chairman, in addition to overall management of the Authority, has the immediate responsibility for and oversees the resettlement and rehabilitation program for the persons displaced by the construction of facilities*. The Vice Chairman, in addition to his other duties, has direct responsibility for the resources council and administration. As may be seen on Figure 2, oversees, the planning program of the Authority. The various specialized functions of the Authority below the Chairman and Vice-Chairman come under the direct supervision of the four members, consisting of power, engineering, planning and finance. The entire power activities from planning to construction and operation and maintenance report to the Member-Power. However, arrangements for coordination with the civil O&M activities, personnel and maintenance services will be refined to assure effective and efficient management and operation of the project. All other planning will be carried out under the Member-Planning, who will receive support from the resources council and the power planning unit. The Member-Engineering will oversee design and construction of all civil works and minor mechanical/electrical works, pumping plants as well as the operation and maintenance of all civil Hydro facilities. Member-Finance will oversee the financial functions of the Authority.

Program Monitoring

9. As may be noted on Figure 1, and on the subsequent, more detailed charts of the sub-units, a program monitoring officer will be assigned in a staff position reporting to each unit chief. This individual will collect information as to the status of all activities in the unit. The items monitored will depend on the level of detail

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* The Organizational arrangements for resettlement, rehabilitation, soil conservation and afforestation are not discussed in this annex. They are described in detail in Chapter VI of the SRA of the "Narmada Sagar Area Development Project."

required by the unit management. These items will be displayed in reference to a CPM or PERT type chart, prepared by management and the various unit heads and documented by the program monitoring officer. It will be continuously updated by the program monitoring officer as information is provided to him by unit management and other sources.

10. Three important points relative to the program monitoring are emphasized :

    (a) All activities of the Authority including those relating to data collection, planning, design, construction, procurement personnel recruitment, training, resettlement and funding which can be described as a series of tasks with completion dates will be defined and charted. Linkages to other programs will be identified on charts at every level;

    (b) The program monitoring officer will gather information and present status of programs at weekly intervals and on special requests. The status, potential deviations from schedule and the cause of such deviation will be presented to unit managers at regular weekly meetings for their use in making decisions for adjusting staff, securing assistance, or altering the schedule;

    (c) The program monitoring, data storage and retrieval and the presentation of charts will be computerized. The selected system will permit management at any level to have access to this information on call. This will be particularly important once construction commences (first quarter 1986), when decisions will have to be made on modifying sequences of work or making adjustments due to unanticipated field conditions. The updated chart of the program monitoring office of each unit will be printed and forwarded to the next level management above, on a routine basis; and

    (d) The program monitoring officer will exercise no management judgement nor will he have any responsibilities relative to decisions on remedial measures or alterations in the programs should delays arise. His sole role is the accurate, prompt reporting of all information and in that regard must be independent of the decision making unit.

11. It is absolutely essential for efficient, effective direction of the authorities that management at each level and its sub-unit heads expand the effort required to prepare a comprehensive, detailed, accurate program to begin with and that program changes are promptly entered so it is current and accurately presents to management, at every level, the status of all activities. Program monitoring will be critical element to facilitate proper management of the project, particularly recognizing its size, complexity and interrelationships and the time schedule which will be of great consequence financially, both from the standpoint to early generation of commercial power and avoidance of delays which will incur extra cost claims by the contractors and increase direct costs of Authority operations.

Planning

12. The Authority has primary responsibility for planning the development of the water resources and the related lands within the boundaries of the Narmada basin.

Irrigation will be the dominant consumptive use and hence will have the primary impact on both resources. The resulting plan is to guide development through the delineation of the various physical projects and management programs - basin operations, water quality control measures, resources conservation and the like. The plan is to document the goals and objectives adopted as the basis for the planning. Policies relating to the allocation and use of resources are to be established. The measures for evaluation of projects are to be clearly stated. Priorities of projects and programs are to be set forth.

13. Planning by its very nature will require updating of the basin plan at intervals as goals change, additional data is secured and opportunities alter or new ones arise. The plan will have to be viewed as a guide reflecting both developments already committed and directions for the future. It must not become a crutch by which past decisions are blindly used as an excuse for undertaking or not modifying a certain project or for following a certain sequence.

14. The planning function by the Authority will, as a consequence, be an ongoing activity under the direction of the Vice-Chairman and the Member-Planning. Figure 2 illustrates the inputs required from other primary units and indicates areas of expertise contained in the resources council.

15. The schedule for updating the existing plan is to be set, but the priority must be high in order to formulate the guidance and have it applied to both present and future activities. A comprehensive update cocentrating on refining water availability and use by December 1986 would permit incorporation of the latest information into the planning of the subsequent phases of the Narmada Sagar Complex as well as guiding the project work in the mid and upper basin. A more comprehensive, detailed plan will be prepared by December 1987.

Design

16. As was shown in figure 1, the various areas of expertise and specialized capabilities to carry out the implementation functions of the Authority have been grouped into specific units. These units will have basin-wise authority and responsibility and will not be limited to individual projects, though initially their sole emphasis will be on the Narmada Sagar Complex.

17. The design unit, headquartered in Bhopal, will develop and maintain a staff capability to carry out the obligations of the Authority in the immediate programs for the Narmada Sagar project, namely design revisions augmenting the CWC/ CEA support to be provided during the construction. It will also provide the design capability for dams, tunnels, power-plants, pumping plants and canals for the subsequent work, particularly Omkareshwar and Maheshwar which are the next components of the Narmada Sagar Complex.

18. Figure 3 presents the units comprising the design organization. Specialization into the categories noted will permit concentration and development of the high level expertise necessary and the consistent applications of high standards and most appropriate methods of analysis to all Authority design work. When

technical questions arise or questions are posed by the field organization, the best talent in design can be readily identfified and brought to bear.

Construction

19. The construction unit will have broad geographical responsibilities, though, as with the design unit, it will focus initially on the complex. Figure 1 and Figures 4 through 6 present the organization. A headquarter's office in Bhopal will provide a direct link with the design unit on one hand and the operations and maintenance unit on the other. The construction unit's offices in Bhopal are shown on Figure 4. It's primary function will be to effectively manage all construction activities including the dam, the civil portion of the power plant and the canals, as well as, any ancillary work involved. It will assure the orderly combined procurement of government materials, the prompt delivery of those materials, the uniform treatment of claims and change orders, the review and control of contractor's payments and other related matters. An essential role will be overseeing and assuring that the field construction staff are properly trained and supported directly or through other means necessary so that quality, cost-effective construction can be assured through prompt and timely supervision and inspection. Another important activity in the Bhopal office of construction will be budgeting. This unit will preapre quarterly, annual and multi-year budgets reflecting actual and projected contract payments and purchase of government supplied materials. All procurement of materials and works will be centered in the Bhopal headquarters including prequalification, preparation of bid documents, bid evaluation and award. The legal expertise related to contract administration will be provided through the legal staff assigned to the Vice-Chairman. These individuals will be specialized and experienced in construction and contract law related to heavy construction.

20. Beneath the headquarter's office, the next level of organization will be the field construction offices. Initially, the principal field office will be the one responsible for the construction of the Narmada Sagar dam and the power plant. Though these are two large undertakings, they are situated at one site and of necessity require a single field organization for the purposes of management and efficient use of resources and support. This field office will have subunits for the two primary activities -- construction supervision of the power plant civil works and of the dam -- both of which will be serviced by a single office engineering unit to handle quantities, payments, claims, change orders and materials coordination; a technical support unit providing laboratories and geology and the administrative assistance unit. Figure 5 presents the arrangement at the Narmada Sagar site.

21. A like unit, though less complex, having only one type of activity, will be established for the canal construction once it is to be launched. These organizations are depicted on Figure 6.

Operation and Maintenance

22. The operation and maintenance organization is depicted in Figure 7. Basin water operations involving forecasting, basin water allocation and instructions on operation

of individual projects in the basin will be head-quartered in Bhopal. Flood periods will require particularly close evaluation and direction of operations by the unit. Standards, procedures, personnel policies and related activities will also be carried out from the headquarter's office.

23. Units at the next level will be located in the individual projects. The level of staffing of these project offices will vary depending on the complexity as may be seen by the chart. The Narmada Sagar Complex will entail very major responsibilities and a substantial number of people. The field project office for the Narmada Sagar Complex O&M will consist of the three divisions noted and the various sub-divisions. The project document, Framework Guide for the Operation and Maintenance (see Schedule 3 in the main report), presents details on this organization. Staffing at every level in the O&M unit and all support facilities, both office and equipment are presented in that document.

24. The initial staffing will occur in the O&M office in Bhopal and though a chief may not be assigned immediately, activities will commence in 1986. Refining the operations plan, developing manuals and procedures, undertaking the development of the basin computer model for the purposes of water forecasting and "real-time" operations and importantly undertaking the immediate planning of the O&M facilities to be constructed under the project will receive first priority. Close coordination will obviously have to be maintained with both the design and construction units to assure a timely, efficient completion of O&M works so that they are available at the time of transfer of responsibility from the construction unit to the O&M unit.

Finance

25. The finance unit will essentially be as established in other government departments. The Member Finance will be the responsible individual in assisting management of the Authority with matters of finance. The units assigned to finance will include financial services.

26. Finance will set budget guidelines, compile unit budgets and prepare the annual budget of the Authority. Accounting, funding and disbursements will be the other primary activities. This unit will be responsible for the securing and managing funds allocated by the state government for the execution of the Authority's programs.

Staff Position Descriptions

27. Staff position descriptions have been prepared for all of the key positions in the planning, design, construction and operation and maintenance units. Position description will be prepared by June 1986 for all positions required during the next two years, down through the level of assistant engineers. These statements present the detailed description of the positions in terms of duties, responsibility and authority. Position qualification statements have also been prepared for the others which present the training, experience and management qualities required of the individuals that are to occupy these positions. Through the use of these two, a clear guide is provided to management for use in filling each slot.

28. It should be noted that many of the positions will demand individuals of substantial and specialized experience and training. Often, many requirements of a position will not be met initially by the individual assigned. An important use of the position descriptions and the qualification statements will be in comparing these with the credentials of the actual candidate and then determining the training and the consulting support that the individual will require. It will be on the basis of these actual needs that the final details and extent of the training program and the hiring of the consultants will be based so that they meet the situation as it evolves and that the staff training and assignment of consultants are carried out immediately when that need arises. This is an essential step that has been incorporated into the institutional arrangements for the project.

Staffing

29. Schedules of required staff will be prepared by unit chiefs and compiled in the personnel unit. Recruitment will commence well in advance of need allowing for change in employer, processing, orientation and training. Provision of additional personnel to allow for staff turn-over and intial inefficiencies will be made.

30. Staff will be recruited mainly from inside, but also from outside the GOMP. Additional sources will be considered if vacancies remain. Evaluation of candidates' abilities will be made as applications are received or individuals are approached. The respective unit heads will participate with the personnel unit in the evaluation and selection of individuals particularly at the middle and higher levels. The staffing schedule for key positions is given in schedule 2 of the main report.

Training

31. The training program will be refined as staff is selected and required courses are finalized. However, there are certain essential subjects that have been identified now. These include training in management and personnel as will be so important in these large units and several technical areas relating to both design and construction. A program has been developed for the initial use in budgeting and planning. This is shown on page A-121.

32. The tentative training program was developed by training specialists from consulting organizations in India and representatives from the technical units in the Authority. This permitted incorporation of the views from both the user and the training specialists. The program proposed is well thought for this stage.

33. Trainers participating in this program will be selected to meet the specific needs, e.g., people with long experience in construction management or in field inspection will be used as trainers in those subjects rather than and professors from the universities. At the same time, trainers in management and personnel will be selected both from management consulting organizations as well as universities. The technical consulting specialists described in the following section who will serve for periods of time in support of the design and construction staff, will also dedicate a portion of their time to the training program.

34. Coordination of the training and updating and refinement of the program as judged best from the results, will be under the direction of a full time training office in the administrative services unit with advice from the supervisors of the respective technical units.

Consultants

35. The Central Water Commission (CWC) and the Central Electricity Authority (CEA) in Delhi have been serving as the primary consultants to MP for the design of the dam and power plant facilities in the complex. Their role, as consultant, will be continued during the construction period of Narmada Sagar dam and power plant. Staff in Delhi, augmented by individuals assigned to Bhopal, will provide the ongoing service.

36. It is recognized, however, that the Authority will have to support CWC/CEA in producing the 2-3,000 drawings which must be provided in the course of completing these two facilities, and therefore NVDA will have to greatly increase its capabilities. Consulting support to the Authority will be essential. Consideration was given to using a consulting firm in an overall lead role or in a support role for specific tasks. Consideration was also given to the assignment of consultants to work directly with Authority staff. These, however, would exercise no authority and have no responsibility for actions of NVDA staff. The prime purpose would be the transfer of technology and management skills. This latter approach has been adopted by the Authority and is the contemplated mechanism to be followed, assuming NVDA staffing goals can be met. Accordingly, resident consultant specialist positions have been identified for Bhopal and for the site. Other specialists are to be available on short-term notice to strengthen staff during the initial phases. The design consultants would also help support individuals who will subsequently be involved in the preliminary engineering on the Omkareshwar and Maheshwar facilities.

37. The primary areas where MP will be in need of the strengthening their capacity is the management of the constuction program. Contract administration, office engineering, field engineering and laboratory testing are examples where specialists will be required to augment the Authority staff.

38. The criteria for accepting the individuals will be based strictly on their qualifications and experience. Country of residence will not be a criterion. This level of consulting support will be incorporated into the program initially. However, as Authority staff are assigned to the positions and as the needs alter, this list will be modified.

39. Indeed the method of providing consulting support may have to be altered if the adopted approach does not yield the total capability required for NVDA to fully and efficiently carry out its assignment. Selection of the alternatives of assigning overall responsibility to a consulting firm may even prove necessary to meet the essential needs. For the presently adopted method, definite advantages exist to have a consulting firm provide the individuals since the firm will assure

responsibility for competence and can provide prompt back-up or replacements if needed.

40. Discussions were also held concerning immediate needs, particularly, that it may be necessary for GOMP to secure a consultant to advise on the detailed structure, procedures, manuals and forms for the construction management organization. This, however, would be over and above the list of consultants. Likewise, the use of consultants to handle specific tasks in planning or design in order to maintain schedule is also assumed, but is not identified on the list.

Project Review Panel

41. NVDA will establish a "Project Review Panel" (PRP) for Narmada Sagar Project. The general scope of activities and experts is presented in the main report of the Project. (Not attached).

TERMS OF REFERENCE - PROJECT REVIEW PANEL

1. The Narmada Valley Development Authority (NVDA) will establish a Project Review Panel (PRP) and maintain it for the duration of the project until all facilities are placed in final operation.

2. The PRP will have the responsibility to examine the adequacy of investigations, design, quality control and construction of project facilities; to propose any modifications to ensure the safety and integrity of the facilities and to suggest measures that will enhance the usefulness and effectiveness of the project. The PRP will not be relied upon by NVDA to serve a technical advisor for optimizing design of the project or its components.

3. The PRP will identify existing and potential problems and make recommendations of remedial actions to NVDA and/or request NVDA to make available additional data or to carry out or cause to be carried out further studies to resolve questions.

4. The PRP will be headed by a Chairman, assigned responsibility to coordinate PRP activities and to assure the objectivity and technical quality of its review and recommendations.

5. NVDA will be represented by the Member Engineering and the Member Power who will attend meetings, as appropriate; arrange for representation of NVDA engineering and construction units and consultants to participate in all meetings; provide data, information, analysis, studies, documents, plans and specifications etc., pertaining to the project and secure such other materials, clarifications and relevant data requested by PRP. NVDA will arrange the necessary logistical and administrative support to allow proper functioning of the PRP.

6. The Central Water Commission (CWC) shall attend meetings in these activities in strict accordance with its charge as central technical authority to monitor the implementation of the review panel's recommendations to the extent that the PRP

recommendations pertain to dam safety. The only exception will be those instances when CWC is called upon to attend in its unrelated capacity as consultant to NVDA.

7. The PRP shall consist of a minimum of four permanent members, all highly regarded international experts with at least twenty-five years of active experience in the type of facilities comprising the project, at least ten of which shall have been in a position of final responsibility for the technical adequacy of works of the nature and magnitude comparable to the project. The fields of expertise in which the permanent members jointly shall possess high international reputation shall include :

(a) design of large concrete dams and spillways;
(b) design of hydropower plants;
(c) design of large excavation and rock reinforcement;
(d) construction management and methods for large concrete dams, powerplants and appurtenant works; and
(e) geotechnical engineering.

All members shall be acceptable to the Bank. The criteria for membership cannot be compromised. At least two members will be from outside India. Any expertise of the qualifications stated that are not provided by the two outside experts and cannot be fully met by Indian nationals will be provided by securing the additional necessary members from outside India. No member may have been previously in the full-time employ of the Government of Madhya Pradesh.

8. NVDA will maintain a list of and arrangements with consultants and specialists having qualification standards equal to the PRP, identified by and acceptable to the PRP and the Bank that may be called upon on very short notice by the PRP to participate in its work. The fields of expertise to be provided by selected consultants and specialists shall include, but not be limited to :

(a) design, fabrication and erection of gates, of valves and hoists;

(b) design and installation of instrumentation and control equipment for dams, plants and large rock cuts;

(c) design, fabrication and erection of hydropower machinery and appurtenant equipment;

(d) concrete design and placement;

(e) materials testing;
(f) operation and maintenance of dams, hydro power plants and related works; and

(g) engineering geology.

9. The list of consultants and specialists may be modified, added to or deleted

at the initiative of the PRP in collaboration with NVDA following agreement with the Bank.

10. The PRP shall meet at times and frequencies that the PRP judges necessary to carry out its responsibilities or at the request of NVDA. A minimum of three meetings per year will be held during the initial three years and two meetings per year in the later phases. The PRP shall be free to engage consultants and experts from the established list (para 9) to assist it in the conduct of its work.

11. Meetings shall, in general, be held in the field or in the headquarters of NVDA, as judged best by the Chairman, PRP with all permanent members in attendance. Inspections by individual members shall be discouraged except under special circumstances. In such exceptional cases, the individual shall sumbit a report to the other PRP members; however, final recommendations of any issues shall be made jointly by the PRP at a meeting.

12. Meetings shall be scheduled in advance to the extent possible to facilitate logistics and the participation of Bank's observers, if desired. Exceptions to advance scheduling shall be meetings judged by the Chairman or NVDA to be necessary on short notice due to special circumstances.

13. The PRP shall submit to NVDA a minimum of three copies of the minutes of its meetings immediately after the meeting is concluded. Within two weeks thereafter the PRP shall submit to NVDA three copies of its report of findings and recommendations and of the actions taken by NVDA on prior PRP recommendations. A copy of each document shall be forwarded by NVDA to the Bank and CWC immediately upon its receipt.

14. Whenever the PRP recommends changes or actions. NVDA will respond within two weeks to the Chairman, PRP and CWC with a copy to the Bank describing its decisions and actions taken. CWC will monitor execution of the actions in strict accordance with its role in safety of dams.

15. NVDA will exercise final decision on all matters, as provided within the established responsibilities respectively of state and central governments.

16. NVDA will establish the PRP no later than June 1, 1986 and convene its first meeting before August 1, 1986.

17. NVDA will make all arrangements for the list of consultants and specialists to be available to the PRP not later than November 1, 1986.

FRAMEWORK FOR OPERATION AND MAINTENANCE OF NARMADA SAGAR COMPLEX

A. GENERAL

1.01 The project is to be operated and maintained by the O&M office of the Narmada Valley Development Authority as a "utility". The sole function of this office is to provide a high quality to its customers. Operation and maintenance (O&M) does not involve the activities of project planning, system design, or major construction. Neither is agricultural extension of "on-farm" development a function or a responsibility of the O&M staff.

1.02 Specifically, the primary objective of the O&M project is to furnish an adequate, reliable and equitably distributed supply of water to each farmer in the commands. The water will be delivered in a manner which assures greatest flexibility to the farmers at the least cost consistent with good service, long system life, and sound financial practice. Further, the project is to remove excess precipitation and control ground water levels to prevent detrimental effects on crop production and operate and maintain these drainage facilities in the same manner as the water delivery facilities. Thirdly, the project is to generate electricity utilizing scheduled and surplus water consistent with the governing policies and dispatching orders from the customer entity (MPEB).

1.03 The importance of these project objectives in the formulation, functioning and effectiveness of the O&M entity cannot be overstressed. A clear understanding and acknowledgement of the objectives are fundamental to the development of the organization. And it is essential for the staff to fully comprehend this in order to instil the necessary attitude.

1.04 Merely setting an objective is not enough. The motive and incentive to work towards meeting that objective must be built into the organizational strcuture and procedures. Contrary to the usual concept of irrigation and drainage agency O&M functions, the O&M role is "people" and "client service" oriented and not engineering or even technically oriented. This is not to say that many highly developed and educated engineering and technical skills are not necessary. They are essential. The focus of every highly successful irrigation and drainage project operation is on its function as a "service utility" to its clients. This basic philosophy, if strongly supported and endorsed by the highest government levels, will produce an eminently successful project. Staff recognition, particularly by giving proper levels of compensation as provided in the other government utility, will attract and hold the staff which are key to success. With these the project staff will have, almost automatically, the motivation to do good work. They will take pride in their individual part in the progress being made and even more satisfaction in belonging to an organization, which serves millions of their fellow countrymen and serves them well.

1.05 Progress and achievement of the project in all areas is to be judged by the effectiveness and efficiency of the service the organization provides to support

and benefit the farmers, and for strengthening of the power supply. In a very real sense, the project and all of its staff, particularly those engaged in system operation and maintenance, must be considered as partners with the farmers. When the farmers throughout the project area succeed and their situation is improved, the project succeeds. If there is no significant improvement in the condition of the farmers, both small and large, then the project has no basis for existence. The power customer likelwise must be treated on an equal basis within policy and water delivery constraints. But since that customer is a strong, well established entity, there will be not difficulty in this respect. As a consequence,the more complex dealing with farmers will be stressed in this document.

1.06 The "Framework of Operation and Maintenance" of NSC Project has been drawn in conformity with the Project Criteria and Plan of Operation (Schedule A) and the above stated philosophy. It constitutes a documentation of O&M decisions and serves as a guide to the initial activities.

1.07 The documentation and arrangement for transfer of custody and responsibility for the physical works from the construction organization to the O&M organization will need to be worked out. However, the O&M activities start long before that.

B. SERVICE CHARGE

2.01 Modifications to current MP provisions for charging for irrigation services are under consideration. The different rates for different crops and the uniform statewide rate for a given crop regardless of reliability or adequacy of supply are but two of the features requiring review. For purposes of discussion and initial guidance on this matter, certain principles have been tentatively defined.

2.02 Charges for Authority services - water supply and drainage - will be assessed against owners of all lands within the project that are offered water supply. Class 6 and those class 4 lands not be assessed. The charges will be determined and computed for NSC independently of charges assessed on other projects in MP. The service charges to farmers constitute the total revenues from both water supply and drainage function. As these are to fully cover all related O&M costs plus a component for capital recovery the required annual totals will dictate the unit rates used to assess farmers for the service.

2.03 Since the water is provided in strict proportion to the farmer's irrigable land at unit delivery rates common for the entire project, the service charge will be based essentially on a volumetric measurement. However, no farm outlet measurements are needed for purposes of billing, and no variation in service or charge rates will be made to reflect different crops.

2.04 Actual volumes of water delivered to all farmers will vary year to year as dictated by the river supplies available. As a consequence, if charges are based on actual deliveries alone, the project O&M revenue would fluctuate widely, presenting severe difficulties.

2.05 The computation of charges to best meet project needs and recognizing the characteristics of service, will be 80% based on irrigable area and 20% based on water actually delivered using average annual volumes as reference. This also reflects that the drainage services can only be based on area of productive lands served, since measurement of actual annual benefits is not feasible.

C. ORGANIZATION FOR OPERATION AND MAINTENANCE OF NARMADA SAGAR COMPLEX

Structure

3.01 Recognizing the type of facilities and relative ease of operation inherent in the canal distribution system as adopted in the Project Criteria and Plan of Operation and having in mind a reasonable span of command at the various levels and offices, the project operation and maintenance organization has been structured as shown in figure 7. In order of decreasing area of level of responsibility the units are the NVDA O&M office in Bhopal, project office, division, sub-division, section and service area (SA). The section does not exercise any administrative functions, but rather is used to designate a geographical area of responsibility for maintenance at a reasonable distance from the SAs and the farmers or covering a reasonable reach of the main canal. The SA will not belong to the O&M organization, but will be constituted of SA farmers and directed by them.

3.02 There will be three divisions - the Narmada Sagar Dam and Irrigation Division, the Omkareshwar and Maheshwar Dam and Irrigation Division and the NSC Power Division. By definition in the project criteria, the outlet to the SA is the terminus of normal irrigation operating responsibility of the Authority. If problems or conflicts arise within the SA hindering equality of service the Authority will, of course, take whatever action or play whatever role is necessary to assure proper operation. Otherwise, the farmers through their own organizations will operate the system below the SA turnout.

3.03 Figure 3 illustrates the composition of units in the irrigation service, both Authority and farmer directed and the approximate area within its jurisdiction. The following table presents area characteristics of the sub-divisions. Each section has five sub-divisions.

Characteristics of Proposed Irrigation Sub-divisions within Narmada Sagar

Sub-division/Sub-divisions	CCA/division (ha)
A	22,000
B	22,000
C	24,000
D	25,000
E	25,000
F (Khargone lift)	23,000

Note :1.Narmada Sagar Dam and Irrigation Division would contain 8 sub-divisions; comprising one dam and power plant, one main canal and pumping plant, and six irrigation sub-divisions. The latter would have five sections and 75 to 100 SAs.

2. Boundaries of the various sub-divisions will start with the determination of canal system location and SA boundaries and proceed by orderly grouping to the succeeding units. The figures shown above are only representative for use in O&M planning.

D. PROJECT UNITS AND KEY INTER-RELATIONSHIPS

4.01. Units constituting the operation and maintenance entity will be described in varying detail. The units first discussed are those that provide the irrigation services. These will comprise the majority of entire organization.

Service Area

4.02. SAs will be defined so far as possible by village boundaries as described in the project criteria, but delivery channel layout must control. Project water will be delivered to the SA through an offtake that will either be shut or open with the flow at a constant rate when open. Minor and sub-minor channels within the SA will convey water proportionately to chaks of approximately 50 ha size. Rotational use of the water furnished to the chak will be made to sub-chaks of about 10 ha each consisting of a single farm or several small farms.

4.03. Farmers within a chak will select one of their members to represent the chak on the Service Area Irrigation Committee (SAIC). It is suggested that following the initial organizational period the terms of chak representatives be staggered to provde continuity. Of primary importance will be the representatives' role in the determination of the SA seasonal irrigation size and schedule. These tasks will be completed with the close help of the agricultural extension advisor assigned to the SA by the Department of Agriculture. The chak representative also will be responsible for rescheduling water rotations and for arranging for channel operations and maintenance inside the chak. Payment of his services would probably be "in kind".

4.04 SAICs will meet monthly or more often if required. The SAIC Chairman will be selected and maintenance of channels to be carried out by farmers* within the SA and will have authority and responsibility to enforce committee decisions and project rules and regulations applicable within the SA. The SAIC Chairman also be responsible for forwarding crop and water records for the SA to the project authority. In this task he will have the help of the agricultural extension advisor.

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*It should be noted that the Authority has ultimate responsibility for channel maintenance down to the sub-chak level. To the extent possible, day-to-day maintenance within the SA will be carried out by farmers, with Authority assistance as appropriate. A monetary incentive such as reducing service assessments to farmers should be used in recognition of lowered direct project maintenance costs due to the efforts of the SA members.

4.05 Water assessment collected by the sub-division will generally reflect both the charges to be remitted to the project and the charges incurred by the SAIC for SA O&M and administration. Delivery of full water allotment to the SA will be made only on payment of the SA's total water bill. Water deliveries will be reduced proportionately to the amount paid to the Authority. The SAIC could elect to pay the full amount even though all farmers had not paid, in order to ensure a full SA supply, and collect farmer overdues at a later date.

4.06 SAIC Chairmen from all SA's within a district will form the Sub-division Irrigation Committees (SIC). This would represent the farmers in meetings with the sub-division for resolving annual operation, policies, procedures and other issues. There will be a similar committee at the division level. These will be particularly important functions in the early years.

Section

4.07 A section will comprise a group of about 10 to 20 SAs and will therefore contain approximately 5,000 ha. On the average, each section will have 8 km of minors 4 km of distributary, 6-10 cross regulators, 10-20 offtakes to SAs and 10 km of natural and improved drains. To carry out maintenance, each section will be staffed by one maintenance foreman and three labourers/ light equipment operators who preferably will reside within the section area. These staff will report to the sub-divisional officer - Maintenance and Construction. The section work station will have a small office and store room, a fenced yard and storage shed(s) for supplies, vehicles and equipment. Living quarters might well be part of the work station, which should be located centrally with respect to the canal and drain system, Security will be improved by this arrangement.

Sub-division - Irrigation

4.08 This sub-division, headed by a Sub-divisional Officer, will be the lowest administrative unit in the project and is the entity which directly serves the SAs. The sub-division will service approximately 50 to 100 SAs grouped into five sections of 10 to 20 SAs each. Hence, the sub-divisions will normally have a size of approximately 25,000 ha, with 50 to 100 SA turnouts and about 100 km of canal and drainage channels.

4.09. A canal operator will be responsible for operating approximately 30 km of canal (the area covered about two and one-half sections) serving about 25 to 50 SAs. If he has more than 35 SAs and they are spread out, an assistant may be needed. In addition to his normal water operation duties, the canal operator will spend some time each day working with SAIC Chairmen to review operations within the SAs and to facilitate liaison between the sub-divisional Officer Operations and the SA and individual farmers. It will be noted that each sub-division will require, on the average, only three canal operators and that this is generally sufficient to ensure coverage of all operations even in the event of absence of one member. The substantial distances and areas served by each operator is a reflection of the relative

ease of operation of the system as adopted in the project criteria. (It may be desirable to sell motorbikes at low prices to the operators and then pay a monthly sum for his use of it on project work in order to incur minimum costs while accommodating his desire for personal use of the bike). Canal operators will assist the agricultural extension advisor on technical matters pertaining to the system in the determination of SA irrigation schedules.

4.10. Supervision and training of operators will be by the Sub-divisional Officer - Operations (SDO). In addition, the SDO will spend about half of his time in the field with SA representatives to assist in solving problems assure equitable water service to all farmers and review the O&M of SA channels to ensure that they conform with project standards. One of his major duties, in addition to operation of the system, will be to facilitate prompt and full two-way communications of information, particularly complaints and suggestions for improvements from the farmers and between their representatives and the O&M units.

4.11. Some major maintenance equipment will be located at the sub-division office, under the direction of the sub-division officer - Maintenance and Construction. Depending on the extent of differences in equipment and other maintenance requirements between major canals and large drains and the smaller distributaries, it may be appropriate to include a "major channel" maintenance staff and equipment group in those sub-divisions having responsibility for such facilities.

Division, Dam and Irrigation

4.12. The unit of the project above the sub-division is the dam and irrigation division. The division will include six irrigation sub-divisions, the Dam and Power Plant sub-division and the Main Canal and Pumping Plant sub-division. About 500 SA turnouts will be served within the division. The division will be substantially larger in regard to the area served and in its responsibilities than most existing irrigation projects today. Hence all day-to-day operational and maintenance decisions on the NSC will be centered within the division and its units. The division will be headed by a Division Manager with three Assistant Managers for Administration, Personnel and Training; Operations; and Maintenance and Construction, supported by two special units.

4.13. The division will secure and disburse its funds subject to budget review and approval by the project office. The approval from the Project Manager will be required for all overages or non-budgetary item expenditures.

4.14. An important unit of the division will be an Evaluation, Planning and Budget Unit (EPBU) to be headed by a Senior person with at least 15 years experience in operations and maintenance, 5 years of which should be in project administration and management. The unit Head will be assisted by three persons with broad and objective backgrounds in water project management. The principal function of the EPBU will be review, evaluate, plan and then budget the next year's activities after consultation with farmer and sub-

division representatives. This unit will report directly to the Division Manager with copies of all reports and recommendations being forwarded directly to the Project Office EPBU (para 4.20).

