1995 WORLD BANK WATER SEMINAR

Dear Friends of Water,

Welcome to the 1995 Water Seminar sponsored by the World Bank's Water Thematic Team and the Learning and Leadership Center. This event is a milestone for the Bank since it is the first fully integrated seminar on water resources. For this event, we have adopted an integrated approach, stimulating the presentation of cross-sectoral experiences and gathering staff and experts from irrigation, water supply, and the environment. Thus this seminar is an effort to put into practice what was advocated in the Bank's 1993 Water Resources Management Policy.

The transition from a sectoral to a cross-sectoral approach to water resources management offers many challenges. Dialogue among ourselves and learning from one another will help to meet the challenges ahead. The seminar is an opportunity for us to learn. We hope we have provided good conditions for successful interaction.

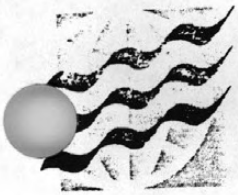
We are grateful to all those who have made this transition possible, in particular to all the speakers, chairpersons, and members of the Thematic Team and of the Organizing Committee. We look forward to your contributions and active participation.

[redacted]

Salah Darghouth
Division Chief, MN2NE
Chair, Seminar Organizing Committee

[redacted]

Guy Le Moigne
Senior Advisor, Water Resources
Water Thematic Team Coordinator



1995 WORLD BANK WATER SEMINAR

AGENDA

MONDAY, DECEMBER 11, 1995

6:00-7:00 pm	**Reception** (The Rotunda)
7:00-8:00 pm	**Dinner** (The Jeffersonian Room)
8:00 pm	**OPENING ADDRESS: The World Bank Water Resources Management Agenda: Challenges Ahead**

Chairperson: ***Salah Darghouth***
Speaker: ***Guy Le Moigne***

1995 WORLD BANK WATER SEMINAR

TUESDAY DECEMBER 12, 1995--MORNING

7:30-9:00 am **Breakfast** (Restaurant)

THEME I: IMPLEMENTATION OF THE BANK'S WATER RESOURCES POLICY

9:00-9:45 am

PLENARY SESSION
KEYNOTE ADDRESS

Chairperson: Guy Le Moigne
Keynote Speaker: Ismail Serageldin

The Washingtonian Room

9:45-11:30 am **GROUP SESSIONS**

GROUP 1

Basin Water Management

Chairperson:
Narendra Sharma

(A) Tanzania National Water Strategy
Fred Njau
(B) Pangani and Rufiji Basins (Tanzania)
Rafik Hirji

Grand Dominion 1

GROUP 2

Intersectoral Aspects of Water Management

Chairperson:
Maritta Koch-Weser

(A) Shanghai, China
Michael Burley
(B) Madras, India
Keith Oblitas & Michael Whitbread

Grand Dominion 2

GROUP 3

Country Water Management

Chairperson:
Stephen Lintner

(A) Jordan
Andrew Macoun & Chris Ward
(B) The Philippines
Jeffrey Gutman, Penelope Brook-Cowen & Mei Xie
(C) Reforming Water Policies--EDI Activities
François-Marie Patorni

Grand Dominion 3

GROUP 4

International Water Management

Chairperson:
Sushma Ganguly

(A) Lessons from Bank Experience
W. Robert Rangeley
(B) Lake Victoria
Lars Vidaeus
(C) The Ganges
Salman Salman
(D) GEF and New International Waters
Richard Paton

Grand Dominion 4

11:30-11:45 am **Coffee** (The Rotunda)

11:45 -12:45 pm

PLENARY SESSION
GENERAL DISCUSSION

Chairperson: Guy Le Moigne

The Washingtonian Room

12:45-2:00 pm **Lunch** (Restaurant)

1995 WORLD BANK WATER SEMINAR

TUESDAY, DECEMBER 12, 1995 AFTERNOON

THEME II: INSTITUTIONAL ASPECTS OF WATER RESOURCES MANAGEMENT

2:00-2:45 pm

PLENARY SESSION
KEYNOTE ADDRESS

*Chairperson: **Kevin Cleaver***
*Keynote Speaker: **John Briscoe***

The Washingtonian Room

2:45-4:30 pm **GROUP SESSIONS**

GROUP 1

Water Rights and Water Markets

Chairperson:
John Briscoe

(A) Chile
K. William Easter
(B) California
Richard Howitt
(C) Mexico
Douglas Olson

Grand Dominion 1

GROUP 2

Restructuring Institutions

Chairperson:
Salah Darghouth

(A) Office du Niger (Mali) ***Djibril Aw & Chantal Dejou***
(B) U.S. Bureau of Reclamation
Sam Guy

Grand Dominion 2

GROUP 3

User Participation

Chairperson:
David Steeds

(A) Indonesia: Irrigation: and Water Supply
Bert Kramer and Vicente Paqueo
(B) Vietnam
Phan Sy Ky
(C) Update on Bank experience in other areas
Joma Mohamadi and Peter Sun

Grand Dominion 3

GROUP 4

Private Sector Participation

Chairperson:
Guillermo Yepes

(A) Brazil (Irrigation)
Gabriel Azevedo
(B) Colombia & Spain (Water Supply)
Juan Ras
(C) Argentina & Chile Bank study tour report
Guillermo Yepes

Grand Dominion 4

4:30-5:00 pm **Coffee** (The Rotunda)

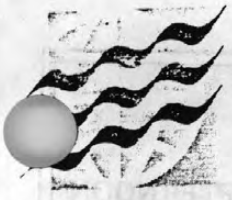
5:00 -6:00 pm

PLENARY SESSION
GENERAL DISCUSSION

*Chairperson: **Kevin Cleaver***

The Washingtonian Room

6:00-6:30 pm **Free Time**
6:30-7:30 pm **Reception** (The Rotunda)
7:30-8:30 pm **Dinner** (Restaurant)
8:30-10:00 pm **OPEN PRESENTATIONS** (To Be Announced During Seminar)



1995 WORLD BANK WATER SEMINAR

WEDNESDAY, DECEMBER 13, 1995 MORNING

7:30-8:30 am **Breakfast** (Restaurant)

THEME III: WATER CONSERVATION AND RE-USE, AND ECONOMIC ASPECTS

8:30-9:30 am

PLENARY SESSION
KEYNOTE ADDRESS

Chairperson: ***Anil Sood***
Keynote Speaker: Caio Koch-Weser

The Washingtonian Room

9:30-11:00 am **GROUP SESSIONS**

GROUP 1

Drainage Water Re-use

Chairperson:
Shawki Barghouti

(A) California/San Joaquin Valley
Vashek Cervinka
(B) Constructed Wetlands
J. Walter Ochs & Jan Post

Grand Dominion 1

GROUP 2

Water Conservation and Re-use

Chairperson:
John Hayward

(A) Israel
Emanuel Idelovich
(B) China Qucun Aquifer
Usaid El-Hanbali

Grand Dominion 2

GROUP 3

Risk Analysis in Water Supply and Sewerage Projects

Chairperson:
Klas Ringskog

(A) IFC
Liz Bronder
(B) MIGA
Daniel Wagner

Grand Dominion 3

GROUP 4

Economic Analysis

Chairperson:
Ricardo Halperin

(A) Economic Analysis at the World Bank
Pedro Belli
(B) Economic Analysis of Water Projects
Mike Garn

Grand Dominion 4

11::00-11:30 am **Coffee** (The Rotunda)

11:30-12:30 pm

PLENARY SESSION
GENERAL DISCUSSION

Chairperson: ***Anil Sood***

The Washingtonian Room

12:30-2:00 pm **Lunch** (Restaurant)

1995 WORLD BANK WATER SEMINAR

WEDNESDAY, DECEMBER 13, 1995--AFTERNOON

2:00-3:00 pm

PANEL DISCUSSION WITH ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT DEPARTMENT DIRECTORS: FUTURE DIRECTIONS

Chairperson: Guy Le Moigne
Panel Members: Alex A. McCalla, Anthony Pellegrini, and Andrew Steer

The Washingtonian Room

3:00-4:00 pm **SEMINAR WRAP-UP** ***Guy Le Moigne*** (The Washingtonian Room)
4:00 pm **Buses Depart** for World Bank
5:00 pm **Arrival** at World Bank

ABSTRACTS OF PRESENTATIONS

Tuesday, December 12, 1995

THEME I: IMPLEMENTATION OF THE BANK'S WATER RESOURCES POLICY

Theme Coordinator: **Stephen Lintner,** ENVLW
Chairperson : **Guy Le Moigne,** AGRDR

PLENARY: Keynote Address by **Ismail Serageldin**
Vice President, Environmentally Sustainable Development

GROUP 1: BASIN WATER MANAGEMENT

Chairperson: **Narendra Sharma,** AFTES

(A) Tanzania National Water Resources Strategy

Fred Njau, Ministry of Water, Energy, and Minerals, Government of Tanzania.

Highlights Bank's involvement in river basin management and smallholder irrigation improvement as part of Tanzania's water resources strategy preparation process. Water and land use conflicts and their economic implications, institutional constraints, proposed interventions and progress to date will be discussed. Lessons will be drawn for water resources management (WRM) in sub Saharan Africa.

(B) Pangani and Rufiji Basins, Tanzania

Rafik Hirji, ENVLW

Summarizes the principal issues and challenges for managing the nation's water resources and describes a phased, participatory approach to strategy formulation adopted by government, together with the Bank. The phases include: water sector review; rapid assessment; seminar on WRM in Tanzania; river basin management and smallholder improvement projects. The phases provide the steps towards the formulation of a national strategy.

GROUP 2: INTERSECTORAL ASPECTS OF WATER MANAGEMENT

Chairperson: **Maritta Koch-Weser,** ASTEN

(A) Shanghai, China

Michael Burley, Mott McDonald, UK

The need to ensure sustained water supply to China's major cities gives rise to difficult institutional, logistical, quantity and quality challenges. These are highlighted by Shanghai, where the Municipal Government has made continual and major investments to support economic growth and industrial production in eastern China while facing pricing and competing-use dilemmas. The Bank is supporting these initiatives which aim to optimize environmentally-sound water use, through the on-going Shanghai Environment Project and the Taihu Basin Flood Control Project. The strategies considered by Shanghai and the solutions adopted will be reviewed along with comments on similar challenges in the highly-industrialized Liaoning Province of China.

(B) Madras, India

Keith Oblitas and Michael Whitbread , SA2AW

The initiatives underway, next steps and future options in the State of Tamil Nadu, India to facilitate the allocation of water between competing uses in the State and its main city, Madras will be outlined. The Bank-assisted Tamil Nadu Water Resources Consolidation project and Madras Water Supply and Sanitation project are assisting changes in State policy, institutions, and capacity building to confront water scarcity, allocation and environmental issues.

GROUP 3: COUNTRY WATER MANAGEMENT

Chairperson: **Stephen Lintner,** ENVLW

(A) Jordan

Andrew Macoun and Chris Ward, MN2NE

Presents results and lessons from the Bank's involvement in preparing a Water Sector review for Jordan, one of the driest countries in the world. The Water Country Team-based approach to addressing assistance needs in the water sector will be outlined. The experience of the Jordan Water Sector review will be presented. The focus will be on the process of formulating a country strategy and on lessons relevant to Bank staff.

(B) The Philippines

Jeffrey Gutman, EA1AE, ***Penelope Brook Cowen,*** TWUWS/EA1IN, and ***Mei Xie,*** EA1AE.

In July 1995, the government passed special legislation in the form of the Water Crisis Act, in a bid to facilitate solutions to a water crisis. Subsequently, the Bank's EA1AE and EA1IN were asked to assist in the preparation of an action plan for the implementation of the Act. A Ten Point Action Plan was produced after due consultations. The Plan seeks to integrate work to improve efficiency and accessibility of urban water and sanitation services with ongoing work towards the strengthening of water resource management in the country.

(C) Reforming Water Policies: EDI Activities

Francois Marie-Patorni, EDIEN

Objectives, progress to date, and upcoming activities under EDI's Water policy reform program will be presented. The Program focuses on four areas: National Water Strategy formulation; River Basin Management; Reforms and Private Sector Participation; Participatory Irrigation Management.

GROUP 4: INTERNATIONAL WATER MANAGEMENT

Chairperson: **Sushma Ganguly,** AF2AE

(A) International Waters – Process and Evolution

Robert Rangeley, Rangeley Associates

Many rivers cross international boundaries and this aspect of WRM is increasingly becoming important for external support agencies. The main principles of managing international waters and their application with illustrations will be reviewed. How these principles and applications match the Bank's operational policies will be discussed. Conclusions on the relevance and potential for donor involvement in international waters will be examined.

(B) Lake Victoria

Lars Vidaeus, ENVGC

The Lake Victoria Environmental Management Program fits into the strategies of the Governments of Kenya, Uganda, and Tanzania towards strengthening national resource management institutions required to support regional programs and establishing a program to manage fisheries, lake water pollution and land use in the wetlands in the region. Several million people use the lake waters and it is also a repository for human, agricultural and industrial waste. Increasing population and demands on water are making the lake environment unstable. The environmental and water use issues related to the Lake Management Program will be discussed in the context of managing international waters.

(C) The Ganges

Salman Salman, LEGSA

The roots of the dispute between India and Bangladesh on the Ganges river will be examined and attempts to reach an agreement between the countries on the sharing of the Ganges waters, including augmentation of dry season flow, will be discussed. Agreements reached and current status will be reviewed.

(D) GEF: International Waters Policy

Richard Paton, ENVGC

GEF has recently amended its policy for support of international rivers issues. The rationale for change, consensus reached and elements of the new policy will be shared.

THEME II: INSTITUTIONAL ASPECTS OF WATER RESOURCES MANAGEMENT

Theme Coordinator: **Ashok Subramanian,** AGRPW
Chairperson : **Kevin Cleaver,** AFTDR

PLENARY: KeynoteAdddress by **John Briscoe**
Chief, Water and Sanitation Division
Transportation, Water, and Urban Development Department

GROUP 1: WATER RIGHTS AND WATER MARKETS

Chairperson: **John Briscoe, TWUWS**

(A) Chile

K. William Easter, University of Minnesota

Chile has taken a number of steps in assigning tradable water rights to users. The outcome of the water rights program will be reviewed through a detailed study on effects on various stakeholders. Facilitating and constraining factors in adopting such a program will be discussed.

(B) California

Richard Howitt, University of California, Davis

Water markets have recently evolved in California and have stimulated incentives to modify current water rights. The presentation uses examples of actual transactions to illustrate the current impediments to increased water markets. California's experience shows that markets are an integral part of reallocating supplies and providing incentives for efficient use. However, problems arising from markets such as third party effects, groundwater depletion and conveyance capacity require that water rights are appropriately modified.

(C) Mexico

Douglas Olson, LA2NR

Examines the application of water rights policies to Mexico to carry forward the reform process initiated in the 1980s to improve conservation, decentralize water management, build government-user partnership and improve financial sustainability.

GROUP 2: RESTRUCTURING INSTITUTIONS

Chairperson: **Salah Darghouth,** MN2NE

(A) Office du Niger, Mali

Djibril Aw, AF4AE and ***Chantal Dejou***, AF5AE

Discusses recent developments that led to a tripling of paddy yields in a large irrigation scheme in sub-Saharan Africa managed by the Office du Niger, Mali. Emphasis is on institutional reforms, especially the process of streamlining the parastatal's functions, divesting some services, laying off redundant staff, enhancing beneficiary participation and securing land tenure. The process of managing such change, including donor coordination, will be reviewed.

(B) US Bureau of Reclamation

Sam Guy, ASTEN/USBR

Describes the recent restructuring of the US Bureau of Reclamation focusing on the process used, internal and external reactions, and current status. The USBR is highly respected in the world water resources community and the restructuring process and its effects are being followed very closely by similar institutions worldwide.

GROUP 3: USER PARTICIPATION

Chairperson: **David Steeds,** AGRPW

(A) Indonesia: Irrigation and Water Supply

Bert Kramer, EA3AG and ***Vicente Paqueo***, EA3PH

User participation in irrigation (Kramer) will touch upon two Bank supported programs the turnover of public irrigation schemes to water users and the

irrigation service fee program. Sustainability of the turnover schemes will be discussed. Conditions for successful implementation of the service fee program -- such as fair determination of fees and use of the money collected for maintenance of the system -- will also be reviewed. Participatory approach to project development and management in water supply (Paqueo) will be reviewed with illustrations from the Water Supply project for Low Income Communities and the Rural Water Supply Pilot project. Evolving rules of participation and management of the system and feedback from users on quality of service will be discussed. Facilitating and constraining factors within the Bank for the adoption of a participatory approach will be outlined.

(B) Vietnam

Phan Si Ky, Vice Minister, Ministry of Water Resources

Reviews the experience of user participation in Vietnam and discusses options for government-water user partnership in irrigation management.

(C) Update on Bank Experience in other areas

Joma Mohamadi, EC1AE and ***Peter Sun***, EDIEN

Reviews the experience of large scale transfer of irrigation systems management to water users in turkey. Since mid 1993, about one million hectares or about 60 per cent of the area managed by government has been transferred. The main results are reduced spending and subsidy by government, improved water delivery to users, improved maintenance and increased agricultural production. EDI's Participatory Irrigation Management Program has played an important role in supporting the transfer of experience from one country to another through study tours and action oriented educational experiences. The programs and plans of EDI in this regard will be presented and reviewed.

GROUP 4 : PRIVATE SECTOR PARTICIPATION

Chairperson: **Guillermo Yepes**, TWUWS

(A) Brazil Irrigation

Gabriel Azevedo, LA1ER

The potential for private investment in irrigation will be reviewed through an assessment of Bank-financed public irrigation projects in Brazil. The Jaiba Irrigation project will be discussed to illustrate an attempt to develop a new model of investments in irrigation. Conditions under which private investment will be forthcoming will be discussed.

(B) Colombia and Spain(Water Supply)

Juan Ras, Groupo AGBAR

The experience of Spain and Colombia in private sector participation in joint ventures with public authorities will be presented. Joint ventures provide long term solutions, where investments are minimized, bureaucratization is avoided and goals common to public and private interests are created. The importance of training is emphasized.

(C) Argentina and Chile Bank Study Tour Report

Guillermo Yepes, TWUWS

Reflections on the recent (November 6-16, 1995) Bank study tour to the two countries will be shared.

Wednesday, December 13, 1995

THEME 3: WATER CONSERVATION AND REUSE AND ECONOMIC ASPECTS

Theme Coordinator : **Guillermo Yepes**, TWUWS
Chairperson : **Anil Sood**, EMTDR

PLENARY: Keynote Address by **Caio Koch-Weser**
Managing Director (Designate), Operations

GROUP 1 **DRAINAGEWATER REUSE**

Chairperson: **Shawki Barghouti**, SA2AW

(A) ***California/San Joaquin Valley***

Vashek Cervinka, Department of Agriculture, California

Several farms in California are using a method for salt removal on irrigated farmland. The method utilizes drainage water as a resource to sequentially irrigate trees and crops with progressively increasing salt tolerance. Drainage water, with leached salt, flows from conventional farm crops to salt tolerant trees, then halophytes, and into a solar evaporator. The reduced volume of drainage

water evaporates and salt crystallizes in the solar evaporator. This experience and the potential for its spread will be reviewed.

(B) Constructed Wetlands

Walter Ochs, AGRPW and ***Jan Post***, ENVLW.

A new concept for water quality improvement will be introduced. Water discharged from irrigation systems or from agricultural areas through drainage systems is often polluted from agricultural chemicals and salts that are leached from the root zone of crops. Constructed wetlands which are designed to permit drainage water to flow through them are expected to improve water quality and provide other environmental benefits. Potential wetland functions that provide multiple benefits to the environment while improving water quality, together with two examples of Bank supported efforts in constructed wetlands, will be discussed.

GROUP 2 WATER CONSERVATION AND REUSE

Chairperson: **John Hayward**, EMTAW

(A) Israel

Emanuel Idelovich

Israel has pioneered policies, technologies and systems in water conservation and reuse. As other countries in the middle east and elsewhere face similar situations of scarcity, the lessons of water management in Israel are increasingly relevant. The country's experience will be reviewed and current status outlined.

(B) China Qucun Aquifer

Usaid El-H̃anbali, EA2RS

Groundwater management is an important element of water augmentation and conservation. The Bank's involvement in the Qucun Groundwater Recharge Scheme in China will be reviewed. The genesis of the scheme, evolution during project processing, and progress to date will be outlined. Agreement with the borrower on steps to implement the scheme has led to its successful execution.

GROUP 3: RISK ANALYSIS IN WATER SUPPLY AND SEWERAGE PROJECTS

Chairperson: **Klas Ringskog**, LATAD

(A) IFC

Liz Bronder, IFC

Issues facing private concessionaires, operators and lenders in water projects will be reviewed. Conditions for private sector participation, "financeability" of projects and risk mitigation measures that can be taken in restructuring contractual agreements for BOT/concession will be examined. Issues in risks facing projects at the municipal level will be addressed.

(B) MIGA

Daniel Wagner, MIGA

Focus will be on the role of political risk insurance in mitigating the risks that a government will interfere in the operation of or control of a project. Means of protection against the risks of expropriation, currency inconvertibility/non-transfer, and war and civil disturbance utilizing MIGA's Guarantee program will be discussed.

GROUP 4: ECONOMIC ANALYSIS

Chairperson: **Ricardo Halperin**, EC1IN

(A) Economic Analysis at the World Bank

Pedro Belli, OPRPG

The economic analysis of projects relevant to today's needs starts from a different conception of the role of government and asks a different set of questions than the methodology of the 1970s. The new methodology should look at the project from the perspective of the implementing agency, the government, and the country. It should try to assess whether all of the main actors have the economic and financial incentives to implement the project as designed, identify and measure external effect of projects, extend the analysis to health and education, and provide a more systematic assessment of risk.

(B) Economic Analysis of Water Projects

Mike Garn, TWUWS

Issues in economic analysis of water projects, including the definition of the major functions of appropriate economic analysis, will be discussed. In addition to economic input into rate of return analysis, aspects of the project -- demand and benefit estimation; tariff setting; structures and implications of tariffs for demand; and risk assessment -- where additional economic input is most needed and where it can be expected to make the greatest contribution to improved project performance will be reviewed. Data and examples from the Bank's regions will be provided.

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WORLD BANK PARTICIPANTS

Division	Name	Title	Ext.	Room No.
AF1AE	Larson, Jeri	Sanitary Engineer	38121	J11-025
AF1AE	Yudelman-Block	Sr. Water Resources Mgmt. Spec.	34665	J11-064
AF1EI	Gambrill, Martin P.	Economist	31933	J4-083
AF1EI	Shepherd, Kenneth J.			
AF2EI	Ruiz, L. Keta	Sr. Municipal Engr.	34079	J10-079
AF2EI	Talai, Iraj	Sr. Agriculturist	33095	J6-129
AF2EI	Tschannerl, Gerhard	Municipal Engineer	34158	J6-123
AF4AE	Aw, Djibril	Sr. Economist	33357	J9-141
AF4IN	Diou, Christian	Sr. Environmental Spec.	34749	J9-129
AF5AE	Dejou, Chantal			
AF5AE	Oka, Abdelkrim	Division Chief	24927	J4-135
AF5IN	Fall, Matar	Sanitary Engineer	87247	J4-129
AF5IN	Harth, Alberto	Sr. Projects Officer	33092	J4-125
AF5IN	Janssens, Jan G.	Financial Analyst	34835	J4-127
AF5IN	Pean, Leslie J. R.	Sr. Water Resources Engineer	34125	J3-121
AF5IN	Powers, Marie Yvonne	Sr. Agronomist	32382	S8-117
AFTES	Grey, David R. C.	Consultant	30444	S8-048
AGRAF	Ter Vrugt, Johannes H.R.	Sr. Adviser	30342	S8-051
AGRDR	Giltner, Sandra	Director	85028	S8-055
AGRDR	Le Moigne, Guy J-M	Consultant	81566	S8-023
AGRDR	McCalla, Alexander F.	Sr. Water Resources Engineer	30354	S8-041
AGRPW	Gadelle, Francois	Principle Drainage Spec.	30357	S-8037
AGRPW	Matthews, Geoffrey J.	Irrigation Adviser	30348	S8-029
AGRPW	Ochs, Walter John	Consulant	35571	S8-027
AGRPW	Plusquellec, Herve L.	Consultant	38792	S8-052
AGRPW	Purcell, Randall B.	Division Chief	38711	S8-033
AGRPW	Smedema, Lambert K.	Water Institutions Development	30359	S8-045
AGRPW	Steeds, David R.	Untitled	87212	MC8-305
AGRPW	Subramanian, Ashok K	Division Chief	33286	MC8-427
ASTEN	Guy, Sammie Dean	Irrigation Engineer	82642	MC8-104
ASTEN	Koch-Weser, Maritta R. V.B.	Projects Assistant	38732	S7-054
ASTEN	Spencer, Geoffrey			
CGIAR	Lajaunie, Marie-Laure	Division Chief	80454	E8-071
EC1AE	Bromhead, Marjory-Anne	Water Resources Mgmt. Spec.	30362	E8-076
EA1AE	Gutman, Jeffrey S.			
EA1AE	Xie, Mei			

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EA1IN	Pancaroglu, Erdogan	Sr. Sanitary Engineer	82920	D8-077
EA1VN	Pham, Cuong Hung	Operations Officer		
EA2CH	Plant, George N.	Sr. Operations. Officer		
EA2RS	El-Hanbali, Usaid I.	Sr. Irrig. Engineer	81925	D7-081
EA2RS	Fujimoto, Naoya	Consultant	85677	D7-101
EA2RS	Reidinger, Richard B.	Sr. Agric. Economist	84065	D7-083
EA3AG	Kramer, Engelbert L.	Sr. Irrig. Engineer	31908	MC9-429
EA3AG	Pruntel, Jan	Sr. Irrig. Engineer	87029	MC9-432
EC3AI	Van Tuijl, Willem			
EA3IN	Iyer, Rajagopal S.	Sr. Management Spec.	30840	MC9-349
EA3IN	Khanna,Anupam	Division Chief	81140	MC9-333
EA3IN	Whitehead, Stuart	Sr. Urban Finance Spec.	82429	MC9-339
EC1AE	Mohamadi, Joma Mohamad	Sr. Irrg. Engineer	32259	H5-069
EC1IN	Coyaud, Daniel Paul	Sr. Sanitary Engineer	32294	H5-129
EC1IN	Halperin, Ricardo A.	Division Chief	38755	H5-143
EC1IN	Ikegami, Takao	Sanitary Engineer	32334	H5-131
EC1IN	Sunja Kim	Financial Analyst	33005	H5-118
EC3AS	Whitford, Peter W.	Unit Manager	32504	H3-035
EC3HR	Klees, Rita	Consultant	34186	H3-203
EC4NR	Soderstrom, Sari K.	Environmental Economist	38726	H6-113
EC4NR	Stephenson, L. Kathleen	Sr. Policy Analyst	32507	H6-161
EDIDR	Groenfeldt, David J.	Consultant	36405	M5-001
EDIEN	Dankova, Rimma	Consultant	85769	M5-072
EDIEN	Fields, Deborah	Consultant	36461	M5-031
EDIEN	Jarquin, Javier A.	Consultant	36386	M5-006
EDIEN	Patorni, Francois-Marie	Principal Water Resources Mgr.	36265	M5-051
EDIEN	Reliquet, C.	Urban Specialist	36385	M5-063
EDIEN	Sun, Peter P.	Sr. Agric. Economist		
EMTAW	Kindler. Janusz	Sr. Water Resources Mgmt. Spec.	32253	H7-007
EMTAW	Koenig, Peter	Sr. Project. Officer	35508	H7-013
EMTAW	Kuffner, Ulrich	Principal Water Resources Eng.	37090	H7-003
EMTEN	Peabody, Norval Stanley	Consultant	32723	H8-026
ENVGC	Paton, Richard A.	Consultant		
ENVLW	Busia, Awa B.	Consultant	37593	S5-127
ENVLW	Hirji, Rafik Fatehali	Environmental Spec.	81994	S5-117
ENVLW	Lintner, Stephen F.	Principal Environ. Spec.	32508	S5-121
ENVLW	Robelus, Robert A.	Environmental Assess. Spec.	33642	S5-105
HRGLL	Husain, Tariq	Manager	33907	U3-237
HRGLL	Nobakht, Hoveida	Consultant	36621	U3-315
LA1ER	Azevedo, Gabriel	Sr. Anthropologist	30055	Q7-049
LA1ER	Gross, Daniel R.			
LA1ER	Simpson, Larry	Sr. Irrig. Engineer	39390	Q7-181
LA1ER	Wittenberg, Peter			

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LA2NR	Olson, Douglas C.	Consultant	39227	I4-361
LA2NR	Simas, Jose	Sr. Water Resources Eng.	31897	I4-411
LA3EU	Libhaber, Menahem	Sanitary Engineer	35327	I7-096
LA3EU	McCarthy, Eugene D.	Division Chief	85190	I7-059
LA3EU	Renkewitz, Johanngeorg H.	Sr. Financial Analyst	30170	I7-095
LA3NR	Moreau, Daniel	Sr. Agriculturist	39562	I5-113
LATAD	Rivera, Daniel		37595	I8-355
LEGSA	Salman, Salman M.A.	Sr. Counsel	81727	MC5-323
MN1NE	Nakayama, Mikiyasu	Consultant	85563	H4-251
MN1NE	Wilson, Mark D.	Division Chief	39200	H4-067
MN2NE	Ben Ali, Mohamed N.	Agriculturist	37357	H9-023
MN2NE	Macoun, Andrew	Sanitary Engineer	35573	H9-017
MN2NE	Souhlal, Bachir			
MN2NE	Ward, Christopher S.	Principal Operations Officer	37334	H9-005
MN2PI	Masanque, Jospehine	Fnancial Analyst	36055	H10-119
OEDD3	Skytta, Tauno K.	Principal Evaluation Officer	31694	G6-141
PMDTR	Tavares, Luiz Claudio Martins		30909	N4-073
SA1IN	Ateng, Benson	Economist	81878	MC10-429
SA1IN	Balakristnan, Trichur K.	Consultant	35221	MC10-378
SA1IN	Lister, Douglas W.	Sr. Agric. Sector Economist	81285	MC10-363
SA1IN	Motha, Guy	Sr. Agric. Economist	82050	MC10-341
SA1AN	Pitman, George T.K.	Consultant	81412	MC10-427
SA1IN	Shobayashi, Mikitaro	Operations Officer	81879	MC10-350
SA1IN	Wambia, Joseph	Sr. Financial Analyst	82027	MC10-355
SA2AW	Couzens, Christopher	Principal Sanitary Eng.	80306	G3-065
SA2AW	Herman, Theodore	Sr. Water Resources Eng.	81282	G3-012
SA2AW	Myint, Ohn			
SA2AW	Oblitas, Keith Robert A.	Sr. Economist	80286	G3-001
SA2AW	Whitbread, Michael J.	Consultant	81468	G3-056
TWUDR	Pellegrini, Anthony	Dircector	36752	S4-051
TWUWS	Aguilar-Riveros, Milford B.	Consultant	34345	S4-125
TWUWS	Briscoe, John	Division Chief	35557	S4-117
TWUWS	Brook Cowen, Penelope J.	Private Sector Devel. Spec.	33784	S4-103
TWUWS	Garn, Harvey A.	Consultant	37515	S4-099
TWUWS	Grover, Brian P.	Program Manager	30693	S4-143
TWUWS	Jensen, Kurt Moerck	Anthropoligist	37177	G3-042
TWUWS	Lambertus, Alfred	Country Officer		
TWUWS	Ouayoro, Eustache	Consultant		
TWUWS	Stone, Paula	Water Resources Mgmt. Spec.	33668	S4-141
TWUWS	Tavares, Luiz			
TWUWS	Yepes, Guillermo	Water & Sanitation Advisor	38428	S4-129

1995 WORLD BANK WATER SEMINAR

INTERNATIONAL PARTICIPANTS

ALGERIA

Mr. M. Ben Blidia
Vice President
Mediterranean Institute for Water
58 bd Charles Livon
13007 Marseille, 75116 Algeria
tel. 33 91 59 38 41
fax. 33 91 59 38 40

Mr. Louis Potie
Mediterranean Institute for Water
Palai Du Pharo-58 bd
13007 Marseilles, Algeria
tel. 33-91-59 38 41
fax. 33 91 5938 40

AUSTRIA

Mr. Reinold Seidlmann
TBW Consulting Engineers
Zollstrasse 1, A-6060 Hall
Austria
tel. 43 5223 43379
fax. 43 52 23 43 826

BELGIUM

Prof. Andre Van Der Beken
UETP - Coordinator
TECHWARE c/o CIBE/BIWM
70 rue aux Laines/Wolstraat 70
1000 Brussels, Belgium
tel. 32 2 5188893
fax. 32 2 5026735

BRAZIL

Ms. Regina Crespo Gualda
Coordinator
Ministry of the Environment, Water Resources and the Legal Amazon
Esplanada dos Ministerios, Bloco B, Sala 843
Brasilia, D.F., 70.068-900 Brazil
tel. 55 61 321 6323
fax. 55 61 224 5605

BULGARIA

Mr. Tzenko Dintchev
President
Bulgarian National Committee, ICID
136 Tzar Boris III Blvd.,
1618 Sofia, Bulgaria
tel. 3592 55 11 41
fax. 359-2-551141

CANADA

Ms. Michele Bertrand
Project Director
Montreal International Conference Center Corp.
Canada
tel. 514 987 8191
fax. 514 987 1948

Mr. Ken Lum
IUCN-WWC
380 Ste. Antoine Ouest, Bureau 3200
Montreal, H2Y 3X7 Canada
tel. 514 287 9704
fax. 514 287 9057/9871567

Dr. Chandra Madramootoo
Professor of Drainage Engineering
McGill University
21,111 Lakeshore Road, Ste. Anne de Bellevue
Quebec, H9X 3V9 Canada
tel. 514 398 7778
fax. 514 398 8387

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY (CIDA)

Mr. Jean Lafferriere
Canadian International Development Agency
200 Promenade du Portage
Hull, Quebec K1A0G4 Canada
tel. 819 953 3410
fax. 819 994 0251

Mr. Aly Shady
Senior Policy Adviser/ Agriculture, Irrigation, and Water Resources
Canadian International Development Agency
200 Promenade du Portage
Hull, Quebec K1A0G4 Canada
tel. 819 994 4098
fax. 819-953-3348

CHIAM (BARI)

Dr. Atef Hamdy
Research Director
CHIAM (Bari)
Via Amendola 165/a
70126 Bari, Italy
tel. 80 780 6284/6111
fax. 39 80 780 6206

Dr. Cosimo Laciringola
Director
CHIAM (Bari)
Via Ceglie, 23
70010 Valenzano (Bari) Italy
tel. 80 780 6284/6111
fax. 39 80 544 2813

DENMARK

Mr. Martin Hvidt
Odense University
Campusavej 55
DK - 5230 Odense M Denmark
fax. 45 65 931 158

EGYPT

Dr. Safwat Abdel-Dayem
Director
Drainage Research Institute
P.O. Box 13621/5
Delta Barrage, Cairo Egypt
tel. 202 218 4692
fax. 202 218 9153

Dr. Mahmoud Abu-Zeid
Chairman
National Water Resource Center
22 El-Galaa Street, Bulak
Cairo Egypt
tel. 202 220 4360
fax. 202 220 8219

Dr Mohammed Amer
Project Manager
Drainage Research Institutute
P.O. Box 13621/5
Delta Barrage, Cairo Egypt
tel. 202 218 4692
fax. 202 218 9153

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)

Mr.Daniel Hillel
Consultant
FAO
tel. 396 5225 4461
fax. 396 5225 6275

1995 WORLD BANK WATER SEMINAR

Mr. Martin Smith
Food and Agriculture Organization
Viale delle Terme di Caracala
Rome, 100 Italy
tel. 39 6 5225 3818
fax. 39 69 5225 6275

Mr. Hans Wolter
Chief, AGLW
Viale delle Terme di Caracala
Rome, 100 Italy
Food and Agriculture Organization
tel. 39 69 5225
fax. 39 69 5225 6275

FRANCE

Mr. Didier Bastide
Project Director
SOGREAH
25 Rue de Pont des Halles
Cheville Larue, 94666
Rungis Cedex, France
tel. 33 1 45 60 1141
fax. 33 1 4686 0986

Mr. Thierry Baudon
Managing Director
International Project Finance
Lyonnaise des Eaux
72, avenue de la Liberte
92753 Nanterre Cedex, France
tel. 33 1 46 95 52 53
fax. 33 1 46 95 51 72

Mr. Loic Fauchon
Managing Director
Societe des Eaux de Marseille
25, rue Delanglade
13006 Marseille, France
tel. 33-91576017
fax. 33 91576374

Mr. Roger Fiszelson
Financial Director
Dumez-GTM
c/o Lyonnaise des Eaux
72, avenue de la Liberte
92753 Nanterre Cedex, France
tel. 33 1 46 95 52 53
fax. 33 1 46 95 51 72

Mr. Gaillard
Director General
SOGREAH
6 Rue de Lorraine
38130 Echirolles, France
tel. 33 76 33 4000
fax. 33 76 33 4295

Mr. Philippe Huvelin
Compagnie Generale des Eaux
52, rue d'Anjou
Paris, Cedex 08 75384 France
tel. 202 857 7820
fax. 202 857 7824

Mr. Harald Jensen
c/o Lyonnaise des Eaux
72, avenue de la Liberte
92753 Nanterre Cedex, France

Mr. Mike Kennedy
Compagnie Generale des Eaux
52 Rue d'Anjou
75008 Paris, France
tel. 33 1 4265 3812
fax. 33 1 49 24 69 99

Mr. Olivier Kreiss
President
Degremont
c/o Lyonnaise des Eaux
72, avenue de la Liberte
92753 Nanterre Cedex, France
tel. 33 1 46 95 52 53
fax. 33 1 46 95 51 72

Mr. Yves Le Bars
Director General
Centre National du Machisme Agricole du
Genie Rural des Eaux et des Forets
Parc de Tourvoie, BP44
92163 Antony Cedex, France
tel. 33 40 96 61 16
fax. 33 1 4666 3744

Mr. Joel Mancel
Director
Office International de l'Eau
BP 75
06902 Sophia Antipolis Cedex, France
tel. 33 92 94 58 00
fax. 33 93 65 44 02

Mr. M. A. Martin
Caisse Francaise de Developpement
35 rue Boissy D'Anglas
75379 Paris cedex 08 France
tel. 33 1 40 06 31 31
fax. 33 1 47 42 7514

Mr. Michel Maruenda
Director, Relations with National &
International Institutions
SAUR International
Challenger, 1 Avenue Eugene Freyssinet
78064 St. Quentin en Yvelines, France
tel. 33 1 30 60 31 01
fax. 33 1 30 60 30 86

Mr. Guy Meublat
Directeur de Recherche
ORSTOM
213, rue La Fayette
75480 Paris CEDEX 10 France
tel. 33 1 48 05 50 08
fax. 33 1 48 05 50 08

Mr. Jerome Monod
President
Lyonnaise des Eaux
72, avenue de la Liberte
92753 Nanterre Cedex, France
tel. 33 1 46 95 52 53
fax. 33 1 46 95 51 72

Mr. Nguyen Q. Trac
Consultant
7 rue de Fauvettes
Fontenay aux Roses, 92260 France
tel. 331 41 13 70 50
fax. 331 41 13 70 93

GERMANY

Mr. Peter Kampe
Water Supply Engineer
Kreditanstalt fur Wiederaufbau
Postfack 11 11 41
Frankfurt, Germany

Mr. Gerhard Redl
Diploma Engineer
Society for Development and International
Cooperation
Zollstrasse 1, A- 6060 Hall/Tirol Germany
tel. 43 52 23 43 3 79
fax. 43 52 23 43 8 26

Mr. Helmut Weidel
Managing Director
Society for Development and International
Cooperation
Zollstrasse 1, A- 6060 Hall/Tirol Germany
tel. 43 52 23 43 3 79
fax. 43 52 23 43 8 26

GUINEA BISSAU

Mr. Gomes Cardoso
Minister
Ministry of Energy, Industry and Natural
Resources
Post Box 399 Bissau
Guinea Bissau
tel. 245 22 10 39
fax. 245 22 10 50

Mr. Lamba I. Wassonde
Director
Ministry of Energy, Industry and Natural Resources
Post Box 399 Bissau
Guinea Bissau

INTERAMERICAN DEVELOPMENT BANK

Mr. Efraim Rueda
Economist
Interamerican Development Bank
1300 New York Avenue
Washington D. C. United States
fax. 96 23 14 97

INTERNATIONAL COMISSION ON IRRIGATION AND DRAINAGE (ICID)

Dr. M. A, Chitale
Secretary General
International Comission on Irrigation and Drainage
48 Nyaya Marg, Chanakyapuri
New Dehli, 110021 India
fax. 91 11 301 5962

INTERNATIONAL RICE RESEARCH INSTITUTE (IRRI)

Dr. To Phuc Tuong
Water Management Engineer
Soil and Water Sciences Division
IRRI
P.O. Box 933
Manila, Philippines
tel. 63 2 818 1926
fax. 63 2 522 4240

ISRAEL

Dr. Emanuel Idelovitch
Consulting Engineer
18, Pilikovsky St.
Tel Aviv 69341, Israel
tel. 972 3 641 5567
fax. 972 3 642 4698

JORDAN

Mr. Koussai Quteishat
Secretary General
Ministry of Water and Irrigation
P.O. Box 2412 - 5012
Amman, Jordan
tel. 683100/680100
fax. 679143

KENYA

Mrs. J. Gichuhi
Ministry of Land Reclamation, Region and Water Development
P.O. Box 30521
Nairobi, Kenya

Mr. C. K. Koske
National Water Conservation and Pipeline Corporation
Nairobi, Kenya
tel. 254 2 540000
fax. 254 2 545882

Mr. N. K. Migwi
Deputy Director of Water Development
Ministry of Land Reclamation, Region and Water Development
P.O. Box 30521
Nairobi, Kenya

1995 WORLD BANK WATER SEMINAR

Mr. Cyrus Njiru
National Water Conservation and Pipeline Corporation
Nairobi, Kenya
tel. 254 2 540000
fax. 254 2 545882

MEXICO

Mr. Enrique Aguilar Ampila
Enrique Aguilar y Asociados, S.C.
Alfonso Esparva Oteo # 144-408
Colonia Gudalupe Inn, C.P.
Mexico, D.F 1020
tel. 525-662-9667
fax. 525-662-4920

Mr. Manuel Romero Beltran
Coordinador de Asesores de la Subdireccion General
Comision Nacional del Agua
Mexico, D.F. Mexico
tel. 5 661 28 05
fax. 5 237 41 12

Mr. Manuel Contijoch Esconteria
Deputy General Director
Comision Nacional del Agua
Insurgentes Sur 2140, Piso 2
Colonia Ermita San Angel, 1070 Mexico
tel. 525 661 3056
fax. 525 661 2060

Ing. Hector Garduno Velasco
Subdirector General de Administracion del Agua
Comision Nacional del Agua
Insurgentes Sur 2400 - 2 piso
Colonia Ermita, Mexico 01070, D.F.
tel. 525 661 0680/0555
fax. 525 661 3590

Dr. Fernando Gonzalez Villareal
The University of Mexico
Penas 550
Mexico City, Mexico 01900
tel. 525 568 0207
fax. 525 568 0207

THE NETHERLANDS

Prof.dr. Bart Schultz
Infrastructure Hydraulics Environment
Westvest 7, P.O. Box 3015
2601 DA Delft, Netherlands
tel. 31 15 151 715
fax. 31 15 122 92

NICARAGUA

Ms. Desiree Elizondo
Ministry of Agriculture
Government of Nicaragua
Managua, Nicaragua
fax. 505 278 6990

SAUDI ARABIA

Mr. Naser Al-Madi
The Saudi Fund for Development
Saudi Arabia
tel. 966 1 464 0292
fax. 9 66 1 464 7450

SOUTH AFRICA

Mr. Cotheo van Robbroeck
President
ICOLD
260 Nicolson St.
Brooklyn, 181 South Africa
tel. 27 12 464 822
fax. 27 12 464 822

SPAIN

Dr. Federico Estrada
Centro de Estudios Hidrograficos
P. Bajo de la Virgen del Puerto, 3
28005 Madrid, Spain
tel. 34 1 3357959
fax. 34 1 3357922

Dr. Jose A Ortiz Fdz.-Urrutia
Vice President Hon., ICID
Ministerio de Obras Publicas
P. Castellana, 67 - Nuevos Ministerios
28071 Madrid, Spain
tel. 34 1 5332253
fax. 34 1 597 8507

Dr. Jose Antonio Naves-Alias
Technical Adviser
Ministry of Public Works, Transports and Environment
P. Castellana, 67 - Nuevos Ministerios
Madrid, 28071 Spain
tel. 34 1 5332253
fax. 34 1 597 8507

Sr. Juan Ras
Director
Aguas de Barcelona
Spain
tel. 343 265 2512
fax. 343 265 8136