Main Canal and Pumping Plants Sub-division

4.15 A separate sub-division will be established to operate and maintain the main canal from the head regulator to the tail including all in-line pumping plants. The organization, staffing and equipment of the main canal sub-divisions will differ from that followed in the other sub-divisions. Daily, weekly and monthly operations will be conducted under criteria and policies of the project office. Water releases to the distributary system will be in accordance with schedules received directly from the irrigation sub-divisions operating those portions of the system. These, of course, will be in conformance with the annual allotments and schedules set by the project office.

Dam and Power Plant Sub-division

4.16. The Dams and Power Plan Sub-division will have responsibility for operation and maintenance of the Narmada Sagar dam and the civil works portion of the power plant. A sub-division officer with appropriate assistants will direct the activities of the unit. Operations of the dam will be carried out under criteria and policies of the project office. Operation of the mechanical/ electrical components of the power facilities will be under another unit; the Power Division - Narmada Sagar Complex.

Division - NSC Power

4.17. The Power Division - Narmada Sagar Complex - will report to the project O&M office. It will be responsible through three sub-divisions for the O&M of the mechanical-electrical facilities to generate power at Narmada Sagar, Omkareshwar and Maheshwar power plant. Following resolution of project water operations it will, at the appropriate levels, work with the SEB and regional dispatch centre to schedule power operations. The determination of basic policies and primary schedules will be the responsibility of the project office and NVD O&M.

4.18. Authority and responsibilities for day-to-day decisions, including budgeting and expenditures, will be comparable to those delegated to the dam and irrigation divisions. A close working relationship with the other divisions will be maintained to facilitate operations and to carry out maintenance in a cost effective manner.

Project O&M Office

4.19. The function of the NSC Project Office will be to assure coordination of activities of the dam and irrigation divisions and the power division and integration of project policies and activities to best meet the objectives of the State of Madhya Pradesh. Although other titles may be used, the title

of Project Engineer will be used in this report for the chief executive office of the project.

4.20. Relationships with neighbouring state governments as well as policy questions will be dealt with by the MP Narmada Valley O&M Organization (NVOMO) headquartered in Bhopal. Policy and coordination action involving the NSC will be handled at the Project Office level. Annual and seasonal projections of project water availability, water allocations, power and water supply operations will be determined by the project office in conjunction with NVOMO.

4.21. With the exception of major project-wide policy decision making and the establishment of project water and power operations, no line functions will be carried out by the project office. Nor will there be any requirement for providing staff support to the units below except in unusual circumstances. In such cases, special assistance from the State or national irrigation entities or from consultants will be more effective and less expensive than the retention of full-time, highly paid staff.

4.22. The Project Engineer will meet at least monthly with the Division Managers and semi-annually with Sub-division Officers. The Head of the Evaluation, Planning and Budget unit at project level meetings with Division Managers on a quarterly basis to ensure optimum performance of project responsibilities at all levels.

Narmada Valley O&M Office - Chief Operations and Maintenance

4.23. The Narmada Valley O&M Office (NVOMO) will be responsible for coordinating all projects within the MP portion of the Narmada River Basin. It will receive and analyze necessary data and issue instructions to the individual projects as relating to water allocations, weekly reservoir release under normal operations, and hourly releases under emergency operations. It will set guidelines; inspect procedures and facilities; and assess results of all basin projects.

4.24. The NVOMO will represent MP in exchange of information and coordinate operations with other basin states and will provide the State's representative on the NCA.

E. STAFFING, FACILITY AND EQUIPMENT REQUIREMENTS

5.01 Staffing, facilities and equipment needs are described for each unit in the organization. These are listed for each entity, office or location and are not aggregated to higher levels.

5.02. The requirements listed are for "typical" organizational units for use in O&M planning. Final requirements will differ as they reflect actual situations and conditions. For example, the size and number of open drains and size of canals will vary considerably from one area to another. These, particularly the drains and large canals, will greatly affect equipment and associated personnel needs. It should be noted that some equipment at the sub-division

and division level serves as back-up to lower units and can be pooled to meet peak demands. In emergencies, mutual support by units will be possible.

5.03. Certain facilities, communication systems and equipment to be used during construction will be transferred to the O&M units. Because the O&M use is long-term, compared to the construction period, anticipated O&M functions and requirements should have priority in design and specifications for procurement of such items with construction elements accommodated on a temporary basis. To the extent possible, buildings and facitlities for construction should be located to best suit O&M requirements.

5.04. The typical sequence of promotion/advancement and qualification needed for management staff at sub-division and divisional level to higher posts in any unit, will be modified from the normal procedure in COMP. Adequate levels of compensation, equivalent to those of other utilities are a must. Permanance and continuity are required. These features are essential in order to retain experience and working relations in the units. This was discussed in para 1.04 as well.

Staff, Facilities and Equipment

5.05. The basic staffing, facilities and equipment is presented for each designated unit. It should be noted that the level of individual in each position is not indicated. These are to be set following further examination of policies to be adopted for the Authority's utility organization.

Section

(a) Staffing

(i) 1 Maintenance foreman/sectional officer (non-engineer)
- 3 labourers/small equipment operator
- Casual labour will be hired for peak work needs only as required.

(b) Facilities

- Storeroom and small office with desk and file for canal
- operator and foreman
- living quarters and foreman
- storage shed(s)
- fenced compound
- fuel storage

(c) Equipment

- 230-40 HP 'farm'tractors (diesel) with 3 pt. hitch and attachments.
- 150-70 HP tractor with backhoe and front end loader (FEL) (Diesel)
- 1 3/4 ton pick up with dump bed (gas or diesel)
- 3 3-wheel cycle with box/storage/bed at rear

5.06. Sub-division - Irrigation

(a) Staffing

(i) Sub-division Officer
- 1 clerk/secretary, finance
- 2 collection clerks
- 1 assistant clerk - payroll records, book keeping, water and organization records, storekeeper
- 1 secretary/typist

(ii) Assistant Sub-division Officer - Operations
- 4 canal operators

(iii) Assistant Sub-division Officer - Maintenance and Construction
- 2 equipment mechanics
- 1 maintenance man - electrician
- 1 vehicle dispatcher/storekeeper

(Maintenance persons for some of the sections may best be located at the sub-division office).

(b) Facilities

- building with reception area, 4 officers and 2 conference rooms capabilities for 50 people and 20 people
- storage building
- warehouse
- storage sheds
- fuel storage/equipment service shop
- fenced compound
- living quarters as appropriate - two people minimum

(c) Equipment

- 2 dump trucks - 1 large, 1 small
- 1 75-100 HP diesel "farm" tractor with backhoe (6 m reach) and front-end loader.
- 1-15 T low-bed trailer (two-type, not 5th wheel)
- 1 full grader
- 1-3/4 ton pick up with utility bed and hoist (for pump work)
- 1-1 sock concrete mixer
- 3-1/2 ton pick ups
- 1 - 4 x 4 vehicle (jeep)
- 8-3 wheel motorcycle with box bed (depends on total number of canal operators)
- air compressor (100 cfm)
- 1 small generator, 2 small pumps
- 1 air compressor (100 cfm)
- 1 microprocessor

5.07 Division - Irrigation, Main Canal and Dams and Plants

(a) Staffing

(i) Division Manager
- 1 Receptionist
- 1 Secretary
- 2 Computer Operators/Word Processors
- 1 Clerk typist

(ii) Head, Evaluation, Planning and Budget Unit
3 Senior Assistants

(iii) Assistant Division Manager - Administration, Divisional Accounting, Finance
- 1 + 2 audit and cost accounting
- 1 + 3 water assessments
- 1 + 2 payroll
- 1 + 4 collection and financing
- 1 + 2 purchasing - stock control
- 1 + 2 computer service, programming
- 1 + 1 communications clerk

(iv) Assistant Division Manager - Personnel and Training
- 1 + 1 personnel
- 1 training
- 3 clerk typists

(v) Assistant Division Manager - Operations
- 2 hydrologists/water routing
- 1 civil drainage engineer or technician
- 3 crop and water records clerks (1 Senior, 2 Juniors)
- 2 clerk typists
- 2 computer operators

(vi) Assistant Division manager - Maintenance & Construction
- 1 secretary
- 1 clerk typist
- Chief equipment maintenance section
- 2 clerk typists
- 1 foreman, shop - heavy equipment, 2 mechanics
- 1 foreman, shop - light equipment, 2 mechanics
- 1 foreman, shop overhaul and repairs
- 1 machinist - mechanic, electrician
- 1 vehicle dispatcher/storekeeper
- Maintenance foreman
- 5 maintenance men
- 10 labourers (primary)
- 4 heavy equipment operators
- 6 helpers
- Chief - construction section

- 2 construction crews of 17 persons each (foreman, 3 general construction, 2 steel and 4 concrete workers and 7 labourers)
- 2 junior engineers/draftsmen
- 2 clerk typists
- sub-engineer (electric)
- Chief - Communications/electronics repair (electrical or electronics engineer)
- 3 computer/radio technicians

(b) Facilities

Size of buildings and shops required will be dictated by number of staff. A conference-meeting room for each department should be provided. A large meeting room, equipped with audio/ visual facilities with seating for about 200 people should also be included. repair shops, electronics shops, spare parts, supplies storage and mess facilities are a few of the additional special needs to be provided in the complex.

(c) Equipment

(i) Heavy equipment

- 2 excavators (hyd.ditch cleaning) (D.9 m^3) (if major canals or channels within division, add 1 with 1.4 m^3 capacity, and long-reach capability).
- 1 tractor, crawler - 150 HP with dozer, ripper
- 2 tractor, crawler - 100 HP with dozers, ripper
- 1 scraper, 10 m^3
- 2 loaders rubber tyred - 2 m^3
- 1 roller, rubber tyred (vibrating)
- 1 roller, sheeps foot
- 2 motorgraders (cat 12 or equal)
- 1 trailer, towbed - 30 T
- 1 trailer, towbed - 40 T
- 1 truck, with 5th wheel to match trailers
- 1 fork-lift - rubber tyred-ground use 8,000 lb, cap. 14' ht.
- 1 fork-lift - rubber tyred-ground use 4,000 lb, cap.16' ht.
- truck crane - rubber tyred - hydraulic 10 T, 60' boom

(ii) Light equipment

- 5 1/2 ton pick-up
- 3 3/4 ton 4x4 pick-up
- 4 dump trucks
- 3 automobiles
- 4 pumps - low head - 5-150 HP
- 2 compressors 200 cfm, 360 cim
- 4 generators, portable, 2.5 KW - 12.5 KW
- 3 concrete mixers, 1 sack

5.08 Sub-division - Main Canal and Pumping Plants

(a) Staffing

(i) Sub-division Officer
- 1 assistant clerk
- pay-roll records, book keeping, storekeepers
- 1 secretary typist

(ii) Assistant Sub-division Officer - Operation
- 2 scheduling specialists
- 4 canal operators (engineers)

(iii) Assistant Sub-division Officer - Maintenance and Construction
- 3 maintenance foremen
- 9 labourers/small equipment operators
- 2 mechanics
- 1 maintenance man - electrician
- 1 vehicle dispatcher/storekeeper

(b) Facilities

- building with reception area, 4 offices and one conference room with capacity for 20 people
- storage buildings - warehouse
- storage sheds
- fuel storage/equipment service shop
- fenced compound
- living quarters as appropriate - two people minimum

(c) Equipment

- 2 dump trucks - 1 large, 1 small
- 2 75-100 HP diesel "farm" tractor with backhoe (6 m reach) and front end loader
- 3 30-40 HP "farm" tractors (diesel) with 3 pt hitch and attachment
- 1 15 T low-bed trailer (tow-type, not 5th wheel)
- 2 motor graders
- 1 - 3/4 ton pick up with utility bed and hoist
- 2 - 1-sack concrete mixer
- 6 - 1/2 T pick ups
- microprocessor(s)
- 1 air compressor (100 cfm)
- 1 small generator
- 2 small pumps

5.09 Project O&M Officer

(a) Staffing

(i) Project Engineer
- 2 secretaries/receptionist
- 1 clerk/typist
- 1 computer operator/word processor

(ii) Assistant Administrator - Administration
- secretary
- 4 computer operators/word processors
- 5 reports and publications (clerk/typists, writers, artists, draftsmen)

(iii) Assistant Administrator - Training
- training institute
- faculty
- staff
- 3 personnel

(iv) Assistant Administrator - Operation and Maintenance
- water supply forecasting
- 1 water operations
- 1 power operations
- 1 project maintenance and dam safety

(b) Facilities

Office space for staff and support equipment and supplies. Conference room for 20 people is adequate.

(c) Equipment

- office equipment
- automobiles

5.10 Sub-division - Dams and Plant

The various functions of the sub-division are operation and maintenance of civil works of dam and powerhouse; instrumentation management of the reservoir; sedimentation observations; maintenance of gauge and discharge station; collection of other data; and maintenance of colonies and roads of right and left bank at Narmada Sagar colonies, Khandwa and Bir.

(a) Staffing

(i) Sub-division officer
- 1 Assistant Clerk Payroll records, book keeping, storekeeper
- 1 secretary/typist

(ii) Assistant Sub-division Officer - Operations
- 2 dams operations

(iii) Assistant Sub-division Officer - Maintenance
- 1 dam and waterways maintenance foreman
- 1 power plant/switchyard maintenance foreman
- 6 labourers/small equipment operator
- 2 mechanics
- 1 maintenance man-electrical
- 1 vehicle dispatcher/storekeeper

(b) Facilities

(same as main canal)

(c) Equipment

- 1 dump truck - large
- 1 75-100 HP diesel "farm" tractor with backhoe (6 m reach)
- 1 30-40 HP diesel "farm" tractor with 3 pt hitch and attachments
- 1 motorgrader
- 1 3/4 ton pickup with utility bed-hoist
- 1 - 1 sack concrete mixer
- 4-1/2 ton pick up trucks
- small generator
- small pump
- air compressor

F. SHOP EQUIPMENT, HAND TOOLS, SPARE PARTS AND SUPPLIES

6.01. Equipment and tools for repair shops, hand tools for field staff, spare parts for equipment and an inventory of supplies, i.e. tyres, lubricants, cables, engine parts, etc. have not been listed. These quantities are to be developed.

Building

6.02. Buildings will be designed to utilize standard plans throughout the project with modifications where unit requirements differ from the norm.

G. COMMUNICATIONS AND COMPUTER EQUIPMENT

Communications Equipment

7.01 Communications equipment has not been specifically designated. However, a very reliable modern system is essential. The system must provide for transmitting information among offices including the farmer entities and representatives involved, and among field vehicles and offices. It must also provide for monitoring of the physical facilities and conditions in the project. The system must permit remote operation of facilities as provided in the design.

Computer Equipment

7.02. Computer equipment of two levels of capability will be needed. Small computers will be adequate for office accounting, inventory control and many computational problems. At the division level, greater capability will be needed for scheduling and analysis of hourly, daily and weekly system operations. Capability to interface with remote monitoring and control equipment will be necessary. Established programs to assure system response and direct each facility's operations under various types of emergencies must be in place and ready for activation when needed. Storage, retrieval and manipulation of data on water deliveries, cropping patterns, climate and other factors must be possible at the division level with appropriate visual displays for operation and print out for use in reports. Much of the data will be logged and available for display or maps. An early analysis by people experienced in the type of canal operation selected for this project - both physical and accounting - aided by people knowledgeable in computers and communications will be needed to formulate the combination of equipment to best meet the overall requirements. Alternative means of specifying procurement, installation and development of software must be considered in the course of this effort. Computer equipment, and most programs, will be identical in all parallel offices. Some functions at the various offices are listed to permit focussing on this subject. But all should be examined further.

7.03. Divisional centres will be responsible for water oeprations and maintenance of facilities of all sub-systems within their jurisdictions. The computer functions to be performed at the divisional centre include :

Data Storage

(a) Information identifying every structure, reach of canal, water supply and service areas in the area.

(b) Historical and current annual and seasonal surface water deliveries, total volume and weekly peak discharge through each reach of canal and to each service area.

(c) Historical data on water supply to each SA derived from farmer wells and from river supply.

(d) Precipitation : location, amount and data

(e) Storm patterns - frequency, extent and direction of travel.

(f) Historical and current cropping and harvest in each SA.

(g) Current annual and seasonal water allocations to each SA.

(h) Seasonal projection of source of water to be supplied to each SA.

(i) Current irrigation size and schedule requested by SA and amount delivered to date.

(j) Schedule of discharge by date through the season through each reach and structure.

(k) Project pumping plant/power plant operation and cross regulator gate positions and operations for next period (8-12 hours).

Display screens of system of large visual

(a) Operational status of all facilities

(b) Discharge through all structures

Digital display of the specifics of all features at each flow control structures

(a) Display on large map for projection on screen (Item (a) through (m).

(b) Digital display by site or subarea (Item (b) through (m)).

Visual display in tabular form

(a) Maintenance/outages of facilities.

(b) Maintenance schedule and activity at each structure.

(c) Maintenance schedule and activity on equipment.

(d) Assignment of personnel.

(e) Status and assignment of vehicles.

(f) Status and assignment of equipment.

(g) Construction activities.

Operational programmes for

(a) Defining gate positions and plant operation for each state flow condition.
(b) Describing conditions at each structure and other selected sites under conditions of any selected flow change and gate and plant operation.

(c) Describing operations of facilities under any of a number of predefined emergencies.

7.04. The project office will require capability to store and manipulate information gained from the divisional offices concerning cropping and water deliveries and system operations. Additionally, information on river flows, basin climate and power and reservoir releases will be secured, stored and used in analysis. The primary computer programmes (and capability) at the project office will be sufficient to monitor and predict hourly, daily, monthly, seasonally and annual basin water conditions. This will be used to determine operations for purpose of water allocations and deliveries, power operations and flood regulation. As elsewhere small computers can be used for other office functions. The higher capacity computer used by the Authority for design analysis at Bhopal should be used for analysis of canal transients and complex system operations. At the onset (1986) the O&M staff should have full access to that equipment for their needs and not separate equipment should be purchased.

7.05. At some time in the future the linkage of the divisional centres can be installed and the larger computer capacity secured and located as appropriate for operating the major project areas then delineated. But no special attention is required now since this is many years in the future.

7.06. One other function which will be provided in conjunction with the training centre will be the real time simulator for training of operators. This, however, should be carried out utilizing the computer equipment secured for other purposes.

H. STAFF DEVELOPMENT

8.01. The initial O&M cadre assigned to the project must be experienced and well-qualified administrators, generalists, engineers and technicians, all of whom will be expected to remain with the project for a period of many years. The Narmada Sagar Complex O&M staff will be permanent and functionally autonomous as described. There should be no transfers in or out of the O&M unit except for just cause or to meet emergencies in other locations. Minimum periods with the units should be five years under any but for the most unusual cases. It must be viewed as a career.

8.02. In order to foster staff perserverance, special emphasis on recruiting local people should be made. Also, and very importantly, many of the positions need not be filled by graduate engineers. Management ability, knowledge of irrigation and O&M and attitude are the most important characteristics. And in every instance the individuals must be satisfied in staying with the O&M Agency and in the specific project area. This will be an essential requirement of all staff at every level.

8.03. Superior performance at all levels will be recognized and regarded promptly by internal action. Such actions, together with similarly appropriate action in the case of unsatisfactory performance, will be within the Authority and responsibility of unit offices down to the sub-division level. Seniority should carry only limited importance in consideration for advancement. promotions will be from within the organization whenever possible. Recognition of solid performance, the possibility of Promotion, and adequate pay levels will serve

as three of the strongest inducements for overall staff accomplishment and staff permanence, so necessary for making the project successful.

8.04. A small permanent training centre including necessary buildings and facilities for training O&M staff and farmer representatives of the SAs will be established in Phase I area of the project. This will be an ongoing institution. (Prior to its establishment training will be provided in Bhopal and elsewhere as appropriate. However, this intitial training will also be directed by an O&M staff member and the courses provided by experienced O&M and specialist personnel. The primary functions of the O&M Training Centre will be :

(a) Staff orientation and training for initial O&M assignment;

(b) Instruction in water operations in project facilities with courses which will concentrate on system operation theory and practice, techniques of maintenance and construction, administrative and fiscal matters, farmer relations and personnel management;

(c) Background training in on-farm management, crop-water requirements, full and supplemental irrigation of crops, and similar agricultural factors useful for O&M personnel. Although this training could be furnished separately to O&M staff and farmer representatives, there would probably be significant benefit to having both groups participate in the same classes; and

(d) Providing courses to upgrade special technical and managerial skills.

The training centre will be established and staffed at the very early stages of project development so that the requisite specialized courses focusing on the particular characteristics of this project -- the facilities and their operation -- can be provided to the O&M staff who will initiate water deliveries to the project lands. The facility need only be adequate for the training of staff for one or possibly two sub-divisions at one time, because cadre for additional increments of the project, as completed, will be drawn in part from the then existing O&M staff. This training activity, however, will remain relatively constant over a long period of time as the project expands.

8.05. During the initial stages of project development, there will not be a need for staffing or facilities above the division level except a limited project office staff to evaluate water supply conditions, coordinate water allocations, schedule water and power operations at the reservoir and prepare basic policies and guidelines.

I. MANUALS AND PROCEDURES

9.01. Manuals presenting procedures and standard operation and maintenance methods, policy manuals and administrative and management instructions, will be prepared in advance of commencement of O&M field activities on the

project. These will be modified as experience in the first portions of the project is gained. The initial full set of documents, however, must be completed several months prior to turning water into the main canal and three months prior to staff training to allow preparation of training lessons and materials.

J. COST ESTIMATES

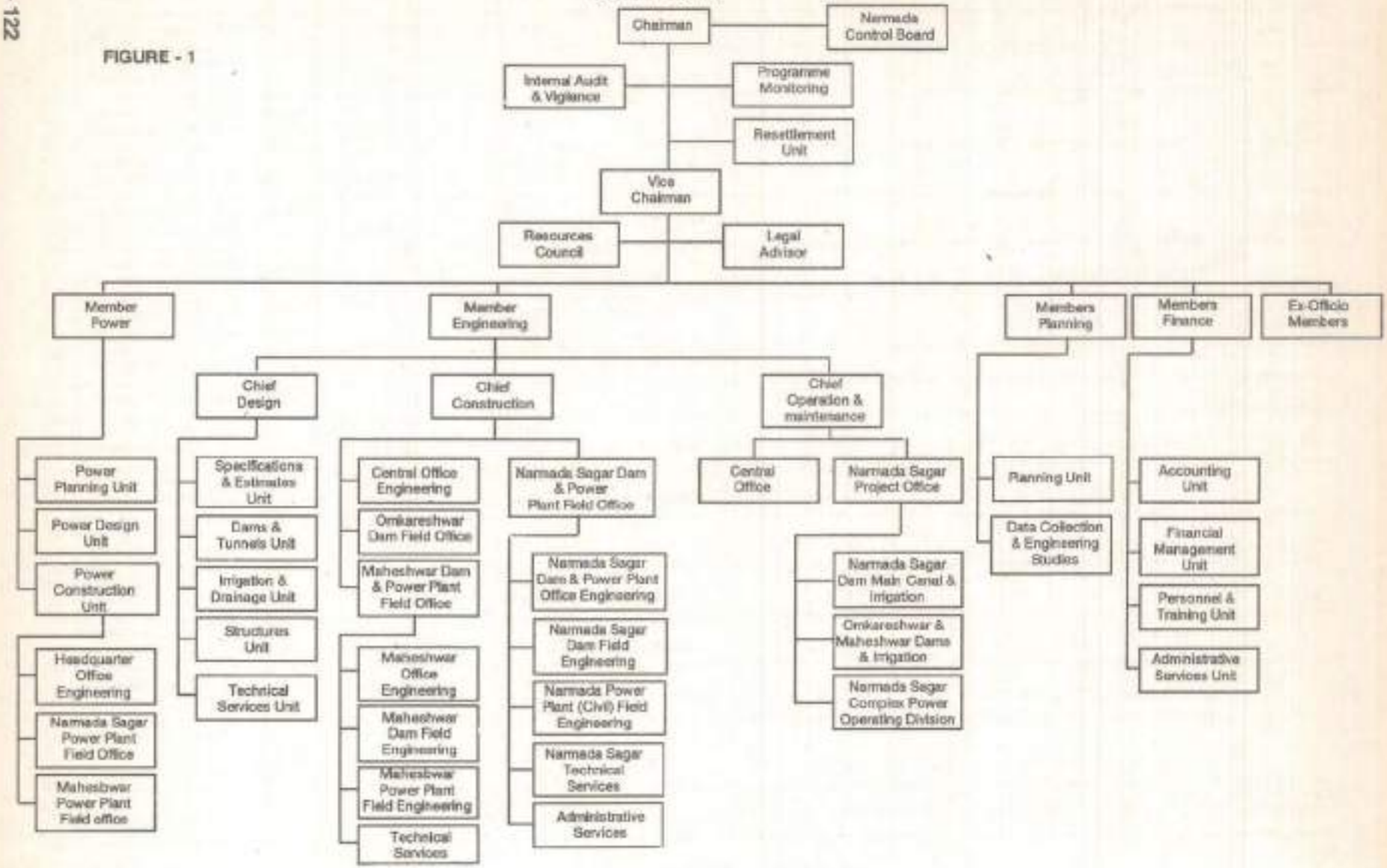
10.01. Estimates of 1985 base recurring and non-recurring costs have been developed. These estimates reflect the staff, facilities and equipment presented herein.

TRAINING PROGRAM

S. NO.	NAME OF COURSE	DURATION SESSION	NO.PER SESSION	LOCATION	INSTRUCTOR	1985				1986				1987				1988			
						Sr.	Mid.	Jr.	Total	Sr.	Mid.	Jr.	Total	Sr.	Mid.	Jr.	Total	Sr.	Mid.	Jr.	Total
1.	Project management (scheduling,budgeting, procurement & contract management)	2/3 wks	16	Delhi/ Bhopal	IIPA	2	10	20	32	2	10	20	32	2	10	20	32	-	-	-	-
2.	Progress review & evaluation technique PERT/CPM	2/3 wks	16	Delhi/ Bhopal	IIPA	2	10	20	32	2	10	20	32	2	10	20	32	-	-	-	-
3.	Construction management office engineering/field engineering	3 weeks	15		Consultant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	Quality control & lab procedures	3 weeks	15	Roorkee/ Nasik	IIT/MERI	-	-	-	-	-	5	10	15	-	5	10	15	-	5	10	15
5.	Material management inventory control	3 weeks	15	Bhopal	MPC	-	-	-	-	-	5	10	15	-	5	10	15	-	5	10	15
6.	Rock excavation/blasting procedure, safety measures, monitoring	3 weeks	15	Delhi/ Bhopal	CWC/CMRI	-	5	10	15	-	5	10	15	-	5	10	15	-	-	-	-
7.	Mass concrete tech. mix design, mixing & transp./placing/temp.control	3 weeks	16	Delhi/ Nasik	CWC/MERI	-	-	-	-	2	10	20	32	2	10	20	32	2	10	20	32
8.	Design & Drawing construction level					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	Specifications				Consult.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	Planning, lay-out & design of water application system and drainage	3 weeks	8	Delhi/ Bhopal	CWC/ WALMI	-	-	-	-	-	2	8	10	-	2	8	10	-	2	8	10
11.	Engineering geology/Geological Investigations & foundation treatment	10 days	6	Delhi	CWC	-	-	-	-	1	5	-	6	1	5	-	6	1	5	-	6
12.	Computer Programming for design of canal & canal structures	3 weeks	5	Delhi	CWC/MIC	-	-	-	-	-	2	8	10	-	2	8	10	-	2	8	10
13.	Rock mechanics & stability of slopes & slope protection	10 days	15	Roorkee/ Dhanbad	IIT/CMRI	-	-	-	-	1	5	-	6	1	5	-	6	1	5	-	6
14.	Relevance of environment in planning & execution of river valley projects	2 weeks	5	Delhi	CWC	2	3	-	5	-	-	-	-	-	-	-	-	-	-	-	-
15.	Hydrology of small & medium catchment	3 weeks	15	Delhi	CWC	-	-	-	-	-	5	10	15	-	5	10	15	-	5	10	15
16.	Remote sensing & application	10 weeks	3	Delhi	IIT	-	1	2	3	-	1	2	3	-	-	-	-	-	-	-	-
17.	Tunnelling	3 weeks	5	Delhi	CWC	-	2	3	5	-	2	3	5	-	2	3	5	-	-	-	-

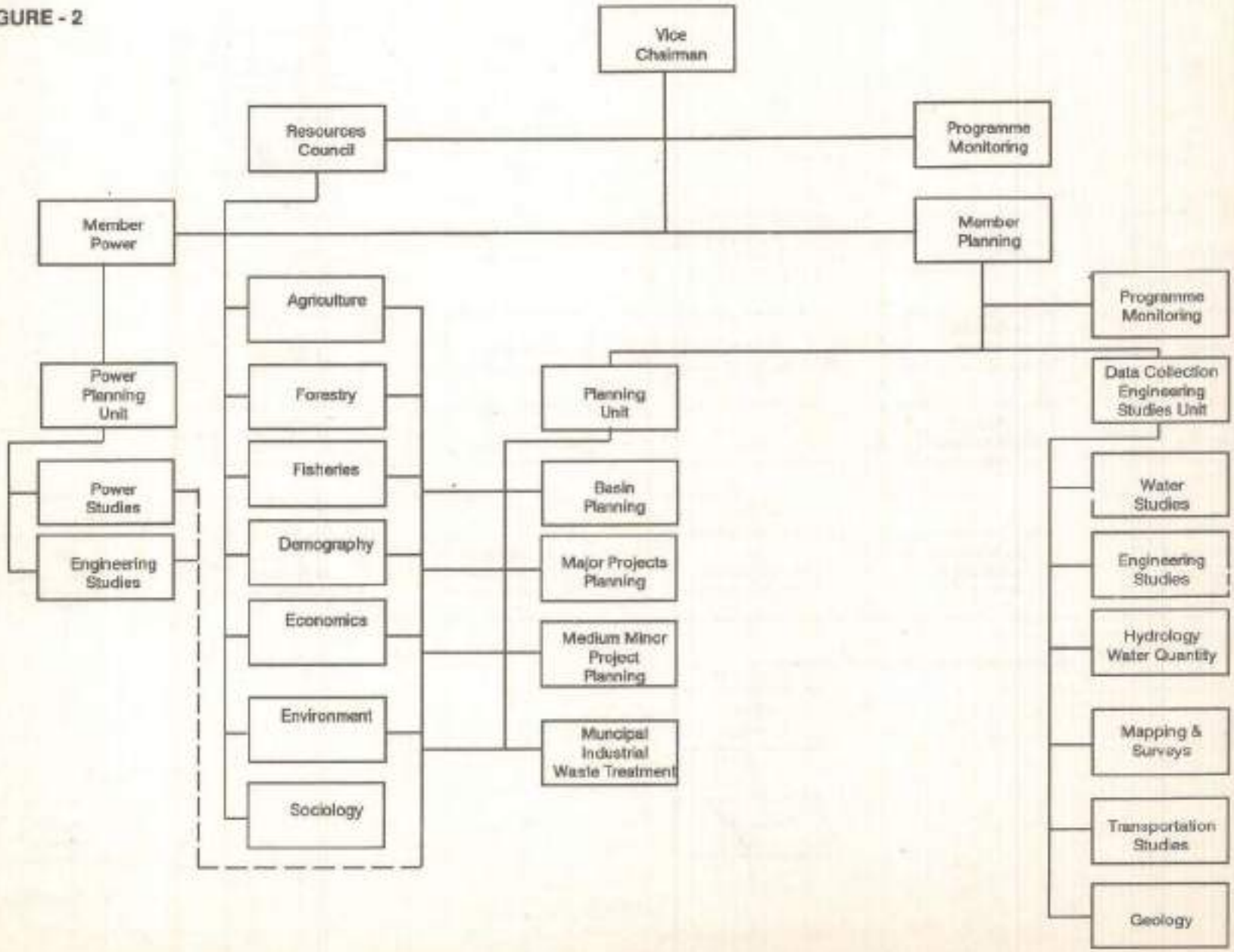
FIGURE - 1

INDIA
Madhya Pradesh
Narmada Valley Development Authority
(Organisation Chart)