THAILAND

Dr. Pushpa Onta
Research Specialist II/Affiliated Faculty
Water Engineering and Management Program
School of Civil Engineering
Asian Institute of Technology
GPO Box 2754
Bangkok 10501, Thailand

TANZANIA

Mr. Donatus M. Ishengoma
Head of Construction Unit
Ministry of Water, Energy and Minerals
P.O. Box 9153
Dar es Salaam, Tanzania
fax. 255 51 46106

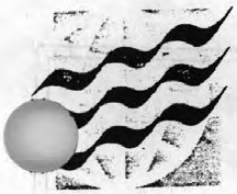
Mr. Meraji O. Msuya
Principal Hydrologist and Head of Hydrological Services
Ministry of Water, Energy and Minerals
P.O. Box 35066
Dar es Salaam, Tanzania

Mr. Mark R. Mujwahuzi
Associate Research Professor
University of Dar es Salaam
Dar es Salaam, Tanzania
tel. 255 51 49039/49192 ext. 2410
fax. 255 51 49039/49052/48274

Mr. Frederick Z. Njau
Principal Executive Engineer I
Ministry of Water, Energy and Minerals
P.O. Box 9153
Dar es Salaam, Tanzania
fax. 255 51 46106

TURKEY

Mr. P. C. Goosens
Vice President
Lyonnaise des Eaux
Istanbul, Turkey
tel. 90 212 212 14 64
fax. 90 212 212 1454



1995 WORLD BANK WATER SEMINAR

UNITED KINGDOM

Mr. Tom Brabben
HR Wallingford Group Ltd.
Howbery Park
Wallingford, Oxfordshire 0X10 8BA
United Kingdom
tel. 44 491 835381, x2490
fax. 44 491 826352

Mr. Michael Burley
Director
Mott Macdonald Group
Cambridge, United Kingdom
tel. 44 1 223 460 660
fax. 44 1 223 461 007

Mr. Alan W. Hall
Section Manager
HR Wallingford Group Ltd.
Howbery Park
Wallingford, Oxfordshire OX10 8BA
United Kingdom
fax. 44 1491 826352

Mr. Fekri A. Hassan
Petrie Professor of Archaeology
Department of Egyptology
University College London
31-34 Gordon Square
London, WC1H OPY United Kingdom
tel. 44 171 387 7050 ext. 4429
fax. 44 171 383 2572

Mr. John Hennessy
Alexander Gibb & Partners Ltd.
Earley House, 427 Lond Road
Earley, Reading, Berks RG6 1BL
United Kingdom
fax. 44 734 491054

Mr. Peter Lee
Chairman
Mott MacDonald Group
Demeter House, Station Road
Cambridge CB1 2RS, United Kingdom
tel. 44 1 223 460 660
fax. 44 01 223 461 007

Mr. W. Robert Rangeley
Consulting Engineer
Rangeley Associates
Kier Park House, Kier Park, Ascot
Berkshire, SLF 7DS, UK
fax. 44-344-24189

Mr. Andrew Russell
Chairman
International Commision on Irrigation and Drainage, British Section.
Sir William Halcrow & Partners Ltd
Burderop Park, Swindon
Wiltshire, SN4 OQD United Kingdom
tel. 44 1 1793 812479
fax. 44 1 1793 812089

Mr. Peregrine Swann
Overseas Development Administration
94 Victoria Street
London, SW1E 5JL United Kingdom
tel. 44 171 917 0170
fax. 44 171 917 0072

Mr. Alistair Wray
Senior Water Resources Adviser
Overseas Development Administration
94 Victoria Street
London SW1E 5JL, United Kingdom
tel. 44 0 171 917 0394
fax. 44 171 917 0072

UNITED NATIONS DEVELOPMENT PROGRAM (UNDP)

Mr. Frank Hartvelt
Deputy Director
United Nations Development Programme
304 E. 45th St.
New York, NY 10017 United States
tel. 212 906-5858
fax. 212-906-6350

Ms. Arienne Naber
United Nations Development Programme
304 E. 45th St.
New York, NY 10017 United States
fax. 212-906-6350

UNITED STATES

Ms. Kathy Alison
Training Resources Group, Inc.
909 N. Washington Street, Suite 305
Alexandria, VA 22314 United States
tel. 703 836 2415
fax. 703 836 2415

Mr. Michel Beguery
Representative
Compagnie Generale des Eaux
2100 Pennsylvania Avenue NW Suite 665
Washington, D. C. 20037-3202 United States
tel. 202 857 7820
fax. 202 857 7824

Mr. Andrew Blelloch
Director of Environmental Services
Louis Berger International
United States
tel. 202 331 7775
fax. 202 293 0787

Mr. F. Lee Brown
Executive Director
International Water Resources Association
The University of New Mexico
1915 Rome NE
Albuquerque, NM 87131-1436 United States
tel. 505 277 9400
fax. 505 277 9405

Mr. Vashek Cervinka
Research Manager
Dept. of Food and Agriculture
State of California
1220 N Street
Sacramento, CA 95814 United States
tel. 916 653 9140
fax. 916 653 9260

Mr. John Courtney
3418 Cummings La
Chevy Chase, MD 20818 United States
tel. 301 657 3059
fax. 301-657-3059

Prof. K. William Easter
Professor Dept. of Agricultural & Applied Economics
University of Minnesota
231 Classroom Office Building
1994 Buford Ave.
St. Paul, MN 55108
tel. 612 625 7728
fax. 612-625-2729

Mr. Ron Hoffer
Senior Advisor for International Programs
U. S. Environmental Protection Agency
Mail Code 4601, 401 M. Street S.W.
Washington, D. C. 20460 United States
tel. 202 260 7096
fax. 202 260 4383

Mr. Richard Howitt
Professor
University of California
Davis, CA 95616
tel. 916 752 1521
fax. 916 752 5614

Mr. Jean-Louis Imhoff
Lyonnaise des Eaux Representative
World Business
1819 H Street NW, Suite 600
Washington, D. C. 20006 United States
fax. 202 223 8437

Mr. John Kuhns
Environmental Economist
tel. 301 261 4280
fax. c/o Harper 410 224 2977

Ms. Ruth Meinzen-Dick
IFPRI
1200 Seventeenth Street, N.W.
Washington, D. C. 20036-3006 United States
fax. 202-467-4439

Mr. Steve Parcells
Florida Atlantic University
c/o 12 Webb Road
Cabin John, MD 20818 United States
tel. 202 458 3556/3571
fax. 202 458 3560

Mr. Marcus Moench
Senior Staff Scientist
Natural Heritage Institute
114 Sansome St., Suite 1200
San Francisco, CA 94104 United states
tel. 415 288 0550
fax. 415 288 0555

Mr. Paul Polak
President
IDE
710 Kipling
Lakewood, CO 80215
fax. 303 232 8346

Dr. Eugene Stakhiv
Chief
Institute for Water Resources, U.S. Army
Corps of Engineers
Casey Building
Ft. Belvoir, VA 22060-5586 United States
tel. 703 355 2370
fax. 703-355-3171

UZBEKISTAN

Mr. Victor Dukhovny
Professor
6025 Vladimir Ivanov
Tashkent, Uzbekistan
tel. 7-3712-331972
fax. 7-3712-891201

Dr. Vadim Sokolov
Chief, Water Resources Management Division
Central Asia Scientific Research Institute of
Irrigation (SANIIRI)
m. Karasu - 4, d.11
Tashkent, Uzbekistan
tel. 7 3712 65 09 55
fax. 7 3712 65 05 58

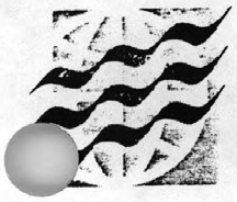
VIET NAM

Dr. Phan Si Ky
Vice Minister
Ministry of Water Resources
Hanoi, Viet Nam
fax. 84 4 256 929

ZIMBABWE

Mr. V. Choga
Acting Director
Department of Water Resources
Government of Zimbabwe
Harare, Zimbabwe

Mr. F. Chunga
Principal Secretary
Ministry of Lands and Water Resources
Government of Zimbabwe
Harare, Zimbabwe



1995
WORLD BANK
WATER SEMINAR

Theme I: Implementation of the Bank's Water Resources Policy

Plenary Session Keynote Address

Chairperson: Guy Le Moigne
Keynote Speaker: Ismail Serageldin

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TOWARDS A WATER RESOURCES MANAGEMENT STRATEGY IN TANZANIA: A PHASED APPROACH

by

Frederick. Z. Njau
Meraji O.Y. Msuya
Donatus M. Ishengoma
Mark Mujwahuzi

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TOWARDS A WATER RESOURCES MANAGEMENT STRATEGY IN TANZANIA: A PHASED APPROACH

INTRODUCTION

The economy of Tanzania is mainly based on agricultural production, livestock, hydropower, fisheries and industry. Since water is vital to the production process of all these sectors, it requires proper management.

To develop water resources for the country, the Government in 1970 declared a 20-year rural water supply program, for 1971-1990. To implement this program, it was decided to carry out regional water master plans, with the objective of inventorying all available water sources. These master plans were established on the basis of administrative boundaries. This ambitious undertaking attracted a number of external support agencies and by the end of 1982, a total of 16 out of 20 regions had master plans. However, by the end of 1993, only about 48% of the rural population, which accounts for about 80% of the total population, had access to safe water; the remainder depend on traditional sources. During the same period, of the 5.3 million people in urban areas, 3.5 million, or 68%, had access to a piped water supply. These figures indicate a poor success rate for the rural water supply program.

The program was hampered by inadequate resources and management skills. One of the difficulties encountered during implementation was that many of the completed water supply schemes were not sustainable. Water resources were diminishing with time, wells were drying up and the failure rate of supply schemes was on the increase. It was also recognized that some of the catchment areas were being degraded due to poor land use practices.

Realizing the deficiencies in the program, the Government in 1985 embarked on the preparation of a national water policy to guide development in the sector. The policy was officially launched in 1991 but despite its good intentions, it lacked some important elements relating to water resources management. To remedy this deficiency, the Government decided in 1993 to carry out a water and sanitation sector review.

It became apparent that the terms of reference for the review put more emphasis on the water supply subsector than on aspects of water resources management. It was further realized that the country's' development programs, including rural water supply , emphasized water supply without considering water resources management as an integral component. As part of the sector review, therefore, it was decided to carry out a rapid water resources assessment which was a compilation, on a river basin basis, of existing information from regional water master plans.

With these initiatives, the Government has set in motion a process to establish a systematic water resources management strategy for sustainable development and ecological balance, based on river basin rather than administrative boundaries..

MAJOR ISSUES IN THE SECTOR

The rapid water resources assessment addressed the following aspects:

- Availability of water resources
- Utilization of water resources and demand
- Water quality and pollution
- Water use and public health
- Land-water use interactions and the environment
- Water resources management policy, legislation and institutions.

The outcome of the assessment was the identification of major issues affecting the sector:

- Availability
- Water use and quality
- Environment/land use
- Management
- Public health aspects
- Institutions, policy and legislation
- Economic aspects
- International water bodies.

Some of these issues apply to the supply side and others to demand.

Since river basins have been taken as a unit for water resources planning and management, the above mentioned issues have been analyzed basin by basin and priority basins for action were identified. Activities have already started in four priority basins, the Pangani, Rufiji, and Wami-Ruvu Rivers and Lake Victoria.

A PHASED APPROACH TOWARDS DEVELOPING A WATER RESOURCES MANAGEMENT STRATEGY

The process of developing a water resources management strategy has to date involved several activities which are mentioned below. In developing our strategy, we have departed from the traditional "top-down" approach which was largely externally driven and which dominated during the preparation of our Regional Water Master Plans.

We have now adopted a more collaborative and participatory process through consensus building. In most of the activities summarized below, the local institutions have taken the lead role, with support and backstopping provided by various external support agencies. We believe that local capacity can effectively be developed by "learning through doing" and that institutional ownership is essential for our strategy to be sustainable.

- ***Water Sector Review.*** The Water Sector Review was carried out by a team of Tanzanian experts and funded by UNDP. Its objective was to build on on-going initiatives, identify constraints, propose necessary interventions and seek commitment of external support agencies to support specific activities.
- ***Rapid Water Resources Assessment.*** The Rapid Water Resources Assessment was conducted by an interministerial task force and was supported by the Bank and DANNIDA. It both builds on and was an input into the water sector review to address the gap between supply and water resources management issues.
- ***The Seminar on Water Resources Management in Tanzania.*** This EDI-funded seminar was jointly organized by the Government and the Bank. The seminar, held in Tanga, Tanzania in September 1994, provided a forum for discussing the findings of the Water Sector Review, the Rapid Water Resources Assessment and various topics related to river basin management and assisted in building consensus among the various sectoral actors on the need to manage water resources in a more integrated manner. It also identified elements relating to human resources and capacity building.
- ***River Basin Management and Small-Holder Irrigation Improvement Project.*** These are parallel initiatives in already identified priority basins (Pangani and Rufiji), aimed at establishing management tools for integrated water resources management. Basin water boards and offices are already operational but will be strengthened under the Project. The Project, to be elaborated in the next presentation, also recommends revising the existing water policy and legislation.
- ***National Water Resources Assessment.*** This on-going joint task between the World Bank and the Government of Tanzania is aimed at identifying critical issues and constraints for preparing a coherent water resources management policy and strategy. The study will also help identify areas for further detailed work in the sector. It should also provide the foundation for further Bank lending in the water supply sector.

MANAGEMENT OF THE PANGANI AND RUFIJI RIVER BASINS TANZANIA

Rafik Hirji[1]

Water Resources Management Specialist
Land, Water and Natural Habitat Division
Environment Department
The World Bank

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1 This paper summarizes the main elements of the River Basin Management component of the River Basin Management and Smallholder Irrigation Improvement Project task managed by Mr. James Coates of AF2AE.

INTRODUCTION

Improving the management of the Pangani and Rufiji River Basins (Figure 1) is a priority that was identified in the recently completed Rapid Water Resources Assessment for Tanzania (URT 1995; Luhumbika *et al* 1994 and Mwaruvanda 1994). The two basins, covering about 23 % of the country's land area, are important for both the local and national economies. They contain about 13 % of its population, all of the existing hydroelectric power production (Table 1) and much of the irrigated agriculture in Tanzania. Most of the hydropower production potential and a significant portion of the irrigation potential (Table 2) also lies in these basins. The water resources in the basins are also used for urban, rural, industrial, livestock and wildlife water supply and for fish and shrimp production, recreation, and maintenance of aquatic ecosystems such as mangrove swamps and wetlands.

Water resources management in Tanzania is hampered by a poor operational infrastructure and capability, fragmented planning, weak policy and legal framework, and financial constraints. Increasing demands from growing populations, uncoordinated sectoral activities, inefficient water use, together with drought, have resulted in severe shortages of water and conflicts among and between cross sectoral users of water. Low water levels in major reservoirs (at Nyumba ya Mungu [NYM] Dam on the Pangani River and Mtera Dam on the Great Ruaha River) have impacted hydroelectric energy production on these rivers. Surface waters in these basins appear to be over apportioned, while groundwater potential is not fully utilized.

The objective of the River Basin Management and Smallholder Irrigation Improvement Project is to (a) strengthen the Government's capacity to manage water allocation and address water related environmental concerns at the national level, and in the Rufiji and the Pangani Basins; and (b) improve irrigation efficiency of select smallholder irrigation schemes in these two basins. This paper summarizes the River Basin Management component of the project, which would improve the national framework for comprehensive management of water and the water environment, and strengthen water management in the Pangani and Rufiji basins.

WATER RESOURCES IN THE PANGANI AND RUFIJI RIVER BASINS

The Pangani Basin is located in north eastern Tanzania. It covers an area of 42,200 sq km of which 2,320 sq km lie in Kenya. The Rufiji Basin, located in south central Tanzania, is the largest basin, covering about 177,420 square kilometers.

Pangani River Basin

Surface Water. The Pangani Basin comprises the Pangani River system, and the Umba, Sigi and Msangazi rivers. The Pangani River system is regulated by the NYM Dam, which is at the confluence of the Kikuletwa and the Ruvu. Below NYM, the river flows through the now dried up Kirua Swamp and is joined by the Mkomazi and Lwengera before discharging in the Indian Ocean.

Groundwater potential of the entire basin is not known, but it is believed to be high in the Arusha and Kilimanjaro Regions. The Kilimanjaro Region Water Master Plan identified major aquifers in the region. Boreholes in the Kahe plains, and in the fractured and fault zones of western Kilimanjaro are high yielding, measuring between 10-500 m^3/h at depths of 10 to 150 meters. In the Arusha region, the presence of numerous springs indicates a high potential.

Water Quality. Many surface and groundwaters in the Arusha region have high fluoride concentration. Maji ya Chai, for example, has concentrations in excess of 32 mg/l, where significant health problems ranging from mottled teeth to dental and skeletal fluorosis have resulted.

Rufiji River Basin

Surface Water. The Rufiji River Basin has three main sub-catchments: the Great Ruaha, Kilombero and Luwegu, which comprise 47 %, 23 % and 15 %, respectively, of the basin area, with about 15 % of the basin being part of the mainstem. The Rufiji River drains the southern highlands into the Indian Ocean and carries over 80 % of the annual surface runoff. The Great Ruaha, where severe conflicts among water users have occurred, originates in the Poroto Mountains in the Gofio plateau and traverses the Usangu (and the Utengule Swamp) and Pawaga Plains before flowing into the Mtera Reservoir. Table 3 summarizes the inflows into Mtera from the tributaries of the Great Ruaha. Most other rivers start from the Kipengere highlands. The Poroto Mountains and Kipengere Highlands have the heaviest rainfall in the country, while the Pawaga Plains are the driest areas.

The Mtera Reservoir fully regulates the Great Ruaha. It is situated in a semi-arid belt, where humidity is low and evaporation, about 2,250 mm/year, exceeds precipitation. Evaporation within the basin varies considerably.

Groundwater potential varies across the basin. Wells in areas bordering Chimala Hills have high specific capacities at depths of 30 to 40 meters. The southern part of the plains has alluvial deposits, where shallow groundwater occurs at depths of 3 to 4 meters. In the northern part of the basin, there are about 90 boreholes and shallow wells with yields between 1 to 20 m3/hr mainly used for rural water supply.

Water Quality. High turbidity, particularly during the rainy season, is the main ambient water quality problem in the basin.

WATER USE, ISSUES AND CONFLICTS

The surface water and groundwater resources in the Pangani and Rufiji river basins are utilized for a variety of consumptive and non consumptive uses. In the Pangani Basin, surface water accounts for about 95 % of the water use in the basin; the rest comes from groundwater. In the Rufiji Basin, the proportion of the total water use from surface sources is higher than in the Pangani Basin.

Increasing demands for water and energy from rapidly growing populations, uncoordinated sectoral activities, including poor land use and inefficient use of water, together with several years of drought, have resulted in severe shortages of water, low water levels in major reservoirs, pollution of water resources, extensive flood damage, damaged water resources infrastructure, and wetlands degradation. These have caused significant conflicts between and among sectoral interests.

Overall Water Use

Pangani River Basin: Accurate information on the number of water users or their total water use in the Pangani Basin is not available. The estimated gross water use in the basin is summarized in Table 4 from IVO-NORPLAN (1995). *Irrigation*, the largest water use in the basin, is mainly practiced upstream from NYM. About 30,000 hectares are estimated to be under irrigation for rice and sugarcane cultivation in the basin. Most irrigation is practiced upstream from NYM through thousands of traditional furrows, operating at irrigation efficiencies of 15-20 %. The Pangani Basin Water Office (PBWO) estimates that there are 1042 formal water rights (from surface and ground water sources) and 2094 abstractions without formal water rights (from traditional furrows) in the basin. The Tanzania Planting Company uses groundwater for irrigating sugarcane and other crops. Table 5 lists the total number of river (informal) abstractions in each region, over 86 % of which do not have control gates.

Flow requirements for *hydropower* are based on the installed capacities at the NYM (8 MW), Hale (17 MW) and the New Pangani Falls (66 MW) hydropower generation facilities, all of which are located downstream from the major irrigated areas. *Municipal* requirements, including both urban and rural supplies, are presently not met. Demands for other consumptive uses such as *livestock and wildlife supply*, and non consumptive uses such as for *fisheries and shrimp production* and *maintenance of wetlands* is not known.

About 88 % of the groundwater extracted in the Pangani Basin is used for irrigation, 4 % for industrial use and 8 % for domestic use. In Kilimanjaro Region, groundwater is used for irrigation particularly at the Tanzania Planting Company (TPC), which irrigates about 6,000 hectares of mostly sugarcane. TPC has 9 high yielding boreholes and a water right for 0.7 m3/s. The Kilimanjaro Christian Medical Center boreholes in Moshi pump around 170 m^3/h. Several private boreholes in Moshi are used for industrial water supply. A large portion of the Mwanga and Same water supply comes from groundwater. Groundwater provides more than 75 % of the Arusha urban water supply. Shallow wells are also used extensively in the Arusha, Kilimanjaro and Tanga regions for rural water supply.

Rufiji Basin: The status of water use in the Rufiji basin is worse. The Rufiji Basin Water Office (RBWO), which was established in 1993, has only begun taking stock of water use, particularly for *irrigation* in the Ruaha basin. The RBWO has estimated that there are about 800 formal water rights in the Ruaha basin comprised of various users. A survey which has covered about 60 % of the Ruaha basin indicates over 400 traditional furrows, or informal abstractions. In addition, the basin contains hydropower generating facilities at Mtera (80 MW) and Kidatu (204 MW), supplying about 73 % of the power to the national grid. However, as in the Pangani Basin, these power generating facilities are located downstream from the major irrigated areas within the Great Ruaha basin. Information on other consumptive and non consumptive uses is presently being gathered.

Groundwater in the Rufiji basin is mostly used for domestic supply. Many rural water supply schemes in Iringa, Mbeya and Ruvuma regions depend on groundwater.

Water Resources Issues

Water Scarcity.- Surface water in the Pangani Basin is over apportioned even though a variety of current water demands (for example, for urban and rural water supply) have not been

met. Figure 2 shows the increasing abstractions from selected tributaries of the Pangani Basin. As a consequence of this, coupled with drought, there is a deficit in water available for the multiple uses in the basin. Table 6, the water balance of inflows into and outflows from NYM. shows a deficit of 2.2 m^3/s for meeting water requirements for downstream needs.

Low Water Levels at Mtera. In 1990, two years after the Mtera hydropower facility was commissioned, the reservoir reached full capacity at a level of 698.50 masl. Since then, however, reservoir water levels have been declining (Figure 3) and have not recovered. Low water levels have resulted in reduced hydropower generation and nationwide rationing of electricity. Multiple causes have been identified and these include increased upstream abstractions for irrigation, drought, and poor reservoir operations. Figure 4 shows the spillway and turbine discharges at Mtera between 1981 and 1993. It indicates that power continued to be generated even when spillway discharges had stopped.

Water Pollution from Point Sources. In the *Pangani Basin*, the municipalities of Moshi and Arusha discharge partially treated sewage into tributaries of the Pangani River and affect downstream users. Sewage contamination at the Njoro Juu springs in Moshi has caused periodic outbreaks of cholera in that vicinity. The overloaded sewerage system of Arusha is polluting the Themi River.

Untreated or partially treated industrial wastewaters from breweries, textile mills, dairies, soap making, beverages, and cosmetics (in Arusha), pesticide manufacturing, textiles, tanneries and coffee-processing (in Moshi), and sisal industries (in Tanga Region) discharge effluents containing toxic wastes, dyes and organic wastes into the tributaries of the Pangani River. The contaminated effluents pose health hazards to downstream communities, deplete the dissolved oxygen in the river, and damage sensitive ecosystems.

In the *Rufiji Basin*, water pollution from point sources is localized. Iringa, the only major urban center, discharges raw sewage in the Great Ruaha and also has few polluting industries. Iringa industries discharge a variety of untreated wastewaters into the Ruaha River, some of which are located near existing municipal water supply intake. Other possible point sources of pollution include tea factories in Mufindi and Njombe Districts, sugarcane factories in Kilosa District, and the Pulp and Paper Factory in Mufindi.

Poor Land Use. Watershed degradation from cultivation near stream banks and on steep slopes, and clear cutting of forests for fuelwood and construction in the Usambaras are significantly impacting the *Pangani Basin* water resources. The increased soil erosion in the catchment of the *Soni River* has resulted in deposition of over 3 meters of sediments in the stream channel near the Mombo Rice Irrigation Scheme. It has damaged intake facilities and altered the bottom slopes of the primary conveyance canals. The resulting loss of conveyance capacity of the Pangani River near Mombo is believed to have exacerbated the consequences of the 1991 floods during which many lives were lost and widespread property damage occurred.

Land degradation in the *Sigi River* catchment has increased sediment deposition in the Mabayani Reservoir, which is the primary source of drinking water for the municipality of Tanga. During the 1991 floods, sediment levels in the water entering the Reservoir had turbidity levels of up to 14,000 NTUs, resulting in severe and costly operational problems at the Water Treatment Plant.

Land degradation in the Kipengere Range and Poroto mountains in the *Ruaha Basin* is accelerating soil erosion and threatening the integrity of downstream natural systems and land and water use in the Usangu flats. Although the extent of land degradation is not known. this in turn may eventually have an impact on the Utengule Swamp, presently serving as a natural sediment trap.

Wetlands Degradation. Lake Jipe, the Kirua Swamp and other wetlands on the northern shores of Nyumba ya Mungu reservoir (in the *Pangani Basin*) and the Utengule Swamps in the Usangu Plains (in the *Great Ruaha Basin*) form natural reservoirs for storing and regulating surface flows, affect groundwater recharge, and act as detention basins for retarding the effects of floods and natural water purification systems. These wetlands also support a host of activities such as flood recession agriculture, water supply for livestock and wildlife during dry season. and are valuable habitats for fish, wildlife and migratory birds. The Utengule Swamp filters silt and sediments carried by streams into the Mtera Reservoir. Wetlands upstream of the Ruvu River reduce suspended solids flowing into Nyumba ya Mungu Dam. Encroachment by farmers, pastoralists and other development interests are degrading the wetlands and may affect the basin and wetland ecology and hydrology, which are not understood well.

Water Resources Conflicts

Uncoordinated sectoral developments that utilize and/or affect water and land resources have resulted in severe conflicts among various interest groups. The conflicts between hydropower interests, the Tanzania Electric Power Supply Company (TANESCO) and farmers, between groups of farmers, between farmers and pastoralists, and between water managers and farmers are highlighted below.

Hydropower Interests Versus Farmers. In both basins. TANESCO is blaming the increased water abstractions for irrigation by farmers upstream from NYM and Mtera as causing the water deficit and low water levels in the reservoirs. While the farmers. are perceiving basin management as a ploy by TANESCO, to deprive them from exercising their historical (customary) rights to use water for irrigation. In addition. they are arguing that the benefits derived from losing their water for generating power is also

Groups of Farmers. In the Pangani Basin, upstream of NYM, conflicts between groups of farmers using irrigation water have intensified. Following the construction of the first phase of the 2300 hectare Lower Moshi Irrigation Scheme, farmers upstream on the Rau River began expanding rice irrigation (to over 3000 hectare) without proper water rights. This increased abstractions, which were unanticipated, have resulted in acute water shortages in the Weruweru River and this has constrained further development at Lower Moshi inspite of their water rights.

Pastoralists and Farmers. In the Usangu Plains upstream from the Mtera Reservoir, tensions have mounted between pastoralists and farmers near and within the Utengule Swamp over access to land and water. The rising number of cattle has increased the requirement for dry season forage and water. The gradual expansion in areas under irrigation has decreased grazing land and reduced the availability and access to water in the dry season.

Farmers and Water Managers. Poor land use activities in the upstream catchments of the Soni and Sigi Rivers in the Pangani Basin, have resulted in costly damage to the water resources Infrastructure. This was highlighted in the previous section in the context of the damaged Mombo

Irrigation Scheme, where extensive damage was caused by excessive sediment deposition. In the Sigi case, the managers of the Tanga Water supply were affected by increased water treatment costs and unreliable water supplies.

INSTITUTIONAL AND MANAGEMENT CONSTRAINTS

The current water resources management conflicts in Tanzania are a result of several operational, regulatory and institutional constraints, the main ones of which are elaborated below.

Operational Constraints. The hydrometric, water use and water quality information base is poor. As a consequence accurate and timely information, which is essential for water resources planning and management decision making is often lacking. the information that is available is often inaccurate, and data collection systems are weak. Preliminary surveys have indicated that in the Rufiji Basin there are 65 hydrometric stations, of which 24 are primary stations (8 in good conditions) and 35 are secondary stations (10 in good conditions), and 6 are local stations. In the Pangani there are 44 hydrometric stations, of which 16 are primary stations (3 in good stations), 24 are secondary stations (with 20 working), and 4 are local stations.

Data on water use is also poor. It is only recently that surveys have been undertaken to document the water users, particularly the traditional furrows. In the Pangani basin. the total number of abstractors have been determined, but the amounts of their abstractions have only been estimated. In the Rufiji, water use information is essentially unknown, although surveys of the Great ruaha Basin are currently underway.

Water quality information is also inadequate. There is essentially no systematic water quality data being carried out. The limited ongoing monitoring efforts are largely project driven or have a sectoral bias. Inadequate resources do not allow for regulation or enforcement of water use or pollution control requirements specified in the Water Utilization Act.

Fragmented Planning. Water resources planning in the past was also fragmented: it was either sectorally oriented (e.g., national irrigation development plan), regionally based (e.g., water master plans) or project specific, and was inadequate for addressing the growing cross-sectoral water management challenges. Irrigation or hydropower development, for example, were not coordinated with each other or with other sectoral activities that depended on the same water resources. The various regional water master plans were not developed on a river basin basis, and therefore did not adequately consider water use from the same source in nearby regions which lie in the same basin. As a consequence, different approaches, standards and criteria have been developed, which are often incompatible with each. other. Another more serious consequence is uncoordinated development.

Fragmentation has resulted in the creation of a number of organizations with overlapping responsibilities and duplication of efforts and scarce resources (URT 1995). For example, the Water Utilization (Control and Regulation) Act No. 42 of 1974 empowers the Rufiji Basin Board to control and regulate the use of water resources within any declared basin. At the same time the Rufiji Basin Development Authority (RUBADA) Act No. 5, 1975, empowers RUBADA to exercise control on water for power generation without any reference to the power of the Basin Board.

Fragmentation has also led to alienation of smaller but widespread users of water. Upstream users, particularly small holder farmers and pastoralists, feel alienated by authorities responsible for managing basin water resources. Rural communities which have been practicing irrigated cultivation for many decades in the upper Pangani and Ruaha basins are now appearing to be the primary losers in basin management efforts. And there is a growing perception that water resources management is urban biased and fosters rural inequity. This perception stems from the fact that activities are now being regulated for hydropower generation, which primarily provides electricity for urban (for domestic and industrial) demands, whereas rural electrification remains a lower priority. This perception is further reinforced by the fact that the production of hydroelectric power in both basins constrains other uses of water, disadvantaging rural communities even further. In the Pangani River Basin, for example, the generation of hydro-electric power from the Pangani Falls Redevelopment project, which is located downstream from much of the arable areas in the basin, will only be possible during the dry season if additional upstream abstractions are prevented. Small holder farmers are therefore not only being prevented from using the basin water resources, they also lose the benefits derived from the use of that water as power generated will be used to meet electricity needs for urban dwellers of Tanga, Moshi, Arusha and Dar-es-Salaam.

No Incentive to Conserve. After independence, government policy was to provide access to safe drinking water to all Tānzanians irrespective of the cost or the involvement of communities in water supply project design or implementation. Water was considered a *social good* and the government took the responsibility for providing this access; thousands of rural water supply schemes were built under the regional water master plans with heavy donor support. Many of these schemes became unsustainable for a variety of reasons and this has led to questioning the heavy investment in the sector by many donors who are withdrawing their assistance. In general the rural water supply approaches were target or product oriented rather than process oriented. There was greater emphasis on meeting targets (for example, completing a specified number of wells within a given timeframe) than on the sustainability aspects of rural water supply. The primary users and beneficiaries of these schemes were not engaged in scheme selection, design or implementation. There was no sense of ownership and many schemes have either broken down or been abandoned; very few have been maintained on a regular basis. Also, across all sectors, fees for using water have been very low and there has been little incentive for using it efficiently or for conserving it, which has resulted in wasteful and inefficient use of water. Scarcity however calls for changing such practices if current and future demands are to be met.

In addition, provisions in government policy provided little deterrent against municipal and industrial wastewater dischargers from polluting water courses or protecting source waters from pollution. As a consequence many water sources have become contaminated with fecal matter and organic and inorganic chemicals. Recent amendments to the Water Utilization Act for increasing fines for polluting are not sufficient to deter polluters from discharging harmful wastes into the receiving water bodies.

Weak Policies and Legislation. The Water Policy was only formulated in 1991 and it primarily focuses on cost sharing and participatory aspects of domestic water supply, particularly rural water supply. It does not adequately deal with cross sectoral aspects of water, watershed protection or with the sustainability of river basin management.

The primary legislation governing water resources management in Tanzania is the Water Utilization (Control and Regulation) Act No. 42 of 1974 as amended by Act No. 10 of 1981 and Written Laws (Miscellaneous) Amendments Act No. 17 of 1989 and General (Regulations)

Amendment. Weaknesses in these legislation have been addressed above and these include inadequate representation of water users or stakeholders in water resources planning and decision making structures. such as regional or river basin boards.

The composition of the Pangani River Basin Water Board (PBWB) or the Rufiji Basin Water Board (RBWB), which were established recently for advising the respective basin offices on water allocation issues and conflict resolution, do not adequately represent the interest of the basin water users. The eleven member Pangani River Basin Board consists of ten civil servants. Eight of the eleven members of the Rufiji River Basin Board are also civil servants. Most of the civil servants in these boards represent sectoral ministries and are based in Dar-es-Salaam. Small holders, pastoralists and environmental interests are under represented.

Other weaknesses in the legislation include the absence of a rational mechanism for pricing water, or setting penalties for polluting, and these issues have been addressed above. This has led to setting arbitrary fees and penalties which do not provide an adequate revenue base for supporting the activities of the newly created structures such as the basin boards and basin offices.

PROJECT OBJECTIVES AND SUMMARY

The objectives of the project are: (i) to strengthen the Government's capacity to manage water allocation and address water related environmental concerns both at the national level, and in the Rufiji and the Pangani river basins; and (ii) improve irrigation efficiency of select smallholder traditional irrigation schemes in these two basins. In carrying out these objectives, the project would improve stakeholder participation in basin management and irrigation scheme operation, and strengthen the institutional framework for basin management.

Under the *river basin management component*, to be implemented by the MWEM, the project would fund interventions designed to improve water management both at a national level, and in the two target basins. Activities to be funded include: (i) strengthening national water resources management by adjusting the regulatory framework to improve stakeholder participation in river basin management. strengthening the water rights concepts and management, and improving information gathering and analytical capabilities at the national level; (ii) improving both the regulatory capabilities, and the information and resource monitoring capabilities at the basin offices in Rufiji and Pangani; and (iii) rehabilitating the hydrometric network in the Rufiji and Pangani basins.

RIVER BASIN MANAGEMENT COMPONENT

This component (valued at US$ 10.6 million with contingencies) would improve the national framework for comprehensive management of water. and strengthen water management in Pangani and Rufiji basins--the basins where the need for intervention and is most critical according to the Rapid Water Resources Assessment. Environmental management considerations would receive particular attention in this program. The activities to be funded under this component include:

Strengthening National Water Resources Management (US$ 4.5 million).

Policy and Legislative Framework. The project would support MWEM's Water Resources Department, Principal Water Officer and Basin Water Officers (statutory officers), and enable these entities to be more effective in monitoring and regulating water use across the country. An important feature of project supported activities will be to improve the legislative and regulatory framework, and the information systems which underpin it, to permit rational management of this common use resource. Government is committed to the concept of integrated, participatory river basin management. The concepts which underlie the new integrated framework are noted below:

- Adoption of a comprehensive approach to river basin management which considers water as a scarce resource, and ensures that interlinkages between the needs of different users (such as irrigators, domestic water supply users, industrialists, hydropower generators, and environmentally fragile fauna, flora and soils), are taken into consideration in deciding on water allocation and management principles.

- Participatory planning and decision making for basin water resource management--ensuring systematic involvement of all stakeholders.

- Improved monitoring of water availability--gathering information on quantity, quality and timing of the surface and ground water in each basin--as well as assessment of cross sectoral resource use, will permit installation of water allocation and management systems, and enforcement of water-related legislation.

- Improved analysis and understanding of hydrological phenomena and their interaction with other natural resources (soils and forest cover), as well as water user needs and characteristics, will permit the design of ever more responsive and effective allocation systems and permit more effective incentives for efficient and non-polluting use.

In order to ensure that there is agreement on the *policy framework* within which this project will be carried out, agreement would be sought that, prior to negotiations, the Government submit to the Bank for review, a draft Statement of Water Resource Management Policy.

The conceptual framework for integrated river basin management is already laid out in the Water Utilization (Control and Regulation) Act of 1974, as amended in 1981 and 1994. However, the legislation has never been effectively implemented. What is needed is to refine and update the concepts and charges so that its implementation will produce the desired results. The project would support a multidisciplinary Task Force, led by MWEM, which would carry out a review and lead public discussion of all legislation pertaining to basin water management, during the first two years of the project, and would recommend that the Government revise the National Water Policy by June 30, 1998. Upon approval by Cabinet, the changes in the policy would lead to revisions in the basic legislation.

The review of the institutional framework and legislation for water management would pick up on four main issues concerning: (i) water rights; (ii) water charges; (iii) protection of

water against pollution; and (iv) strengthening and broadening stakeholder participation in the institutional framework for basin management. Particular topics to be addressed include:

- the strengthening of the "water right" concept by: (i) clarifying how the vesting of all water in the State, with the Government sanctioning all uses. affects customary water rights exercised by riparians, or livestock owners or other traditional users, who have not sought, nor been given, water rights under the law; (ii) clarifying the cases in which the State is entitled to modify or withdraw this water right (now very broadly defined, and permitted whenever water is required for a "public purpose");

- the further detailing of the water charges to be collected by Government for the right to use water by: (i) clarifying the parameters to be taken into account in the calculation o these charges; (ii) differentiating between the charges associated with the application fee, and those for "economic water use fees." which it is recommended be redefined as a tax on water use. assessed to cover the costs of operation and maintenance of basin monitoring and regulatory facilities:

- giving the Basin Water Office the legal authority to collect the above mentioned charges, as well as the fines assessed for breaking the law. particularly those for exceeding the permissible pollution standards. and utilize them in operating the basin monitoring and regulatory system:

- improving stakeholder participation and voice in the allocation and management of water resources, by broadening stakeholder representation on the Basin Water Boards. establishing democratic methods for stakeholder selection and strengthening the administrative power of the Basin Water Board--including giving it the responsibility for the final approval of water right allocations (or modification) as proposed by the Basin Water Officer:

- strengthening the Basin Water Office by: (i) facilitating direct action by the Water Officer to enforce and follow up on existing legislation, regulations and operating rules governing water use; (ii) establishing the Basin Water Board as a preliminary center for conflict resolution in water allocation; and (iii) separating water use management from regulatory activities, following agreement on standard operating rules;

- clarifying laws and regulations pertaining to pollution. including: (i) improving the provisions which provide for pollution control, by establishing a prior control of the polluting activities and enacting the needed requirements for a suitable permit system for dumping of wastes and other effluents into water instead of the "consent: currently required: (ii) providing for protection of water against abuse; (iii) strengthening the sanction and fine system by establishing much more serious penalties and introducing reference to penalty factors (which adjust for inflation), and finally (iv) developing enforcement procedures and means.

Prior to the formal initiation of the project, first steps would be taken to adjust the framework for basin management, to strengthen the incentives for improving user efficiency, reducing pollution. First steps would also be taken to broaden stakeholder representation in basin management. These initial adjustments represent changes in current regulations and

appointments under the existing Water Utilization (Control and Regulation) Act, 1974, which are the prerogative of the Minister for Water, Energy and Minerals. Such adjustments would include:

- increasing the "economic user fees" (more appropriately considered a tax) for water use to levels which will: (i) cover the basic costs of maintaining the resource monitoring and regulation system in each river basin; and (ii) provide for a more equitable sharing of the burden of paying for this regulatory structure;

- increasing penalties for exceeding the legal pollution standards, with industry to carry some of the costs for monitoring and analysis;

- broadening participation in the Basin Water Boards (which can have from seven to ten members) to include legitimate, private sector representatives of irrigators, environmental issues and town dwellers, in addition to current representation of TANESCO and Government agencies;

- enabling statutory Water Basin Offices and Boards to be financially autonomous, funded from the collection of application fees, user charges and pollution fees.

Strengthening the Water Resource Department, and the Office of the Principal Water Officer. The project would support the strengthening of the Water Resources Department of the MWEM, with the provision of specialized equipment needed to improve monitoring capabilities at the national level as well as vehicles, training and technical assistance. Where necessary, specialized staff would be contracted to provide support services to the department to permit it to carry out its responsibilities under this project. The project would also strengthen the Government's regulatory functions in the water sector by providing equipment, training and technical assistance to the offices of the Principal Water Officer and the Basin Water Officers in the Pangani and Rufiji basins.

Special Studies. The project would also finance a series of special studies on key aspects of the policy and legislative framework, river basin modeling, and environmental and natural resource management. The objectives of the studies of the legislative framework have been described above. The project will also support studies of the hydrology and ecology of the Utengule Swamp in the Great Ruaha sub-basin, which provides a large wetland habitat for wildlife, regulates flow and improves quality for water flowing out of the Usangu Plain and into the Mtera Reservoir, and the swamps at Pawaga and at Mafinga, on the Little Ruaha.

The project will also support studies on the mounting tension between pastoralists and farmers and other more sedentary inhabitants of the Usangu Plain over access to land and water resources, particularly during the dry season. Measures will need to be taken by authorities concerned with natural resource management in the Ruaha sub-basin, to reduce these tensions and find long term solutions to these problems. A study will be included in the project to analyze the issues and develop feasible recommendations for action, following on initial work undertaken during earlier missions.

In the context of improving river basin management, allocating water in times of scarcity, ensuring environmental sensitive development, improving irrigation efficiency and implementing the precepts of the National Irrigation Development Plan, an issue which should

receive further attention is the question of regulating water use (especially in the dry season) and the environmental impact of the various State Farms and Government-owned farming enterprises engaged in large scale irrigation in both basins.

Strengthening Water Quality Monitoring. The project would strengthen the national water quality monitoring network to carry out three activities: (i) point source effluent monitoring; (ii) non-point source monitoring; (iii) monitoring of ambient conditions: and (iv) groundwater monitoring). The project would bring in expertise in water quality monitoring, to devise ways to strengthen the existing program. The project would also focus initially in improving the situation in the Pangani and Rufiji river basins, by supporting the replacement or upgrading of equipment and facilities in the MWEM's four regional laboratories which serve the two river basins.

Strengthening Basin Management (US$ 5.8 million)

The project would strengthen both the statutory (regulatory) functions of the Basin Water Offices, their information collecting and development activities, and improve the quality of the hydrometric network.

Basin Office Strengthening. The project would provide WRD and Basin Water Office staff at the basin and regional level with training, vehicles and equipment, to enable them to operate the above mentioned network, collecting, forwarding and analyzing data related to water availability and use.

Network Rehabilitation and Upgrading. The Basin Water Offices require accurate, timely information on water quantity and quality at all points in the basin to carry out their mandate. The information available at present is often inaccurate, and collection systems are weak. The project would rehabilitate the 5 existing networks in the Pangani and the Rufiji Basins in order to permit the following types of measurement: hydrological, meteorological, groundwater, water quality and sediment. During the course of the project, the existing network of monitoring stations would be assessed, and upgraded and expanded as necessary to improve monitoring of key areas currently not covered (particularly the Kilombero and Rufiji valleys of the Rufiji Basin).