(Organisation for Planning)

FIGURE - 2



Madhya Pradesh
Narmada Valley Development Authority
(Organisation for Design)

FIGURE - 3

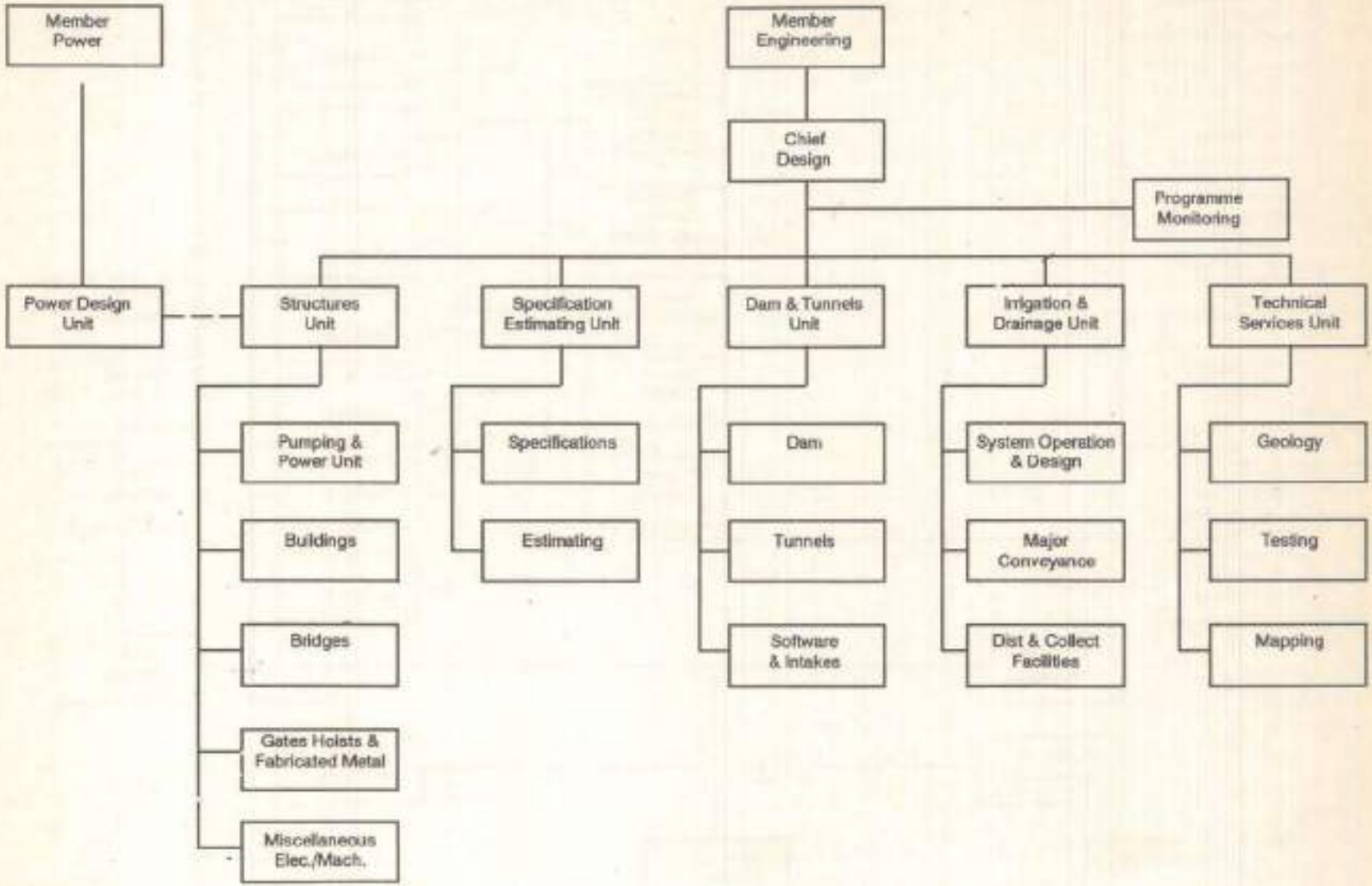


FIGURE - 4

Madhya Pradesh
Narmada Valley Development Authority
(Civil Construction Organisation in BHOPAL)

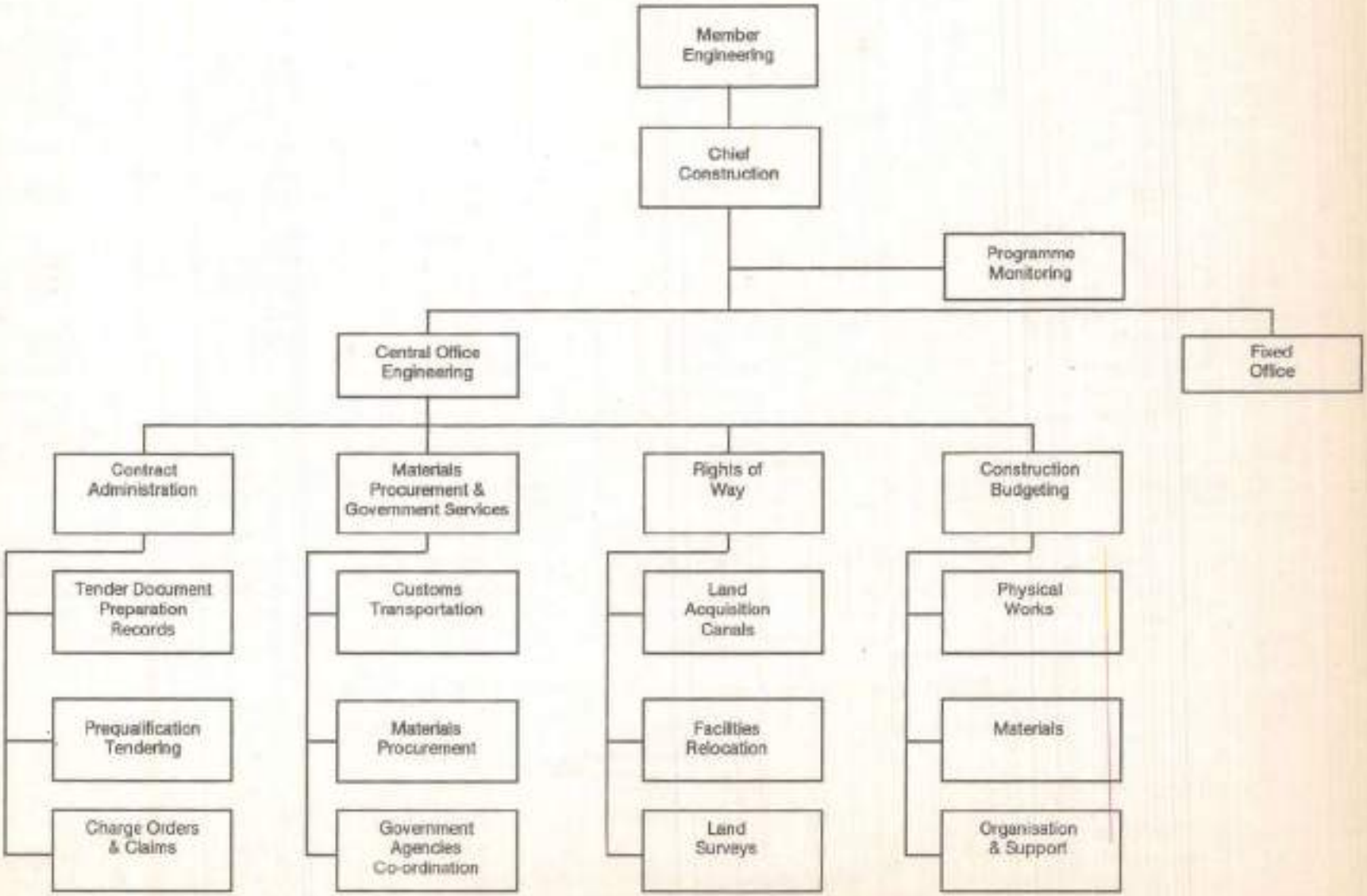


FIGURE - 5

Madhya Pradesh
Narmada Valley Development Authority
(Construction Organisation at Narmada Sagar Dam Site)

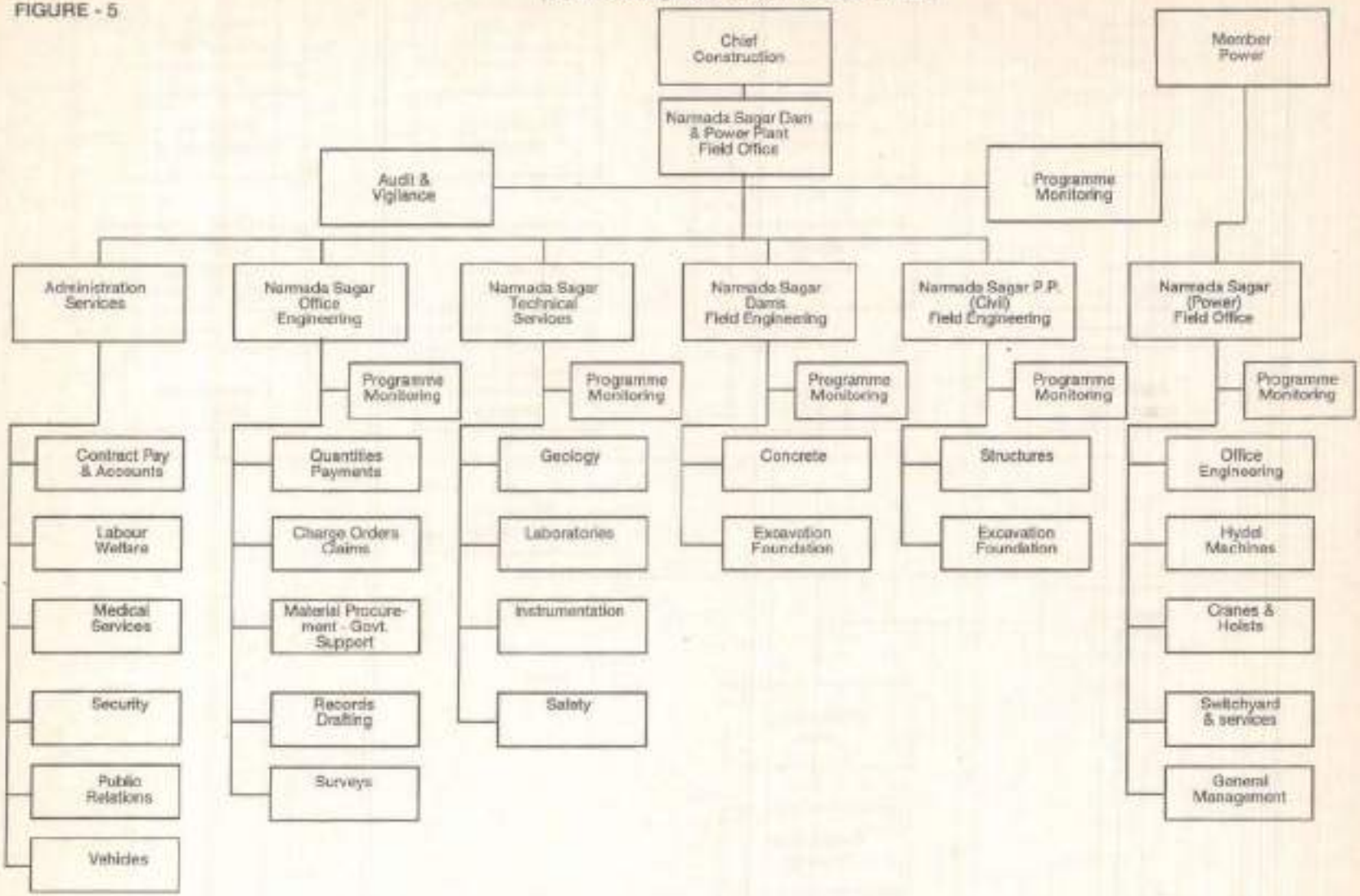
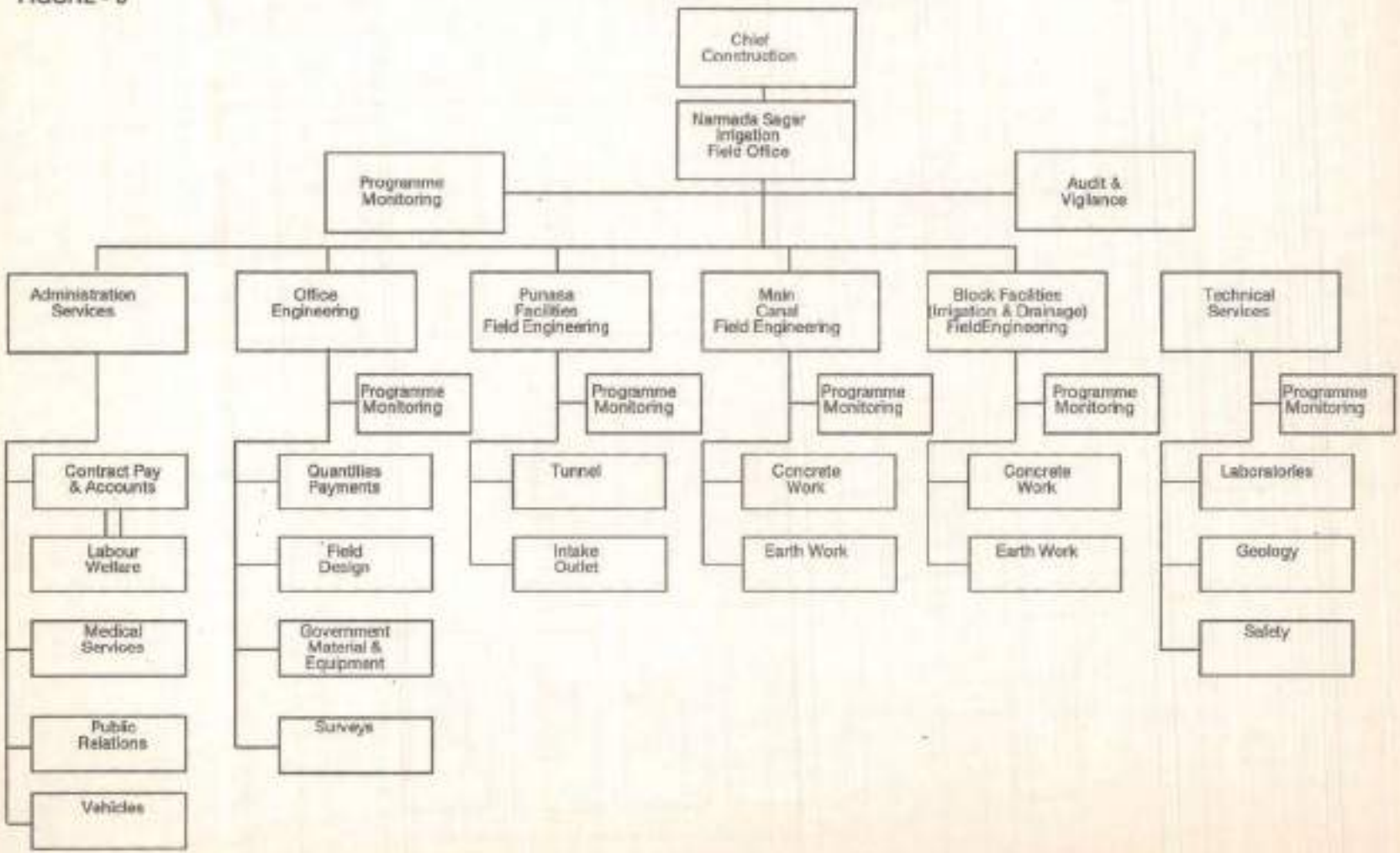


FIGURE - 6

Madhya Pradesh
Narmada Valley Development Authority
(Construction Organisation at Irrigation Site)



Narmada Valley Development Authority
(Organisation for Operations and Maintenance)

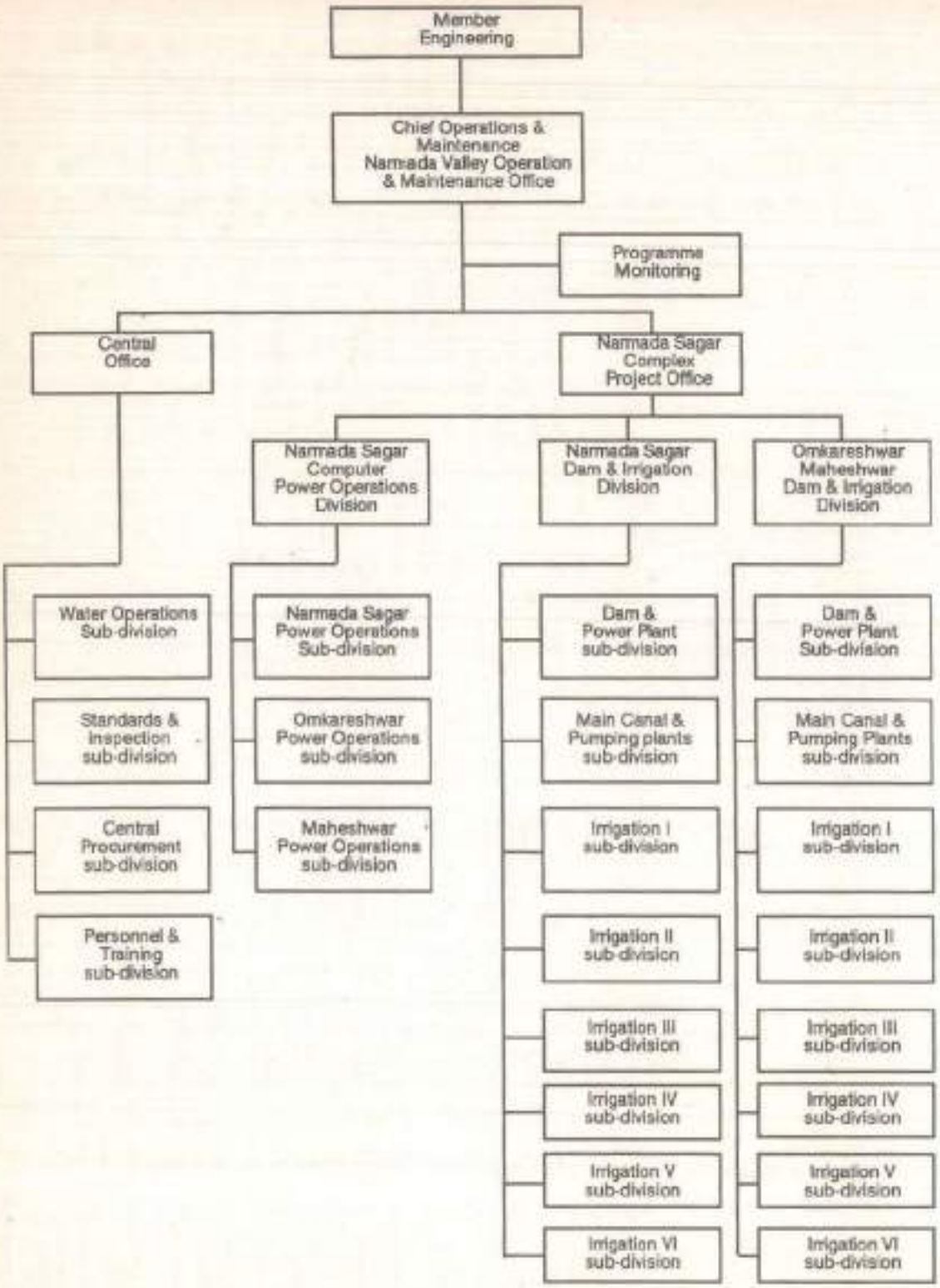


FIGURE - 7

ANNEX XII
(to Chapter 6)

DUTIES AND RESPONSIBILITIES OF IRRIGATION PERSONNEL : EXTRACT FROM PWD HANDBOOK, GOVERNMENT OF MAHARASHTRA

1.0 Role of an Irrigation Engineer

The popular notion that has come to stay by an environ of circumstances, both in the official circles and in public is that the Irrigation Engineer is responsible for the ultimate use of irrigation facilities. He is not only responsible for the creation of irrigation facilities but in addition is responsible for the ultimate utilisation of the irrigation waters. Hence beyond the maintenance and operation of irrigation structures such as dams, canals, distributaries, minors, head regulators, etc. he has to deal with the less informed mass of cultivators, who require to be properly guided not only in the direction of economic use of water but also in other allied aspects of irrigated farming, requirement of water for different crops interval between two waterings. He has also to keep account of the day-to-day use of the stored water. He should be able to keep the record of various block sanctions and other papers pertaining to Irrigation Management.

An organisational set up of the Irrigation Management is given below :

Administrative set up for Irrigation Management - A chart detailing out the Administrative set up for the irrigation management right from the level of Chief Engineer down to the lowest Government servants in the field is at Exhibit A. The Chief Engineer at Regional level deals with the general administration and the development and utilisation of the irrigation projects. The Chief Engineer is assisted by the Superintending Engineer at regional level. The Superintending Engineer is the Administrative Head at the regional level. He has full powers within the regulation laid down by Government to sanction use on irrigation water for the different activities in the region. The Superintending Engineer has to approve the yearly utilisation of the storage in reservoirs and to modify and approve irrigation programmes from year to year as per availability of water. The Superintending Engineer has full administrative and financial control over the budget provisions allocated by Government. In addition to above, the Superintending Engineer has to certify the safety of Major and Medium Irrigation dams by inspecting them during pre-and-post monsoon periods.

The Superintending Engineer executes and controls irrigation policy through the Executive Engineers who are stationed and in each district. Executive Engineer is responsible for maintenance of irrigation works and management

of Irrigation in the field. Apart from technical duties, the Executive Engineer has to perform duties, under the Irrigation Act and rules thereunder. The management of irrigation is a very important work assigned to the Executive Engineer and has to play a very important role in day-to-day sanction and distribution of canal water to each individual irrigator.

The set up for the Field Organisation is at Exhibit A.

1.1. Duties and Functions of the Field Officers in the Irrigation Management

(1) The Executive Engineer has to prepare timely forecast (Preliminary Irrigation Programme) for the utilisation of storage water.

(2) The Executive Engineer has to keep constant vigilant watch over the gauges in the canal and special situation points in large canal lengths.

(3) He has to give surprise inspections at least once in a month to the field irrigation and to note down the following points -

(a) Working of the S.W.F.s and the Head Regulator.
(b) Conditions of the distributing channels and whether any repairs are needed.
(c) Whether the Irrigators passes are dated up-to-date.
(d) Whether the irrigation is generally in good order.
(e) Whether the well and pazar irrigation is having any suspicious contact with canal irrigation and to take action to remove it.

(4) The Executive Engineer has to watch the progress of realisation of the assessment and to keep watch over recovery of arrears.

(5) The Executive Engineer has to give percentage check of 2 percent of number of the Panchanamas in a season.

(6) The Executive Engineer has to check 50 per cent of the number of cases of emergency canal water supply allowed to crops on wells and pazar.

1.2 Sub-Divisional Officer

(1) The Sub-Divisional Officer has to be in direct touch with and in control with the field staff of the Irrigation Department.

(2) The Sub-Divisional Officer has to keep vigilant watch on the gauges of water depths in the storage reservoirs and at the off-take points of canal and major distributaries and to regulate the rotations and the discharges in the system under his control.

(3) The Sub-Divisional Officer has to inspect field irrigation at least once in a rotation and to observe the following points in particular :-

(a) General condition of the Head Regulator, the S.W.F.s and Canal.

(b) The discharges in the channel, sub-channels and the rotation and schedule of operation of the system.

(c) Whether the irrigators passes are dated up-to-date.

(d) Whether unauthorised irrigation, Gairkayada, waste of water and excess utilisation of irrigation water is brought on books and panchnamas are framed in time.

(e) To control the unauthorised use to crops on wells and pazar.

(4) The Sub-Divisional Officer has to give necessary check on 8 percent on number of Panchnamas in a season and 2 percent on seasonwise crop measurement, as prescribed under the rules.

1.3 Section Officer

(1) The Section Officers are responsible to the superior officers for carrying out orderly irrigation management and to prevent and detect misuse of canal water.

(2) The Section Officer has to inspect field irrigation in his beat very frequently and to keep with him -

(a) Schedule programme of rotation and the running of the distributaries in his beat.

(b) Discharge table of the S.W.F.s of the Channels.

(c) "Shejpali" Patrak.

(d) Control Chart.

(e) Panchanama Pahani Tippan.

(f) Note book containing statistical and hydrological information of channels in his beat.

(3) During the course of inspection, the Section Officer has to check the following items :-

(a) Up-dating of the irrigators passes and duplicates thereof,the latter being with canal inspector.

(b) Proper, neat and up-to-date maintenance of Zade Patrak by the Canal Inspectors.

(c) Working conditions of the S.W.Fs., with their gauge plates.

(d) Water conditions of Government own channels and irrigation water courses.

(e) Demarcation and utilisation of the fields.

(f) Conditions of the outer bunds and water tightness of various areas under irrigation.

(g) Excess over permissible than sanctioned.

(h) Irrigation on well and pazar.

(4) The Section Officer should immediately note the irregularities noted above in the Palani Tippan from and give to the canal inspector for holding Panchanamas. If there is urgency and special circumstances, the Section Officer may himself hold Panchanama.

(5) The Section Officer in case of misuse of Canal water to crops and pazars or likely inter-mixture, should note his findings in the Inspection Note and should send a copy to the Sub-Divisional Officer before the start of next rotation.

(6) The Section Officer should note down working conditions of the pumps, motors, with their capacity of irrigating the areas. The Section Officer should note crops grown on the wells and on pazar. In case of suspicious contact with canal irrigation the Section Officer should take step to remove them.

(7) The Section Officer should check the seasonwise area under crops to the extent of 7 per cent and to check Panchanamas to the extent of 20 per cent for individual areas of 0.81 Hect. (2 acres) above, as prescribed.

1.4 **Sectional Inspectors** - Section Inspectors are upgraded Canal Inspectors, at time placed in-charge of an irrigation Section. Their duties in respect of irrigation management, control and supervision, are the same as those specified above in the case of Section Officers.

1.5 **Canal Inspectors** - These are Class-III Government servants borne on "VII" or "XVIII-Irrigation". The minimum educational qualification needed for the sake of recruitment is standard X passed.

(a) Duties of Canal Inspectors are -

(a) To prepare a "Pali Patrak" and to get it approved by the Section Officer for each distributing channel before the irrigation season starts.

(b) To submit to Section Officer at least 4 days in advance of the ensuing rotation, indent for supply of water in that rotation at the head of each distributing channel in his beat.

(c) At an appointed hour and place "to-date" "irrigators" water passes for their next following day turn of irrigation, according to Pali Patrak.

(d) Where no Patkari or other assistant is given, to open the gates of the outlet channels at the scheduled hours, to let down adequate discharge of water and to close them at the appointed hours.

(e) To go round and inspect the field irrigation. Here, he should see if the irrigation of all those areas for which dates were given on water passes on the preceding day is completed. In case an Irrigator actually takes no water though due, for such reasons as (Khurpani rains) etc. a note to that effect should be recorded against the entry of the date, in the irrigators' pass and duplicate with the Canal Inspector. Same procedure should be followed where part area is actually irrigated.

(f) To bring on book, any type of misuse or waste of water, or detectable excess irrigation, as soon as it is noticed and to follow the procedure prescribed.

(g) To give an immediate possible intimation to the Section Officer where such misuse or waste of water in any individual case involves an area of 0.81 Ha. (2 acres) or more.

(h) To see that no channel once closed at the scheduled time, is reopened in the same rotation except with the orders of his superiors.

(i) To see that demarcation, utilisation and corner stones of areas under blocks are intact and that the outer bunds round irrigated areas are strong enough to prevent waste of water, otherwise, to record a suitable note in the irrigators' water pass, and to inform the Section Officer to enable service of the necessary written notice on the irrigator. To take similar action where an irrigators' channel is out of repair.

(j) To keep under frequent and vigilant watch the irrigation of wells and pazar in the irrigated tract of his beat, and to keep the Section Officer, constantly and fully informed in writing of it.

(k) After the irrigation of a rotation period is over, to submit to the Section Officer the Discharge Al/DC Dasawada.

(l) To submit the diaries of their work.

Note(1): This elaborate procedure is not necessary on Minor Tank and even in non-parennial zones of major canals. The Executive Engineer may with the approval of the Superintending Engineer, prescribe for such irrigation works, such short procedure as in his opinion would suit best.

Note(2): On Minor Irrigation Works in charge of the Irrigation and Power Department, where there is normally monsoon and/or Rabi Irrigation only, where the "canal Karkoons" are equivalent to "Canal Inspectors". Thev have to look

to the maintenance work of the canal etc., in addition to their duties in respect of irrigation management.

1.6 **Measurers** - Class-III Government servants, borne on "XVIII" or "XVII Irrigation".

(1) **Duties of a Measurer are -** Where the crop areas under irrigation are not demarcated, the measurers acting under the orders of the Section Officer or the Sub-Divisional Officer are to actually measure the irrigated areas with the help of cross staff and chain and to enter the measurements with a rough sketch in the field book called "Crop Measurement Book". Every page of measurements in the field book shall be signed and dated by the Measurer taking the measurements. The areas to be so measured should be recorded cropwise; the calculations to find out each such area, in group or in parts should be done and the actual areas should be worked out by the measurers themselves.

(2) Where the sanctioned areas are demarcated and unitised and the demarcation sketches are duly preapred and approved by the Sub-Divisional Officer, the measurers have to take requisite copies thereof and have to fill-in all the requisite preliminary details thereon, before they proceed for crop measurements under the orders of the Sub-Divisional Officer, or the Section Officer. Unless they have doubts that the demarcation and the plots are in any case disturbed on the site and such cases will be very few requiring regular measurements as in (a) above, they shall only fill in the details of the plotwise crops and their areas on the backside of the form on columns 4,5,6,9 or 10 and put their dated signature below the entries.

(3) If in any case, an unauthorised irrigation not booked by the Canal Inspector is noticed by a measurer he should immediately measure it and take it on the crop measurement book, with a simultaneous report to the Section Officer concerned. It will be only after the personal inspection and inquiries by Sub-Divisional Officer, that such measurements can be confirmed. In case, those cannot be confirmed the Sub-Divisional Officer shall report the matter to the Executive Engineer, who may issue orders to confirm or cancel it as he deems fit.

(4) After the crop-measurements work allotted to him, is over, the measurer shall prepare assessment papers in accordance with the programme and orders issued by a Sub-Divisional officer or the Section Officer.

(5) Before starting of measurement work under the orders of the Sub-Divisional Officer, he himself shall take for his guidance, a list of areas to be measured by him, in the beat or beats allotted to him by the Sub-Divisional Officer or the Section officer. The Canal Inspectors need not accompany him at the time of crop-measurements.

(6) The measurers shall also do, when called upon by the Sub-Divisional Officer or the Executive Engineer, the work of demarcating and unitising areas sanctioned under block system and preparing sketches thereof, to the prescribed scale.

(7) They shall also do such office work as finding out and keeping ready on record, the acreages of various irrigated crops, their assessment, etc. if and when called upon to do so, by the Sectional Officer or the Sub-Divisional Officer when free from their work, specified at (a) to (h) above they shall help the Sectional and Sub-Divisional Officer staff in their work, if and when the Sectional Officer of the Sub-Divisional Officer directs them to do so.

(8) When on out-door duty, the measurers shall submit punctually to their superiors the diaries of their work.

1.7 **Patkaries** - Class-IV Government servants borne on "XVII" or "XVIII Irrigation".

(1) Patkaries are meant to assist Canal Inspectors In-charge of heavier or more important beats. They are to open and close the outlets channels in the beat of the Canal Inspector, according to the instructions of the Canal Inspector acting under the orders of the Section officer. They are to go round the fields under the irrigation to see that the irrigation is going on in an orderly manner. They are to immediately report to the Canal Inspector, the cases of misuse or waste of water, if they detect any. They can even hold Panchanamas subject to personal inspection by the Canal Inspector.

1.8 **Keymen** - Class IV Government servants borne on "XVII" or "XVIII Irrigation".