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FIGURE 1
Pangani and Rufiji Basins, Tanzania

FIGURE 2
Water Abstractions in Selected Pangani River Tributaries

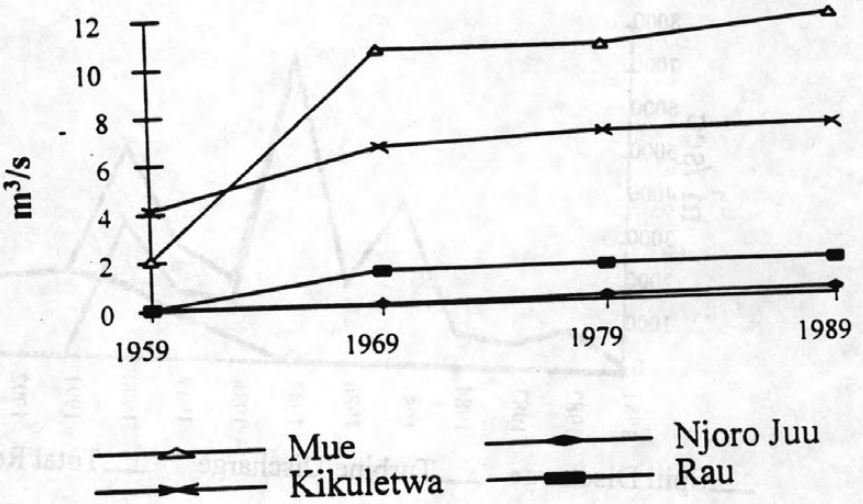


FIGURE 3
Water Levels at Mtera

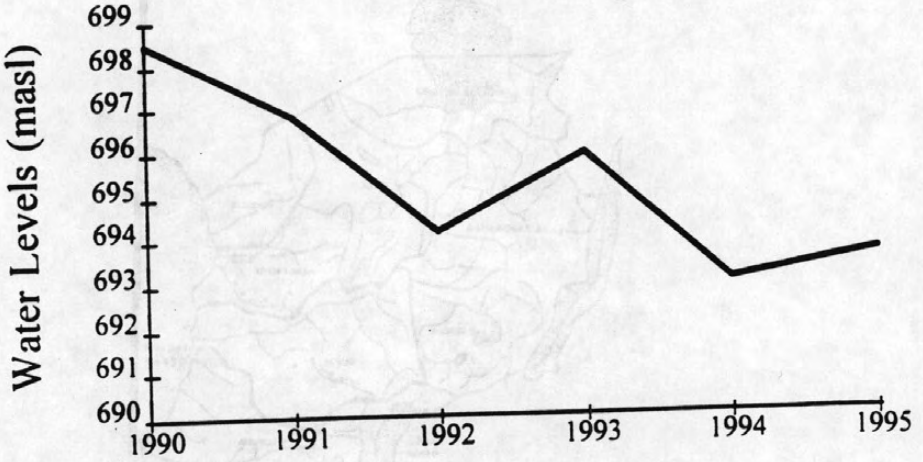


FIGURE 4
Spillway and Turbine Discharges at Mtera (1981-1993)

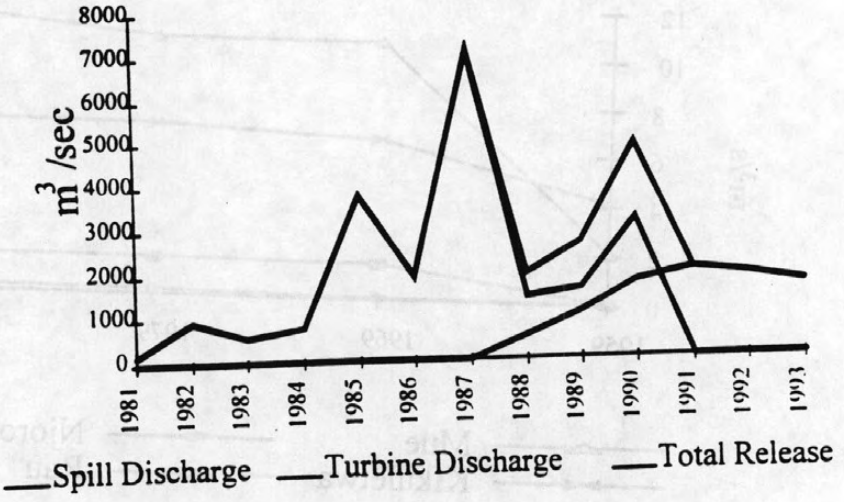


TABLE 1

HYDROELECTRIC POWER PRODUCTION IN THE PANGANI AND RUFIJI BASINS

Basin	Facility	Installed Capacity
Pangani	Nyumba ya Mungu	8 MW
	Hale	21 MW
	Pangani Falls	66 MW
Rufiji	Mtera Dam	80 MW
	Kidatu Dam	204 MW

TABLE 2

IRRIGATION POTENTIAL IN THE PANGANI AND RUFIJI BASINS

Basin	Sub-basin	Hectares
Pangani	Upper Basin	4,020
	Middle Basin	3,700
	Lower Basin	8,640
	Upper Mkomazi basin	4,760
(Sigi)	Lower Sigi River	400
(Umba)	Mnazi Plains	640
	Mnazi Floodplain	100
	Mwabijembe	320
(Msangazi)	Mzundu Valley	800
	Mkalamo Project	4,000
Rufiji	Usangu Plains	207,000
	Kilombero Valley	330,000
	Lower Rufiji Valley	80,000
	Pawaga	4,800

TABLE 3

AVERAGE ANNUAL RUNOFF INTO MTERA RESERVOIR BETWEEN 1962-1992

	Great Ruaha at Msembe		Little Ruaha at Mawande		Kisigo at Kinuguru		Total	
	MCM/yr	(%)	MCM/yr	(%)	MCM/yr	(%)	MCM/yr	m^3/s
Yearly	2026	56	673	18	972	26	3671	116.4
Wet Season	1750	55	480	15	941	30	3171	201.1
Dry Season	283	57	185	37	32	6	500	31.7
Low Flow	11	33	21	64	0.9	3	32.9	12.7

Source: United Republic of Tanzania (1995)

TABLE 4

GROSS WATER REQUIREMENTS IN THE PANGANI BASIN

User	m^3/s	Mm^3/yr	%
Irrigation	52.0	1640	64
Hydropower	23.6	744	29
Irrigation below NYM	3.5	110	4
Environment	1.4	44	2
Municipal	1.1	35	1
Total	**81.6**	**2573**	**100**

TABLE 5

INSPECTED WATER ABSTRACTIONS IN THE PANGANI BASIN WITHOUT WATER RIGHTS

(Traditional furrows--excluding boreholes)

Region	River	No. of Control Gates
Tanga	501	89
Kilimanjaro	1497	170
Arusha	96	24
Total	**2094**	**283**

TABLE 6

THE WATER BALANCE AT NYUMBA YA MUNGU: A DEFICIT

USER	m^3/s
Hydropower	23.6
Environment	1.4
Irrigation below NYM	3.5
Required Inflow	28.5
Observed Inflow	26.3
Deficit	**2.2**

INTERSECTORAL ASPECTS OF WATER SUPPLY IN CHINA

M J BURLEY

MOTT MACDONALD LTD

1 INTRODUCTION

The Sectoral Water Uses

In China as in many parts of the world there are many conflicting demands for water. These usually include the following:

1. Domestic Water Supply - Urban
2. Domestic Water Supply - Rural
3. Industrial
4. Agricultural
5. Fisheries

(Flood Control, Navigation, Hydropower)

As well as the 5 main demands listed above, flood control and hydropower generation are strongly related to water use and often have to be considered when evaluating the resources to meet the various demands.

Water Sources

In most cases one considers only:

Surface Water
Ground Water

as the sources of water to meet demands. However in areas particularly short of water other sources can be considered:

Desalination of Sea Water
Reuse of Treated Effluent

Desalination is only relevant in rich societies and can be ignored in China, due to the high costs, in all but the most unusual circumstances.

In water short areas reuse of treated effluent often has to be considered in one form or another.

Immediately, water quality is introduced as a factor of importance.

- **Water Quality/Quantity**

Where water is abundant water quality is seldom a critical factor although as discussed below this is not the case in Shanghai.

In areas of water shortage the quality of water is often critical and some form of sequential use is required in order to meet the quality standards/objectives for the various types of use. In these circumstances water pollution control becomes critical and one cannot then separate water supply from water pollution control.

It frequently becomes impossible to quantify the resource without definition of the quality.

- **Surface Water/Groundwater**

In many parts of the world, surface and groundwater resources are managed by the same organisation. In these cases the coordinated development of the two resources can be achieved.

Where the two resources are separately managed it is seldom possible to achieve sensible planning and the interaction of the resources are seldom fully understood.

- **Economics**

Where free trade is practised costs and prices are very close to economic values and assessment of development options in economic terms is relatively simple.

Where trade barriers or forms of subsidy occur it becomes extremely difficult to prepare sensible economic assessments.

Each of the five uses above have a different tolerance to water costs. Clearly industry can normally cope with a higher cost water than agriculture.

The contributions to GDP of industry and agriculture are often widely different.

Where personal income in real terms is relatively constant or growing at a very small rate, affordability and demand/price elasticity can be established. When real income is rising rapidly such assessments require a crystal ball as well as a degree of optimism.

- **China**

Many of the difficulties in managing water summarised above occur in China. In this paper no attempt is made to provide an overall solution but rather specific examples experienced during Mott MacDonald's ten years in China are presented.

2 GROUNDWATER/SURFACE WATER

Surface water resources are managed by the Provincial Water Conservancy Bureaux or River Basin Bureaux under the Ministry of Water Resources. Groundwater is managed by the Ministry of Resources. This division of responsibilities creates difficulties.

2.1 Conjunctive Use (Figure 1)

In Liaoning Province water resources are limited. Water is stored in the Dahoufang Reservoir on the Hun river and is released in April and May for prewatering rice. An evaluation of the groundwater aquifers showed that use could be made of groundwater for prewatering and that the aquifers would be fully recharged each year in the following wet months (July - September).

In this way the water stored in the reservoir could be used for public water supply and best use could be made of wet season water which otherwise would be lost to the sea. The effective yield of the scheme was significant at 850 000 m^3/d.

The 1987 costs of the groundwater were 15-18 fen/m^3 (some 2 c/m^3) which are low in any circumstances.

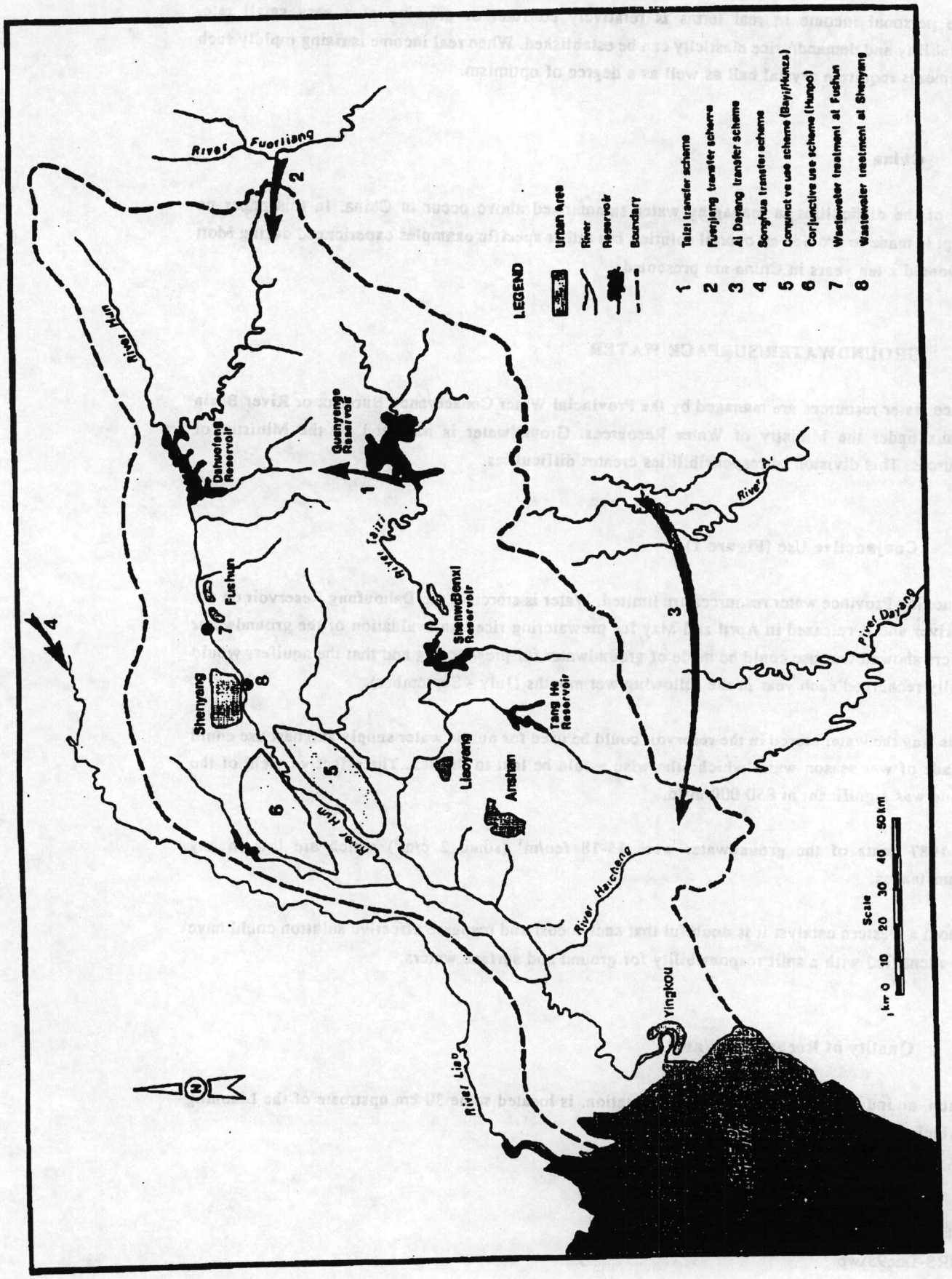
Without a western catalyst it is doubtful that such a cost and resource effective solution could have been identified with a split responsibility for ground and surface waters.

2.2 Quality of Recharged Water

Fushun, an industrial city of 2 million population, is located some 30 km upstream of the Liaoning Provincial capital Shenyang on the Hun river.

1

Liaoning Province - Hun/Taizi River Basin
Location Map for Water Resource Enhancement Schemes



Some 750 000 m^3/d is withdrawn from groundwater to meet the urban demands of Shenyang. Groundwater studies showed this to be largely derived from recharge from the Hun river which is heavily contaminated by the wastes from Fushun.

The water supplies were found to be heavily contaminated with up to 3 mg/l of manganese for which the drinking water standard is 0.05 mg/l.

Studies showed that there is no manganese in the river but degradation of BOD and ammonia during recharge led to very low pH and DO concentrations, the ideal conditions for dissolving manganese from the underground strata.

The fundamental solution was therefore found to be to treat the Fushun wastewater rather than to treat the Shenyang drinking water for manganese removal.

It is notable that to avoid precipitation of manganese within the Shenyang water distribution system it was essential to apply chlorine at minimal levels and to maintain a low pH (less than 6.5). conditions which are corrosive to the mains.

3 INDUSTRY/URBAN USE

3.1 Water Quality and Industrial Use

The giant Anggang Steelworks is located within the Hun/Taizi River Basin, above a major aquifer containing high quality water. This steelworks is State owned and the single factory produces more iron and steel than the whole of the UK.

High quality water is withdrawn from the aquifer and used for iron ore washing. The effluent is discharged untreated and forms the 'Red River'. Naturally the rural population who wash their clothes in this river are dissatisfied with the quality of the water. It was estimated that the effluent could be treated for reuse for a cost of 3 fen/m^3 (0.4 c/m^3).

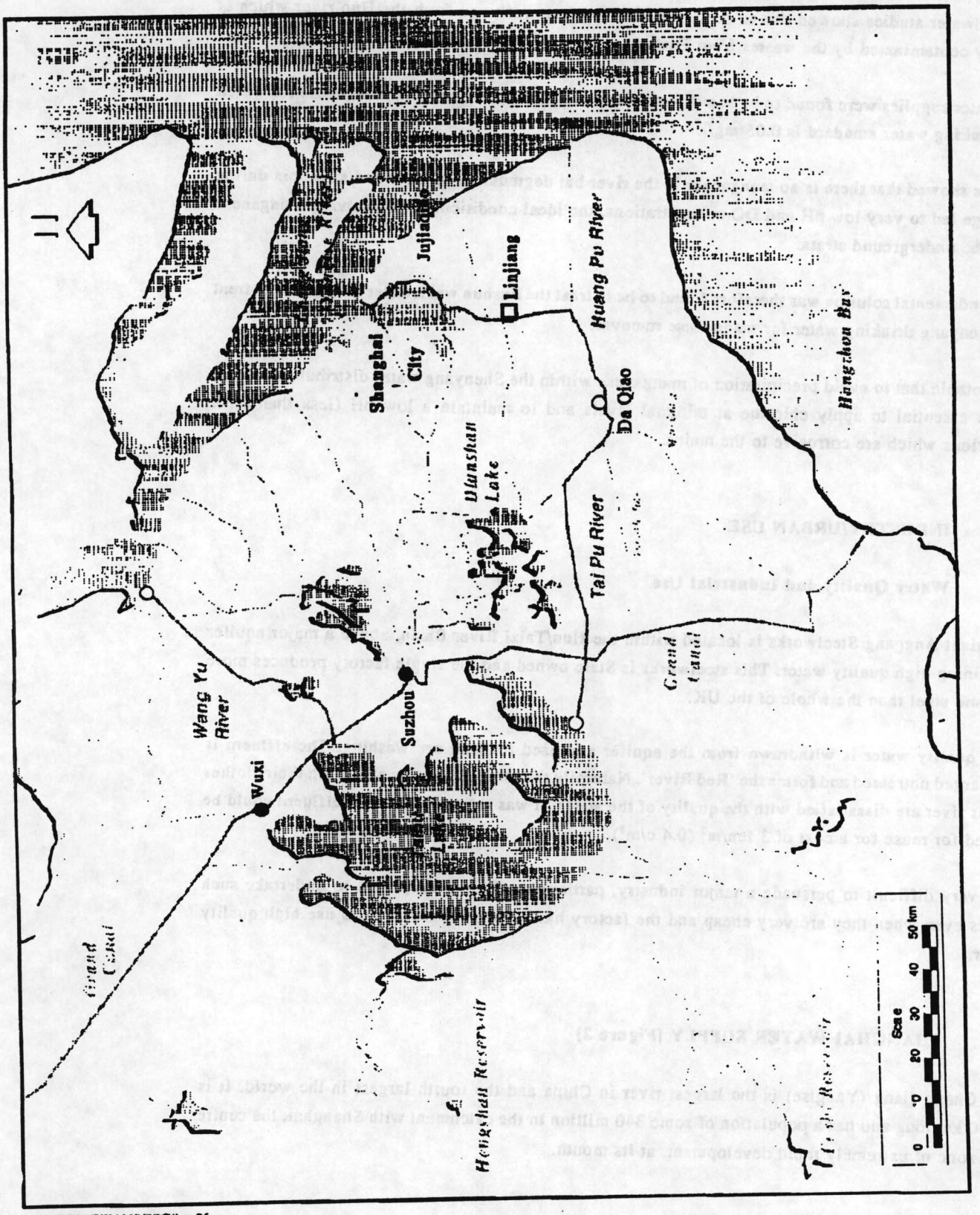
It is very difficult to persuade a major industry, particularly State Enterprises, to undertake such works even when they are very cheap and the factory has been given the right to use high quality water.

4 SHANGHAI WATER SUPPLY (Figure 2)

The Chang Jiang (Yangtse) is the largest river in China and the fourth largest in the world. It is 6 000 km long and has a population of some 340 million in the catchment with Shanghai, the centre of a zone of extremely rapid development, at its mouth.

2.

Lake Tai Basin



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Shanghai has a population of some 13 million with 9 million located within the city. The city is located on the Huangpu river. Puxi (the western part) being the centre of the old city and Pudong (the eastern part) is at present a massive construction site which is rapidly becoming the largest industrial area of the world.

Shanghai has traditionally drawn its water from the Huangpu since the Yangtse is partially saline in the vicinity of the city. The Huangpu is fed from Dianshan Lake but this is a very limited resource. In order to supplement this supply water is released from Taihu Lake to the Huangpu via the Taipu river.

The Taipu river crosses the Grand Canal and the Huangpu/Taipu/Grand Canal provides a major navigation route to the inland cities of Waxi, Suzhou etc. There are some 7 000 shipping movements per day on the Huangpu and it is a marvel to behold when tugs towing 10 or 15 barges find their way through the intersection of the Taipu and the Grand Canal.

The entire area is extremely flat, there being only some 2 m between Dianshan Lake and the Huangpu/Yangtse confluence. As a result the whole maze of rivers and canals in the area are tidal. It is these tidal effects which have created such difficulties for the Shanghai water supply.

The traditional water intakes in the city centre have long been polluted by domestic and industrial wastes. In 1987 a new intake was constructed at Linjiang as a first step in solving the problems of pollution of the drinking water. But even so the tide washes pollutants up to Linjiang and indeed the industrial centres of Wujing and Minhang which are upstream of the intake.

The World Bank Shanghai Environment Project centres around the second stage of this project, the relocation of the intake a further 40 km upstream at Da Qiao. The key questions in the study of this project were whether the quality of water at Da Qiao is satisfactory for drinking use and if so would it remain so.

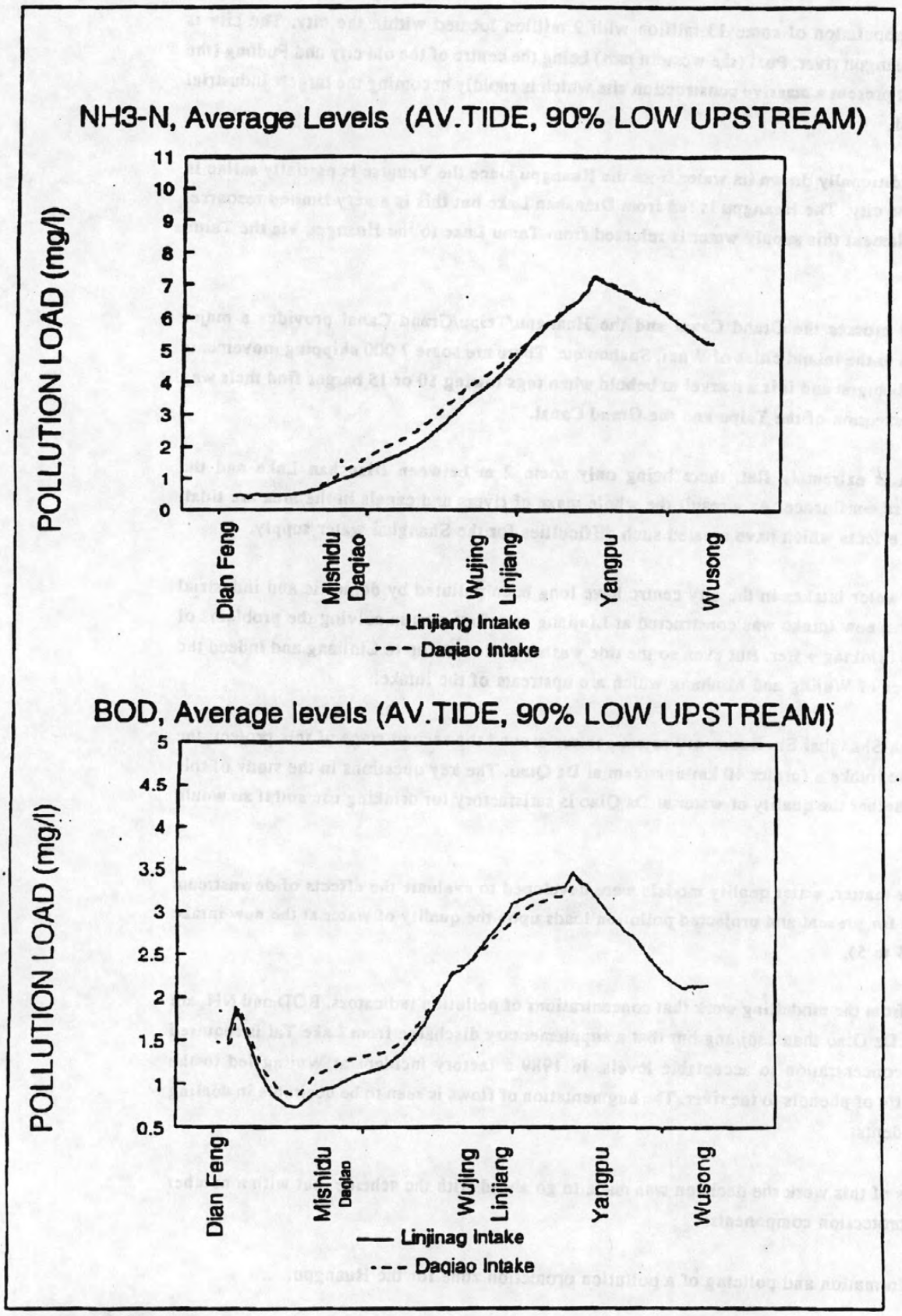
To evaluate the matter, water quality models were developed to evaluate the effects of downstream and tidal flows for present and projected pollution loads upon the quality of water at the new intake site. (Figures 3 to 5).

It can be seen from the modelling work that concentrations of pollution indicators, BOD and NH_3 are much lower at Da Qiao than Linjiang but that a supplementary discharge from Lake Tai is required to reduce the concentration to acceptable levels. In 1989 a factory incident at Wujing led to the discharge of 2 t/d of phenols to the river. The augmentation of flows is seen to be desirable in dealing with such incidents.

Upon the basis of this work the decision was made to go ahead with the scheme, but with a number of additional protection components:

- The formation and policing of a pollution protection zone for the Huangpu.

90% Low flow, Comparison of Intake Sites



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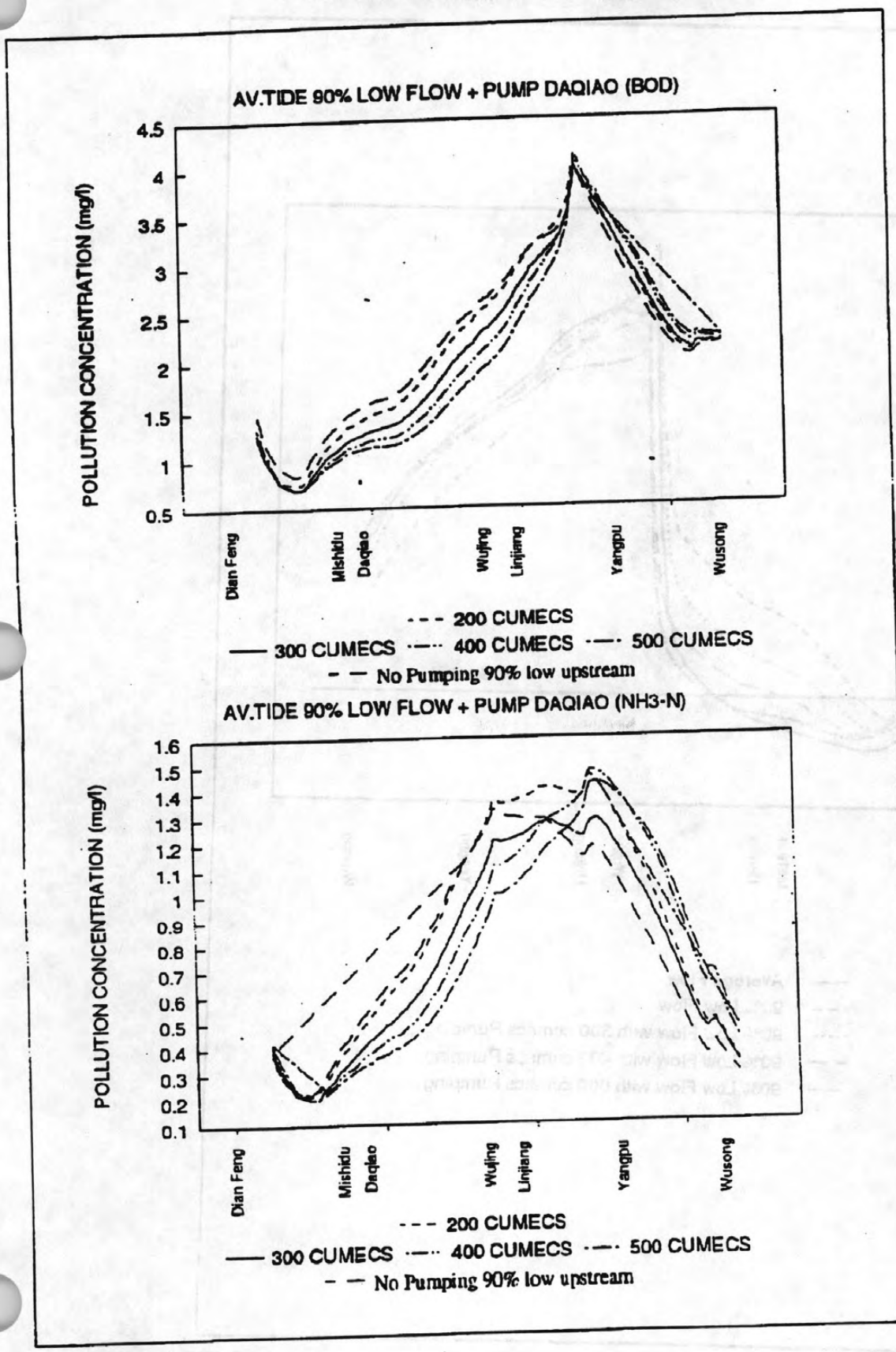
4

Production Run - The Effect of Pumping at Taihu



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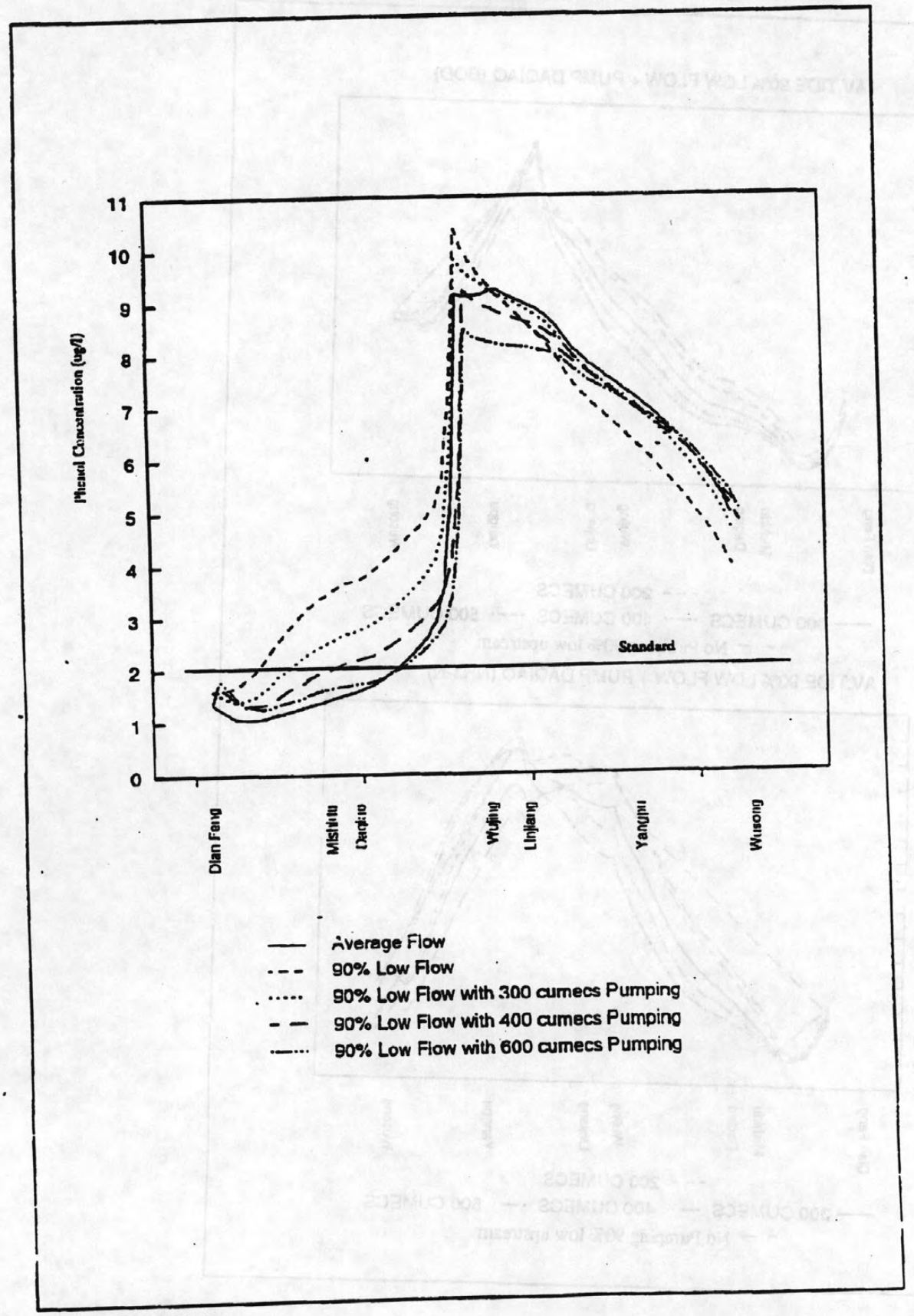
Effects of Accidental Phenol Release at Wujing



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R=93%

- The construction of wastewater treatment facilities for the town of Songjiang since the effluent discharges upstream of the intake.

- The provision of facilities to enable releases of up to 300 m^3/s from Lake Tai to the Huangpu.

The capacity of the scheme in 63 m^3/s, the conveyor is 30 km in length and comprises four barrels each 3.75 m × 3.25 m.

5 Future Competition for Water Resources

- The area surrounding Lake Tai, provides some 25% of the GDP of China and is one of the areas with the highest industrial growth rates.

- The rural population is dependent upon agriculture with predominantly rice and livestock farming.

- The natural run-off to Lake Tai is limited and ever increasing reliance is placed upon transfers from the Yangtse.

- The present water supplies for Shanghai are sufficient for little beyond the year 2000.

- Agricultural water demands are increasing

- There is great competition for the waters of the Lake which will clearly become inadequate.

- Problems exist in the equitable supply of water for different uses and for different provinces.

If the development of the area and the aspirations of about 50 million people are to be realised then a massive new injection of water is required. This will be no simple matter either technically or administratively:

- The Yangtse with an average flow of 28 000 m^3/s is the only source.

- It will be expensive to develop this source. The SEP study showed a supply from the Yangtse to involve capital expenditure of $1.2 billion (for 63 m^3/s).

- A combined supply to Lake Tai is likely to require 200 to 300 m^3/s to meet all demands which would need to be transferred a distance of some 70 km.

- Administration problems are foreseen in financing, construction and management of such a scheme.

- Where traditionally water for agriculture has been heavily subsidised with prices typically 0.4 to 1 c/m^3, one can foreseen difficulties in allocating costs on interprovincial and intersectoral bases.

The work must proceed but internal streamlining within China and possibly in Bank procedures will be required to get things off the ground.

6 POLLUTION AND FISHERIES

The Hangzhou Bay Study, managed by the Bank, involves an assessment of the effects of pollution upon the fisheries of Hangzhou Bay.

The work has included an assessment of pollution loads entering the study area. The findings are of interest in that the relative importance of intersectoral sources of pollution have been identified.

The sources of pollution were categorised as being delivered to the study area by the Yangtse river or discharged from Shanghai or Zhejiang Provinces (Figure 6).

The following figure shows the significance of the Yangtse loads. Despite the large industrial complexes of Shanghai and Zhejiang the load contributions of the Yangtse are overwhelming:

BOD	88%
Nitrogen	90%
Phosphorous	94%

It was also found that individual sources were as follows (Figure 7):

	BOD (%)	Inorg. N (%)	Total P (%)	Oils (%)
Domestic	22	10	14	-
Industrial	17	5	-	4
Fertiliser	-	40	7	-
Livestock	17	35	21	-
Other	44	10	60	96

6.

Sources of Pollution Entering the Study Area

Case Nr. 1

1994 Low

BOD

Inorganic N

Total P

Sources of Pollution by River Basin

Case Nr. 1
Year 1994 Low

	Qiantang	Cao E Jiang	Yong Jiang	Zhoushan	Changtan	Yangtse	Huangpu	Zhejiang	Shanghai	Yangtse	Total
BOD	1884	347	674	282	296	56430	4564	3483	4564	56430	64477
COD	7195	1226	2159	773	1475	363654	17822	12927	17822	363654	394303
Inorganic N	2059	276	412	85	331	50523	2577	3163	2577	50523	56283
Total P	69	25	32	6	33	5000	148	165	148	5000	5314
Oils	74	19	27	2	13	5382	763	134	763	5382	6280

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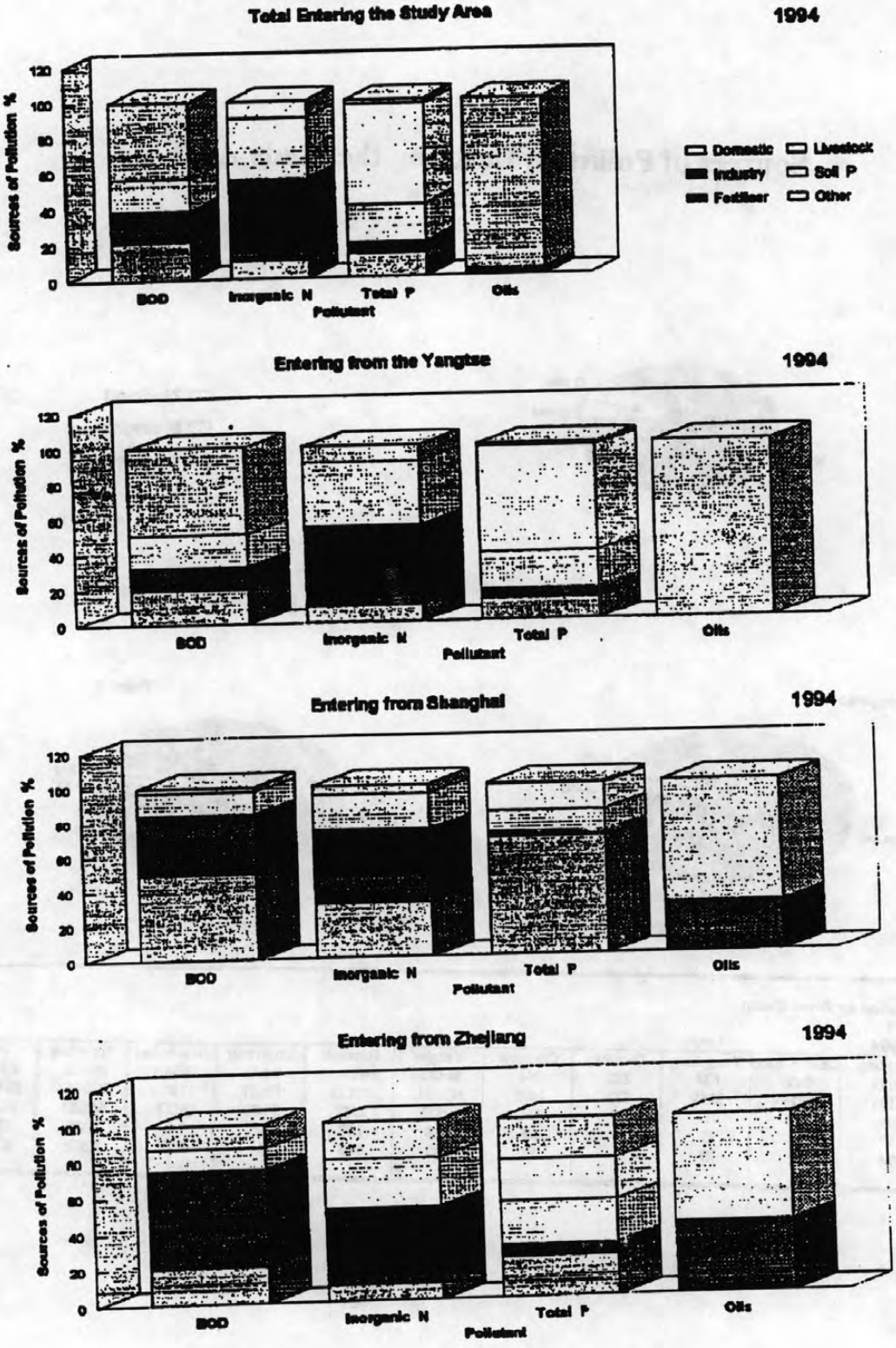
Sources of Pollution by Sector



The large contributions of BOD and Total P quoted as other are believed to comprise natural vegetable debris and silt loads whilst much of the other oil is believed to be derived from shipping.

The nutrients nitrogen and phosphorous discharged to the marine environment enter the food chain and therefore contribute to fisheries. But the rapid growth in these discharges, it is believed are upsetting the nutrient balance and explain the growing incidences of the harmful red tides in the area. Uncontrolled discharge of nitrogen may ultimately have a serious effect upon the marine ecology and put at risk the regional fisheries, valued at $700 million pa.

It has been found in the study that it is the agricultural discharges from livestock and fertiliser which are the major contributors.

It appears therefore that not only is there serious competition for water resources from urban and rural demands but severity of the pollution generated from the various sectors is of importance.

The conclusion to be drawn is that great attention is required not only in managing the water resource allocations to the individual sectors but also in evaluating the environmental impacts of such supplies.

CONFRONTING WATER SCARCITY
INSTITUTIONAL AND POLICY CHANGES IN TAMIL NADU AND MADRAS

(Keith Oblitas)[1]

Abstract: This paper outlines initiatives underway in Tamil Nadu, India to improve water use efficiency and facilitate the allocation of water between competing uses in the state and its main city, Madras. The Bank-assisted Tamil Nadu Water Resources Consolidation project and Madras Water Supply and Sanitation projects are assisting a process of change in state policy, institutions and capacity building to confront water scarcity, allocation and environmental issues. The paper will outline initiatives to date and assess next steps and future options.

A. INTRODUCTION

1. The state of Tamil Nadu in southern India is faced with an increasingly urgent need to devise responses to scarcity of water in the state; in particular for its urban areas, notably for Madras. Until recently, Tamil Nadu had done little to adjust to this situation of increasing scarcity. A government oriented approach primarily geared to public works construction had not enabled development of instititutions and policies to manage water resources holistically: state water planning was very limited; institutions to deal with water allocation across sectors and within basins were absent; environmental capability was disparate; and, pricing and regulatory mechanisms were weak.

2. Change is required in policies, institutions and economic and environmental management in Tamil Nadu in order to adjust to the issues and constraints posed by water scarcity and increasing urbanization. The Bank-assisted Tamil Nadu Water Resources Consolidation Project (TNWRCP) and Second Madras Water Supply Project (MWS II) are helping Government of Tamil Nadu (GOTN) to forge a start in this direction. This paper discusses initiatives and actions by GOTN to-date and discusses follow-up needs and possible future directions.

3. The primary areas of action discussed relate to: (i) formulation of a state water policy covering the broader areas now required; (ii) strengthening water planning

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[1] This discussion paper has been prepared by Keith Oblitas with assistance from Michael Whitbread, both in the Agriculture and Water Operations Division, South Asia Region.

Advice and comments from Christopher Couzens, Theodore Herman and Christina Wood are gratefully acknowledged.

including establishment of an institutional apparatus for water allocation decisions; (iii) institutional transformation to create a modern state water agency and, for Madras, an autonomous water utility; and (iv) developing beneficiary participation linked with improved efficiency of agricultural use. From these initiatives, further options in the areas of privatization, user involvement and water pricing are expected to develop and are also discussed.

B. BACKGROUND

4. Tamil Nadu, at the southern tip of India has an area of 130,000 sq km and a population of 56 million, of which two-thirds are rural. Per capita income is average for India (US$319/head). About 40% of the population are below the poverty line. Due to higher literacy and a successful Bank-assisted family planning drive, population is growing more slowly than the India average (1.5% in Tamil Nadu compared with 2% nationally). But population density is high, even by Indian standards: 428 persons/sq. km in Tamil Nadu compared with the national average of 264. Madras is the largest urban center with a population of about 6.0 million growing at about 2.3% per annum. GDP growth in Tamil Nadu is about 6% per annum.

Institutions

5. India has a federal constitution with substantial powers at state government level. Under the constitution, water is a "state subject", and is thus managed in Tamil Nadu by the state's institutions. For irrigation, Tamil Nadu's Public Works Department (PWD) has been responsible for irrigation and drainage, in addition to other public works activities such as buildings, ports, and formerly roads and public transportation. For Madras[2], until 1978 water supply and sanitation was handled by the Madras Metropolitan Corporation. In 1978, Tamil Nadu created an autonomous government body -- the Madras Water Supply and Sewerage Board (more commonly known as "Metrowater") -- for Madras' water supply and sanitation.[3]

6. Metrowater has made some progress towards institutional capacity building, but needs to develop further as a modern water utility. Lagging behind was PWD, responsible for the bulk of water use in the state, but impeded by its multiple role on construction across a multitude of purposes, to the detriment of specialist water management. In 1994, decision was taken to restructure PWD to create a specialist state water agency, the "Water Resources Organisation" (WRO). An associated objective is to foster

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[2] With the exception of Madras, planning, design and construction of other water supply and sanitation infrastructure is under the Tamil Nadu Water Supply and Drainage Board (TWAD), a government parastatal formed in 1971. After commissioning, TWAD hands projects over to local bodies for operation and maintenance.

[3] Metrowater is structured as a water utility with full responsibility for all its planning, design, construction, operations, maintenance, billing and revenue collection. It generates cash flow surpluses sufficient to contribute to about 20% of its annual investments.

development of water user organizations for farmer management of distribution systems. Although some historical tradition of user participation had existed in irrigation in Tamil Nadu, this had progressively eroded under the years of public infrastructure expansion in both the colonial period and post-independence. Irrigation, except for private groundwater exploitation, became operated and maintained by government, with minimal beneficiary participation. As concerns state water planning and multi-sectoral allocation, this was not effectively picked up by any agency, and was also recognised as needing to be addressed.