(1) The Keymen are to work directly under the Section Officer. Their duties are:-

(2) To open, regulate and close in each rotation and distributing channels in a Section, strictly according to the orders of the Section Officer, i.e. according to the programme given to him by the Section Officer.

(3) To leave all the keys in the custody of the Section Officer and to take them back to with his permission according to necessity.

(4) To note down in the gauge register the gauge readings of water depths in the S.W.Fs. at the heads of each such channel preferably between 6.00 a.m. to 6.00 p.m. at least once in a day (a second-time reading at about 12 hours interval may be insisted upon in the case of important distributaries) and to report those every day to the Section Officer.

(5) To see if the head regulators of the Channels are working satisfactorily if the gauge plates are intact; if the stilling chamber of the S.W.F. is clean and the pipes admit free flow of water into it. Defects if any, to be immediately reported to the Section Officer.

(6) If and when the necessity arises and the above mentioned duties permit, to help the Canal Inspector as would be directed by the Section Officer.

(7) To carry with him -

(a) Authorised programme of rotational runnings of different distributing channels in the section.

(b) An order book in which the inspecting officers may note their orders and instructions.

(c) Gauge registers for noting down the gauges.

(8) When there are no duties to be performed as per (2) to (6) above, to deliver local tapal of the Section Officer to the Canal Inspectors, village officers, etc. away from Section Head Quarters.

1.9 The Canal Advisory Committees and Water Panchayat Committees are established on the different major canal systems for advising Government on the management of the canal water. The construction and rules of business of Canal Advisory Committees are specified under Government, Irrigation Department resolution No. CME-1081/(1902)IMG-3, dated the 17th march 1982 (in Marathi).

1.10 Duties of Field Officers in Vidharbha Region

Executive Engineer - Same as for Western Maharashtra.

Sub-Divisional Officer (Irrigation)-Same as for Western Maharashtra.

Canal Deputy Collector - The Canal Deputy Collector is a senior Tahsildar, posted to look after one or more tanks spread over one or more Sub-Divisions. He is subordinate to the Executive Engineer. He has to discharge the following duties:-

(a) To hear appeals under Sections of Irrigation Act regarding main incidents of irrigation agreement.

(b) To accept Irrigation agreements as authorised by the Executive Engineer.

(c) To preside over the election meetings of Irrigation Panchayats and keep watch of working of Panchayats in General.

(d) To check wet areas for purpose of Irrigation agreements.

(e) To check if necessary the position and circumstance under which unauthorised use of canal water is made.

(f) To supervise the work of Irrigation Inspector, Amin etc. in respect of timely preparation and submission of assessment papers at various stages.

(g) To check when on tours the working of Irrigation Panchayats in respect of collection of Revenue and its remittance in the Government Treasury within reasonable period, issue of receipts by Panchayats to the irrigators,

etc. and to visit the villages in which the satisfactory collections are reported.

Irrigation Inspector - An Irrigation Inspector is a Senior among the Junior engineers posted to each Sub-Division to assist the Sub-Divisional officer (Irrigation) and Canal Deputy Collector in discharging their duties. He has to perform the following duties.

(a) To accept Irrigation Agreements on authorisation by an Executive Engineer.

(b) To supervise the working of Irrigation Panchayats in respect of collection and remittance of revenue issue of receipts etc. and bring to the notice of the Canal Deputy Collector which Panchayat, it is desirable that he should visit in order to expedite collections.

(c) To preside over the election meeting of Irrigation panchayats if authorised by Executive Engineer.

(d) To prepare preliminary report of authorised use of canal water if he is in the vicinity at the time of incidence.

(e) To inspect and report the areas in respect of which applications for remission have been made.

Section (Subordinate) Office - Section Officer is in-charge of one Section. He comes from Junior Engineer's Cadre. His duties are as in Western Maharashtra.

Amin - The Amin is a lowermost post in the administrative set up in the work of Irrigation Management. He is directly in touch with the irrigators and Panchayats. He has to discharge various duties concerning irrigation agreements, assessment papers and collection of revenue etc., which is given below :-

(a) To prepare list of persons who are entitled to be electors from the village at least once a month before the date of election and paste the same at prominent places in the village. The names of the elected Panchas should be pasted also at prominent places in the village by him. These names should be communicated to the Canal Deputy Collector by him.

(b) To prepare detailed tracings from Patwari maps for the areas under agreements or likely to come under agreements and to collect maps already prepared annually.

(c) To prepare Khasra Shudkar, Ledger Kistabandi, Khatoni and Parchas for assessment purposes.

(d) To measure areas on demand and part areas under agreements on Form 'A' (Not enclosed).

(e) To collect the objections to the parchas served to the Irrigator for irrigation under the agreements and submit them to the Section Officer for due corrections.

(f) To receive water applications for areas on demand and forward the same to the Section Officer with recommendations.

(g) To report any misuse of canal water viz., unauthorised irrigation or waste of water to the Section Officer and Irrigational Inspector.

(h) To report the progress of collection of revenue weekly with all relevant details to the Irrigation Inspector, while the collection of Irrigation revenue in its progress.

(i) To see that the revenue collected is remitted to the Government Treasury and report to the Irrigation Inspector if not done.

Panchayat - Panchayat is an elected body from the Village Chak or Mahal under agreement. The number of Panchas in a Panchayat is fixed according to the area in village, normally the number is 3 including one Sarpanch. The Panchayat has to perform duties in respect of Irrigation Management as follows:-

(a) To compound offences as detailed under Sections 60 and 74 of the Maharashtra Irrigation Act 1976 and recover the amount from the offender.

(b) To distribute water so as to complete all irrigation in the jurisdiction of the Panchayat in an efficient way.

(c) To avoid misuse of water and report to Amin if any such misuse is occurred anywhere.

(d) To show Kistabandi Khatoni to the irrigators, issue receipts and collect the irrigation revenue and remit the same in Government Treasury within minimum period from collection.

(e) To receive water applications for irrigation on demand and forward the same to Amin.

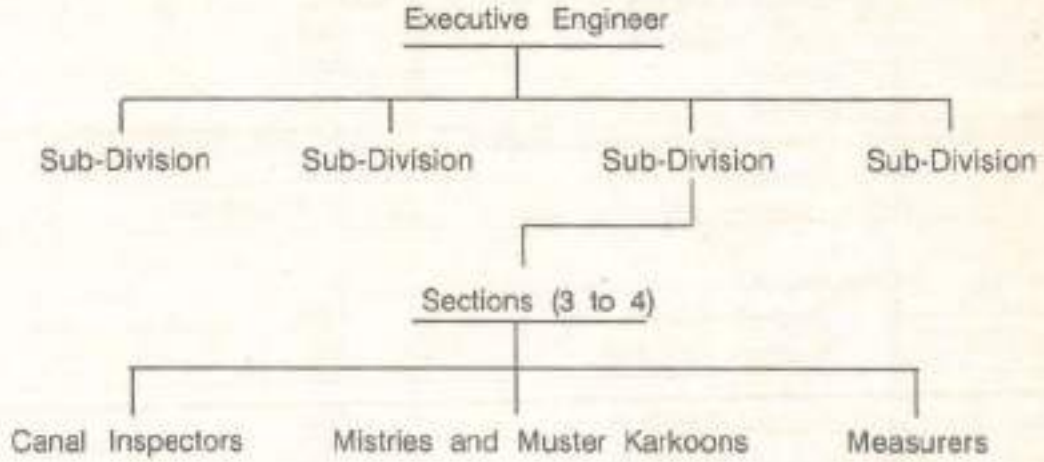
(f) To maintain the documents regarding proceedings of Panchayats, compounding offences, Canal Revenue realised and remitted, Panchayat fund etc., and

(g) To prepare and send applications for remissions in Form- X and send them to Amin for further disposal.

EXHIBIT A
(ANNEX XII)

FIELD ORGANISATION

Generally under a Management Circle, there are 4 to 5 Divisions of Irrigation Management each covering a hectarage of 40 to 60 thousands of mixed irrigation. Under every Division there are generally 3 to 4 Management Sub-Divisions, each Sub-Division dealing with 10,000 to 12,000 hectares of mixed irrigation. Field organisation of a Maintenance Division is given below :



Norms of Establishment for Irrigation Management Section

The following are the norms :-

1. Category (A) .. One or more irrigation projects irrigating an area of about 3,200 ha to 4,000 ha (8,000 to 10,000 acres) of lands.

2. Category (B) .. One or more irrigation projects irrigating an area of about 2,000 ha to 3,200 ha (5,000 to 8,000 acres) of lands.

3. Category (C) .. Three or more irrigation projects irrigating an area upto 2, 000 ha (5,000 acres) of lands.

Establishment for the Sections

1. Category (A)

1.	Section Officer	1	No.
2.	Section Karkoon	1	No.
3.	Maistry and Muster Karkoon	2	Nos.
4.	Canal Inspector	4	Nos.
5.	Daftar Karkoon	1	No. for each 2,500 ha. (6,250 acres)
6.	Measurer	3	Nos

7.	Gauge Karkoon	1	No.
8.	Messenger	1	No.
9.	Patkari	2	Nos.
10.	Chowkidar	2	Nos.
11.	Canal Chowkidar	2	Nos.
12.	Canal Tapali	2	Nos.
	Total for (A)	22	Nos.

2. Category (B)

1.	Section Officer	1	No.
2.	Section Karkoon	1	No.
3.	Muster Karkoon	1	No.
4.	Canal Inspector	3	Nos.
5.	Measurer	3	Nos
6.	Patkari	3	Nos.
7.	Chowkidar for each Project		As per requirement
8.	Attendant	1	No.
	Total for (B)	13	+ Chowkidar

3. Category (C)

1.	Section Officer	1	No.
2.	Section Karkoon	1	No.
3.	Attendant for S.O.	1	No.
4.	Muster Karkoon	1	No.
5.	Canal Inspector	2	Nos.
6.	Measurer	2	Nos.
7.	Patkari	2	Nos.
8.	Chowkidar (for each Project)		As per requirement
	Total for (C)	10	+ Chowkidar

(Ref.Government, I. and P. Department No. EDC/1360/35453-I(5), dated 15th January 1968).

ANNEX XIII
(to Chapter 7)

LIST OF FORMATS FOR USE IN COMPUTER-BASED MIS FOR OPERATION AND MAINTENANCE ACTIVITIES

WATER ALLOCATION INPUT FORMS

* Input for Water Allocation

WATER ALLOCATION OUTPUT FORMS

* Water availability for canal systems
* Share of different canal Systems (Rabi)
* Share of different divisions of the selected canal system for preparation of roster (Rabi)
* Water availability for different canal systems (Kharif)
* Share of different canal systems (Kharif)
* Share of different divisions of the selected canal system for preparation of roster (Kharif).

CANAL OPERATION INPUT FORMS

One-time Input

* Area irrigated and recorded in the previous year (Division-wise)
* Area irrigated and recorded in the previous year (Channel-wise)
* Division-wise data of water input and expenditure for the period.
* Channel-wise data of water input for the period

Recurring Input

* Input for water allotted and supplied. (Division and Specified Channels)
* Input for irrigated area recorded area-kharif (Division and Specified Channel-wise)

* Input for sub-headwise expenditure.

* Input for targets for the season. (Division and Specified Channel-wise)

* Input for Area Irrigated Crop-wise and Revenue Assessed - Kharif (Division and District-wise)

* Input for Area Irrigated Crop-wise and Revenue Assessed - Kharif (Specified Channel-wise)

* Input for Area Irrigated Cropwise and Revenue Assessed - Rabi (Division and District-wise)

* Input for Area Irrigated Cropwise and Revenue Assessed - Rabi (Specified Channelwise)

CANAL OPERATION OUTPUT FORMS

* Water allotted, supplied and utilized for irrigation (Divisionwise)

* Water allotted, supplied and utilized for irrigation (Specified Channelwise).

* Exception Report* for specified channels scheduled to run but not run.

* Exception Report for specified channels - water delivered

* Area Irrigated and water depth obtained - kharif (Division-wise)

* Area irrigated and water depth obtained - kharif (Specified Channel-wise)

* Area Irrigated and recorded - kharif (Division-wise)

* Area Irrigated and recorded - Kharif (Specified Channel-wise)

* Area irrigated, area recorded and water depth obtained - Rabi (Division-wise)

* Area irrigated, area recorded and water depth obtained - Rabi (Specified Channel-wise)

* Exception Report for Specified Channels - Area recorded

* Expenditure for Operation and Maintenance (Division-wise)

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* Exception report highlights achievements/shortfalls in overall progress of area irrigated, revenue assessed, other important activities, behind/ahead of schedule to enable devote necessary efforts to achieve targets; usually required by senior management, say, Engineer-in-chief or Chief Engineer.

* Expenditure for Operation and Maintenance (Sub-head-wise)
* Area irrigated crop-wise and revenue assessed -kharif (Division-wise)
* Area irrigated crop-wise and revenue assessed - kharif (District-wise)
* Area irrigated crop-wise and revenue assessed - kharif (Specified Channel-wise)
* Area irrigated crop-wise and revenue assessed - Rabi (Division-wise)
* Area irrigated crop-wise and revenue assessed - Rabi (District-wise)
* Area irrigated crop-wise and revenue assessed - Rabi (Specified Channel-wise)
* Exception Report for specified channels - Area Irrigated
* Database Report on Irrigated Performance for Canal System/Specified Channels/Circle/Division.
* Database Report on Crop-wise Area Irrigated - Kharif -for Canal System/ Specified Channel/Circle/Division/District.
* Database Report on Crop-wise Area Irrigated-Rabi-for Canal System/ Specified Channel/Circle/Division/District.

ANNEX XIV
(to Chapter 9)

AN EXAMPLE OF WATER USERS ASSOCIATION

It is in three parts :

I : Guiding principles for formation of Water Users Association

II : Draft agreement between Govt./ID and Water Users Association, and

III : Model bye-laws of Water Users Association.

I

GUIDING PRINCIPLES FOR FORMATION OF WATERS USERS ASSOCIATION/ OUTLET COMMITTEES (OCs) :

1. **Objectives** : To carry out irrigation management within the chak/outlet command

2. **Formation and Membership**

The Outlet committee will be a committee representing all the irrigators under a chak. Five irrigators will be elected every year from all the irrigators to work as members of outlet committee, who will in turn elect one chairman from themselves.

For getting elected as member of the outlet committee, the irrigator must not be a defaulter. One irrigator can contest for only one outlet committee even though he may posses land in more than one outlet within the command of same project.

Every beneficiary in the outlet command of the project shall have right to become the member of the OC in order to derive the full irrigation benefits provided he is not a defaulter but he will cease to remain as a member of the OC if he sells his land in the command.

3. **Business year, Jurisdiction and Tenure**

Business year for the outlet committee will be from May 1 to April 30. The elections for outlet committee shall take place not later than second fortnight of April. The jurisdiction of an outlet committee will be the command area under the outlet and its tenure will be upto two years maximum.

Source : Shri M.K. Narasimhiah, General Manager, Consulting Engineering Services Pvt. (Ltd.), 5th Floor, Manjusha Building, 57 Nehru Place, New Delhi - 110 019.

4. **Functions of the Committee**

i) To frame the rules and procedures for proper functioning of the Outlet Committee.

ii) To give concurrence to the proposed planning/layout of Water Course (WC) and Field Channels (FCs) after suggesting the modifications, if necessary, and to assist the department in the execution of or undertaking these works.

iii) To take over from the department and maintain/repair the distribution system below outlet.

iv) To maintain the records pertaining to irrigation, total water received in each rotation including duration, areas under each crop grown, chak maps, etc. for that outlet.

v) To collect all water applications and to submit them alongwith the information regarding scheduling of water releases to the ID/Management Committee.

vi) To assist in following/implementing the irrigation schedule of the outlet and ensuring the completion of rotation in assigned time.

vii) To prevent unauthorized use of water, waste of water and to report the cases of default to the ID/Management Committee.

viii) To monitor the inflow from the chak outlet and in case the design flow is not received, the fact to be brought to the notice of the ID/Management committee for immediate rectification of the fault.

ix) To liaison with ID/Management Committee on matters of irrigation schedule, water releases, unauthorized use of water etc.

x) To assist the ID/MC in collection of water charges from the irrigators promptly.

xi) To resolve all disputes regarding water use, distribution, conveyance, etc. and seek ID/MC assistance if required to resolve the dispute.

MODEL STRUCTURE FOR WATER USERS ASSOCIATION

1. **Management Committee (MC)**

a) **Objective :** Irrigation management of the minor till such time that Water Users Association is formed.

b) **Formation and Membership**

The Management Committee will consist of :

i) Five members, elected from group of eligible irrigators, out of which two each will be from Tail and Middle outlets and one from head outlet. The classification of outlets as tail, middle and head will be done by the concerned EE well in advance.

ii) The concerned Section Officer (JE) will be an ex-officio member of MC. He will participate in the committee proceedings but will not have voting right.

iii) All the eligible irrigators in the command or minor will have the right to vote to elect the members of the Management Committee. EE or his nominee shall convene a meeting of all the eligible irrigators, with a notice of not less than 15 days, mentioning the date, time and place thereof for holding the elections of candidates for MC. The election shall be made by majority of votes. The election officer incharge of conducting the election shall notify the results of such election on the same day and communicate the same to concerned officers/ agencies.

iv) The tenure of each member will be for a period of 2 years or until WUA is formed. The Section Officer shall ensure that the office bearers i.e., Chairman and Secretary are elected by the elected members of MC within 7 days of holding the General Body Election.

c) Business year and Jurisdiction

The business year of the Management Committee will be from May 1 of each year. The elections for members of Management Committee will be held not later than second fortnight of April each year. The activities of Management Committee will extend over the entire command area served by the outlet/minor.

d) Functions of Management Committee

The functions will be as follows :

i) to decide all the matters pertaining to release of water into the minor, the rotation period, Irrigation Scheduling, discharges to be released in minor. The Management Committee shall collect the water applications from outlet committees/ irrigators and present them to canal inspector/section officer, after duly completing them.

ii) To decide the crop pattern for each season within the approved crop pattern for the three crop seasons (kharif, rabi and hot weather), for the command of the Project, their respective areas, taking into consideration the advice from Irrigation Department (ID) and Agriculture Department (AD) on the likely availability of water, crop water requirement of different crops, dates of planting and harvesting etc.

iii) To frame the rules in relation to performing the various functions of the Management Committee.

iv) To allocate water outlet-wise in every season, and to ensure no unauthorized use of water and to prevent the wastage of water.

v) To coordinate the working and operation of outlet committees and to keep liaison with them.

vi) To assist ID in holding panchnamas etc. in accordance with the rules against those who commit such offences as are mentioned in (iv) above.

vii) To settle mutually the complaints arising in connection with the (i), (ii), (iii), (iv), (v) above and to communicate in writing their disposal together with the complaints acceptance of such disposal; to concerned government officers.

e) Advisory Committee and Linkage of Irrigation Department with Management Committee

The Irrigation Department officers shall provide all possible assistance for smooth functioning of the MCs and nurture them till they are able to form Water Users Association (WUA). For this purpose an Advisory Committee (AC) consisting of MC,SDO (ID), AD and AU representatives shall be formed which shall meet at least quarterly or if required by MC earlier too. The AC shall provide required information and advice/assistance to MC for optimum irrigation management.

f) Illustrative Role of ID Officers

i) SDO to notify the classification of outlets as tail, middle and head prior to the first irrigation water release.

ii) The SDO shall notify the list of eligible irrigators of the minor not later than 15 days prior to issuance of notice for holding election.

iii) SDO to convene meetings of all eligible irrigators for electing members of MC per Section 1(b)iii.

iv) JE shall establish good working relationship with irrigators and motivate them to form outlet committes.

v) The concerned Section Officer (JE) shall work as ex-officio member of the Management Committee and shall attend all the meetings of Management Committee but shall not have voting right in the meetings of the Management Committee.

GUIDING PRINCIPLES OF WATER USERS ASSOCIATION (WUA)

1. Formation of WUA

The WUA can be formed for a particular minor when more than one Outlet Committees resolve to associate themselves to form WUA for improved irrigation management. However, the ID shall agree to deliver water on volumetric basis only when occupiers of not less than 51% of the lands or not less than 51% of the holders or the occupiers of the lands from that particular minor show their consent to take water on payment of volumetric basis. All the outlet committee members will be the members of the WUA General Body, and will elect a Management Committee from themselves to manage the affairs of the WUA.

If there are more than one village in the command of a minor, then separate Water Users Associations (WUA) can be formed for each village which will then constitute a single WUA at the minor level to deal with all the matters of the particular minor with ID, AD and all other allied govt.departments and institutions. However, care will have to be taken to see that formation of such separate WUA is practicable from the point of view of distribution of water among the different WUAs. No WUA will be formed if the area served by the WUA is less than 20% of the total command or 100 ha. whichever is smaller.

2. Objectives

The main objectives of the WUA shall be as follows :

i) To receive the allocated quantity of water at the measuring device and to arrange its distribution among members for irrigation purposes.

ii) To resolve complaints, if any, regarding distribution of water

iii) To facilitate dissemination, among the members, the information/latest technology to be provided by Govt./AD regarding the proper and suitable cropping pattern that can be adopted and their requirement of water, seeds, fertilizers and all other necessary inputs.

iv) To maintain the entire distribution system including all water courses/field channels under the jurisdiction of the WUA.

3. Business Year and Jurisdiction

The business year of the WUA will be from May 1 of each year. The election for the vacant posts of members of Management Committee shall be held not later than the second fortnight of April each year.

The jurisdiction of the WUA will extend over the entire command area served by minor.

4. Management Committee (MC)

The number of members of the Management of the WUA will depend on the total number of outlet committees (Say 1/3 to 1/5). The minimum number of the members of Management Committee being five and maximum limited to seven. The Chairman of Outlet Committees shall not be eligible to contest for the Management Committee of the WUA/WUO. A member will cease to be a member of management committee for two years if he loses his status as bonafide irrigator.

The members of the MC will elect, by majority vote, as soon as the election of members are over, one Chairman and Secretary from themselves. The tenure of Chairman and Secretary of the MC will be for two years. The tenure of each member of the Management Committee will also be two years. About half of the members shall retire in rotation each year. Elections will be held each year for the purpose of filling such vacancies. In the first year of formation of this WUA about half the number of members in the order of percentage of votes secured (votes secured/total number of votes polled) will be appointed for two years and the rest for one year. An outgoing member shall not contest again before expiry of one consecutive term.

5. Functions of the Management Committee (MC)

The functions of the managing committee will be as follows :

i) To decide all the policy matters of the WUA from time to time and to frame rules to perform all functions of the Management Committee.

ii) To enter into an agreement with Govt./Irrigation Department, for securing irrigation water on volumetric basis.

iii) To decide the crop pattern for each season for the command of the minor within the approved cropping pattern and their respective areas taking into consideration the likely availability of water, crop water requirement of different crops, dates of planting and harvesting etc.

iv) To decide the period of irrigation to be allotted to each outlet, the rotation period and the discharges to be let in the distribution system.

v) To allocate water outletwise in every season.

vi) To maintain the entire distribution system in good working condition.

vii) To keep liaison with the outlet committees and with any other committees/ groups/individuals for meeting the objectives.

viii) To decide the service charges, over and above the water rates fixed by Govt./ID, to be charged from members/non-members of the society and also to share the profit amongst members.

ix) To frame rules of business of the WUA for carrying out all the executive functions as and when required.

x) To perform any or all functions in furtherance to the objective of the WUA.

xi) To receive grants from Govt.ID for the maintenance and special repairs of the distribution system and execute such works also.

II

DRAFT AGREEMENT BETWEEN GOVT./ID AND WATER USERS ASSOCIATION

Agreement between Pramukh Paniwatap Vywastha Sahakari Sanstha, Outlet/Minor and Govt. of (Irrigation Department), for Irrigation and Water Management.

Executive Engineer, Project Division (on behalf of Governor of and Chairman of _____ _____ (Registration No. _____ dt. _____) on behalf of the Association have entered into this agreement at _____ on _____.

As per this agreement, command area of village _____ on Dy. Minor ____ of _____ Canal of _____ Project, is handed over to above society for the period of agreement for management (Command area map is attached). However, ownership of Dy./Minor along with OFD structures and land acquired for the water delivery system and all works executed through Govt. funds will remain with government.

To achieve the objectives, terms and conditions of this agreement are accepted by both the parties. These terms and conditions can be modified with the consent of both the parties.

1. **Objective of the Agreement**

The main objective of the Government behind this agreement is to utilise the available water to crops as per crop water requirement and to increase the crop production and increasing farmers participation in irrigation water management.

Rules, regulations, objective and line of action for the Association will be as under:

(A) Minimum 2/3 area of concerned Minor shall be under command of Society. Out of total beneficiaries 2/3 beneficiaries shall be members of Association.

(B) Government will supply water on volumetric basis at the minor head and the same shall be distributed by the association to all members and non-members in proportion of their crop area, and economising the use of water and thereby making profit.

(C) Field channel, Field drain, Minor and structures thereon in the area of operation of the Association shall be required and maintained by the Association.

(D) Beneficiaries shall be trained in latest technology in water management for economic and proper water use.

If any objective other than above is to be included by the Association, Government will have no objection to include it. However, these shall be got approved from Government and if any objectives affects main objective,then these will be cancelled automatically. This provision needs to be made in the by laws of the society.

2. Right of Water

(a) In each season water will be supplied to society at Minor head on volumetric basis(This will be regulated as per condition No.2 (d) below.)

Kharif	- MCM
Rabi	- MCM
Hot weather	- MCM

If during any of the three crop seasons the sanctioned quantum of water is not to be fully utilised, Association can be permitted to store this balance quantum within the command of water. However this water can be used for crops other than boropaddy and other perennial crops and this water shall be utilised only in the command area of the Association.

If additional quantity of water is required by the Association in any of the season, the same can be considered, but Govt. is not obliged for its sanction/or give reasons for non-sanction of such additional allocation.

(b) After utilising water allocated for each season, as mentioned in 2(a) above, if extra water is demanded by the Association and sanctioned by Government, then for such extra water, extra charges will be levied at the rate prescribed for respective seasons, if pre-soaking watering is given for a crop prior to beginning of season. If water is given after completion of season, it will be charged at the rate fixed for the next season.

(c) Right is reserved to sanction/or reject extra demand of water. After taking into consideration actual availability of water, extra water can be sanctioned and if due to any reason, Government is not able to sanction such extra water then Government will not be responsible for any losses.

(d) If in any of the year water available at the head work is less than the quantum of water mentioned in (a) above it will be proportionately reduced. Intimation regarding the same will be given at the beginning of each season.

(e) After this agreement comes to effect, if the Government accepts or decides to change cropping pattern, same policy will be applicable to

command area of Association and accordingly sanctioned quantity of water mentioned in 2(a) above will be changed.

(f) If any member of the society has sold his land, his membership will be automatically cancelled and new owner will be eligible for membership of association.

(g) For each season, rotation programme in canal will be published and will be given to association 10 days prior to beginning of season.

Accordingly in each rotation when and how much water will be taken and how it is planned to be distributed amongst members shall be intimated by the Association to concerned canal officer prior to commencement of rotation. Name of the concerned canal officer will be intimated to the Association by the Executive Engineer, Division, within 10 days of execution of the agreement. Record of water use will be maintained jointly by the Association and concerned canal officer. The Association cannot take water except during rotation.

(h) All beneficiaries in the command area of Association have right for membership of Association. Each member has right for taking water in each season. If some members do not take water or take less water then Association has right to distribute this water to other members.

Government will have no restriction on the cultivation of any particular crop by the members of the Association. However, Government reserves the right to prohibit boro paddy and perennial crops to avoid water logging of lands. From this point of view, Association shall take care that the water table shall not rise within 3.0m from G.I. If it is noticed that water table is rising beyond this limit, Government has right to reduce water supply to the Association proportionately. Government will not be responsible for any loss occuring to the Association if action is taken on the above grounds.

(i) Water will be supplied to the Association only for irrigation purposes. If water is required for any industry, then the Association shall give separate demand for the same and will have to obtain separate sanction for the same.

3. Terms of Reference

(a) If due to topographical limitations water is not supplied to some areas prior to this agreement (this also includes uncommand area) of flow irrigation and if such area is to be included in the command area of the Association for irrigation, subsequent to the agreement, water can be sanctioned for such area so as to encourage utilisation of available irrigation potential. However, such quantum of water will not be more than 5% of quantum mentioned in 2(a) above.

(b) Association has right to decide different water rates for non member farmers and members of the Association and accordingly the Association has right to recover higher water charges from such non-member farmers. However, the additional rate shall not exceed 30% of the rate applicable to members of Association.

(c) Water rate and cess on that will be fixed by Government from time to time for volumetric water supply for irrigation.

Until further orders these rates will be as under :

Kharif	- Rs.	Per MCM
Rabi	- Rs.	Per MCM
Hot Weather	- Rs.	Per MCM

Where water is not taken on volumetric basis the water charges will be worked at the water rate and cess levied by Government per hectare and if this amount is less than the amount worked out at volumetric rate then amount will be recovered as worked out at rate per hectare. However, if this amount is more, then, recovery will be affected at volumetric rate.

After the agreement is signed, normally rates will be reviewed every two years and if any change is decided, the same is applicable.

4. Right of Members

In the command area of the Association land owner or tenant can become member of Association, however, his name must be on the revenue record of 67% of that land.

Member shall apply for his water demand to the Association in prescribed form and the Association is bound to inform decision on such demand in suitable time limit, after consideration.

Each member has right to get water in each rotation from the quota given to the Association by Government for each season as per policy decided by the Association. Under no circumstances number of actual water utilising members (Nos) and area of actual irrigation (ha) on thi Minor at the time of agreement shall be reduced. If it is reduced, Government has right to stop the water supply.

5. Recovery of water charges

Government will supply water to society on volumetric basis at the outlet Minor head as per sanction.

For the quantity of water supplied, bill will be prepared at the rate mentioned in para 3(c) above for each season and will be sent to society on the dates as indicated in the statement below :

Statement showing water charges and recovery dates :

Sr. NO.	Description season	Kharif season	Rabi season	H.W.
1.	Date for sending bill to Association by Govt.	30th Nov.	15th Mar.	15th Aug.
2.	Date for payment of bill by Association to Govt.	1st Feb.	1st May.	1st Oct.
3.	Date for payment of bill after which 10% surcharge will be levied	30th April	31st July	31st Dec.

The date for payment of bill to Government is mentioned at Sr.No.2 in the above statement. If the Association pays the amount of bill before that date, 5% discount will be given. Similarly, if the amount is not paid before the dates mentioned at Sr.No.3, 10% surcharge will have to be paid by the Association. Government has right to stop water supply to the Association if water charges of the season are not paid within date stipulated by the Irrigation Departement after the expiry of the dates at Sr.No.3.

6. Repairs and Maintenance of outlets & minors

(a) After execution of this agreement and before starting of water supply,Minor and structures thereon and outlets of the command area under the Association will be jointly inspected and repairs will be carried out at Government cost as per joint decision. After such repairs, the Association will be given assurance that desired carrying capacity is available in the system after actual joint inspection.

(b) It will be the responsibility of the Association to repair and maintain the Minor in the command. For this, Government will give Rs. to the Association. Review of adequacy of this fund shall be after every two years. Following items are covered under maintenance.

(i) Maintenance of Minors.

(ii) To keep service road and inspection path in good condition

(iii) To remove grass, shrubs and trees

(iv) To keep structures in good condition

(v) To keep outlet gates and sills etc., in good condition.

NOTE : If the maintenance is not properly done, Govt. has right to stop the water supply or carryout repair works on behalf of Association and recover the cost from the Association giving 15 days notice.

7. **Repairs and Maintenance**

I) Field Channel (FC) and Field Drains (FD)

After execution of agreement with the Association and prior to giving water supply, field channels, field drains and OFD structures in command area of the Association will be inspected jointly and the repairs as per mutual decision be carried out at Government cost and after such repairs, the Association will be assured that desired carrying capacity is available in the system, after actual joint inspection

ii) Responsibillity of subsequent repairs and maintenance of FC, FD and OFD structures in the command area of the Association will rest with the Association and no funds will be given by Govt. to the Association for the same. Government will have right to stop water supply if proper maintenance is not done.

Following items are included in maintenance :

i) To remove silt from FC and FD

ii) To keep service road and inspection path in good condition.

iii) To remove grass, shrubs, trees

iv) To keep OFD structures in good condition.

v) To keep outlet gate and sills in good condition.