Water Resources

7. Average rainfall is 925 mm/annum but is highly variable, both year-wise and geographically, due to erratic monsoons. The state comprises 17 river basins, all flowing eastwards from the western Ghats and Deccan plateau. Water resources potential is substantially utilized: at about 93% consumptive use for surface water flows, and at variable levels for groundwater, with exploitation exceeding recharge in a number of areas. Agriculture uses about 85% of consumptive use, the rest being primarily for domestic and industrial use. Irrigated area comprises 1.3 million ha under surface irrigation and about 1.1 million ha served by wells. Relative to the rest of India, Tamil Nadu is both land and, in particular, water short. It has 7% of the country's population but only 4% of the land area and 3% of the country's surface water resources.

8. Madras' water situation is acute. The maximum availability of water for Madras from existing sources is about 290 million liters per day (mld) which provides an average for areas covered of about 70 liters/capita/day (lpcd) inclusive of demands by industry and other non-domestic consumers. Corresponding figures for other cities are Bombay 253, Delhi 220 and Calcutta 190, making Madras the lowest-supplied major metropolitan area in India. Average per capita domestic daily availability in Madras is only 47 liters. In poor monsoon years, which have been frequent in recent times, water delivery is reduced to periods of one to three hours on alternate days. Occasionally, even this low level of supply for domestic users can only be maintained by diversion of industrial water supply requiring industries to reduce or even curtail their operations. Middle-class residents have taken to contracting private deliveries of water by truck. In droughts, Metrowater also transports water in at great cost by rail and truck. The problem is particularly acute for the poor, reliant on erratic standpipes or puchasing from transporters, at prices substantially higher (by as much as ten-fold) than prices paid by consumers with access to piped household water.

9. There is a clear need for increasing the overall supply to Madras, but this presents difficulties because of Madras' geographic situation. The Madras basin is not well endowed with major rivers, and available surface flows are fully utilized for agriculture and Madras' present needs. The groundwater is heavily tapped by Metrowater and private consumers, beyond recharge capacity in many areas.

10. Faced with this urgent situation[4], MWS II is taking recourse to transfering water from its water allocation in another basin, the Cauvery. A 235 km pipeline of 1500 to 1900 mm diameter and pumping stations will take water from Veeranam tank fed by Tamil Nadu's Mettur reservoir. The tank itself will also be enlarged to safeguard the irrigation interests of the farmers currently served by the tank. This will increase existing water supplies to Madras by 180 mld or by about 35%.

11. Nevertheless, this is still far from Madras's present and future needs. By year 2000, Madras' demand is estimated at 1750 mld based on industrial and urban growth projections and surveys of consumer willingness to pay at estimated long-run marginal cost. Accordingly, under the Krishna Water Supply Scheme, construction is nearly complete for headworks and a total of 330 kms of canals to supply water from the Krishna basin in the adjacent state of Andhra Pradesh to Madras[5]. The first phase of the Krishna water supply scheme would provide 400 mld and a second phase would supply an additional 530 mld. Taking account of distribution losses, the city would still be short of water by some 630 mld, and still further short of the longer term needs of the city.

12. Additional potential sources include reallocation from agriculture in the Madras basin, additional interbasin transfers, and less likely options such as desalinization of sea water. All require technical feasibility studies. Basin studies in Tamil Nadu are as yet very limited. Institutions to handle inter and intra-basin issues, to make planning and allocation decisions intersectorally, and to involve stakeholders have not been present.

C. RECENT AND ONGOING POLICY AND INSTITUTIONAL CHANGES

I. STATE WATER POLICY

13. A basic need was to establish a policy framework for future management of water resources, to set the stage for a broader management and institutional approach. In July 1994, Government of Tamil Nadu (GOTN) issued a policy note entitled "Water Policy for Tamil Nadu." The document, prepared on the basis of a state-level discussion workshop, took account of Government of India's "National Water Policy" (1987), the Bank's "Water Resources Management" policy paper (1993), and the Bank/GOI "India Irrigation Sector Review" (1991), and established Tamil Nadu as the first of India's states to issue a state water policy.

14. The policy statement highlights Tamil Nadu's water scarcity and the need for its management as a unitary resource: by river basin, conjunctively for both surface and groundwater, integrating environmental management, and planning holistically for all uses

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[4] After taking account of the water savings from an ongoing "Unaccounted for Water" (UFW) management program being implemented by Metrowater with MWS I and MWS II financial support.

[5] Under an agreement between Tamil Nadu and the state of Andhra Pradesh, according to which Tamil Nadu participated in the financing of the required diversion of water in Andhra Pradesh up to the Tamil Nadu border.

of water. Actions highlighted included establishment of a state institutional apparatus, with participation from all users, for planning and allocating water between sectors, improving the productivity and efficiency of existing water infrastructure, improving environmental capabilities, enhanced cost recovery, and strong emphasis on beneficiary participation.

II. STRENGTHENING WATER PLANNING

Multi-Sectoral Water Planning

15. There was an urgent need to create a state institutional structure for multi-sectoral water planning and allocation. In September 1993, as part of the TNWRCP preparation exercise, GOTN established a "Water Resources Control and Review Council" (WRCRC) as the State's most senior body for water allocation and planning decisions. Chaired by Tamil Nadu's Chief Minister, the Council contains representation of all departments concerned with usage and environmental management of water, including Metrowater and TWAD. In parallel, the mandate of the existing Institute of Water Studies (IWS), formerly a research institution, was revised to be reponsible for preparing basin plans and a state water plan, and to be the technical secretariat of the WRCRC. A WRCRC/IWS multi-sectoral sub-committee handles working level liason between government departments. To facilitate sufficient focus on environmental issues within basin and state water planning and allocation, WRCRC also contains an environmental sub-committee. The basin planning work is off to a good start with "rapid basin assessments" prepared for 16 of Tamil Nadu's 17 river basins. These will be progressively upgraded in modelling sophistication over the course of the TNWRCP period, culminating in full basin plans and a state water plan to be updated periodically thereafter.

Hydrological Data

16. A parallel need was to upgrade the quality of hydrological data, which is to be funded under Tamil Nadu's component of India's multi-state "Hydrology Project" (recently approved for Bank funding under Credit 2744, FY96). As part of the Water Resources Organization's institutional restructuring, all hydrological data measurement, collation, storage and dissemination will be handled by a specialist sub-unit of WRO under its own Chief Engineer. The unit will collate surface and groundwater data, including water quality as well as quantity measurements, and meteorological data, and will expand the network of hydrological measurement stations. A multi-sectoral State "Hydrology Data User Group" will provide feed-back and guidance on data needs for the hydrology units work program. Data will be made available in computerized form to all legitimate users, including the national data network.

Environmental Management

17. Strengthened capabilities for environmental management were also required. Under the TNWRCP's Environmental Action Plan (EAP) WRO's capabilities are to be enhanced through establishment of environmental units in IWS (for basin planning and macro-allocation issues) and in WRO's project formulation unit (for project-specific environmental assessments and monitoring). Smaller cells will also be established at basin manager levels. A groundwater regulatory unit has also been established and preparation of a groundwater act for regulation of groundwater usage is planned. A next step needs to be addressment of power pricing for rural users, currently fully subsidised by the state electricity board, and contributing to groundwater depletion. The EAP also includes eco-restoration of catchments with depleted vegetative cover, and special studies, monitoring and demonstrations in groundwater utilisation, catchment interlinkages, soil conservation planning, pesticide impacts, wastewater reuse, industrial and urban pollution and health hazards, as well as state seminars and awareness building for engineers and the general public.

III. INSTITUTIONAL TRANSFORMATION

Transforming a Public Works Department to a State Water Agency

18. PWD needed to transform from a broad purpose construction-oriented agency to a specialist state water agency. The former PWD, with frequent staff transfers between widely different engineering functions both within and outside the water sector provided little opportunity to focus on comprehensive water management and the skills necessary to carry this out. Following a detailed institutional study conducted during TNWRCP preparation, PWD was bifurcated in March 1994 to create a "Water Resources Organisation" (WRO), fully separate from buildings and other non-water functions. WRO now handles irrigation, drainage and primary source bulk water supply. In parallel, the WRCRC for multi-sectoral state water planning and allocation was created (refer para 15).

19. Subsequent to its creation, GOTN announced a major reorganisation of WRO. The reorganisation, now nearly complete, both decentralizes management and restructures the organization by specialist line functions. Field activities are now decentralized under four "Basin Managers", each responsible for a group of basins. At the center, WRO is now organized by functionally specialized units: eg., design, construction, operations and maintenance, project formulation, water resources data, etc. Strengthened corporate management in areas such as programming and budgeting, monitoring and evaluation and personnel development are also part of the new structure. The next emphasis will be sustained capacity building for the newly organized WRO, through training, consultancies and contacts with other water resources agencies in India and abroad. This includes accessing research and technology, both technical and in the management and social engineering domain, overseas through a research and technology transfer program involving outside private and government agencies

Transforming Metrowater to a Modern Water Utility

20. Metrowater had a number of advantages over PWD from its inception. It was created as a specialist water agency, is geographically focussed, and as a Board has greater autonomy than a government department, with its own sources of revenue. Under MWS I (FY87) and the recently approved MWS II projects, effort has been put into transforming the entity to realize its potential and evolve its capability to a modern water utility. The approach has involved three interrelated thrusts.

21. First, there has been extensive capital investment to renew and enhance Metrowater's infrastructure and reduce water wastage. This had received minimal investment since the 1950s and was in serious disrepair, also needing modernization, including reduction in transmission losses, extension of the system to additional areas and investment in wastewater collection and disposal.

22. Second, much needed to be done to strengthen the management and staffing of the organization. Management strengthening has involved filling key senior posts with professionally qualified personell, reductions in staffing (from about 6,900 in 1987 to 3950 in 1995), reorganisation of operations and maintenance activities, introduction of commercial accounting, streamlining management information flow, and reducing the number of depots, and training at all levels from artisans to senior managers.

23. Third, Metrowater's finances needed radical overhaul. Before 1987, inadequate tariffs resulted in consistent annual losses. Under MWS I, revisions to both the levels and structure of tariffs have been implemented. A particularly large tariff increase was introduced in 1994 resulting in an overall doubling of revenues for Metrowater. For the last two years, Metrowater has generated a net surplus. Under the agreed program for Metrowater, there will be at least 10% annual increases in tariffs, and 17% of cash requirements for investment will be generated internally by the agency. The second project will also progressively implement a metering program (presently only industrial and large users are metered) leading to metering of all consumers with private connections.

IV. INVOLVING BENEFICIARIES

24. Notwithstanding the major transformations underway with WRO and Metrowater, the largest change over time is intended to be in the devolution of responsibilities from government through the involvement of users. For Metrowater, medium-term objectives will be limited to greater public awareness and participation in its planning, investment and tariff decisions, and in setting the stage for various private participation options (para 29). For irrigation users, Tamil Nadu's and world experience indicates that a solely government service is ineffective at handling micro-planning, operations, maintenance, revenues collection and resolution of disputes on geographically wide-spread infrastructure. User participation, and development of decentralized and autonomous management for

irrigation distribution systems, is also key to improving irrigation's efficiency, enabling additional agricultural growth without additional demands on water consumption. Agriculture consumes some 85% of surface water consumptive use in Tamil Nadu and its efficiency of water use will be critical, both for rural sector development and for water availability for non-agricultural users.

25. The TNWRCPs largest investment component (the "Systems Improvement and Farmer Turnover" (SIFT) program) comprises rehabilitation and modernization of about half of the State's existing irrigated area (660,000 ha) interlinked with farmer participation in planning and the investment program, revisions to water charges and handover of O&M for distributaries to Water User Associations (WUAs). The WUAs will be legally recognized entities with rights and responsibilities spelled out in a contract ("Memorandum of Understanding") with WRO. At whole command levels, "Apex Committees" will be formed to participate with WRO staff in command-level investment decisions and annual water plans, and to resolve conflicts between the distributary level WUAs.

26. The SIFT component involves significant social change and will take time to implement on the scale envisaged under the project. WRO must move to a service and user oriented agency with a large focus on extension. Major staff retraining is underway, and at field levels WRO will be assisted by NGOs. For farmers, the now ingrained culture of receiving water without high expectations on service quality and almost no involvement in O&M, must change to a primary role for the farmers themselves. Multi-stage incentives have been built into the program, with each command's improvements implemented in step-wise fashion corresponding to stages in the farmer organization process, and contributions by farmers to their WUA's capitalization, the investment program and O&M. The medium term objective is to improve efficiency and agricultural productivity associated with achieved cost recovery and full funding of maintenance, and user management at the lower levels of the systems. If successful, opportunity for further developments will arise, particularly in the areas of further devolution of responsibilities and ownership to whole command level, user participation in basin management (para 35), and future water rights and marketing options (para 33).

D. PROSPECTIVE FUTURE DEVELOPMENTS

27. As TNWRCP and MWS II have only recently got underway, WRO's and Metrowater's immediate agendas are to implement their programs under the two projects as designed. Each program involves significant institutional transformation and capacity building and meeting these challenges will be a large achievement. Longer term perspectives are, however, relevant to how the medium term objectives are implemented. The discussion below attempts some of these perspectives, but should be recognized in some of its comments as being speculative and representing the views of the authors rather than necessarily the current views of Tamil Nadu or the Bank.

Metrowater

28. For Metrowater, the medium-term objective will be to continue transforming the agency into a modern urban water supply and sanitation utility, with assistance under MWS II and the proposed MWS III projects: emphasis will be on the modernization and extension of the systems; reducing conveyancing and other losses; continued corporate management improvements (eg., in financial accounting, computerized accounting); cost savings through staff reductions primarily through attrition; metering to cover all consumers by the end of MWS III; and, continued financial strengthening through tariff restructuring and increases to enable the utility to become fully financially independent. In parallel, management style will continue its reorientation to a consumer and service oriented organization, including greater public consultation and interactions in decision making on tariffs and investment planning. These objectives have received and will continue to need political support. Government's role should also be modified: to broad steerage and monitoring of the program, while stepping back from Metrowater's day-to-day management decisions.

29. Potential for future options will materialize from the above developments. If Metrowater succeeds in becoming an efficient public utility and sustains its financial viability, it could attract interest from private finance. Future investment could be financed through issuance of bonds. A good litmus test for Metrowater's successful development would be the acceptance of debenture or bond issues in financial markets without the backing of government guarantees. Various modes of privatization of Metrowater could also be a future possibility, and with the steps above, the conditions for such would be present. Such options would require deeper consideration than given in this paper. For instance, they would need to find ways to internalise incentives or regulate to handle the public as well as private good nature of water, including environmental, health and poverty objectives and incorporation of long term considerations in planning, investment and operations, and to regulate tariffs and financial returns to investors.

30. As an immediate need, it will be important for Metrowater to ensure its active participation in the basin planning work of IWS under the state WRCRC. Metrowater needs to further develop its own water planning capabilities, and take the opportunity of its full membership in the new WRCRC and IWS to become an active and dynamic participant in basin and State water planning.

State Water Management, WRCRC, WRO and User Participation

31. A broader and more difficult challenge will be to effect changes at the level of whole-state water management. This will necessarily depend on performance of WRCRC and its multiple actors, successful development of WRO which manages the bulk of the state's water resources, and, at its base, the success of the WRCP's SIFT component, particularly in the degree to which farmers take responsibility and O&M becomes managerially and financially autonomous. User involvement, whether in O&M of systems

or in water planning, will be at the heart of most long-term scenarios for sustainable water management in Tamil Nadu.

32. Success with the SIFT component would result in self-management and financing at the lower (distributary) levels of the systems, full financial contributions to O&M of headworks and the primary distribution systems, and a viable basis for subsequent options. Under consideration for commands that develop successful WUAs and Apex Committees would be to extend the Apex Committee's role beyond consultative to full command management, effectively evolving to become an autonomous WUA at command level. This scenario may be feasible for piloting in the medium term for some of the TNWRCP's smaller commands (less than 10,000 ha).

33. Opportunity should also be taken for an increased role of pricing in water allocation. Under the SIFT program, WUAs will be supplied volumetrically and will implicitly have water rights through their Memorandum of Understanding with WRO. Opportunity would thus exist for formalizing water rights and potential for sale of water shares (agreeing with another party to sell or lease part of their water). Such developments, while probably long-term in evolution, may be an important future contributor to the problem of water allocation or re-allocation between rural and urban sectors. The appropriate entity for provision of water rights would likely be at WUA rather than at individual farmer level, given the small size of farms in Tamil Nadu. Within WUAs, however, substantial informal transactions between farmers can be expected.

34. WROs longer-term development options would depend on simultaneous achievement of its capacity building program, achievements under the SIFT program, and related cost recovery. Under full cost recovery, with funds collected (through WUAs) by WRO and retained by WRO, the option of separating WRO's O&M activities from other functions as a separate financially autonomous entity becomes available. The governmental role could reduce to design, construction supervision, planning, environmental and regulatory functions.

35. WRCRC's development as a multi-sectoral decision making apparatus will require continuous fostering by state authorities. Emphasis also needs to be placed on development of grass-roots participation in the planning process. Under the WRCP, basin-level planning committees will also be formed including non-government users. Over time, these could evolve to more formalized status as basin authorities or boards. Obvious candididates include Madras basin and Vaigai basin (containing Madurai, Tamil Nadu's second largest city). The increasing need for allocation decisions between agricultural, urban and environmental uses will likely need strong forums for resolving differences, directly representing key users (municipalities, WUAs, industrialists, environmentalists, etc.).

36. A key lesson from the above discussion is that water issues in Tamil Nadu are unlikely to be resolvable from uni-sectoral perspectives. The needs of Madras or the several other large cities in Tamil Nadu cannot be isolated from the needs of the rural

sector, environmental considerations and other needs. The policy and institutional measures under TNWRCP and MWS II have been designed to take steps towards a more integrated approach. As discussed above, they are also stepping stones to further initiatives. Any long-term scenario of demographic and economic growth in Tamil Nadu will clearly indicate the importance of implementing the medium-term changes targeted by Government of Tamil Nadu under the TNWRCP and MWS II. And of looking beyond the medium-term horizon to the further changes that will likely be needed thereafter.

CONFRONTING WATER SCARCITY

INSTITUTIONAL AND POLICY CHANGES IN TAMIL NADU AND MADRAS

(Presentation for 1995 World Bank Water Resources Seminar)

Keith Oblitas and Michael Whitbread

(Agriculture and Water Operations Division
South Asia Region, Department II)

CONFRONTING WATER SCARCITY

INSTITUTIONAL AND POLICY CHANGES IN TAMIL NADU AND MADRAS

Keith Oblitas and Michael Whitbread

**(Agriculture and Water Operations Division
South Asia Region, Department II)**

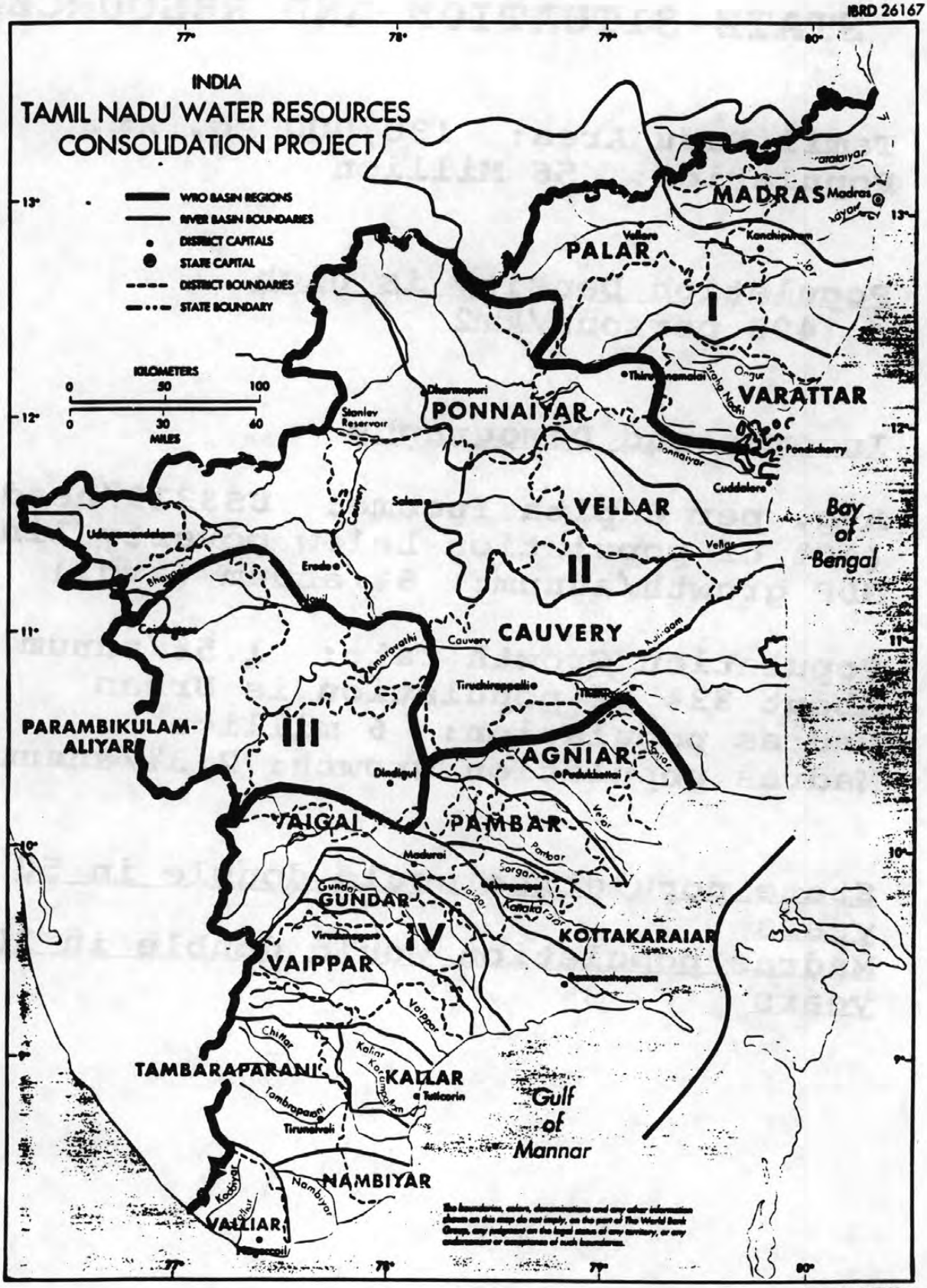
"Tamil Nadu Water Resources Consolidation Project (TNWRCP)"

- **Water Resources Organisation (WRO) (former Public works Department)**
- **Water Resources Control and review Council (WRCRC)**

"Second Madras Water Supply Project (MWS II)"

- **Metrowater**

IBRD 26167



AUGUST 1994

STATE SITUATION AND RESOURCES

Tamil Nadu Area: 130,000 sq. km.
Population: 56 Million

Population Density is high
: 428 persons/km2

Incomes and Demography

Avg. per Capita Income: US$319/head
(40% of population below poverty line)
GDP growth/annum: 6%/annum (avg.)