Government will have the right to stop water supply or carryout repairs on behalf of the Association and recover cost for the same, if proper maintenance is not done.

8. **Extra Facility for Encouragement**

For achieving the objectives viz., utilizing all the available water in proper manner, controlling unauthorized irrigation, supply of water on maximum command area for encouragement of the Association, as following special facilities will be given to the Association if required :

(a) Fund facilities if receivable from Govt. of India, World Bank or from any other source for establishing WUAs, such assistance will be made available to the Association.

Managerial subsidy will be given

(i) First two years Rs.--/- per ha
(ii) Rs.--/- ha.for the third year.

(b) Services of one Canal Inspector for water supply and management of the command can be made available to the Association for maximum 3 years after execution of the agreement at minor level.

During this period, canal Inspector will work under the direction of the Association. His pay and allowances will be borne by the Govt. and this amount will be partly adjusted from the management subsidy payable to society as per rule 8(a).

9. Irrigation from percolation/leakage

If water is used from the percolation/leakage from distributary/minor and drainage scheme in the command of the Association water charges will not be imposed. However, the Association will have no right on the percolated/ leakage water from main canal and water in drains/nallas.

10. Rights of Government Officers

Concerned canal Officer has right to see that the conditions mentioned in the agreement are properly implemented or not and inspect the system and command area of the Association at any time. Inspection of working record of the Association will be carried out by the concerned canal Officer from time to time in a year and the Association is responsible for compliance of permits contained in the inspection report.

11. If there is any dispute regarding various provisions made in this agreement between the concerned canal Officer and the Association, then a decision given by the Government is final.

12. This agreement will be in force for five years from the date of agreement whether same is to be extended or not will be decided by both the concerned parties.

Provisions in this agreement will be reviewed after expiry of 3 years to decide whether any changes are required including continuance of the Agreement.

There will be one representative of Government as standing honorary member on the Executive Committee of the Association.

III

MODEL BYE LAWS OF WATER USERS ASSOCIATION

1. The name of the Association shall be water users Association. The registered address of the Association shall be at Village/Taluk/District.

Any change in the address of the registered office shall be notified to the District Registrar, Cooperative Socelties within 30 days of such change.

2. The area of operation of society shall extend to

3. **Objectives**

The main objective of the Association shall be to evolve and execute a need oriented equitable system of utilisation of water resources at outlet level in acordance with the principles of cooperation so as to improve productivity of agriculture in the area of operation of the Association and will undertake following functions :

i) To obtain land and to plan, design, construct and maintain well/ponds, water channels etc. for ensuring timely and adequate water supply to the members.

ii) To arrange for equipments, machines, tools, pumps etc., required for maintenance of water resources under control of the Association.

iii) To work out system of distribution of water resources by fixing up turns among beneficiaries and by undertaking Warabandi system.

iv) To prevent wastage of water and to see its proper utilisation.

v) To fix water rates to be charged from members and to ensure timely recovery of the same and remittance to the Government.

vi) To take steps for carrying out technical improvements in irrigation system under its charge in accordance with the suggestions of Irrigation Department.

vii) To raise funds required for efficient conduct of business as per bye-laws.

viii) To make arrangements for supportive services and inputs including agricultural extension activities, both during pre-irrigation and post-irrigation for better productivity.

ix) To make arrangements to impart cooperative education and better water management education to the members.

x) To undertake other activities to encourage mutual help & cooperation etc.,in the matter in farming particularly for the supply of water for agriculture.

xi) To create spirit of cooperation and self-reliance among the members.

xii) To undertake scheme for supply of drinking water to the members with approval of general meeting and any other activity which may be incidental to any of the above mentioned functions.

4. **Membership**

i) Any owner/cultivator/permanent tenant/protected tenant in the area of

operation of the Association and who has agreed to take water for cultivation under the scheme of water supply of the Association can become member of the Association.

ii) To be admitted as a member of the Association the applicant should fulfill the eligibility condition under bye-laws No.5(1) and shall make appliction in writing and shall purchase atleast one share of Rs.50/- and pay entrance fee of Re.1 provided that those members who have signed an application for registration of the Association shall be exempted from making a fresh application in writing and they will be deemed to have become members of the Association.

iii) Power to admit member or refusal there of shall vest in the Managing committee of the Association.

iv) Any dispute regarding refusal of membership will be referred to the Dist. Registrar/Asst. Registrar, whose decision shall be final and binding on the applicant and on the Association.

v) If any member of the Association has sold his land his membership will be automatically cancelled and the new owner will be eligible for membership of the Association.

5. Funds

The funds of the Association shall be raised in the following manner :
By issue of shares
By deposits
By raising loans
By gifts
By entrance fees
By Govt.contribution

6. Share capital

a) Authorised share capital of the Association shall be Rs._____ consisting of shares of Rs.50 each.

b) The full value of each share shall be paid by the holder at the time of getting the share. The general meeting of the Association can fix not more than two instalments in special circumstances.

c) The Association can accept deposits-cum-loans, at a rate of interest as decided by the Managing Committee subject to maximum of prevailing rate of interest charged by banks.

d) The maximum borrowing power of the Association shall not exceed 10 times the authorised share capital.

e) The Association shall issue share certificate to each member for the shares subscribed by him.

f) No member shall have claim on any share or interest from the Association exceeding Rs.1000/-.

g) Any share held by a member of the Association can be transferred to any other member after one year only. But no such transfer shall be valid other than under bye-laws Nos (1) unless tha name of the member who has purchased the share is entered in the share transfer register and a fee of 25 paise is paid for each share.

h) Any member of the Association can appoint his legal successor for full or part of the share held and change if any in the appointment or cancellation of the appointment of the successor can be made by payment of fees of 25 paise per share to the Association.

i) The share of the deceased member can be transferred to his legal nominee provided that such nominee has become a member of the Association, as per provision of bye-laws.

j) The Association shall maintain one share register as per prescribed proforma under cooperative societies rules.

7. **General Body**

I) The first general body meeting shall enjoy all the powers of the annual general meeting given in the bye-laws.

ii) The General Body shall consist of all the eligible members of the Association.

iii) The General Body of the Assoiation shall be supreme authority. It shall have the following powers and functions:

a) To elect the Managing Committee as per the rules prescribed for the cooperative societies.

b) To approve annual accounts i.e., income and expenditure statement, profit and loss accounts and balance sheet for the previous cooperative year.

c) To approve annual report of the Association submitted by the Managing Committee.

d) To consider the audit report and approve rectification report on audit objections as prepared by Managing Committee.

e) To consider annual budget and programme of activities to be undertaken by the Association during the next year.

f) To fix limit for borrowing and deposits to be obtained for expenditure for supply of canal water etc. subject to the bye-law No.3

g) To perform duties prescribed in these bye-laws.

h) To fix water rate and crop pattern.

i) To fix the rotation(as per Govt. policy).

j) To fix specification of land for supply of water.

k) To give consent to the contribution and fines levied by the managing committee.

l) To fix terms and conditions for supply of bulk water and to make amendment in the same from time to time.

m) To approve distribution of profit.

n) To dispose of other matters concerning the Association.

iv) The special General Body meeting shall be called within one month from the demand of majority of the Managing Committee members or by written demand of one fifth of its members or by the order of the District/ Assistant Registrar or by the order of the Federation of Water Users Association.

v) General Body meeting called according to the provision of the act, rules and bye-laws shall resolve matters by majority votes. The voting shall be done by raising hands or through ballot paper. The president shall have power of casting vote in case of equality of votes when the voting is done by raising hands or by ballot system. Each member will have a right of one vote irrespective of the share held by him.

vi) Two fifths of the total members shall form quorum for the general body meetings. If there is no quorum on the day of meeting, the meeting will be adjourned for seven days and if there is no quorum in the adjourned meeting, the meeting will be conducted without reference to quorum and will transact the business.

vii) The notice of ten days for annual general body meeting and seven days for special general body meeting shall be given to the members.The date,time and the places of the meeting and the agenda will be specified in the notice.

viii) The circular/information of the General Body meeting will be sent as under:

a) by beating of drum in the area of operation of the Association.

b) by passing the notice of the general body meeting at the common place of the area of operation of the Association.

c) by circulating the information book and taking signatures of the members on the Circular Book.

d) by sending the notice under the postal certificate.

ix) The Chairman of the Committee will preside over the General Body meetings of the Association. In his absence or in his unwillingness to preside, the president will be elected from the members of the committee present.

x) The Chairman has right to postpone the meeting and fix the date of next meeting, with the consent of the General Body. But the meeting if held shall transact business of the uncompleted items and no new items shall be taken up in that meeting. If the meeting is proposed after 21 days or more a fresh notice will be issued as in case of original meeting.

xi) The Association shall affiliate itself with the central financing agency.

8. Special General Body Meeting

During the period of execution of on-farm development works, the Managing Committee shall call for special general body meeting every month.In such special general body meetings, a brief note on the progress achieved shall be placed for perusal and approval of the Geneal Body besides the following:

a) The details of expenditure incurred on each members land.

b) Details of loan (amount sanctioned and received) from the financing agency.

c) Any other suggestions shall be examined and given due weightage.

d) Special Annual General Body Meeting shall be held on the requisition of the Chairman/Managing Committee Members/written requisition received from 1/10 of members by giving 21 days notice. Such meeting shall be held within 40 days from the date of requisition.

9. Managing Committee

i) The Managing Committee will consist of 7 members and 4 members will form quorum for conducting the meeting.

ii) The Managing Committee elected in the Annual General Body meeting shall function till the next committee is elected. If any member of the managing committee expires or for any other reasons vacancy occurs, the same will be filled in by co-opting members.

iii) The committee shall elect chairman from its members. The Chairman will preside over the meeting when he is present. In the absene of the Chairman, members present in the meeting will elect the chairman.The chairman will have a casting vote in addition to his own vote.

iv) The Committee will have full right to conduct the business of the Association as per the bye-laws and directions given in the general body meeting.

v) Managing Committee will meet as and when required for disposal of business. There shall be atleast one meeting of the Committee in each month. However during execution of on farm development works the committee shall meet atleast once in a week.

vi) Defaulter member has no right to be elected as chairman or to be continued in the Managing Committee.

vii) The Managing Commitee Member will be liable to be dropped if he remains absent in the three consecutive Managing Committee Meetings without notice.

viii) The Managing Committee Members will not remain present or vote during the discussion on the matters of their personal interest and cannot vote in the matter.

ix) Even if the appointment of the committee or its members if found defective later on, the business transacted by them shall be legal as though committee and its members had been properly appointed.

x) No fee shall be paid to members of the Managing Committee. They will work honorarily.

xi) The functions of the Committee shall be as under :

a) to appointment, to remove, to punish Manager with the consent of the District/Assistant Registrar

b) to dispose the applications for admission of member.

c) to borrow loan and to accept deposits.

d) to raise funds on the property/security of land of the members of the Association for construction of field channel, as per the scheme undertaken to supply water for irrigtion.

e) to fix rate of supply of water in consultation with officers of the Irrigation Department and to recover the water charges.

f) to accept and approve the forms of demand of canal water.

g) to examine the accounts maintained by the Manager and Treasurer

h) to take steps to recover dues of the Association from members.

i) to approve running expenditure, accounts and cash of the Association and do such other works.

j) to see that the cash book of the Association is written every day and it is signed by one of the committee members daily.

k) to hear complaints and dispose them off.

l) to arrange to get insured the property of the Association.

m) to appoint other executive staff (except manager) and to fix their remuneration and to remove or to suspend them.

n) to call the general body meeting, within 15 days from the date of orders issued for suspension of the Manager, according to bye laws to recommend to the general body meeting to suspend the manager and to appoint a substitute temporarily in his place till final decision is taken in the matter.

o) to appoint any number of sub-committees for smooth working of the Association.

p) to consider application received for extension of repayment loan and to recover due instalment of loan from the member.

q) to prepare annual report, balance sheet and work programme for the next year and to put before the General Body Meeting.

r) to enter into all the contracts on behalf of the Association and to determine the terms and conditions thereof.

s) to prepare rules and regulations for working of the Association and make addition and alteration in the same and to implement them, provided such rules and regulations are approved by the District/ Assistant Registrar in advance. No such rules shall be implemented unless they are approved by the District/Asstt.Registrar.

t) to compromise all claims of the Association or to refer such claims to arbitration. The compromise for demand exceeding Rs.500/- shall be made with the approval of the General Body.

u) to call all the meetings including special General Body Meeting as per provisions of the bye-laws of the Association.

v) to supply proper books for record of minutes of the meetings, preparation of notes as per the direction of General Body Meetings and to enter all transactions of accounts and business etc. of the Association.

w) to take securities from the staff including Manager who handle cash, stocks and securities of the Association as per the amount of securities decided by the District/Asstt. Registrar.

x) to construct tanks, ponds, field channels and maintain them in good condition as per decisions of the General Body.

y) to see that water is supplied properly and timely to the members, no member harasses other member, hear complaints and dispose off these complaints suitably.

z) to see that the charges for water are recovered in time in case of default to take necessary action to recover the dues alongwith land revenue.

z.1) to execute contracts or agreements with the owners of land for water course.

z.2) to take such actions as directed by the General Body Meeting.

z.3) to undertake all those functions which fulfill the objective(s) of the Association or for the fulfillment of the objective(s) fixed by the General Body.

10. Duties of Chairman

In addition to the duties prescribed under these bye-laws elsewhere the duties of the Chairman shall be as under :

i) To get the resolutions of the Managing Committee executed through the Manager/Secretary.

ii) To supervise the work of the Manager/Secretary.

iii) If it is decided to keep cash (with Chairman or other office bearers of the Association other than Chairman) in order to meet exigencies, to see that the cash exceeding the limit prescribed is credited in the bank atleast once in a month.

iv) To check the stock at least once in a month and to sign the stock register.

v) To see that the works of the society is conducted as per cooperative societies Act, rules, bye-laws and the resolutions of General Body Meeting.

vi) To get the discrepancies of audit memo inspection memo and visit memo attended to in time.

vii) To arrange to supply all the information required by the department and the bank.

11. Duties of Manager

The Manager will work under the control of the Managing Committee and his duties are prescribed as under :

i) To call General Body Meeting, Managing Committee Meeting and to remain present in such meetings and to record proceedings of the meetings in the respective proceedings books.

ii) To keep records and books and registers as prescribed under the cooperative society rules, bye-laws and as per direction of the District/Assistant Registrar subject to such modifications which are necessary according to the Managing Commitee and to prepare balance sheets, other documents and to issue receipt pertaining to the transactions of the Association.

iii) To do the correspondence work of the Association.

iv) To secure expenditure and to recover the dues as per the directions of the Managing Committee.

v) To see that the machinery and other equipments of the Association are kept in working condition and to keep them proper for day to day use.

vi) To get the spares of the machinery replaced or repaired with the sanction of the Managing Committee as and when necessary.

vii) To guide the paid staff of the Association and to keep watch and control on their work.

viii) To do all other work entrusted by the Managing Committee. The Managing Committee is empowered to entrust the work to any other person in the absence of the Manager. The cash receipt will be signed by one Managing Committee Member along with the signature of the Manager.

ix) The Manager should have the cooperative training. In case he is not trained, he should be sent for training when instructed by the District/Assistant Registrar. He will have to give an undertaking to undergo training within a time limit at the time of joining the service.

12. Distribution of Profit

The net profit will be distributed as under :

i) 70% of the net profit shall be distributed to the members in preparation to the use of water and the water charges paid by them to the Association.

ii) 10% of the net profit will be paid as bonds to the paid staff of the Association but the amount of such bonus payable to each staff member of the Association may not exceed one month salary.

iii) 10% of the net profit shall be utilised for public welfare or charitable purpose as may be decided by the Managing Committee and for the functions as prescribed in the bye-laws.

iv) 10% of the net profit shall be credited to cooperative propaganda fund.

13. Recovery of dues of the Association

a) Any dues of the Association from the members or past members shall be liable to be recovered from the investment in the share capital of the Association of the members or any interest due to the Association from deposits or any amount of dividend/bonus payable to the respective member or past member.

b) The due date for payment of dues by the member to the Association can be extended by the Managing Committee subject to the provisions of bye-laws. The Managing Committee can demand a surety of the member in addition to the undertaking that in case the dues are not paid by the member within six months from the due date of payment of the dues, the Association may take appropriate action to recover dues.

c) The advances for the members of the Association on the security shall not be more than five times to the paid up share capital of the member. The advance prescribed under the bye-laws will be the personal responsibility of the member for repayment of advances or dues.

d) Extension may be granted by the Managing Committee only upto a period of one year subject to the provisions of bye-laws. Extension above one year will be granted by the General Body or if the Association is a borrower of the central financing agency, then the approval of the financing agency shall be obtained.

e) Notice shall be issued to the defaulter and his surieties where no extension of time for repayment of advance or dues is given to the member. The limit for repayment prescribed in the notice shall not be less than one month or more than three months. In case the amounts cannot be recovered within the notice period, the managing committee shall go for arbitration.

f) The Managing Committee has a right to recover the dues partly or fully from the sales proceeds of agriculture produce sold by the member through the Association.

g) The rate of interest on advance of loans may be altered with prior approval of the central financing agency, but the rate or such interest shall not be more than 3 percent of the lending rate of interest of the central financing agency.

h) If no repayment is made on the due date of repayment of loan or instalment, a penal interest will be charged from the date of repayment of instalment

at the rate of 5%. No penal interest will be recovered from the defaulters without the approval of the General Body.

i) The Managing Committee will frame rules for acceptance and remittance of deposits and also fix the rate of interest, but such rate of interest shall not be more than 2 percent of the rate of interest of deposit of the central financing agency.

14. Reserve Fund

The amount of entrance fees and penal interest shall be carried to the reserve fund. The amount mentioned under item 13(iii) & (iv) as also any amount not specified under the bye-laws for investment will be covered to the reserve fund.

15. Cash and Securities

The limit of cash to be kept in hand, security, thereof, the maintenance of books of accounts and responsibility thereof shall be fixed by the Managing Committee.

16. Change of name of the Association, Rules and Regulations

The Association may amend its rules and regulations by convening a Special General Body Meeting for the purpose and having sent written or printed 21 days notice to all the eligible members. The resolution should be voted by 3/4th of the members present. The resolution should be sent to the Registrar for approval and registration. If the Registrar refuses to approve the amendment an appeal may be made to the Appellate Tribunal for decision which is binding. Whenever change of name of the Association is contemplated, due notice to the Irrigation Department shall be given as this will have impact on the Agreement executed with the Irrigation Department.

ANNEX XV
(to Chapter 9)

RECOMMENDED MODEL BYE-LAWS OF FARMERS' ASSOCIATION IN A MAJOR PROJECT IN SOUTH INDIA

CHAPTER 1

1. SHORT TITLE AND APPLICATION

i. These bye-laws may be called as bye-laws of the Water Users Association (WUA) of the farmers cultivating land under the command of the lateral/ lateral number_____ of distributary No._____ of the branch/ NLBC of UKP _____ at Village _____ Taluka _____ District_____ Karnataka.

ii. The provisions of these bye-laws apply to the said WUA.

All present or future owners, cultivating, using water from the UKP canals, working as owners of land or as labour on the land of the said command area will signify that these bye-laws are accepted, ratified and will be complied with.

2. DEFINITIONS

In these bye-laws, unless the context requires otherwise :

a. Act means the Registration of Co-operative Societies Act of Karnataka, Karnataka Irrigation Act 1965 including amendments thereof and The Karnataka Command Area Development Act 1980 including amendments thereof.

b. The Water Users Association (WUA) means the association of all the farmers constituted by such land owners for the purpose of WUA.

c. General body means all the share holders i.e. farmers owning land in the area of operation.

d. Managing/Executive Committee means, a Committee consisting of one elected member from each of the outlet command under the lateral/laterals distributary or direct outlet clubbed with the lateral/distributary for this purpose.

e. Field Irrigation Channels (FIC) means the channel constructed by the farmers/WUA/Govt. from outlet upto individual fields including all structures, turn outs, road crossing etc. to convey water for irrigation supplies from UKP Canal net-work.

Source : Master Plan for Operation and Maintenance : Upper Krishna Project (Stage-I), Volume IV, WAPCOS, July, 1989.)

f. Field Drainage Channel (FDC) means the channels constructed by the farmers/WUA/Govt. from the fields to the common/link drain to remove excess irrigation/rain water.

g. "Equaliser" means channels constructed by the individual farmer for the turn-outs, to supply water to crop plots.

h. Field Drainage Ditch (FDD) means the channels constructed by the farmers/ CADA within their fields to convey excess water from the fields to the Field Drainage Channel.

i. Fields mean the individually owned farm by the members/ WUA growing irrigation crops.

j. Absolute majority of members means more than the two third members of WUA within the area of operation of the WUA.

k. Simple majority of members means those shareholders of the WUA holding 51 per cent of the votes in accordance with the bye-laws.

l. Owner means land owners within the area of operation of the WUA.

m. On Farm Development (OFD) means construction of FIC/FID, land levelling/ shaping, construction of FDD, graded bunds, regulators and other such works for conservation of water and uniform distribution of water in the fields.

n. Section means a section of the Bye-laws.

o. Registrar means the Registrar of Co-operative Societies.

p. The out-let Sub-Committee means the sub-committee comprising outlet leader as Chairman and two other members from the out-let, out of which one shall be tailender.

q. Member means the person who joined at the time of application for registration or a person whose membership has been permitted as per bye laws.

r. Water users means the farmers who derive benefit form the irrigation facility.

s. Warabandi system means sharing water equitably by turns.

t. Registrar means Registrar of Co-operative Societies or any person nominated as per cooperative socities Act to carry out all the duties of Registrar or any one of the duties.

3. OBJECTIVES OF WUA

The objectives of the WUA shall be

i. To study the OFD (land development) schemes prepared by Irrigation/ CADA for construction of FIC/FID, land levelling/shaping for supply of water/removal of excess water etc. and to suggest improvements/ modifications in the interest of all the members.

ii. To help the executive agencies, irrigation department/ CADA, in finalising alignment of FIC/FID, location of turnouts, drop-structures, road crossings and tail escapes.

iii. To help the executing agencies in carrying out construction speedily and to make available land for levelling/shaping on demand and mobilising Institution finance for the same.

iv. To jointly inspect the FIC/FID after completion of construction and hydraulic tests and to take over the charge of these works from Irrigation/CADA for maintenance and repairs. In case any dispute arises in respect of adequacy, proper construction of the FICs/FIDs between WUA and the department, the matter would be referred to Registrar Cooperative Societies whose decision will be final and shall be binding on the WUA.

v. To maintain the FIC/FID within the area of operation in sound condition, educating the farmers on avoiding grazing/trampling crossing by animals, carts, vehicles, tractors, etc. and in protecting the land level from getting damaged, eroded due to rains.

vi. To distribute water from the UKP canals equitably and in an orderly manner to all the members/non-member farmers, strictly according to the holding and induce/ persuade the farmers to follow discipline in water use.

vii. To assist irrigation department/CADA in preparing Warabandi schedules.

viii. To disseminate quickly all the information, messages received from various departments in respect of canal water supplies, rostering of distributaries, frequencies, opening/closing dates of canals, agronomical aspects, package of practices, supply of seeds, inputs, pesticides etc. to all the members.

ix. To educate the farmers/members and train them in preparing the fields suitably for receiving irrigation water, adoption of modern methods of irrigation such as borders/furrows, check-basin, use of syphon tubes, canvas dams, appropriate stream size cut-off points to conserve water and attain high application efficiency.

x. To educate farmers on irrigated agriculture, suitable crop varieties, sowing times, crop combinations, package of practices, for optimal and efficient use of water, increasing agricultural production, yields and profits of the farmers.

xi. To induce the farmers to adopt uniform cropping pattern, cyclic order of sowing as per schedules of water supply, organize spraying/dusting of pesticides at one time, matching the water deliveries with crop water requirements and control of pests and diseases.

xii. To observe the quantity of water supply in the lateral/ out-let and to check the same as per authorised discharge stipulated by the irrigation department and to take-up the matter with the department in case of short/less supply.

xiii. To suggest frequency of supplies, rotations, opening/ closing time of canal in view of the cropping/pattern actually developing in the command.

xiv. To suggest closing of lateral/distributary, in case the commands receive high rainfall or request the irrigation department to supply additional turns in case of severe drought/scanty rainfall.

xv. To resolve disputes by sharing of water by the individual farmers under the outlets or group of farmers under the outlets of lateral/distributary. To detect any offence and impose fine/penalty on the offenders or help irrigation department in taking such penal action.

xvi. To correspond with all the concerned agencies, departments connected with water supply, irrigated agriculture, processing, marketing, transporting and offer suggestions for improvement of the services.

xvii. To collect water charges for the use of water from canals as levied by the Government from time to time and to remit the same to the Government.

xviii. To procure various agriculture implements such as threshers, tractors, implement for field preparation in adopting modern methods of irrigation such as borders/ furrows, transport vehicle and lend them on rent for use to the members.

xix. To recieve water in bulk from the Government/irrigation department on volumetric basis at the head of the lateral/distributary and to distribute the same equitably and timely as per the procedure laid down by the Govt., approved by the Government, to all the members/non-member farmers either on volumetric basis or area basis as per the water charge duly got approved from the Government.

xx. To raise funds required for office, staff employed, watch and ward, maintaining correspondence with various departments and mainly for executing repairs and maintenance of FIC/FID etc. by way of

a. Contribution from the members collected uniformly at appropriate rates per ha of holding from all the farmers.

b. Donations/grants/subsidies received from the Government or their welfare funds institutes.

c. The surplus amount of water charges i.e. the collection of water charges from the farmers either on volumetric or area basis as per rates got approved from Government less the amount paid to the Government on volumetric basis as per rates prescribed by Government from time to time.

d. Other funds created by the WUA from hiring implements, transport vehicles, etc.

4. MEMBERS OF WUA

i. All land owners, cultivators, share croppers within the jurisdiction of the Association who have agreed to receive water for cultivation as per irrigation plan of the Association and who are qualified as prescribed in the Cooperative Societies Act are eligible for membership. Persons not eligible will also be supplied water.Eligible members should have signed in the application for registration of the Association or should have applied for the membership.Each member shall pay a sum of Rs.100/- as share as mentioned in section 5.

Every member should give an undertaking in writing to abide by the bye laws/rules and regulations of the Association.

ii. Upon any land owner selling his land or absolutely conveying the same by way of gift under his will or otherwise, the purchaser or donee shall automatically become a member of the WUA and shall be admitted as member on payment of Rs.100/- as share.

5. HOLDING OF SHARES COMPULSORY

Every member must hold a share of Rs.100/- of the WUA.

6. DISQUALIFICATION

No member shall be entitled to vote on the question of the election of member of the executive committee, outlet leader, chairman, vice-chairman, treasurer or any other office bearer or be entitled to stand for election to such office, if he is in arrears on the last day of the year (30th June) in respect of the contribution fixed by the WUA from time to time.

CHAPTER 2

VOTING, QUORUM AND PROXIES

7. VOTING

Every member shall have only one vote irrespective of his holding.

8. QUORUM

Except as otherwise provided in these bye-laws the presence of one third of members or twenty-five whichever is less shall constitute a quorum.

9. VOTE TO BE CAST IN PERSON

Vote shall be cast in person.

CHAPTER 3

ADMINISTRATION

10. POWERS AND DUTIES OF WUA

The WUA will have the responsibility of water distribution among the members/ non-members, administering the WUA of _____ Village _____ Taluka _____ District of karnataka, maintenance and repairs of FICs/FIDs, approving the Annual budget establishing and collecting contribution from members, receiving water in bulk on volumetric basis from irrigation department/Government and distributing the same to the farmers collecting water charges and remittance to government from time to time and arranging for the management of the WUA. Except otherwise provided, resolution of the WUA shall require approval by a majority of members casting votes in person.

11. PLACE OF MEETINGS

Meeting of the WUA shall be held in the office of WUA or a suitable place convenient to the members from time to time to be designated by the WUA.

12. MEETINGS

The annual meetings of the WUA shall be held on the _____ of _____ of each year. At such meetings there shall be elected executive committee in accordance with the bye laws _____. The members may also transact such other business of the WUA as may properly come before them, approve Annual budget contribution from members and approval of audited accounts of the previous year. Minimum two seasonal meetings should be convened one month before every kharif and rabi season to discuss irrigation, cropping programmes and maintenance/repairs of FIC/ FID.

13. SPECIAL MEETINGS

It shall be the duty of the Chairman to call special meetings of the WUA as directed by the executive committee or upon a petition signed by 10% of members and having been presented to the secretary or at the request of Registrar of Co-operative Societies/Irrigation Departments/CADA etc. or any

other offices duly authorised by them on their behalf. The notice of any special meetings shall state the time and place of such meeting and the purpose thereof.

14. NOTICE OF MEETING

It shall be the duty of the secretary to inform or send a notice of each Annual/ seasonal or special meetings, stating the purpose thereof as well as the time and place of meetings to each member at least '2' but not more than '7' days prior to such meetings. Notices of all the meetings shall be mailed to the registrar of Co-operative Societies/Irrigation department/CADA etc. as the case may be.

15. ADJOURNED MEETINGS

If the meeting of members cannot be organized for want of quorum, the members who are present, may adjourn the meeting to a time not less than 24 hours from the time of the original meeting was called. If at such adjourned meeting also, no quorum is present, the members present in person being not less than five, exclusive of members of the committee, shall form a Quorum.

16. ORDER OF BUSINESS

The order of business at all meetings of the members of WUA shall be as follows:

i. Roll call.

ii. Proof of notice of meeting on.

iii. Reading of minutes of preceding meeting.

iv. Reports of Committee.

v. Election of the committee/in case of annual meetings.

vi. Unfinished business, if any.

vii. New business as per agenda and passing resolution.

CHAPTER 4

17. MANAGING/EXECUTIVE COMMITTEE

The affairs of the WUA shall be governed by the Managing/Executive Committee.

The Managing/Executive Committee shall have the powers and duties necessary for the administration of the affairs of the WUA and may do all such acts and things as are not in bye-law or by those bye-laws directed to be exercised and done by the General Body.

18. OTHER DUTIES

In addition to the duties imposed by these bye-laws or by resolutions of the WUA, the Managing/Executive Committee shall be responsible for the following that is to say -

i. Care, upkeep and surveillance of the FIC/FID in the area of operation of the WUA and the common areas and facilities.

ii. Collection of contribution from the owners.

iii. Designation, employment, remuneration and dismissal of the personnel necessary for the operation, maintenance and repairs of FIC/FID, supply of water, collection of contribution etc.

iv. To provide for the manner in which the audit and accounts of the WUA, shall be carried out.

v. To inspect the FIC/FID, distribution of water, resolve disputes, accounts kept by secretary and/or treasurer and examine the registers and account books and to take steps for the recovery of all sums due to the WUA.

vi. To sanction working expenses, count cash balance,engage labour, organise labour contribution from farmers or award contracts for maintenance and repairs of FIC/FID.

vii. To see that the cash book is written promptly and is signed by one of the members of the managing/executive committee authorised on their behalf.

viii. To prepare annual budget and getting approval from the general body.

ix. To hear and deal with complaints.

x. To correspond with the department/agencies.

xi. To allow the sub-committee of the outlets to organise and carryout repairs of the FIC/FID under their respective outlets if so desired by themselves through labour and material contribution.

19. MANAGER

The Managing/Executive Committee may employ for the WUA a manager at a compensation determined by the General body to perform such duties and services as the General body shall authorise including but not listed in bye-laws. The managers will be entrusted with the duties as decided by the working committee.

20. ELECTION AND TERM OF OFFICE

The general term of the members of the Managing Executive Committee shall be of three years. At the first annual meeting of the WUA, the term of one-third number of members shall be fixed for three years. The term of offices of the other one third number of members for two years and the term of the office of the remaining one-third number of members for one year. The members of the Managing/executive committee shall be elected separately by the member farmers of each outlet in the area of operation of the WUA. The elected member will work as outlet leader and also as member of the Managing/Executive committee of the WUA.

The members of Managing/Executive Committee thus elected shall hold office until their successors have been elected and hold their first meeting.

21. VACANCIES

Vacancies in the Managing/Executive Committee caused by any reason or removal by a vote of the WUA shall be filled in by the members of that outlet by majority and the person so elected shall be a member of the Managing/ Executive Committee until the expiry of the authorised term for that particular member.

22. REMOVAL OF MANAGER

At any regular or special meeting of the General body duly called, the Manager may be removed with or without cause by a majority of the members present. The Manager whose removal has been proposed by the Managing/Executive Committee shall be given an opportunity to be heard at the meeting.

23. ORGANISATION MEETING

The first meeting of a newly elected Managing/Executive Committee shall be held within ten days of election.

24. REGULAR MEETINGS

Regular meetings shall be held at such time and place as shall be determined from time to time by a majority of the members but at least one such meeting shall be held per month. Notice of regular meetings shall be given to each member at least three days prior to the day named for such meeting.

25. SPECIAL MEETINGS

Special meetings of the Managing/Executive Committee may be called upon by the Chairman on three days notice to each member which notice shall state the time, place and purpose of meeting.

26. QUORUM

At all meetings of the Managing/Executive Committee one-third of the total strength of the members shall constitute a quorum for the transaction of business and the acts of members present at a meeting at which quorum is present shall be the acts of the Managing/Executive Committee.

If at any meeting of the committee there are less than a quorum present the meeting may adjourn from time to time and at any such adjourned meeting, any business which might have been transacted at the meeting as originally called may be transacted without further notice, provided there is a quorum present.

CHAPTER 5

OFFICERS

27. DESIGNATIONS

The Principal Officer of the Water Users Association shall be a Chairman, a Vice-Chairman, a Secretary and a Treasurer all of whom shall be selected by and from the Members of the Managing/Executive committee. The Managing/ Executive committee may appoint an Assistant Treasurer and an Assistant Secretary as their judgement may be necessary.

28. ELECTION OF OFFICERS

The Officers of the Managing/Executive committee shall be elected annually by the members at the organisation meeting of each General body meeting and shall hold office at the pleasure of the General body.

29. REMOVAL OF OFFICERS

Upon an affirmative vote by a majority of the members of the General body any officer may be removed either with or without cause and his successor elected as per the procedure laid down.

30. CHAIRMAN

i. The Chairman shall be the Chair Executive Officer of the Water Users Association and the Managing/Executive Committee. He shall have all the general powers and duties which are usually vested in the office of the Chairman of the Water Users Association (WUA) including but not limited to the power to appoint various committees/sub-committees from among the members from time to time as he may in his discretion decide to be appropriate to assist in the conduct of the affairs of the WUA.

ii. He shall preside the meetings of the WUA General body and Managing/ Executive Committees and conduct the proceedings.

iii. The Chairman shall appoint outlet sub-committees comprising the outlet leader as Chairman and two other members from the outlet command of which one shall be a tail ender.

31. VICE-CHAIRMAN

The Vice-Chairman shall take the place of the Chairman and perform his duties whenever the Chairman is absent or unable to act. If neither the Chairman nor the Vice-Chairman is able to act, the WUA/Managing/Executive Committee shall appoint some other member of the Managing/Executive Committee so as to act on an interim basis. The Vice-Chairman shall also perform such other duties as shall from time to time be imposed upon him by the General Body in Managing/Executive Committee.

32. SECRETARY

The Secretary shall keep the minutes of all meetings of the General Body, Managing/Executive Committee in the minutes of all meetings of the association. He shall have charge of such books and papers as the General body, Managing/ Executive Committee may direct, and he shall, in general, perform all the duties incidental to the office of Secretary.

33. TREASURER

The Treasurer shall be responsible for WUA funds and securities and shall also be responsible for keeping full and accurate accounts of all receipts and disbursements in books belonging to the WUA. He shall be responsible for the deposit of all money and other valuable assets in the name and the credit of the WUA in such depositaries as may be from time to time be designated by the WUA/Managing/Executive Committee as per provisions of the Act.

CHAPTER 6

OBLIGATIONS OF THE MEMBER FARMERS

34. ASSESSMENT

a. All the farmers including members of WUA/non-member farmers in the area of operation of the WUA, are obliged to pay the assessments imposed by the Water Users Association (WUA) to meet all expenses relating to the WUA_____ Village_____ Taluka _____ District, which may include annual contribution per ha of the holding Irrigation charge levied by the Irrigation department for the use of canal water or any other sums decided to be assessed by the WUA.

b. All the farmers in the area of operation of the WUA are obliged to strictly follow the operation rules, procedures prescribed by the Irrigation Department/ CADA or the WUA in respect of water supplies, water use and conservation, protection of the Government/WUA and individual members property, crops, canal networks, drainage channels, structures etc.

35. MAINTENANCE AND REPAIRS

1. Every Member/non-member farmer in the area of operation of the WUA, shall carry out periodically maintenance, of equaliser i.e. irrigate channel constructed in his field by himself or by CADA to supply water from turn-out to individual crop plots and the FDD in good order. The land levelling/ shaping/bunds shall also be protected/repaired for uniform distribution and conservation of water.

2. Every Member/non-member farmer shall close the turnout of the FIC after completing the irrigation of his field.

3. Every member/non-member farmer shall take water from the irrigation network only from the authorised turn-out provided in the FIC and shall take water strictly according to the time allotted to him by irrigation department or by WUA if volumetric supply in bulk is undertaken by the WUA.

4. Every Member/non-member shall take due care not to graze cattle, cross the FIC/FID or bunds constructed in the fields by carts/tractors, vehicles or animals, and the road bridges provided shall only be made use of for the crossing.

36. RIGHT OF ENTRY

The farmer shall grant the right of entry to the Manager, the Chairman, the Vice-Chairman, the Secretary, Members of the Managing/Executive Committee or to any other person authorised by the WUA/Managing/Executive committee for insepction, supervision or for any enquiry in respect of disputes regarding sharing of water or for maintenance and repairs of FIC/FID.

CHAPTER 7

FUNDS AND THEIR INVESTMENTS

37. FUNDS

Funds may be raised by the WUA in all or any of the following ways, namely.

i. by shares

ii. by contributions per ha from the members and non-members.

iii. by donations from the members/farmers from the area of operation or any other Institution Trust, State Govt.

iv. by receiving subsidies - from the State Government.

v. From profits which shall arise from the hiring implements/equipment to the farmers or from the margin of water rates in receiving bulk quantity of water on volumetric basis at the rates prescribed by State Government/ irrigation Department from time to time and rates charged to the members after getting them approved from Irrigation Department.

vi. Commission charges received from the State Government/ Irrigation Department in collecting water charges from the members and remitting them to the Government.

38. INVESTMENTS

The Water Users Association (WUA) may invest or deposit its funds in the bank authorised by the registrar of cooperative societies.

39. ACCOUNTS

1. A banking account shall be opened by the WUA into which all moneys received on behalf of the WUA shall be deposited, provided that the Secretary may retain in his personal custody an amount not exceeding Rs.1,000/- for petty expenses. All payments other than wages above a certain amount as directed by registrar of cooperative societies shall be made by cheques signed by the Secretary and the Chairman or any other member authorised by the Managing/Executive Committee.

2. The accounts for maintenance and repairs of the FIC/FID should be kept separately for each outlet so as to satisfy the members about the fair and equal attention paid by the Water Users Association to the upkeep of the distribution network under each outlet. The outlet sub-committee should verify the accounts of respective outlets.

3. The Water Users Association (WUA) shall on or before 30th September in each year publish an audited annual financial statement containing the following :

   a. The profit and loss accounts

   b. the receipts and expenditure of the previous year and

   c. a summary of the property and assets and liabilities giving such particulars as will disclose the general nature of these liabilities and assets and how the value of fixed assets has been arrived at.

4. The audited Financial Statement shall be open to the inspection of any member of the WUA during the office hours and in the office of the WUA.

Copies thereof shall be submitted to the competent Authority, Irrigation Department/CADA not later than 1st October every year.

40. PUBLICATION OF ACCOUNTS AND REPORTS

A copy of the last financial statement and of the report of the auditor, if any shall be kept in a conspicuous place in the office of the WUA.

41. APPOINTMENT OF AUDITORS

The WUA shall appoint at its General Meeting an Auditor who shall audit the accounts of the WUA to be prepared by the Managing/Executive Committee here-in before provided and shall examine the annual return and verify the same, with the accounts relating thereto and shall either sign the same as found by him, to be correct, duly vouchered and in accordance with law, or specially report to the associations in what respect he finds it incorrect, unvouchered or not in accordance with law.

42. POWER OF AUDITOR

The Auditor shall be entitled to call for and examine any papers or documents belonging to the WUA and shall make a special report to the WUA upon any matter connected with the accounts which appears to him require notice.

CHAPTER 8

AMENDMENTS OF BYE-LAWS

43. The Bye-laws may be amended by the WUA in a duly constituted meeting for such purpose and no amendment shall take effect unless approved by absolute majority i.e., two thirds of the members of the WUA and the modified bye-laws will be effective only after approval by the Irrigation Department/ CADA Registrar of Cooperative Societies.

ANNEX XVI
(to Chapter 9)

PROPOSED DRAFT LEGISLATION FOR WATER USERS' COOPERATIVES UNDER NORTHERN INDIA CANAL AND DRAINAGE ACT 1873.

Draft Sections

Section X - 1

(1) Where holders or occupiers of not less than 51% of CCA or not less than 51% of the occupiers thereof to which water is being or is intended to be supplied from a canal, give in writing to the Divisional Canal Officer to take water on payment on volumetric basis and to form a Water Committee or Water Users' Cooperative, hereinafter referred to as the Cooperative, of all such holders or occupiers of land in CCA for distribution of water on that canal in accordance with provisions of these sections, such consent shall be binding on all holders of all the lands under that canal command.

(2) Thereupon the Divisional Canal Officer, subject to the general or special orders of Government in this behalf, by order in writing, may approve formation of the cooperative and direct that the water to be supplied to the cooperative will be on volumetric basis on rates to be fixed by the Government from time to time and the cooperative will charge from the occupiers on cropped area basis on rates fixed by Government from time to time.

(3) Upon such an order the cooperative shall be constituted in accordance with and be subject to all the relevant provisions in respect of similar cooperatives under sections X-2, X-3 and X-4 of this Act.

SUPPLY OF WATER TO WATER USERS' COOPERATIVES UNDER A SCHEME

Sections X - 2

(1) Wherein the opinion of the State Government a canal is likely to irrigate lands not exceeding 200 hectares in an area or as may be prescribed, the State Government may, in the public interest, by notification prepare a draft scheme for supply of water from such canal to such lands. The draft scheme shall

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Source : Manual for Operation and Maintenance for Upper Ganga Canal System, Vol-3, WAPCOS, September, 1991.

provide for handing over the management of the irrigation work and distribution of water therefrom to a Water Users' Cooperative, hereinafter referred to as the Cooperative, appointed under Section X-4.

(2) The draft scheme shall contain the following particulars, that is to say :

(a) the area to which the scheme applies;

(b) the field numbers of lands included in such area and the names of owners;

(c) the period or periods during which water will be supplied to such lands;

(d) the crop or crops which will be permitted to be irrigated;

(e) the water rate at which water may be supplied to such lands included in the scheme;

(f) the amount to be paid by the State Government for the management of the irrigation works to the cooperative; and

(g) fixing a period of not less than three months from the date of publication of such notification, for submission of objections or suggestions to such scheme.

(3) After the publication of such notification, it shall also be published by the Divisional Canal Officer duly empowered in this behalf, as soon as practicable, in the language of the residents of the area through which the canal passes, in such place or places and in such manner as he thinks fit, for the information of the owners and occupiers who are likely to be affected by such notification.

(4) After considering such objections and suggestions, if any, as may have been received within the period fixed as aforesaid, the State Government may, after making due inquiries,sanction the draft scheme with or without any modifications or may reject it.

(5) The scheme as sanctioned under sub-section (4) shall be published in the official Gazette, and the village and at the headquarters of the Tehsil and of the district in which the lands included in the scheme are situated, in such manner as the State Government deems fit, and shall on such publication, be final.

Section X - 3

(1) The Scheme shall come into force on such date as the State Government may by notification appoint.

(2) The Scheme may at any time be varied by a subsequent scheme made, published and sanctioned in accordance with the provisions of Section X-2.

(3) The Scheme may at any time be cancelled by the Government by a notification.

Section X - 4

(1) After a scheme has come into force, the State Government shall direct constitution of Water Users' Cooperative, hereinafter referred to as the Cooperative, to execute the scheme, subject to the Superintendence, direction and control of the Divisional Canal Officer.

(2) Thereupon the cooperative shall be constituted in accordance with the general or special orders of the Government in this behalf.

(3) The Cooperative shall

(a) manage the irrigation work and ensure distribution of water to the lands included in the scheme;

(b) decide the crops to be irrigated during any period or periods according to the provision of the scheme;

(c) charge water rates for supply of water to its members at rates charged by Government on crop area basis from time to time;

(d) maintain the irrigation system of the irrigation work beyond the outlet in a fit state of supply of water;

(e) assist the canal officer :

(i) in detecting and preventing encroachment on the irrigation work and on the lands appertaining thereto;

(ii) for preventing damage to the irrigation work;

(iii) for repairing any damage caused to the irrigation work.

(f) have power to impose a penalty for unauthorised use of water, or use of water out of turn or for growing crops contrary to the provisions of the scheme;

(g) maintain the financial accounts of the society in such manner as may be prescribed.

(4) The penalty may consist of a fine not exceeding two hundred rupees.

(5) Any person aggrieved by the decision of the cooperative may within thirty days from the date of receipt of the decision of the cooperative make an appeal to the Divisional Canal Officer or any officer duly empowered by the State Government for the purpose.

(6) The State Government may, not later than two years from the date of order, call for and examine the record of any inquiry or proceeding underlying such order of the Cooperative, or of the officer appointed by it, for the purpose of

satisfying itself as to the legality or propriety of any decision or order passed or as to the regularity of the proceeding, and it may pass any order upholding, annulling, modifying or reversing the order of the Cooperative or of any such officer.

Provided that no order affecting any person shall be made unless such person is given a reasonable opportunity of being heard.

(7) If any time the Divisional Canal Officer is of opinion :

(a) that the Cooperative has persistently made default in the performance of the functions imposed on it by or under this Act, or

(b) that the circumstances exist which render it necessary in the public interest to do so the Divisional Canal Officer may by notification, supersede the Cooperative or its managing Committee as appropriate, for such period, not exceeding two years as may be specified in the notification.

Provided that before issuing a notification under this sub-section for reasons mentioned in clause (a), the Divisional Canal Officer shall give a reasonable opportunity to the Cooperative or its Managing Committee to show cause why it should not be superseded and shall consider the explanation and objections, if any, of the cooperative.

(8) Upon the publication of a notification under sub-section (7) superseding the Cooperative:

(a) all the office bearers of the Cooperative and the Members of the Managing Committee shall, as from the date of supersession, vacate their offices as such;

(b) all the powers functions and duties which may, by or under this Act be exercised, performed or discharged by the Cooperative shall until the Cooperative is reconstituted under sub-section (9) be exercised, performed or discharged by the Divisional Canal Officer or any officer authorised by him;

(c) all property owned or controlled by the cooperative shall until the Cooperative is reconstituted under sub-section (9) vest in the State Government.

(9) On the expiration of the period of supersession specified in the notification issued under sub-section (7), the Divisional Canal Officer may "

(a) extend the period of supersession for such further term, not exceeding six months as it may consider necessary; or

(b) rescind supersession of the Cooperative by fresh notification/appointment, and in such case any person who vacated his office under clause (a) of sub-section (8) shall not be deemed to be disqualified for holding any office of the Cooperative or its Managing Committee.

Provided that the Divisional Canal Officer may at any time before the expiration of the period of supersession, whether originally specified under sub-section (7) or as extended under this sub-section take action under clause (b) of this sub-section.

(10) When the Cooperative is registered in accordance with the State Cooperative Societies Registration Act, the provisions under that Act which are not repugnant in the context of this Act shall be applicable to the Cooperative.

ANNEX XVII
(to Chapter 10)

IRRIGATION TRAINING IN THE PUBLIC SECTOR*

CHAPTER 1

IRRIGATION DEVELOPMENT AND A HUMAN RESOURCES DEVELOPMENT STRATEGY

Accomplishment and Challenges

Public irrigation has contributed increasingly to satisfy national and international needs for food security. From 1964 to 1984, net irrigated areas of Asia, Africa and South America grew by 40 percent, from 111 to 156 million hectares. This growth has yielded remarkable results. Cereal production in developing countries increased at an average annual rate of 3.4 percent through the 1960s and 1970s, two thirds of which came from irrigated land. Countries such as Bangladesh and Indonesia have doubled the production of rice, their staple crop, within fifteen years, while India is now a net exporter of wheat. It is difficult to imagine how the world would have avoided a food crisis without these recent gains in food production made possible by irrigation. Irrigation has been the main stimulus to additional grain production in many developing countries.

Under the combined pressures of rapid population growth and economic constraints in many countries, such as India and Thailand, expanded irrigated agriculture has met the increased need for domestic staple products. To finance this expansion, these countries have regularly invested in irrigation over three-fourths of public moneys designated for agricultural development. The World Bank, the Asian Development Bank, the Government of the United States and the Government of Japan invested at a combined rate of about U.S. $1.5 billion per year during the 1970s and early 1980s, with much larger investments by the developing countries themselves.

An expansion of this magnitude and duration can be expected to reach a point of diminishing returns. The remarkable benefits of irrigation are now more clearly seen as costly in several ways. The cost of new construction has increased sharply and many of the newer systems are deteriorating faster than expected. These problems are not really new, but during the past two decades irrigation departments have not sufficiently addressed the changing needs of irrigation. Similarly, research programs have rarely been able to link research and world-wide experience with the realities of local operations.

As a result of these factors, it has become much more difficult to attract money for investment in irrigation. Irrigation finance extended by the World Bank, the Asian

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* **Source :** EDI Technical Materials : Irrigation Training in the Public Sector - Guidelines for Preparing Strategies and Programmes, The World Bank, and the United States Agency for International Development, The World Bank, Washington, DC 1989.

Development Bank, the United States, and Japan in 1986 fell to barely half that of 1981 in real terms. The necessity to sustain crop productivity and financial returns on often considerable investments has highlighted the need to operate and maintain irrigation schemes in a more effective and efficient manner.

The way of sustained productivity has been shown to depend on two factors : first, the capacity of irrigation organizations to meet the technological challenges of environmental problems, such as the scarcity and cost of developing new sources of water or the increased salinization of irrigated lands; and second, the ability of technical and managerial staff in these organizations to adapt to changing circumstances, such as crop diversification, and to ensure that their irrigation systems continue to be productive. In view of these factors, the effective operation and maintenance of irrigation systems are clearly most important. This in turn must focus attention on the effective management of human resources of each irrigation department to reach production goals while safeguarding the significant investments these systems represent.

In the coming decade, one of the most important challenges to irrigation organizations will be their ability to use their technical and managerial resources effectively. To this end, irrigation departments must include training as an integral function of their operations and maintenance plans and include comprehensive human resource development as part of their long-term strategic planning.

Some management teams are already beginning to assess management and staff performance as a major factor in irrigation system performance. To help them formulate a systematic approach to training, they are asking some fundamental questions :

* How can training be instrumental in raising production from irrigated land? Who must be trained? In what skills must they be trained? When is the training beneficial?

* What is the relationship between training and the overall performance of irrigation organizations?

* What improves the level of individual performance? To what extent will personnel motivations be affected by changes in the incentive structure, opportunities for career development, and styles of management?

* What kind of training strategies and programs should be formulated for managers and all levels of staff?

* How can you identify training needs?

* How can the institutional environment be made more compatible with attaining the intended development objectives and

* How can the effectiveness of training programs be assessed?

Systematic and Department-wide Training

The present widespread interest in irrigation training is a natural consequence of the 'ncreased attention given to irrigation management around the world. The need for training and research in irrigation systems was discussed and debated at the first Technical Advisory Committee (TAC) of the Consultative Group on International Agriculture Research in January, 1971. At the 1987 ICID meeting in Morocco, 33 papers on irrigation water management training were presented by 19 countries (Boumendil, 1987) and participants reached five main conclusions during the 1987 ICID meeting with regard to training :

* Programs should be based on an assessment of the needs for training and developed in line with the organizational objectives;

* Programs should comprehensively and systematically enhance the skills needed by management, operating, maintenance and administrative staff;

* Initial training of project operating and maintenance staff should be completed before new works are commissioned;

* Water users and their associations should be taken into consideration when developing training strategies. This may require complementary training programs on their behalf; and

* Training programs should be conducted as close to the field as is possible.

Most irrigation training programs seek to upgrade the technical skills of individuals in the field. While this is useful in many cases, evidence is accumulating that most staff already have the skills needed to carry out their assignments. They may, nevertheless, carry them out poorly, or fail to attempt them at all. Some reasons for these failures are lack of clear supervisory direction, physical conditions that prevent successful execution of the work, lack of commitment at various levels of the department, uncertainty regarding the purpose of the job and opposition from important constituents including farmers.

Relationships within the department have a major impact on the effectiveness of irrigation staff. In many countries, however, field level staff develop closer, more dependent relationships with local farmers with their supervisors in distant central offices. Moreover, a wide range of factors, for example, low salary scales, work against the department orientation of staff.

Few irrigation departments have systematically helped their staff to contribute to the overall effectiveness in meeting the mandate of the department. Those that have done so possess a force of people who are able to project strongly the objectives of the department. The key strategy is to develop staff at all levels who are motivated and able to carry out :

their own technical jobs;

* the development of subordinate staff;

* activities useful to the internal functioning of the department; and in some cases,

* collaborative activities with other organizations in the irrigation sector.

Most managers of public irrigation departments recognize the new challenges before them, and are aware that training must go far beyond the periodic upgrading of technical and managerial skills. For example, substantial farmer participation in tertiary irrigation is well accepted in many countries, and senior managers increasingly accept the need for a more direct means of financing operation and maintenance (O&M) activities. Public planners in Brazil and several other countries realize that the management of irrigation by "District" organizations of farmers can be more effective than public sector schemes.

A training strategy that focuses on only one aspect of irrigation cannot lead to system-wide improvements, Comprehensive changes can be achieved through a training strategy that addresses the needs of different categories of managers and staff, as well as those of clients. It will also depend on the rejection of an assumption of individual training as a one time event. In most instances, upgrading skills will require much training, including formal, informal, in-house, and training centre experiences. The order in which these training experiences are provided, and the role to be played by management in reinforcing the outcomes, are issues which should be carefully considered by those in designing a training strategy.

To develop a successful training strategy an irrigation department must :

* Determine which irrigation system constraints can be most successfully addressed through training;

* Identify the training needs of specific categories of managers, staff and users;

* Select and design appropriate training segments and methods for each target group identified;

* Determine the logical sequence of training function and the physical location of the actual training;

* Decide on the institutional location of the training function and the physical location of the actual training;

* Integrate training into the budget process; and

* Plan for follow-up, monitoring and evaluation of training investments.

Training for Whom?

A successful training strategy must have explicit boundaries, the most important of which is careful identification of the people to be trained. In most countries, many organizations and people are active in the irrigated agriculture sector. The most prominent of these are discussed below. They are :

* Irrigation department and project staff with primary responsibility for designing and operating the systems(for example line irrigation departments and project authorities);

* Staff of other organizations with irrigation-related responsibilities (for example agriculture departments, public administration, universities).

* Farmers who are responsible for water management at the farm level.

Irrigation Department Staff

These guidelines propose strategic training choices appropriate for public-sector organizations that have primary responsibility for irrigation. These are departments that finance, plan, design, construct, operate, maintain, rehabilitate, and modernize irrigation systems. Their objective is to increase agricultural production and related benefits. They are not normally involved in agricultural activities such as research or extension, although in some countries they provide such services as input and output marketing and credit.

Irrigation Departments[1] usually have large staffs and well-defined bureaucratic structures. Frequently, the structures have evolved over a very long time, giving a permanence greater than that enjoyed by most other government entities. Becuase of the rather specialized technological content of work of irrigation departments, their staff tend to develop strong internal bonds, but have relatively weak linkages with related departments or with the farmers they serve.

Staff from irrigation-related organizations

Irrigation endeavors are enhanced or diminished by the activities of staff in irrigation-related organizations, such as agriculture departments. In some countries, these staff have responsibility for irrigation at the farm level, and their training needs are quite obvious.

Training programs for staff of agriculture departments, command-area departments, and similar organizations active in the irrigated agriculture sector are numerous and in many cases effective. They may need strengthened capacity in irrigation-related matters. But their obligations and expected output are not same as those of irrigation departments, and irrigation functions normally comprise a relatively small part of their mandate. Training needs of these organizations should be seriously addressed in

1. Public institutions of irrigation to which these guidelines apply include ministries, departments, agencies, special authorities, offices, boards, administrations, projects and schemes. For simplicity, this report uses the term "department" throughout to refer all public-sector irrigation institutions.

the context of their own departments, not the context of the irrigation departments. Such training is not directly addressed in these guidelines. However, to ensure that the objectives, strategies and programs for training in the related organizations are mutually compatible and supportive, liaison among the involved organizations is essential.

Farmers

Managers seriously interested in upgrading the quality of the work of their department in the irrigation sector may be surprised to find only passing reference in this document to the critical role of farmers and the need to upgrade their performance. A companion report, focusing on training for water users, is envisioned for the future. But as a first step, the focus on requirements of departments for training is appropriate because:

* Irrigation departments clearly have a mandate to provide irrigation services and to recruit and train large numbers of people to that end;

* Departments charged with managing water will be expected to "put their own houses in order" before attempting to upgrade the skills of farmers; and

* Governments directly disburse funds to irrigation departments, not to farmers, and need to know that these disbursements are cost-effective.

CHAPTER 2

DEVELOPING A TRAINING STRATEGY

Performance of Irrigation Systems and Agencies

There is not a single criterion to describe "good"irrigation. The traditional measure of irrigation efficiency - the percent of irrigation water productively used by the crop- can be an important gauge, but has little relevance under conditions of abundant water resources. These conditions are often present when irrigation supplement rainfall, as in the case of main-season rice.

A second criterion is the agricultural output per unit of water supplied. This is a good measure of the value of water, but variations due to fluctuations in rainfall and varying crop practices reduces its utility as a measure of how well a system works. And because it can be estimated only after harvest, it offers little practical value in guiding day-to-day irrigation decisions.

Most irrigation managers have come to accept a combination of at least the four following measures in assessing how well their systems operate :

* The amount of water wasted from the system (the inverse of irrigation efficiency), because the supply of water is frequently limited and wastage is apparent;

* The effectiveness of irrigation in promoting farmers' objectives (for example, planting earlier, producing higher yields, producing a second crop);

* The degree of equity in water supply throughout the system; and

* The frequency and extent of repair and rehabilitation work required to the system.

Several other criteria often found useful are the following :

* The prevention of uncontrolled flooding;

* The effectiveness of drainage systems;

* The avoidance of salinization;

* The conjunctive use of surface water and groundwater sources;

* The extent of participation of water users in water regulation; and

* The cost of operations in relation to services delivered.

None of these measures is easily quantified under field conditions. Water flow measurement, required for the first two items above, is rarely carried out in a sufficiently reliable manner to be a useful measure of how well systems operate, especially at the secondary or tertiary levels. Assessing how well farmers' objectives are achieved is somewhat subjective and may involve crop yield estimates, which irrigation staff are not normally qualified to make.

Nevertheless, it is important that managers and staff of irrigation departments have performance targets to guide them. On the one hand, these targets should be as specific as possible and should exclude factors over which they have little control, such as crop yield levels. On the other hand, they should be flexible, taking into account variability in climate soils, crops and cropping intensity.

One such performance indicator is the degree of equity in distributing water throughout the network. Systems are normally designed to supply roughly the same per-hectare water flows to all units within the command area. Operational staff can be responsible for achieving this objective, within the limitations imposed by the physical system and water availability. Equity at various bifurcation or offtake points does not necessarily mean accurate and continuous flow measurement; it only means that there is little sustained bias in over-or under-irrigation in different parts of the system.

The success of field efforts to operate at high performance levels can be determined by planning decisions made higher in the department. For example, if there is not enough water to adequately supply an entire system, a decision may be made to deliver all the water to a portion of the area and to rotate the portion receiving water each season. This would improve the equity of water sharing between the seasons, and equity of water distribution within the truncated system would also be easier to achieve.

To operate a system according to performance objectives is quite different from the routine administration of a system. In the latter case, staff largely supervise others, with little intent to intervene in managing water deliveries within the network. This hands-off policy stems from the lack of generally accepted standards of intervention, and because operational staff are generally trained to consider only the hydraulic properties of canal systems - that water will flow as automatically as the system permits.

Some Performance Issues

Most irrigation managers agree that the systems under their jurisdiction should operate at higher performance levels. They could improve performance by adapting or revising existing water distribution plans, but may not be able to do so for the following reasons :

Physical Factors

* The canal structures, cross sections and gradients are not physically as originally designed; consequently the right quantities of water do not flow into or along specified canals;

* Department staff cannot measure or control water flows accurately enough to implement a plan leading higher performance;

* Variation in water flows is so great and unpredictable that it is impracticable to put any standardized water distribution plan into operation;

Institutional and Human Factors

* Staff do not have sufficient ability or training to put a plan into operation;

* There are not enough staff to implement effectively a water distribution plan;

* Staff cannot be expected to put a water distribution plan into operation because they are strongly influenced by those few farmers who stand to benefit from disorganized distribution;

* Farmers generally may interfere with operating systems, particularly if they have not been consulted in the design;

* There is so much variability in crops and cropping practices that it is unlikely any plan would serve the interests of enough farmers to justify implementation; and

* Implementing a water distribution plan would inevitably bring department staff into conflict with staff of other organizations.

When present, these factors certainly limit the performance level at which systems can operate. It is unrealistic to train field staff under ideal conditions and then expect

them to produce optimal results within systems that are handicapped by several of these factors. Nevertheless, old and partially deteriorated systems sometimes operate at relatively high performance levels despite their generally poor condition.

A strategy for high performance irrigation should not rely exclusively on the effort of operational staff. The department should orient and strengthen the design staff so that the systems are designed to be easier to manage and flexible to serve changing requirements. Thus, training that leads to higher performance levels must include the planning and design staff, in addition to operational managers and staff.

Training programs designed only to help staff overcome their technical limitations overlook the institutional constraints that managers, staff and departments face. For example, low salary scales or frequent transfers are department characteristics untouched by training programs. Similarly, irrigation responsibilities in most countries extent to two or more organizations which may work at cross-purposes. Agriculture and irrigation officers, for instance, sometimes act on quite different assumptions regarding cropping patterns and times of planting. Furthermore, the absence of effective water users groups will inhibit the development and implementation of efficient and equitable water distribution plans.

The Department Context for Irrigation Performance

Irrigation departments often perform poorly because of internal institutional constraints and weak linkages with other organizations. Improvements in irrigation system performance must begin with the irrigation department itself. Another important aspect is the relationship between the department and water users and approaches to training farmers. These will be the subjects of a future document.

The department context[3]

In countries with extensive irrigated agriculture, irrigation organizations are among the strongest agencies of government. Sometimes, as is the case of Thailand, they enjoy the highest level of patronage and dwarf other departments in their ministry. Their staff may receive higher salaries and other perquisites unknown in other government agencies.

Irrigation departments have often become large bureaucracies with permanent staff stationed at many levels from rural village offices to cabinet posts. Irrigation officers in the field are frequently the most accessible government contact for farmers. In irrigated areas they are usually far more numerous than are agricultural extension or land revenue officers.

Irrigation department staff assignments tend to be fixed in terms of focus and location. Project design staff usually are housed at the headquarters of the department where they plan new systems based on engineering principles and department norms. Operations and maintenance (O&M) staff in the field are responsible for running and repairing systems after construction is completed. There is often little interaction and almost no rotation of staff between these units. Systems designers may make plans without the potentially valuable on site knowledge of O&M personnel and O&M

decisions may have to be made within the constraints of an inflexible design. Consequently, departments do not usually consider a sufficiently wide range of design or operating options.

Department issues

It is not necessary for these guidelines to list all of the issues with which irrigation departments cope. But it is important to discuss several internal issues that condition and determine staff performance and thus affect irrigation system performance.

* Inadequate or misleading information. When the operation of main canals is based upon allowing specified flows at various reaches along the canal, it is important that the measuring systems work well and that the data are recorded and acted upon in a timely way. But frequently these data cannot be relied upon for operational purposes. Similarly, topographic data is rarely complete or accurate enough to permit optimum system layout and design.

* Conflict with farmers. The relationship between irrigation departments and farmers is frequently antagonistic. Farmers seek political support to oppose department decisions which were often made without consulting farmers in a meaningful way. The field officers bear the brunt of this ill will, even though it is usually department policies that are under attack.

* Conflicts with other organizations. These often arise, when, for example, an agriculture department recommends a cropping pattern which is inconsistent with the water delivery schedule planned by the irrigation department.

* Weak control over dispersed staff. The widely dispersed, poorly paid, and infrequently supervised irrigation officers develop strong relationships with local farmers. This is a potential strength for the department if it values farmers' views and can act on them. But it frequently leads to a situation in which department staff act, at least to a degree, as farmers' agents. This relationship creates a climate in which some farmers may pay extra compensation to department staff, thus destroying the possibility of an equitably implemented water distribution plan.

The traditional definition of department performance

Irrigation departments traditionally have given high priority to technical competence. They place emphasis on solutions that are technically correct and efficient and can be administered without undue delay or difficulty. These qualities are particularly appropriate where the water is very limited and strong rules govern equitable sharing arrangements.

These priorities have, in turn, shaped the character of the departments themselves. They tend to be somewhat inward-looking, favour strong technological and administrative orientations, and have a straightforward focus on water as an input. Irrigation departments have been comparatively less interested in joint efforts with other departments, new and untried solutions, and the outputs from water use. It is no

surprise, therefore, that few irrigation departments have an ongoing research program analogous to that of most agriculture departments.

The administrative character of irrigation departments is perhaps their most significant attribute. It promotes highly centralized decision making and emphasizes implementation of predetermined plans, with little delegation of authority. These departments run almost automatically, with few day-to-day decisions required except during times of crisis of change, when they are made at the highest level. Key staff skills include the ability to pass orders downward, handle papers smoothly, and help the unit function smoothly without the intervention of higher level officials.

Irrigation departments are custodians of valued public resource-water-which is distributed according to a plan. Their responsibility is not unique; many agricultural banks and extension departments treat credit, seed, fertilizer and information in much the same way. In general, they view as their mandate the provision of these resources in accordance with governmental programs and rules that usually specify the rates of supply to different locations over a given period of time. Performance is evaluated in terms of how well these requirements are met.

These characteristics have shaped the evolution of departments. They have strengthened those departments with relatively unchanging programs over the years, but have made it more difficult for them to adapt to new conditions.

The changing definition of department performance

Many departments, particularly in East Asia, have come to realize that the main issues which affect the irrigation sector have changed significantly. They have begun to question if the traditional roles and responsbilities of the department and its staff are adequate to meet the present and probable future needs of the sector. Specifically, some irrigation leaders are looking for greater managerial content in training programs and a focus on the needs of water users and the productivity of their farms; issues that are discussed below :

* Managerial capacity is obviously present in all departments. In some, however, it is being encouraged as a way of introducing greater flexibility in applying rules. According, more decision-making authority is delegated to lower-level officers. In some cases, the rules themselves have been revised; for example, to accommodate the need for changing target rates of flow for different weeks or locations. This calls for fewer centralized and predetermined rules and greater day-to-day local management.

* Client orientation has become the hallmark of the communal irrigation program of the Philippines National Irrigation Administration (NIA), an effort to get farmers to take on much greater responsibilities in operating, repairing and financing systems under the direct control of NIA. Formal mechanisms for communicating between the department and farmers were required as a first step. Other irrigation departments are finding that a more explicit client orientation helps protect them to some extent from farmer opposition, often supported by local politicians.

* Focusing on results means giving attention to the effects of irrigation, not just to the supply of water as an input. Monitoring of cropping patterns, dates of planting and yield levels are important to this approach although the irrigation department does not need to do all the monitoring itself. It may make fuller use of data collected by other departments and also help them to collect information in ways which later will be more useful for irrigation purposes.

The changing definition of performance referred to above requires many institutional adjustments in the department itself. Most are relatively small steps in themselves, but require a substantial commitment to change the way the department perceives its role and conducts its business. For example, to achieve greater farmer involvement in operating and financing systems would require new mechanisms for meeting with farmers on a regular and structured basis. More delegated decisions would require some reallocation of responsibility and authority to the field in order to reduce the travel expenses and time required to reach an appropriate decision.

It is an oversimplification to characterize all irrigation departments as traditional - administrative, self-centered, and input-oriented - and unresponsive to change. However, under present and future circumstances, improved irrigation performance will be more likely for those departments which become increasingly managerial, client oriented and focused on results. In considering these changes, senior department officials need to evaluate the institutional environment of the department - not just its physical systems - and how effectively the department is structured to deal with it.

Today's irrigation environment is more complicated and dynamic than ever before. The political environment is more responsive to the demands farmers make of the department. The economic environment has changed as self-sufficiency in food has largely been reached in some of the most important irrigated countries. Farmers may look to irrigation not so much as an input to raise yields but as a means to shift the cropping season to different months, or to increase the wage rate of daily labour. Unintended harmful effects of irrigation, such as the risk of salinization, must be dealt with rapidity and seriously.

In considering these and other changes, the senior management of an irrigation department seeks to match the new conditions with a strategy. A central element of the strategy is a systematic approach to staff training. Without it, management's intentions are unlikely to be fulfilled.

The Need for Systematic Training in Irrigation

Staff training is now universally accepted as an essential element of organizational "management." With respect to irrigation management, Robert Lenton (1988) has proposed the following definition :

> "Irrigation management is the process in which individuals set objectives for irrigation systems, establish appropriate conditions and identify, mobilize and use resources so as to attain these objectives, while ensuring that these activities are performed without causing adverse effects."

Training for irrigation normally includes pre-service, university level preparation for technical staff who are then recruited by the department; post-graduate courses on special aspects of irrigation; staff college training; orientation for newly inducted staff; short-term refresher courses; specialized courses; training linked to a specific project or systems; on-the job training; international short-courses; and seminars and conferences either within or outside the country.

A recent department-wide training survey in Sri Lanka found that the number of professional people trained in recent years equalled the total number of professional staff in the department; while training opportunities at the operational or field technician level were equal to about one-third of staff. The survey also found that the training offered by a wide range of institutions, universities and international organizations was not effectively coordinated, nor was any central record or personnel inventory kept of those who had undergone training. These results are probably similar to what would be found in irrigation departments in many other countries.

The survey revealed that international organizations partially finance a high proportion of the training courses most of which were offered and funded through specific projects. Such short-term, specific training was aimed to improve the effectiveness of design or O&M staff assigned to operate a system, but could not seriously attempt to improve the way the department itself operated. Few of these training activities were related to or supported each other.

Categories of Training

"Training" encompasses a wide range of planned activities designed to strengthen the performance of managers and staff. Three types of training that would be included in a systematic training plan as proposed by these guidelines and their relevance to different situations, are presented below. The distinction among them are rather arbitrary and in some respects they overlap.

In-service and maintenance training

This is intended to maintain staff skills at given levels of proficiency. It may be called short-term, routine, continuing, in-house, or on-the-job training for existing or new staff members. Its objective is to strengthen the technical skills of staff when they join the department or are to be upgraded. In-service training is not usually intended to impart more skills than are required for the positions currently held. It may be used to certify continuing or increased staff proficiency within the same career path.

In-service training is closely linked to the vocational training staff usually receive as part of their pre-service, formal education which qualifies them for employment. At the time employees first join the department, their skills should be assessed and recorded. New employees should then be listed for the particular in-service training activity or activities which address their shortcomings. This procedure may be repeated periodically to keep staff abreast of their fields and closely responsive to the requirements of senior management.

In-service training frequently is seen by staff as a path to promotion. When this happens it often becomes only a tool for personnel management rather than as a means to improve performance. At worst, in-service training is used temporarily to relieve operating units of unsatisfactory staff.

Adjustment or reorientation training

This may be required following changes in policy or technology when irrigation staff may be called upon to undertake new jobs for which they are not adequately prepared. In the 1970s, the National Irrigation Administration of the Philippines decided that the Water Management Technologists of its Upper Pampanga River Project should advise farmers about agricultural matters. Training was needed in agricultural extension skills. Some irrigation systems in Thailand are now equipped with double-gated outlets. Training was required to use the outlets as designed. Irrigation staff in many countries are increasingly expected to bring farmers into compliance with, or at least acquiescence to, water-related matters. For the success of these and many other examples of change, training must be redefined to bring staff capibilities in line with new departmental objectives. This is adjustment training.

Adjustment training is usually carried out through one or more of three formats :

* Specialist training is short term and may be carried out through special courses at local institutions. Regional or international experts may be brought into supplement local experience, if needed. Study tours are an example of specialist training for adjustment purposes. Superintending engineers from India have gained new perspectives on farmers-managed irrigation through well prepared visits to other parts of India and to the Philippines and Indonesia.

* Refresher training is a course of study in the staff person's field of basic qualification that will introduce new concepts as well as reinforce earlier training. The refresher training should focus on the skills needed to perform the newly designed job properly. Refresher training is usually of relatively short duration and includes some theoretical background.

* Retraining is needed when a staff member is moved from one type of job or career stream to another. This frequently happens when there is a significant shift in the mandate of the department, or when certain phases of organizational development are complete. Some irrigation departments have retained design staff to operate irrigation system when a permanent slowdown in new construction is anticipated.

Project and task force training is a special category of in-service training that is particularly appropriate for pre-commissioning training of staff not yet in place for new projects. Assessments of training needs for new projects differ from the TNA procedures in **Exhibit 'A'** because new projects focus on the whole range of irrigation skills, and not just those skills related to performance requirements. Assessments for new projects must also evaluate the employment pool and the capacity of relevant training institutions to provide the necessary training within the desired time frame. It is usual to distinguish between training for the construction phase and, at a later stage, training for operational and maintenance work.

Unlike adjustment training, which is undertaken concurrently with operational activities, project and task force training should be carried out so that all aspects of the scheme will take shape in accordance with a systematic plan and with necessary staff properly trained in all aspects of the project. The required numbers of staff and their training needs depend on the institutional design of the new scheme. There are generally three alternatives :

* Projects wholly under the irrigation department;

* Project with the more traditional joint management (government and farmers); and

* Projects intended to be managed by farmers. Project training has to be built into the whole process of project planning.

Task-force training is a form of project training in which the key staff to be involved in an aspect of the project receive training as a team before that aspect of the project begins. Task force training strengthens interaction among the various team members. Management training is an important part of a successful task-force approach and is being tried in some projects, including some under the Department of Irrigation in Nepal. The main problems encountered with task-force training are difficulties for the department in scheduling teams of staff to be available for training at the same time and in devising new training methodologies based on team participation.

Purpose of Current Training

Training for operations and maintenance

Most irrigation department training in recent years has been designed to provide the skills and knowledge with which staff (and farmers) can direct or distribute water. These programs have focused on the measurement and control of water flows in operating systems. They have emphasized the use of measuring devices such as double-gated offtakes, monitoring of canal flows, estimation of crop-water requirements, and some of the principles of canal design on which flow measurement is based.

In the last decade these training efforts have been broadened to help field staff assess how well or badly the systems operate. Some training emphasizes rapid appraisals of system, which include not only water distribution, but also crop productivity, farmer satisfaction and other factors related to irrigation.

Training for planning and design

In recent years, some attention has been paid to training design staff. This training is intended to upgrade the quality of irrigation planning and design, which in many countries is still excessively time-consuming and costly and frequently results in systems that are difficult to build and operate. Systems built 50 or more years ago are now generally regarded as better designed than those designed more recently.

Staff designing irrigation systems must often depend on remarkably misleading and incomplete information on the topography and other parameters on which their design

is based and they have little experience in relating engineering principles learned in the classroom to real conditions in the field. Due to the unprecedented pace of irrigation development, however, they must turn out designs faster than ever. Training to bring closer awareness of field conditions into the design process would be particularly valuable.

General observations

First, training programs are often project-specific. Because they are normally financed by external organizations as part of project loans or grants, the national departments may not have local funds for more general training. Thus, the benefits of training are found largely within the limited project and do not benefit the department as a whole.

Second, this training usually focuses on the technology of irrigation : how to design systems and how to move water through them. There is growing recognition that irrigation technology must also take into account environmental consideration and sociological characteristics such as farmers' behaviour. Current training continues to focus mainly on stregthening staff competence in the technical aspects of design and operation.
Third, conventional training focuses on staff in discrete, hierarchical levels of a department. The ability of trained staff to put into practice what they have learned is often limited by individuals in position above or below them, who often remain outside the scope of the training.

Technological training in water management should remain a very important part of the total training strategy, for ultimately the primary benefits of irrigation are closely associated with the physical distribution of water and how well that distribution matches the needs of farmers, crops and soils. But technological training in the future should be carried out within a broader framework that includes developing the management capacity within irrigation departments and projects. Human resource development programs for most large organizations should also include training in:

* Planning (including corporate and strategic planning, organization planning, and financial planning);
* Assessment of cost/benefits and performance;
* Leadership and management skills; and
* Information management.

CHAPTER 3

SYSTEMATIC TRAINING

Training in one form or another is well regarded by most staff as a means to advance within their department. In addition to its personal value, however, sound management training is very important to proper unit management and project implementation.

Training as a Tool for Senior Management

Heads of large irrigation departments sometimes believe they may not be able to carry out changes which they know would benefit not only the department, but the irrigated agriculture sector as a whole. This explains why they sometimes do not fully implement the recommendations for change stemming from research or the conditions attached to loan contracts. Senior management may agree with the intent of the proposed changes but doubt that their staff has the commitment or ability to carry them out, or that they themselves have the capacity to communicate the vital importance of the proposed changes. Many senior managers also have quite definite ideas of beneficial changes they would like to introduce.

There are many reasons why these desirable innovations are rarely implemented, but one of the strongest is the inertia of the department staff whose natural predisposition is to resist changes that may affect them or their place in the department. They often do not understand or share the overall objectives of the managers of the department.

In Asia, the structure and historical nature of large irrigation departments explain much of this inertia. Relying heavily on irrigation rules and traditions, some dating back more than a century, managers reinforce their staff's concern for continuity. It is difficult to train a field officer to do things differently when the rules and traditions defining the position have remained the same for so long.

But there are important reasons why the senior management needs a more responsive staff. One is the need to match staff skills more closely to present irrigation conditions. These conditions have changed rapidly in the last twenty years and will change even more in the future. Many managers and directors would like to realign their departments to match the new conditions better. They would like to build an organization which could adapt more readily, while retaining a strong body of rules to assure continuity.

Department leadership also has recognized the value of closer linkage with other irrigation-related departments of government. At present this linkage is not strong in most countries. Linkage with agriculture departments is typically so distant that new structures, such as command area development authorities, have been initiated to help bridge the gap. National or state administrative staff colleges often could be used more deliberately to promote inter-institutional understanding and collaboration.

From the management's point of view, appropriate training programs are those which strengthen its overall control, permit innovation in providing irrigation services closely matched with current needs and contribute to the unity of the sense of purpose of the department. For the reason it is important that all staff know, understand and share the departmental objectives-this subject is discussed more fully in chapter 4.

Training as a Part of Staff Development

Chapter 2 described some forms of training that strengthen staff technical knowledge. This is relevant to the needs of the department, especially if newly joining staff are not well prepared. In addition, the fact that staff usually see training as a means

to advancement has peculiar ramifications since most individual-skills training is essentially designed to strengthen employees' skills within their present posts. Some of these programmes even stipulate that trainees must remain in their present posts for a year or more after receiving training. But at least as important to the long-term interests of both the department and the trainee is training that equips both to deal with new problems.

In recent years considerable interest has emerged in training irrigation department staff about agricultural matters and training agriculture staff about irrigation technology. This training has value in promoting a more client and result-oriented approach as described previously, but should not be highly technical or detailed. Irrigation department staff should understand how irrigation can be most useful for farmers and their crops and know enough about farming to relate effectively to farmers, but they should not be expected to carry out the whole range of agricultural work.

Systematic Training : Some Concepts

Most irrigation departments have managed to provide many training opportunities, but often have failed to design and implement systematc department-wide plans to upgrade and maintain the skills and motivation of their managers and staff. They have supported discrete training activities rather than comprehensive programmes of what may be termed human resource development. Furthermore, in very few cases has any attention been given to the effect of retirement and recruitment on the skills-mix available or on management succession planning.

Company-wide training programmes are widely practiced in private-sector firms, including those based in developing countries. They are regarded by corporate management as essential to recruiting and retaining high-quality staff and a means by which the management can directly influence staff. Specific job descriptions and performance evaluations form essential parts of such a programme. These programmes are designed to enhance the knowledge of both managers and staff and to link that knowledge with measures designed to improve departmental performance. They are essentially about achievement of positive results and not only about statistics on skills and management training.

How an irrigation department would implement such a plan can only be specified by the senior management of that department. In that process, the following strategic issues should be considered.

Comprehensiveness of levels

The programme should offer some form of training to all managers and staff in the department in order to build morale and a more responsive work place and to provide technical knowledge at all levels.

A programme covering essentially all staff levels would be effective because strengthened staff contributions at one level would be complemented, rather than impeded, by those at higher and lower levels. Individuals who should be involved in a comprehensive programme include :

Senior Managers,

Middle Managers,

Supervisors,

Professional Staff,

Administrative/Clerical Staff,

Technicians and Operators.

A comprehensive training strategy would reach across all projects and regional offices of a department, so that staff transfers-which are bound to occur in irrigation departments - would not seriously disrupt the effectiveness of the department.

Matching methods to target group

Each specific training activity within the programme should be carefully matched against the appropriate staff level. For example, technical on-the-job training might be appropriate for technical field staff, whereas brief seminars would be more appropriate for managers and other senior officials. Eventually, when the training plan is well underway and accepted, management may wish to design specific individual training opportunities rather than a more generalized programme. The skills proficiency and training history of each staff member should be recorded in their personnel file, routinely updated and regularly reviewed.

Department Initiative

An outside institution is usually not in a good position to advise on the details of training for a department. To be successful, the training should be result of a research and planning process carried out by senior management. Training consultants and institutions are available to assist management in developing such a plan, but their involvement should follow, not precede or substitute for, department initiative.

Establishing Comprehensive Training Programmes

Assuming a departmental goal to implement a comprehensive training plan, it is not necessary immediately to reach all staff or staff levels. There are advantages in initially training a relatively small group, even if that group thus becomes an elite unit within the department. The Upper Pampanga River Project within the Philippine National Irrigation Administration held such a position until many of its attributes were absorbed by the parent department.

To achieve the most impact, a comprehensive training plan should be managed by a very senior department officer. The person with responsibility for implementing the plan should report directly to top management if the programme is to serve their interests as well as those of the staff as a whole. While overall departmental coordination and direction is essential, it is equally important that the programme is adequately funded and strongly supported by individual managers. The training and development of subordinate staff must be seen as a direct responsibility of managers and supervisors

at all levels in the department. They should be involved in identifying training needs and in implementing some programme elements.

Some training activities envisaged within this programme may be quite similar to those already being offered. The basic differences will be the greater scope and closer attention paid to matching the activity to the needs of the staff and the department. In particular, the scope of the training programme for managers and other higher-level staff, who do not usually receive much training under conventional programmes, will be much broader and stronger.

Some of the most appropriate activities for senior officials are workshops and seminars of several days duration. These may be arranged in the home country or, in association with other institutions, in both the home country and abroad. If the training is held abroad, the department should play an active role in defining the scope and content of the activity.

CHAPTER 4

STRATEGIC DECISIONS IN PLANNING FOR TRAINING

Initial strategic steps in planning and selecting appropriate training activities are outlined in the following suggested sequence :

* The objective, targets and goals : the corporate mission statement;
* The functions and tasks to be performed by management and staff, consistent with agricultural sector policies and structures;
* The relative priority of tasks, including coordination with other agencies and users;
* The definition of requirement for training;
* The organization and implementation of the training programme;
* The budgeting for a training programme, periodically to be reviewed; and
* The follow-up, monitoring and evaluation of the training programme.

Development Objective

To achieve effective management, the relevant management authority of any organization must first develop a clear statement of the mission or purpose of the unit-those functions the organization is to perform and for which it is to be accountable. Such a statement, sometimes referred to as a "Mission Statement" or "Corporate Plan", should set forth the general philosophy and goals of the organization. It usually provides, as well, general guidance on human and financial resources; physical systems and technology choices; and information systems and performance management.

The Corporate Plan, which sets the overall policy for the organization, will require periodic, systematic review in the light of experience and changing circumstances. Changes may be required in the plan because of modifications in the socio-economic context, new technology choices resulting from research or shifts in price relationships. While the overall policy objectives may remain unchanged, technology choices, human resource and financial allocation and the rate of implementation may have to be modified. A plan that is realistically conceived will hold up well through such modifications.

Functions and Tasks Performed

Several government agencies, as well as the farmer and other water users, are usually intimately involved with the many aspects of irrigated agriculture. All the involved parties should be clear about their own functions and responsibilities and should also understand how these relate to the functions and taks of other. Effective collaboration should, in fact, be a mandated function for all concerned parties. Functional and task responsibilities should then be defined at the work-unit level and finally, to be set out in job descriptions for individual managers and other staff members.

Priorities for Critical Tasks

The relative priority of the many tasks involved in irrigated agriculture will change over time. Certain functions, such as ensuring public safety, may always be of major importance. On the other hand, management of construction will be important only during the development phase of a new irrigation scheme. Plans to recruit and train managers and staff obviously must take into account changes in the priorities of other critical tasks, while maintaining a coherent overall staffing and training program.

Training Programme Specification

Training should be a continuing activity in any public organization and is required for managerial and all other staff. However, it has seldom received continuing support from senior managers because its value is often unclear and its impact is uncertain. For this reason well designed and implemented programmes of training that lead to real performance improvements, increased staff motivation and commitment to change are of particular importance. The issue is to select the right subject areas and sequence of training for people who can and will make a difference to overall performance.

Two converging activities are needed to specify an effective, permanent staff training programme. The first, and more fundamental approach, is to define, in quantitative and qualitative terms, the staffing characteristics that will be desired by some future time, perhaps in five or ten years time. This is particularly important in developing a programme for induction training and for predicting future demands for university trained staff. The second and more usual approach, is to analyze current performance discrepancies and decide which deficiences may be corrected with management or other staff training. This second approach commonly requires a Training Needs Assessment (TNA).

TNAs are usually conducted when identified problems of irrigation performance are thought to be amenable to a training solution. But such assessments should not be conducted only when serious problems arise. The information assembled for an irrigation department TNA is essentially the same as that required to maintain a reliable record of staff and system performance. TNAs, therefore, should be an intrinsic part of the management process.

The following issues should be considered when preparing a productive TNA

Training does not solve all performance problems

There are many problems of irrigation performance that cannot be solved by staff training. Training of operations and maintenance staff, for example, is not likely to improve the performance of systems that are in bad physical condition. Similarly, where performance problems can be attributed to absenteeism or poor staff morale, organizational policies, not training, should receive urgent attention.

Before finally deciding to conduct a full-scale TNA, the current deficiences should be identified and defined and a determination should be made as to whether or not training is likely to remedy the problems. Only after training is determined to be a fairly certain solution is it advisable to undertake a comprehensive TNA that can support efforts to design an effective training strategy and programme.

Irrigation problems that result from poor performance of staff who have not mastered technical skills are among those most amenable to training solutions. Such easily remedied technical skills include estimating rates of water flows in canals and estimating and recording areas cropped at certain times during the season.

TNA methods

It is often assumed that different methods of needs assessment are required for different situations - for example, that training needs of individuals should be assessed differently from those of departments. Procedures for assessing individuals are, selected from among a wider set of procedures used to assess departments. They include, among other things, references to reports and records and use of external specialists to analyze specific aspects of irrigation performance and responses by managers and staff. However, processes for data collection-surveys, questionnaires, expert panels, peer group reviews and direct observation-are common to almost all TNAs.

TNA data

Two types of data are particularly important for successful TNAs:

* Information that identifies the nature and extent of irrigation performance shortcomings, and

* Accurate and complete personnel records.

Information on performance shortcomings may be available from monitoring units where they exist; but for countries in which monitoring is not yet well-established, a thorough assessment of how well the irrigation system and the department performs would be required before the decision is made to carry out a TNA.

A personnel inventory based upon employment records can provide an aggregate picture of staff performance, levels of skill, experience, formal education, in-service training and aptitudes. It should also include information about frequency of transfers, terminations, resignations and retirements, as well as potential for normal staff advancement and promotion. This information is important to planning the department's manpower requirements and to understanding the likely impact of training on irrigation performance. Departments should maintain locally a uniform human resources information system. Centrally-located personnel files should contain less details, but local managers should be fully informed of all aspects of their staff.

The most time-consuming part of conducting a TNA is to assess the skill levels of all critical personnel categories, such as junior engineers (section officers or watermasters) and executive and superintending engineers. This time can be reduced substantially if an up-to-date personnel inventory is maintained, especially if it includes supervisory evaluations of staff performance.

The process of carrying out a TNA can be summarized in the following seven steps:

* Define performance shortcomings
* Define the degree to which the shortcomings can be resolved by training;
* Select assessors for the TNA;
* Set performance and skill standards for key managers and staff;
* Draw profiles of the skills proficiency of key managers and staff;
* Define the gaps in skills of key personnel; and
* Determine which personnel to train and on what subjects.

The way in which the TNA is carried out is likely to determine the success of the resulting training programme. The key questions are :

* Does the whole process have the strong and declared support of senior management?
* Are operational staff involved in designing the TNA?
* Are all levels of management and staff consulted during the TNA?

Selecting appropriate elements of a training programme : Having reviewed the types of performance problems encountered in irrigation and a range of different training methods, we turn now to selecting appropriate activities.

Most irrigation problems can be addressed through a process of change that can be facilitated with suitable training activities. These activities differ in each situation and irrigation departments must decide which category of training is most appropriate to solve their current problems. Some of the more useful systematic training activities are discussed below.

Supervised on-the-job training

This is potentially the most effective means of upgrading the skill levels of individual staff, if the department clearly supports the training. To attain maximum success, the department must find appropriate supervisors to provide the training and convey to supervisors and participants, alike, the importance the department attaches to on-the-job training.

Virtually every irrigation department or project has some supervisors with the experience, knowledge and communications skills to organize and carry out on-the-job training. However, for a variety of reasons-seniority, protocol and discipline, among others-the most appropriate supervisors may be overlooked as possible trainers. The best on-the-job training supervisors are those who can impart to staff their sense of good judgement, along with their technical mastery of specific skills.

Initially, the supervisors providing on-the-job training will require guidance. External training consultants with extensive field experience may be useful in helping to set up the training. The department should also assist by prioviding training materials, transport and other logistic support. Most on-the-job training can be completed in one or two weeks.

On-the-job training is an effective way to deal with specific skill gaps, because the missing element is usually in staff ability to apply in the field skills they have mastered in the classroom. But perhaps the most important change accomplished through on-the-job training is attitudinal: it instills, throughout the department, a sense of individual confidence and a climate of self-help improvement. Departments that make skilled and repeated use of on-the-job training have well-establihsed means of communication within the department and clearly demonstrate their commitment to improve irrigation performance.

A common observation about on-the-job training is its gradual evolution into a more formalized course offering. Formal courses are relatively less costly, more convenient to schedule and hold, and easier to teach. Formal courses have an important place as discussed in the following section. They should complement on-the-job training, rather than substitute for it.

Formal courses

Courses, such as those of the Water and Land Management Institutes in India, are often appropriate mechanisms to strengthen individual skills. Many formal courses, particularly longer ones, impart information on a wide range of topics, only some of which may have an immediate bearing on the performance of the individual participants and the units in which they work. Long-duration courses, unless intended for retraining, may not offer distinct advantages in either time or cost over the recruitment of new, well-trained staff, where they are available and when the irrigation department has that option.

The most effective formal training is often provided by a course that rectifies specific skill deficiencies of a group of individuals with similar backgrounds and job assignments. Such courses are most appropriately given in-house. They may be expensive to prepare, however, in relation to the numbers of staff trained, unless the basic course can be repeated many times.

The major problem with formal courses is to find suitable instructors. External institutions are not normally in a strong position to provide them. Experience suggests that the best instructors usually come from the irrigation departments themselves, as they are able to maintain a sharp focus on the participants' work environment. External training consultants and other specialists may be called upon to assist with formal courses. The continued use of proven consultants for successive courses is generally more satisfactory than hiring new consultants each time. Formal courses do not offer much scope for dealing with problems of staff morale and attitude.

Workshops and seminars

Workshops and seminars are less appropriate for individual training, but can provide a good way to improve the effectiveness of the department as a whole. In practice, there is not much distinction between workshops and seminars, except that workshops are normally expected to produce an output-frequently a set of recommendations-whereas seminars are largely opportunities to exchange information. In the following discussion, the term "workshops" refers to both workshops and seminars.

Workshops are an excellent way to train managers and senior-and middle-level technical staff. They provide useful opportunities for personnel from both the department and other organizations in the irrigation sector to exchange views and learn from each other. Becuase they involve senior people, they must be carefully planned and carried out with due regard for protocol and interdepartmental sensitivities. The timing and location of workshops must fit the schedules of busy people, yet provide an atmosphere that is conducive to openness and informality.

A prerequisite for successful workshops is a focus on a limited set of issues. It is easier to gain agreement among participants on narrowly defined topics than on broad ones. As participants work together in a relatively narrow context, they develop mutual understanding that will later enable them to collaborate on issues of a broader nature.

Successful workshops involving relatively high-level participants should be prepared by a respected professional or an academic person perceived to be neutral, rather than a leader of one of the organizations involved. External training consultants can also be valuable resources for workshops, provided they have broad experience with such meetings.

Irrigation performance is frequently constrained because of factors "beyond the control" of the department. These may include the external context or environment of the agricultural sector or even the national economy. Workshops are an excellent means through which staff can be sensitized to some of these forces. They are then better able to adjust to and even influece some of these constraints.

Study tours

These are controversial training activities because of their cost, limited participation and potential for abuse. Yet study tours, such as those carried out with senior irrigation officials from India during 1980-82, can have a long-term impact far greater than might be expected.

Successful study tours are in effect seminars or workshops conducted in several locations and with a substantial field component. Their success derives from many of the same principles described for workshops. It is not always necessary to provide overseas travel for study tours; large countries such as India can provide a wide range of new field experiences to Indian irrigation personnel without taking them out of the country. The attraction of travel is, however, a strong incentive for senior irrigation staff to participate in study tours that take them to foreign countries.

Study tours are perhaps the most effective way that senior management can begin the process of changing key policies. In 1987, for example, relevant irrigation organizations in India planned and carried out a study tour in India and two other countries specifically to acquaint participants with the latest experience in farmer management of parts of an irrigation network.

People from a range of institutions and locations within a country come together as a team when they participate in a study tour. Many of those who then return to an active professional life can be extraordinary influential in opening their units to key policy changes.

Internships

Internships, in effect, provide extended in-service training with another organization. They are most useful for imparting to selected staff the workings and culture of those organizations. Internships can also be effective ways to training staff in new disciplines, such as research methodologies.

Departments generally tend to nominate junior staff who are not in critical positions as interns. This does minimize the impact of losing a staff member. But, as novices, many interns cannot convey to their temporary institution a strong picture of the sponsoring department and they may not gain as much from the experience as expected. Nevertheless, a limited number of internships remains an effective way

by which irrigation departments can bring in new ideas and skills and interact productively with other agencies concerned with irrigated agriculture.

Location of the training unit

A choice that often must be made at the outset of any new training plan is whether to set up a training unit within the irrigation department or to make use of outside training capability. Internally conducted training has the advantages of greater department control, fuller use of department staff and resources and perhaps lower costs. However, it does have several disadvantages. First, it may not have access to some of the best training expertise available to the sector. Second, it will not be strong in areas, such as agronomy, not normally within the immediate responsibility of the irrigation department. And third, it may not be perceived by staff as a prestigious benefit. In many countries, administrative staff colleges or other training institutes exist and may be able to provide suitable training for irrigation personnel on some aspects of their work.

In-service and on-the-job training should usually be carried out directly by the concerned department. This training strengthens the skills of its staff and builds a more responsive bureaucracy capable of change. But training of managers and senior and middle-level staff in many cases may be more effective if conducted jointly with other organizations.

A physical centre

A related question is the value of physical centre or campus dedicated to irrigation training. Several countries have constructed irrigation training centres during the past twenty years, but some of them now stand unused.

A training centre comprising buildings and perhaps some irrigation hardware gives an important sense of permanence and continuity to training. The centre may warrant a separate line in the department's annual budget, thus increasing the security and prestige of the training staff.

Irrigation training activities at a specialized campus can become too academic and remote from performance problems in the field. The in-house training staff may even conclude that training outside the centre is unimportant and should not be supported. If these views prevail, the department is left with essentially no on-the-job training, only formal classes which strengthen traditional ways of doing things, rather than promoting change. This situation often leads to the assignment of inferior staff as trainer, which further reduces the value of the training centre.

A training centre appears to make sense only when a department has a strong commitment to training for change; when ongoing training activities carried out in the field are strengthened, not by-passed, by training at the centre; and when the centre is staffed on a rotational basis with the ablest senior-and middle-level department field officers.

Research and training

Experience from higher education indicates substantial benefits when training, research and the provision of advisory services are combined. A research component provides new information to feed into the training function, which otherwise tends to become tradition-bound. Furthermore, combining a research function with training may increase the programme's appeal to competent staff who may not wish to be associated with a training programme alone. The Third element-consulting-ensures that research and training staff are faced with practical problems and have the opportunity to put their ideas into practice.

The Water and Land Management Institutes in India and some international centres have combined research with training. But-with the exception of routine measurement of evapotranspiration and similar data-most training programmes mounted by irrigation departments do not have significant research functions.

It appears that when irrigation training and research are combined at the national level, the former strengthens the latter; but the reverse may not occur. This is because in many countries irrigation research capacity is even more limited than training capacity, so the research mandate may retard training rather than strenghten it. Furthermore, traditional irrigation research has tended to focus on physical and biological effects of water use, not on operational and management decisions. That focus does not support the innovative training activities needed by irrigation departments to overcome their performance shortcomings in a changing environment.

Judgement in Irrigation

Irrigation systems, as mentioned in the early chapters, have traditionally been run according to rather set rules and norms. These have the advantage of being clear and presumably impartial and allowing minimal opportunity for field staff to use the system for their own purposes.

One of the objectives of the training strategy envisaged in these guidelines is to enable the department and its staff to respond intelligently to changes in the system, such as those related to water supply, farmers' wishes, or the system's external environment. With limits, training should enable staff to use sound judgement in applying irrigation rules with some flexibility.

How much creative judgement irrigation staff should be encouraged to use is largely a policy question. In constraining situations where water is in short supply, where system operation cannot accommodate much variation and where field staff have not earned the trust of senior management, the exercise of judgement by field staff cannot yet be encouraged.

But it should also be a department objective gradually to ease these constraints. As they become less binding, the department and its staff will achieve higher performance levels by exercising somewhat greater judgement in discharging their duties than is the case at present. They can be helped to learn sound judgement and sensible limits to its use by taking part in appropriate training activities.

Budgeting for a Training Programme

Training is a continuing requirement for all levels of management and staff and yet time is often not set aside and funds are not provided for this important function. During the construction phase of an irrigation system, training can be regarded as part of the initial investment costs, both in terms of its financial and staff time requirements. After the system is in operation, the cost of training should become an integral part of the costs of operations.

The proportion of management and staff time devoted to various forms of training varies very widely, according to the nature of the enterprise. Some private corporations dealing with rapidly changing technology may devote over 20 percent of their administrative budget to improving the performance of their staff. For irrigation departments, a range of 3 percent to 5 percent of staff time has been suggested as appropriate. However, each case should be analyzed separately. In all circumstances it is important that time and funds are specifically designated in the budget for management and staff training.

External borrowed and grant funds are appropriate for pre-commissioning training costs and to set up facilities and the training capacity for continuing operational training. However, the recurrent cost of operational training should be covered by domestic sources of funds, as it is an integral part of the cost of operations and maintenance.

The Follow-up and Evaluation of Training Programmes

At the end of each training activity it is customary and useful to seek the opinions of the participants on the substance and the process of the event. This evaluation is not sufficient to assess if the training has effectively imparted new skills or attitudes to work that will improve the performance of the trainees. It is, therefore, necessary to have some form of systematic follow-up some time after the training event.

The follow-up usually will have to be on a sample of former trainees. It should be designed to find out from the individuals concerned and their immediate supervisors, whether or not their performance has improved and if they are satisfied with their working conditions. Interviews with former participants provide an opportunity to reinforce the earlier training and perhaps to provide information and opinions helpful to improving future training activities.

In order to facilitate follow-up and to provide a sound basis for monitoring career development, it is important that the human resource information system of the personnel unit include records of all training events attended by each person in the department.

Periodically, at intervals of two to five years, it is advisable to evaluate the whole training programme of the department. The methodology can be quite similar to that suggested for a Training Needs Assessment. In addition, it would be useful to assess the quality and amount of training material developed for and through the various training events in the preceding period.

Next Steps

To establish a strong training programme along the lines envisioned here, each interested country could start with a workshop on the oeprations and maintenance of irrigation schemes under the auspices of the national central planning organization from which some recommendations on human resource development should emerge. This could lead to a small national workshop on the topic at which all agencies concerned with irrigated agriculture would be represented. The purpose of such a meeting would be to:

* Identify strategic concerns and issues in the irrigation sector;
* Identify and assign relative priority to issues and proposed actions;
* Review the current status of training within all agencies or departments who are concerned with irrigated agriculture regarding the priorities identified;
* Identify areas where performance can be improved through training; and
* Agree upon a plan of action to develop a detailed training strategy.

PREPARING AND CONDUCTING TRAINING NEEDS ASSESSMENTS FOR IRRIGATED AGRICULTURE

Training needs assessments (TNAs) are a structured way to analyze the training needs in relation to the objectives and targets of an irrigation department. Information from a TNA forms the basis of a department's plans for relevant and cost-effective training. This Exhibit describes the seven steps which comprise the TNA methodology and provides some suggestions as to how it can be implemented. In some cases it may be useful for "Step 3" to come first if help is required on the first two steps.

Step 1. Define performance shortcomings

When an organization analyses the performance of its managers and staff to determine the extent of shortcomings between expected and actual performance, it has undertaken the first and most important step in a review process leading to an overall assessment of its training needs. Some of these shortcomings may be addressed through training, but not all of them (See Step 2 below).

Measures of performance include indices relating to output and to performance of personnel at all levels. Output indices may be area-based measures of land benefited from irrigation, comparative yield data, or in some cases indices of rates of water supplied from various points in the canal network. Where water measurement data are reasonably reliable, they provide a strong basis for assessing performance shortcomings because water supply is a direct responsibility of irrigation personnel; crop yields are indirect. Other indices, such as time and cost to complete projects in relation to planned time and cost, may also be used.

Personnel indices include rates of absenteeism, the nature and number of personnel disputes and the extent to which staff act on behalf of the organization. Both quantitative measures and qualitative judgements of supervisory and management personnel may be used. In either case, senior management must evaluate the degree to which the information characterizes the organization as a whole before accepting and acting upon it.

Step 2. Determine the degree to which the shortcoming can be resolved by training.

Once performance shortcomings have been identified or changes in performance cirteria have been decided, an initial decision has to be made regarding the probability that training, alone or in combination with other improvements, is an appropriate solution. This can be facilitated by locating the management or staff level and source of each of the shortcomings. For most irrigation organizations, shortcomings may occur at any of these levels and may result from gaps in mastering the management or technical skills, lack of motivation or the environment of the job. These sources are elaborated and illustrated below.

* Some shortcomings are at the institutional level affecting the operation of the department as a whole; examples of these may be found in personnel management problems or counterproductive division of responsibility. To resolve these cases, a management restructuring may be required in which training has only a complementary role, since workshops may be useful to design and to introduce the new structure of the organization.

  In these situations, the department should be analyzed and new objectives set for those functions that are not being performed satisfactorily. Only when it can be clearly stated who will carry out the individual responsibilities of an organization and at what levels of proficiency, can current skill levels be assessed and training needs defined precisely.

* If the performance shortcoming can be traced to the individual level and is due to a lack of management or technical skills, direct training may be an appropriate remedy and an assessment of the training needs of these individuals should be carried out. An example is the finding that field staff are not measuring water as directed at various offtake points; a refresher course in water measurement might solve this problem.

  But other possibilities should also be considered, such as whether or not the staff had ever been properly exposed to water measurement; the measuring structures are fully functional; the staff's original or induction training was sufficient, or the recruitment and selection process brought the right individuals in to the department. The judgement that water measurement is an appropriate skill should also be confirmed before launching a refresher course in that subject, because many irrigation systems today are operated in the absence of water measurement.

* If the shortcoming can be traced to a department's functions, its remedy is likely to involve several management and staff levels and a combination of technical and clerical skills. Two examples of such shortcomings are the below-target collection of water user fees levied in most countries and rapid depreciation of construction equipment.

  These examples reflect the fact that many shortcomings at the function level result from management weaknesses or inconsistencies, the solutions to which may involve significant training activities. But changes in organizational procedures, either in conjunction with the training or separately, may be even more important.

* Shortcomings resulting from the relationship between an irrigation department and its external environment are least amenable to training solutions. Examples of these issues are salary structures set by national authorities and the relationships among the various agencies concerned with irrigated agriculture. These shortcomings are difficult to resolve through training because they cannot usually be reduced to specific operational tasks, functions or skill gaps. However, it may be useful to arrange an inter-institutional workshop to develop a consensus on how to resolve the issue.

Step 3. Select "assessors" for the TNA

Senior management must decide who will carry out the TNA. It may be done by the department's internal training or personnel unit, a similar unit from a local university or faculty of public administration, or by external management and training consultants. In all cases, line managers and user groups should be included. Internal assessors are familiar with the department and with the subtle but important reasons why it performs the way it does. External people have an advantage in independence of judgement and are less influenced by internal politics than internal assessors; however, it is important that they should be neutral and not suppliers of training. In either case, however, those carrying out the assessment must have clear authority from senior management to observe how field and office staff do their jobs, to interview managers and staff, to convene meetings and to have direct access to all relevant internal reports and personnel records.

Step 4 Set performance and skills standards for key managers and staff.

After identifying those activities and positions which require the improvement, assessors and senior management should then set standards of competency which, if met by staff, will ensure performance in key jobs at levels acceptable to management. In doing this, it is important to set realistic targets which can be achieved by the bulk of managers and staff with reasonable training, rather than very high or ideal targets which are not likely to be met by many of them.

This step is much easier if job descriptions are already available for the examined positions. Job descriptions serve as a standard against which staff may be evaluated. If they are not avilable, the TNA can still be carried out using standards similar to job descriptions against which to assess the performance of staff. The long-term aim should be to integrate performance evaluation with job descriptions.

Step 5. Draw profiles of the skills proficiency of key staff.

If the organization has reasonably complete personnel records or an inventory of staff skills, it is not too difficult to prepare a profile of the current skills proficiency of key staff. If this information is not available, it will have to be generated by the TNA assessors. This can be done through surveys of a sample of staff in each position, and is one of the most time-consuming parts of the TNA; however, it is possible to use the "nominal group technique" to speed up this stage of work (see below). At this stage it may be useful to make an evaluation of critical tasks, as outlined in the Illustration.

An Illustration : Evaluation of Critical Tasks

Can the task be performed?

- To the specified standard?
- In the timeframe identified?
- Under existing conditions?

NO YES —— No action at this time

It is related to people?

Is the present composition of employees appropriate, i.e., the number and type of employees to get the job done?

YES NO —Possible area for action : Recruitment
Job Redesign
Re-Deployment

Is the type of skills required to get the task done the same as in the past?

YES NO — Possible area for action : Training & Development
Retraining Job Redesign
Technology Change

Is the level of competence of employees appropriate ?
(i.e., the ability to get the job done)?

YES NO —Possible area for action : Training & Development
Retraining Job Redesign
Technology Change

Is the level of commitment of employees appropriate?

YES NO —Possible area for action : Training & Development
Communication Strategies
Consultation Strategies
Performance Review
Team Building

Step 6. Define the gaps in skills of key managers and staff.

The gaps are the diferences between the performance and skill standards (Step 4) and current skills proficiencies (Step 5).

Step 7. Determine which personnel to train and on what subjects.

Different types of training are appropriate for various levels of managers or staff and for different performance problems. This can be visualized as a range of training with different degrees of priority :

Priority 1. Those activities which should be strengthened as quickly as possible, for example, to prevent damage to canal structures or to achieve a target irrigation schedule during a season. Normally this training takes the form of on-the-job or refresher training for personnel who already possess many of the required skills.

Priority 2. Performance shortcomings which do not require immediate intervention or those resulting from a shortage of qualified personnel will probably involve specialist training at a location outside the department.

Priority 3. In every organization there are managers and other staff whose performance is not likely to improve as a result of training and who are not eligible for specialist training. These people possibly may, however, be re-trained to carry out a different set of jobs.

Nominal Group Technique (NGT)

The NGT is a decision making strategy which is designed to help generate a maximum input from group members while limiting unconstructive personal conflict within groups. One of its major features is the way it regulates group input and decision selections, limiting opportunities for conflict by structuring the steps in the decision process. The process also ensures that each participant has an equal chance to contribute. The sequential steps in NGT are as follows :

* Silent generation of ideas in writing;

* In turn feedback from group members to record each idea in a brief phrase on a flip chart;

* Discussion of each recorded idea for clarification and understanding; and

* Individuals voting on the relative priority of ideas with the group decision being mathematically derived through rank-ordering or rating.

Although this technique is commonly used as a decision making procedure, it can be modified for use in diagnosing and analyzing training needs.

Diagnostic Meetings

To begin the process, natural work groups within the department should be identified. Each of these groups must consist of up to 15 persons. Care should be taken to ensure that all participants in each meeting are at the same organizational level and have similar duties and responsibilities. The process can be broken into three distinct phases.

Phase 1: Nominal Grouping

The meeting for each of the natural groups should start with an introduction by a senior manager and the staff development officer. Each of them should emphasize that the purpose of the meeting is to identify problems in the organization which were inhibiting efficiency so that they should be corrected through training possibly combined with administrative changes. The group would be asked to provide open and honest input by simply listing on paper all of the problems which they perceived in their unit and in the department in general. After the problems are listed and clarified, the participants should be thanked for their input and informed that methods and procedures

for resolving the issues would be developed in later meetings. This entire process may last for no more than an hour for each group.

After these initial diagnostic sessions, the data should be summarized and collated according to the natural groupings within the department. It is quite usual to generate something in the order of 700 to 800 problems in a department. These may range from simple things, such as the inadequate lighting in staff areas, to more complex issues, such as the inability to operate sophisticataed machinery.

Phase 2: Rating

This phase concerns rating and assignment of priority to the problems identified in the first phase. Again natural groups should be formed representing the work areas in which unit problems have been identified. The groups should be given a list of all the problems relevant to their unit and asked to rate the importance, priority, and safety of each problem on a 10 point scale. In addition, they should be asked to mark either or both of two columns to indicate if the problem was caused by a performance or knowledge deficit. During the meeting, each of the categories should be carefully defined before the rating process is begun. The definitions are as follows:

Importance. This category refers to the degree to which this problem affects the quality of the department. Ask yourself: Will solving this problem noticeably improve the quality of the department? If so, give the problem a rating at the upper end of the scale, or vice versa.

Priority. This rating has to do with the degree to which you believe the problem is the management's or someone else's, give it a low rating. If you believe you can make a contribution to solve the problem, give it a high rating.

Safety. If this problem threatens the life or health of any of the population, give it a "yes",if not, give it a "no".

Knowledge. If this problem is attributable to a lack of knowledge, information, or training, give the problem a "yes". There is need for care on this one. Ask yourself: Would the employee be able to correct the problem without additional training, if their life depended on it? If the answer is "yes", the problem gets a "no" rating.

Mechanical. If this problem is mechanical or structural rather than a lack of ability or information, give it a "yes" rating. Give it a "no" rating if it cannot be corrected until a piece of equipment or structure is repaired or redesigned.

It normally takes groups 30 to 45 minutes to complete their ratings.

After the ratings have been completed, the data should be collated and tabulated for each unit of the department. The mean scores in the rating categories for priority, importance and knowledge should be totalled in order to determine the most critical problem areas.

Phase 3: Action Planning

The final diagnostic phase consists of action planning with the natural work groups. Two major things should happen in these sessions.

First, a senior manager should summarize all the high priority items for each group and indicate managerial actions to be taken in order to resolve issues. Second, the natural work groups should analyze and discuss the remaining problem. Task forces may be established, some of which may include several natural groups. These task forces should return at a later date with action plans to alleviate problems.

An important outcome of these action plans is generally to improve standard operating or administrative procedures. In addition, specific training programmes may be designed or arranged with suitable providers and other qualified personnel to help solve the technical and organizational problems.

ANNEX XVIII
(to Chapter 10)

QUESTIONNAIRE (CONFIDENTIAL)
FOR ASSESSMENT OF TRAINING NEEDS (ASSISTANT ENGINEERS)

1. What is your designation?_____

2. Please give your Academic Qualification (Tick √)

   Secondary/Inter Science _____ ☐

   Graduate _____ ☐

   Post Graduate _____ ☐

3(a) Please give your Technical Qualifications?

   Engineering Diploma _____ ☐

   Engineering Degree _____ ☐

   Post Graduate _____ ☐

   Other _____ (Specify)

(b) Membership of Professional Socieites

4. In which age Group are you now? (Tick √)

   Less than 30 years _____ ☐

   30 to 40 years _____ ☐

   40 to 50 years _____ ☐

   beyond 50 years _____ ☐

5. For how many years have you been working in the department of irrigation in :

   a) Investigations, planning only _____ ☐ yrs.

   b) Research and Designs only _____ ☐ yrs.

Source : Technical Report No.18 : Guidelines for conducting training needs assessment in irrigation management, LBII-WAPCOS, 1989.

c) Construction only _____ ☐ yrs.

d) Operation and Maintenance only _____ ☐ yrs.

e) Combined responsibilities from among a,b,c & d (above) _____ ☐ yrs.

Total _____ ☐ yrs.

6. How many years of this total were in major/medium irrigation? _____ ☐ yrs.

7. Do you feel Assistant Engineers and equivalent are well informed about the duties they and you are expected to perform in their job? (Tick√)

Very well informed _____ ☐

Somewhat informed _____ ☐

Not well informed _____ ☐

8. List of eight of the main duties of Assistant Engineers (& equivalent) performed in their job. (List all eight before going on to the next question)

i) _____
ii) _____
iii) _____
iv) _____
v) _____
vi) _____
vii) _____
viii) _____

9. Which of the above main duties do you find easy to perform? (Tick√)

i) ☐ ii) ☐ iii) ☐ iv) ☐

v) ☐ vi) ☐ vii) ☐ viii) ☐

10. Which of the above listed duties do you find somewhat difficult in performing satisfactorily? (Tick√)

i) ☐ ii) ☐ iii) ☐ iv) ☐

v) ☐ vi) ☐ vii) ☐ viii) ☐

11. For which of your main duties listed above do you feel that additional knowledge or training would be most helpful in performing your duties? (Tick √)

i) ☐ ii) ☐ iii) ☐ iv) ☐

v) ☐ vi) ☐ vii) ☐ viii) ☐

12. Do you feel that Assistant Engineers (& equivalent) have sufficient knowledge of :- (Tick √)

		Sufficient	Not Sufficient	Little	None
i)	Irrigation manual				
ii)	Storage/capacity design				
iii)	Dam Site selection				
iv)	Soil sampling & Soil mechanics & selection of materials				
v)	Spillway design				
vi)	Canal alignment & layout				
vii)	Construction management and C.P.M. techniques				
viii)	Project economics				
ix)	Design of weirs				
x)	Design of distribution system				
xi)	Quality Control in earth Dam construction				
xii)	Quality control in masonry works construction				

13. Think of an Assistant Engineer (or equivalent) officer who enjoys a high professoinal reputation for his work in designs and construction (do not write his name). List three things he does particularly well :

i) _____

ii) _____

iii) _____

14. Think of an Assistant Engineer (or equivalent) officer who has a poor reputation in designs and construction (do not write his name). List three things he does poorly:

i) _____
ii) _____
iii) _____

15. Do you feel Assistant Engineers (or equivalent) have sufficient knowledge of :-
(Tick ✓)

		Suffi-cient	Not Suffi-cient	Little	None
i)	Methods of flow measurement				
ii)	Calibration of measuring instruments/devices				
iii)	How to keep the irrigation system in efficient running condition				
iv)	Preparation of preliminary irrigation program				
v)	Monitoring of irrigation program				
vi)	Water balancing, water losses & water Conservation				
vii)	Overview knowledge of agronomy, soils, crops water requirements, etc.				
viii)	Scheduling of weir gates operations				
ix)	How to decide water allocation policy for each major/medium irrigation system				
x)	How to effectively organize farmers for scheduling/maintenance				
xi)	Maintenance and repairs of irrigation systems				
xii)	Cost estimating for mainte-nance and repair works				

16. Think of a Assistant Engineer (or equivalent rank) officer who has a good reputation for his work in system operation and maintenance. (Write his name) List three things he does particularly well :

i) _____
ii) _____
iii) _____

17. Think of an Assistant Engineer (or equivalent rank) officer who has a poor reputation for his work in operation and maintenance. (do not write his name) List three things that he does poorly in his work :

i) _____
ii) _____
iii) _____

18. Before a major/medium irrigation project is submitted for approval, initial work such as surveys, designs, drawings, estimates, cost benefits, etc. have to be carried out in compiling Irrigation Project Reports. Are Assistant Engineers (& equivalent) confident that they can compile such a report independently? (Tick √)

Very Confident _____ ☐

Confident _____ ☐

Not Very Confident _____ ☐

Do not know how _____ ☐

19. What skills do you feel the Assistant Engineer need to have strengthened in order to improve their job performance? (Training required for Assistant Engineers).

i) _____
ii) _____
iii) _____
iv) _____

20. What skills do you feel Assistant Engineers (& equivalent officers) need to strengthen by training in order to improve their job performance?

i) _____
ii) _____
iii) _____
iv) _____

21. Keeping in view official duties, which is the best month to release your subordinates for training?

1st Preference _____
2nd Preference _____
3rd Preference _____

22. What is the best month for you to be released for training?

1st Preference _____
2nd Preference _____
3rd Preference _____

23. If you could choose the topics to be covered in your own training, what would you be most interested in?

i) _____
ii) _____
iii) _____
iv) _____
v) _____

24. If you could continue higher professional education, in what field of specialisation would you be most interested?

1st Preference _____
2nd Preference _____

25. What other suggestions do you have regarding in-service training for the major/ medium irrigation sector?

_____
_____
_____
_____
_____
_____
_____
_____
_____

ANNEX XIX
(to Chapter 11)

SUMMARY OF RECOMMENDATIONS OF THE NINTH* FINANCE COMMISSION

The recommendations for O&M grant are given in the following paras. This grant is exclusive of interest charges otherwise payable by the State Governments on loan-advanced by the Central Government.

1. MAJOR AND MEDIUM SURFACE IRRIGATION PROJECTS

1.1 Rs.180 per ha per annum of gross irrigated area (GCA refer para 1.1.2 below) for O&M grant taking the base year as 1988.

1.1.1 Out of this, allocation for headworks should be to the extent of Rs.30 to 40 per ha depending on the type of the headworks.

1.1.2 While working out the gross irrigated area of any project, the two-seasonal crops and perennials are counted only once alongwith kharif and rabi crops.

1.2 Rs.65/- per ha to Rs.90/- per ha per annum of C.C.A. for the component of regular establishment.

1.3 An amount of atleast Rs.25/- per ha of the protected area to be provided for maintaining the drainage system in the command area.

1.4 1/3rd of the norms at para 1.1 above, should be provided for unutilized potential.

1.5 20 per cent of para 1.1 above should be provided for special repairs over and above the normal maintenance grants as and when required.

2. MINOR SURFACE IRRIGATION SCHEMES

2.1 For minor surface irrigation schemes in hilly areas of Himalayan region, O&M grant should be atleast Rs.900/- per ha of gross irrigated area including the cost of regular establishment.

2.2 In addition, 20 per cent of the above O&M grant should be provided for special repairs as and when required.

2.3 For hilly regions of the other States the grants may be increased by 30 per cent of para 1.1 above for the extra requirements of maintenance in such systems.

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* The Government of India has constituted the Tenth Finance Commission on 15th June 1992.

3. LIFT IRRIGATION SCHEMES (Inclusive of Electricity Charges and Establishment)

3.1 Lift irrigation schemes by pumping from river and storages	Rate in Rs. per ha of actual irrigation
Group A upto 0.15 cumec	770.00
Group B above 0.15 to 0.75 cumec	620.00
Group C above 0.75 to 3.00 cumec	500.00
Group D above 3.00 cumec	475.00

3.2 Lift irrigation from canals

Group A upto 3.00 cumec	550.00
Group B above 3.00 to 15.00 cumec	520.00
Group C above 15.00 cumec	500.00

3.3 Irrigation from augmentation tubewells 735.00

3.4 Irrigation from direct State tubewells 665.00

3.5 The O&M grant should be updated annually for the escalation in the costs of labour, material and equipment based on the overall increase in the All India Consumer Price Index.

3.6 The Finance Commission Members felt that the recommendations made above are the minimum requirements required for proper maintenance of created assets. No reduction may therefore be effected in the O&M grant as otherwise the systems will go in disuse.

3.7 The Plan funds are required to modernize (or rehabilitate) the system. The Commission members further felt that the above recommendations will increase the burden on the States' exchequer and desired that suitable measures may be initiated by the State Governments.

ANNEX XX
(to Chapter 12)

SPECIMEN FORMAT

Y CANAL SYSTEM
INPUT FOR WATER ALLOCATION

Form Code : **Frequency : Annual**
Unit : Cumec

January	February	March	April
I II III IV	I II III IV	I II III IV	I II III IV

River

Year

Location

May	June	July	August
I II III IV	I II III IV	I II III IV	I II III IV

September	October	November	December
I II III IV	I II III IV	I II III IV	I II III IV

Prepared by :

Date :

Reviewed by :

Date :

ANNEX XXI
(to Chapter 13)

LIST OF FORMATS
(Manually monitored large irrigation system)

1. Monitoring of outletwise irrigation during field inspections.
2. Graphical Bar Chart showing roster and running of channels.
3. Monitoring of tail gauges.
4. Weekly progress report of area irrigated.
5. Monthly statement of checking Rabi/Kharif irrigation measurements.
6. Monitoring of week-wise water allotted and delivered (cusec days) to various divisions under the command in each season,
7. Water depth obtained for maturing Rabi and Kharif crops in the command.
8. Monthly report on number of unauthorised irrigation cases reported.
9. Junior Engineer's Monthly Journal - Canal Maintenance Inspection Report.
10. Junior Engineer's Monthly Journal - Canal Operation Achievement Report.
11. Junior Engineer's Monthly Journal - Clearance of Channels and Repairs to Lining.
12. Monitoring of discharge carrying capacity of channels.
13. Weekly statement of monitoring of power supplied to tubewells and demand.
14. Report for Monitoring of Groundwater levels for May/ October.
15. Irrigation Performance Review - Area Irrigated and revenue assessed.
16. Quarterly Expenditure Report for Operation and Maintenance costs.
17. Fortnightly statement of u/s and d/s gauges at Hydro-power stations.
18. Conveyance losses in watercourses/field channels before and after lining.
19. Number of waterings given from canal irrigation.

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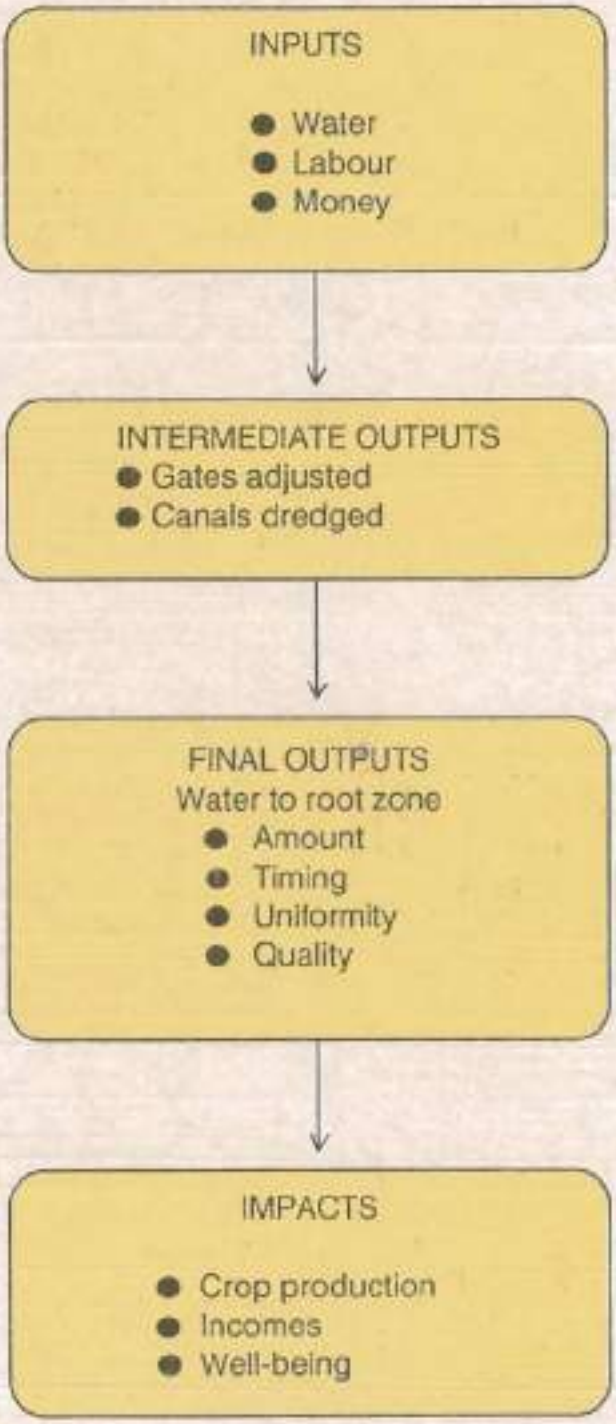

Model of irrigation systems showing inputs, outputs and impacts
(Source : IFPRI 1992)

ABOUT INCID

The Indian National Committee on Irrigation and Drainage with INCID as its acronym, was first constituted by the Ministry of Water Resources (MOWR) in April, 1990 with a composition of 18 members with Chairman, CWC as its Chairman. This has again been reconstituted by the MOWR in January, 1994 with a composition of 21 members. The INCID is presently having 9 Special Committees looking after 9 subjects with a total membership of about 135, a multi-disciplinary group of irrigation, drainage and agricultural Engineers, soil and crop Scientists, agro-economists, hydro-geologists, social and environmental scientists, economists etc; drawn from State Irrigation Departments, Central Water Commission, Planning Commission, Indian Council of Agriculture Research, Indian Agriculture Research Institute, Water Technology Centres, Research Institutions, Water and Land Management Institutes, Agricultural Universities, Engineering Universities and Consultancy firms like WAPCOS etc.

The main functions of INCID include advising Central and State Governments and their agencies on matters related to irrigation and drainage; preparing and updating the State-of-the-art on different branches of irrigation and drainage; dissemination of information; coordination and recommendations for funding of research programmes including monitoring of the schemes; promotion and coordination for effective participation of India in International Programmes of ICID and other agencies; promotion of educational and training and manpower development programmes; arranging and conducting Seminars/Conferences/ Workshops and also R&D review sessions etc.

INCID has an ambitious programme of bringing out publications on matters of topical interest in the field of irrigation and drainage. Development of Irrigation, Drainage and Flood Control in India, Non-Structural Aspects of Flood Management in India; Text and Current Status in India on Agenda 21, Chapter 18 of Earth Summit held at Rio etc are some of the publications brought out so far, besides the periodical Annual Reports at the end of financial years. The present publication is one up in the series, greatly beneficial to the project operating agencies in preparing the POMs to achieve efficient and optimal functioning of the irrigation systems.

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