Population Growth rate: 1.5%/annum
About 33% of population is Urban
Madras population: 6 million
Madras population growth: 2.3%/annum

State population would double in 50 years
Madras population would double in 30 years

LAND AND WATER RESOURCES

Land and Water Short

Tamil Nadu has 7% of the country's population; but 4% of land area and only 3% of surface water resources

93% of Tamil Nadu's surface water resources are already utilized
(groundwater variable; in some areas net depletion)

Irrigation is main user
(about 85% of consumptive use)
(1.3 million ha under surface irrigation, 1.1 m. ha under wells)

Acute Water Shortage for Madras
70 liters/capita/day, of which 47 liters for domestic users

Middle class residents buy water from private suppliers
In droughts:
- reduce/curtail industrial supplies
- bring water by train and truck
- poor have little/pay high prices

Madras Basin virtually fully utilized
(by agriculture and urban/industrial use. Already constructing for inter-basin transfers.)

RECENT AND ONGOING INITIATIVES

I. ESTABLISHING A POLICY FRAMEWORK

"TAMIL NADU STATE WATER POLICY" (1994)

Consistent with:

- "National Water Policy" (1987)
- Banks Water Policy: "Water Resources Management" (1993)
- Bank/Government "India Irrigation Sector Review" (1991)

Key Themes:

: management as a unitary resource
: water planning
: institutions for water allocation
: improving water productivity
: environmental capability
: cost recovery/financial viabiity
: involving beneficiaries

II. STRENGTHENING WATER PLANNING

DIAGNOSTIC:
No Institutional Apparatus to Plan, Allocate and Manage Water by basin and multi-sectorally.
Very Limited Basin Planning.
Disparate, ad-hoc decisions on water use and investment, not based on basin plans or multi-sectoral use.

"WATER RESOURCES CONTROL AND REVIEW COUNCIL" (WRCRC)

Created in 1993 To be the state's formal body for making decisions on state and basin water planning, allocation and management, and for resolving conflicts between users.
Key features include:

- **Multi-Sectoral Representation**
- **Neutral and Senior Chairmanship**
- **Working Level Sub-Committees (Technical, Environmental, and Water Charges)**
- **Permanent staffed Secretariat:**

"Institute of Water Studies (IWS)"

Existing water research institution chosen, mandate adjusted and status elevated. IWS to now be the "Nodal Agency" for basin and state water planning, and the "Secretariat" of WRCRC. IWS Work program:

- **prepare Multi-sectoral River Basin Plans**
- **prepare State Water Plan.**

Ancillary actions:

Strengthening Hydrological Data

(through Tamil Nadu's component of the Hydrology Project)

Strengthen Environmental Capabilities

III. TRANSFORMING PWD TO A SPECIALIST STATE WATER AGENCY

- Former PWD a state construction agency. (irrigation, buildings, ports, transportation, etc.).
- Not well equipped to handle water management
- Government approach. Limited beneficiary participation.

(a) Creation of WRO

PWD bifurcated in 1994 to create the Water Resources Organisation (WRO)

Specialist State Water agency, divested of non-water functions and responsible for irrigation, drainage, flood control and bulk water supply.

(b) Reorganisation of WRO

- **Reorganised by specialist functions**
- **Decentralized by River Basin management units**

(c) Capacity building for WRO

(d) Improve Irrigation Efficiency/Involve Farmers

"Systems Improvement and Farmer Turnover (SIFT)"

-interlinks rehabilitation and modernization of existing irrigation commands with:

- **-farmer participation in investments**
- **-formation of Water User Associations (WUAs)**
- **-improved cost recovery and**
- **-turnover of O&M of distributaries to WUAs.**

IV. TRANSFORMING METROWATER TO A MODERN WATER UTILITY

MADRAS ESTIMATED THEORETICAL DEMAND AND SUPPLIES

Demand	**1750 mld**
Supplies	
Current sources	290 mld
Veeranam Project	180 mld
Krishna - 1st. phase	400 mld
Krishna - later	530 mld
Total	1400 mld
Less losses in distribution at, say, 20%	280 mld
Remaining shortfall	**630 mld**

COMPARISON BETWEEN MADRAS CONSUMPTION AND OTHER INDIAN CITIES

For areas covered, consumption for all purposes:

Madras	70 lpcd
Bombay	253 lpcd
Delhi	220 lpcd
Calcutta	190 lpcd
Bangalore	125 lpcd

THE MODERN WATER UTILITY

Dedicated specialist institution with statutory responsibilities

Professional management

Staffing reforms, training at all levels

Reorganization of administration, o&m functions, project planning

Reform of finances - computerization of functions, revised tariff structures, increased tariff levels, program of conservation

Institutional reforms linked to long-term plans to modernize and extend the capital assets and infrastructure

Metrowater Recent Financial Performance - for purposes of calculating performance against financial covenant targets under Madras WSS-I

Rs millions

	1989/ 90	1990/ 91	1991/ 92	1992/ 93	1993/ 94	1994/95 (1)
Operating Income (2)	301	336	356	472	511	826
Operating Expenditure	287	331	338	420	825	523
Depreciation	24	36	44	52	65	91
Debt Service	41	27	39	37	59	61
Excess of Income over Expenditure (2)	(51)	(58)	(65)	(37)	(438)	151

Note: (1) 1994/95 Provisional
(2) Before receipt of Government subsidies

PROSPECTS FOR METROWATER

To continue the modernization process -

- capital works program for improvement and extension
- conservation and loss reduction
- corporate management improvements
- containment of staff costs
- comprehensive metering
- full financial independence from Government

PROSPECTS FOR METROWATER

For the longer term -

- private finance - without Government guarantees
- Board membership changes
- a new relationship with Government - detached, accountable, serving the consumers
- extension of privatization

PROSPECTIVE FUTURE DEVELOPMENTS

Develop the initiatives underway:

- WRCRC and state water planning
- WRO program.
- Metrowater program (and other cities)

Decentralization/participatory management:

- Basin Level Committees/Boards

Farmer Irrigation Management

- Farmer Management of Entire Commands as WUA capabilities develop

Pricing in Water Allocation

- Prices to cover financial costs (agric); eventually to better reflect scarcity/value of water (agricuture)
- Polluter pays fees (industry)
- Metering urban domestic users
- Metering and Pricing for Groundwater Pumpsets
- Development of Water Rights and Markets (at WUA levels)

Further legislative and regulatory developments

Environmental Management

PHILIPPINES

IMPROVING WATER RESOURCES PLANNING AND MANAGEMENT AND STRENGTHENING NWRB

by Mei Xie, EA1AE, World Bank
(December 12, 1995)

Water Issues in the Philippines

The water resources management issue in the Philippines is at a critical stage. On the surface, the main concerns are recurrent water supply shortages, especially in Metro Manila, increasing conflicts in water allocation among users; severe water pollution near urban centers and a noticeable degradation of watersheds. Philippines is not an exceptional case compared with other countries in the region. To illustrate the increasing conflicts among the water use subsectors, a good example is the Angut water supply to Metro Manila (Fig. 1).

The government is conscious of the urgent need to address the water issue, and also recognized that at the core of the problem is the absence of an adequate framework to guide water resources development, protection and efficient use; weak institutional capacities for regulating and coordinating activities across subsectors; and inadequate investments in water infrastructure that have lagged behind levels needed to keep up with increasing demand.

Government Response to These Issues

A significant recent response was the 1994 "National Water Summit", opened by the President and attended by top level officials from all subsectors. The Summit concluded *an urgent need for coordination of all water related efforts, and a shift from a subsector approach to a more integrated approach to water management*. As a result of the summit, a number of responses has happened:

- The former Cluster G was reconstituted into a **Water Management Cluster**, which serves as the advisory committee to the President and the Cabinet on matters related to the water resources sector. The Cluster provides a focal point at high policy making level for dialogues on water policy issues.

- The **1995 "Water Crisis Act"** was issued and created a Joint-Executive Water Crisis Commission for implementation of the Act and for recommending actions to be taken by the President before mid-1996.

- **NEDA resolutions to strengthen NWRB**. The Water Summit reached a consensus on the need for strengthening of institutional mechanisms for closer coordination among water related agencies. NEDA thus passed a resolution to carry out a phased upgrading of the key coordination and regulatory body-- the National Water Resources Board (NWRB)--to become an effective national water resources management agency.

- **Draft "Irrigation Crisis Act"** under preparation.

The above only illustrates the urgency given to the water issues by the public and the government. This urgency provides a window of opportunity for adopting reforms in the water sector.

Bank Response in Accordance with Implementation of Water Policy

The Bank responded to the above situation through policy dialogues, technical assistance, and lending support to development projects.

- Water Supply and Sanitation **Sector Study** (1994)

- **Quick response to Government request**. At the Government's request, the Bank assembled a "quick response" team (September 1995) to assist the government in formulation of a time-bound strategy to implement the Water Crisis Act. The team worked with representatives of relevant government agencies, and formulated an action plan, which included an overall management framework strategy for medium-long term considerations, and immediate actions required for implementation of the Crisis Act.

- **Technical assistance to strengthen NWRB.** The program was carried out to assess water related legal and regulatory systems, formulate an action plan (both technical and institutional) to strengthen NWRB capacity to carry out its policy implementation and coordination functions.

- The above framework and recommendations from the TA have been fed into preparation of the **Water Resources Development Project.**

These actions have been directed by the thrust of the Bank Water Policy, especially with regard to supporting governments to adopt an institutional structure at the national and regional/basin levels to coordinate the formulation and implementation of policies and strategies for improved water management, and sector-wide public investment programs.

Major Institutional Constraints in the Water Resources Sector

Fragmented Water Management Responsibilities. Agencies in each subsector have largely independent strategies for resource development and operations. Negative externalities from excessive water withdrawals and discharges have extended across subsectors, and between the upstream and downstream areas of river basins (e.g. Angat).

Absence of an Overall Planning Framework to Guide Investment Activities. All subsectoral plans are submitted directly to NEDA and DBM for inclusion in the national MTPIP. There are no cross-sectoral water resources plans to integrate effectively the various

water and land use activities, water quality and quantity management, and conjunctive use of surface and groundwater. The most recent assessment of water and land resources in the Philippines was conducted almost 20 years ago. These plans continue to be used for identifying investment opportunities, despite substantial changes in the environment over the past two decades. Land use activities have affected flow patterns and the quality of waters in rivers and in coastal zones. Watershed degradation has modified hydrological conditions. Some data are no longer valid. The earlier plans seldom considered water quality, which has emerged as an important problem in recent years. During emergencies, actions are mostly taken on an *ad hoc* basis, accompanied by establishment of temporary committees, the announcement of new policies or speedy passage of laws, which often result in inconsistencies in policies.

Weak Law Enforcement Law enforcement is weak, reflected in the illegal tapping of urban and irrigation water by parties who do not hold permits, the exploitation of groundwater resources beyond levels permitted, inefficient use of the limited resources available, and degradation of watersheds. E.g. in 65% of cases, abstractions take place without permits, and only 6% of the wells of permit holders have been monitored to check for compliance with the permits. Some withdrawals are estimated to be 20-60% over the permitted levels.

Need for Strengthening NWRB

The responsibility for cross-sectoral coordination of water resources development and management stays with NWRB, which was created in 1974 to enforce and administer the water Law. The members of the NWRB consist of the heads of 10 government departments most concerned with water allocation. The Board is supported by a pool of full-time technical staff[1] headed by an Executive Director. Vested by the Code with broad regulatory and executing power, NWRB serves as an agent of the State under the Law for coordinating, controlling, supervising, and regulating the utilization, exploitation, and protection of water resources.

However, constrained by the composition and functioning of the Board, limited by funds and technical capability, NWRB has been unable to effectively enforce the provisions of the Water Code or to carry out its mandates. Despite clear stipulations in the Water Code, development plans seldom go through prior NWRB approval. NWRB has neither the guiding strategies, national master plans, updated basin plans, nor adequate staff resources needed to assess such investment plans and grant approvals. As NWRB does not have its own field offices, it has to delegate regional and field monitoring to other agencies. This arrangement has proven to be ineffective and long delays are common.

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[1] NWRB has presently a total number of 130 staff positions, of which 109 are filled, leaving 21 positions vacant.

Recommendations:

There are both institutional and technical recommendations, some of which require immediate actions and some require further studies or long term considerations. Some technical recommendations will be incorporated into the design and implementation of the WRDP project. While others would have to be implemented in a phased manner. Some preliminary recommendations are:

Legal measures:

- Amend Implementing Rules and Regulations to the Water Code
- Attach NWRB to the office of the President (rename it as Philippines Water Resources Authority)
- Amend the Law (water allocation principles)

Administrative measures: While the water law is generally considered adequate, the major constraint is a weakness in its implementation and monitoring.

- Only policy-making functions to be vested in the Board (also dispute solving)
- Delegate administrative functions (such as granting water permits) to NWRB's line divisions and the Executive Director, who will be authorized by the Board to grant the permits
- Establish three NWRB regional offices
- Vest each regional office with specialist administrative and hearing officers
- Redefine the composition of Governing Board members (e.g. confining to Cabinet level members only)
- Pass resolutions that approval by the Board of all development plans and programs of water resources agencies as a condition for submission to NEDA for inclusion into the national general development Plan

Financial measures:

- Enforce collection of the NWRB's receivable
- Lift the exemption from paying water fees and charges by Government and cooperative entities
- Increase the level of water fees and charges in line with existing proposals, and operationalize a Special Account in the General Fund of the Treasury

Technical measures:

- Strengthen NWRB's overall planning capability, update water resources assessment at national, regional and basin levels
- Improve collection of basic bench mark data network, improve coordination of NWRB with other relevant agencies dealing with water collection
- Strengthen NWRB's field capability and staff training

Presently, the final report is yet to be completed. We expect to have intensive consultation with various government agencies. Some of the above measures require Presidential Orders, some require amendments of law, some need merely resolutions by the Board of National Economic Development Authority, and some NWRB's now resolutions, or through memorandum of agreements. However, the opportunity is great. By April 1996, the Joint Executive Committee, to which NWRB is the Secretariat or the Technical Staff of the Committee, will submit proposals to the President. The Crisis Act empowers the President to issue special orders under the provision of the Act within a limited time (without going through Congress).

LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAM

Case Study in International Water Resources Management
(by Radha Singh, Eastern Africa Department, World Bank)

1. **History of Environmental Change:** Lake Victoria, with a surface area of 68,800 km^2 and an adjoining catchment of 184,000 km^2, sustains the life for tens of millions of people. As the world's second largest freshwater body, the lake ecosystem harbors unique biological resources. Kenya, Tanzania and Uganda control 6, 51, and 43 percent of the lake surface, respectively. The lake basin is used as a source food, energy, drinking and irrigation water supply, shelter, transport, and as a repository for human, agricultural and industrial waste. With the populations of the riparian communities growing at rates among the highest in the world, the multiple uses have increasingly come into conflict. This has contributed to rendering the lake environmentally unstable.

The past century has seen dramatic changes in the Lake Victoria ecosystem. In 1868, John Speke became the first European to visit Lake Victoria and declared it the Source of the Nile. The lake was a vast blue sea, and fish were caught in finely craft basket traps. By 1900 the railroad reached Kisumu, gill nets were introduced to the lake, and fresh tilapia were transported to Nairobi markets. Fish had become a commodity as well as a means of subsistence. By 1928, the declining catches of tilapia caused the colonial government to bring in fisheries experts from Britain to advise on management practices to maintain the tilapia fishery. As a result of the fishery study, regulations on mesh size were introduced to the gillnet fishery. The depth to which a white disc was visible from the surface (a measure of algal abundance) was 5.0 m in the offshore regions. By the mid-1960's, independence movements ended colonial rule under which the Nile perch had been introduced to Victoria in the 1950's to improve the fishery (Ogutu-Ohwayo and Hecky 1991), and the first scientific stock assessment of the lake's fishery was underway. So many species of cichlids were found that only species of the commercially important tilapia could be discriminated as "identifiable haplochromines (a subgroup of the cichlids) were the most abundant fishes in the lake accounting for 80% of the demersal fish biomass. The Nile perch was much less than 0.01% of the fish biomass in the lake. The catch from the lake was on the order of 100,000 tonnes of a diverse mix of native species. The transparency of the lake had declined to 3.0 m. By the early 1990's, many of the haplochromine fishes were thought to be extinct, only three species (just one native) were significant in the 500,000 tonne annual catch of which Nile perch contributed approximately 70%. The lake fishery had been "saved" from declining catches and dramatically enhanced as those who had introduced the perch had hoped; but, the lake had suffered a massive extinction of vertebrate animals unprecedented in modern times. The fishery had become an industry and substantial source of foreign exchange from international markets on four continents; however, undesirable and disturbing trends in the lake and its fishery had become obvious. The mean size of the Nile perch catch in many parts of the lake was below the size of first reproduction, the transparency of the lake for most of the year was one metre or less (Mugidde 1993), the hyplolimnion had become

deoxygenated (Hecky et al. 1994), there were massive blooms of potentially toxic algae (Hecky 1993, Mugidde 1993), water-borne diseases were endemic and increasing in frequency, and the water hyacinth, absent before 1989, was choking important waterways and landings in Uganda. Although Lake Victoria had experienced significant changes since it was dried out 14,000 years ago, it has never before been in this condition (Hecky 1993).

The lake and its fishery are the sources of most of the evidence cited above for the dramatic changes in the Lake Victoria basin over the past century, but the lake is not the source of the problem. The problems arise in the basin through human activity. In aquatic systems, fish are the largest organisms in food webs in which the primary producers are microscopic. Consequently without specialized equipment it is difficult to apprehend changes in aquatic systems except for fish which are filling a human requirement. In contrast, in terrestrial systems the plants dominate our visual impression. Humans can readily perceive differences in landscapes; but, when changes occur slowly over time, they may be unappreciated even in terrestrial systems unless historical records are kept. There is little debate that profound changes have occurred on the land since Speke first sighted Lake Victoria. Forests have been reduced to allow agriculture, to build houses and to provide warmth. Natural rangelands have endured increasing herds of livestock which have benefited from modern veterinary practice and elimination of predators. The fundamental cause of this visible change in the landscape has been the burgeoning human population of the riparian countries which continue to have 3-4% per annum growth rates permitted in part by the availability of modern medicine and the natural, previously underutilized, fertility of the country and the lake. The effective "ecological" limits to this population growth may already have been exceeded as changes in Lake Victoria bear witness. Most people recognize that there is beneficial transfer of essential resources from the lake to humans on the land such as water from rain and for irrigation, water for domestic use, and fish for food. Repeated human experiences demonstrate that we can extract these, obvious, beneficial transfers too rapidly and deplete water and fisheries resources. The most invisible process (and therefore the hardest to quantify) contributing to the evolution of the Victoria ecosystem is the transfer of materials at ever increasing rates from the terrestrial basin to the lake. Examples of these transfers are: 1) organic and inorganic suspended solids and dissolved nutrients borne by streams, 2) terrestrial dust, smoke, and inorganic compounds produced from combustion borne by air, and 3) the direct additions along the lakeshore of human and animal waste accompanying domestic water consumption and use. These transfers are usually unintended and undesirable for downstream water quality, e.g. increased soil erosion represents a loss of fertility from agricultural or pastoral activity which causes it or conversion of wetlands to agriculture which eliminates their water purification function. These invisible and unconscious transfers threaten the quality and utility of the water and fisheries; and, if unchecked, they eventually threaten the health and economic security of the people around the lake.

Lessons from the developed world

Developed nations were ignorant of the significance of these mass transfers from land to water, collectively called pollution because of their negative consequences, for much of their history. The Great Lakes of North America have gone through a similar history of fisheries overexploitation, species introductions obliterating productive fisheries, nuisance invaders, nutrient enrichment and toxic pollution. Only within the last quarter of the twentieth century have they begun to address the legacy of neglect, and many of these countries now spend billions of dollars restoring and protecting aquatic ecosystems so that their positive qualities and resources can continue to be enjoyed and utilized. In the developed countries, recognition and action followed substantial economic development, and the costly remediation was deemed affordable as well as necessary. Through the period of degradation in those countries, alternative sources of income, sustenance and water (through treatment) were available, and so degradation did not hinder economic development. For the riparian countries of Lake Victoria, alternative sources for the benefits which Lake Victoria yields are not obviously available. Loss and degradation of these critical aquatic resources (including the endemic biodiversity) **will check economic development** and consequently must be addressed by internal assistance. One lesson from developed countries is that delay in addressing pollution only increases eventual costs. Another lesson is that these negative trends are individually reversible through appropriate management even in great lakes if the public is committed to ecosystem restoration. But the most important lesson from developed countries in that issues of water quality and fisheries management are not independent of each other, and they are certainly not independent of socioeconomic activity. Ecosystems are complex integrations of intertwining flows and exchanges of mass and energy (of which fish yield is but one), some flows originate naturally and some are generated or altered by human activity. Addressing any single issue in isolation can be as disruptive to the ecosystem as the original cause for concern. An analogy would be pulling a single, loose thread in a tapestry without attention to the whole; such single-mindedness could lead to the unraveling of what was to be improved. Similarly ecosystem management must never lose sight of its overall which for Lake Victoria **must be sustainable use for the benefit of the riparian peoples**.

Consequences of inaction

Inaction in addressing these negative trends in overharvesting of the fishery and declining water quality will bear serious consequences. Unregulated, overfishing of Nile perch by the commercial fishery and use of destructive fishing practices such as beach seines or poisons by subsistence fisherfolk will diminish and perhaps eliminate a high-value fishery which is an important source of foreign currency to the countries. The success of the fishery in itself has led to increased activity on and around the lakeshore. Around 1970, 26,000 fisherfolk were actively fishing Lake Victoria (Bayley 1988), but by 1990 over 100,000 people are involved in fishing related activities. In 1990 this fishing effort sustained a lucrative processing industry, which has further attracted people to the lake, as well as a local market much larger than in 1970. Current estimates show that annual fish catch from Lake Victoria is between 400,000 - 500,000 metric tons generating around

US$ 300-400 million as revenue. The fishery is open to entry by all at present as opposed to land-based activities which follow a strict tenure system for allocation. Consequently, the lake's fishery will continue to be accessed by the poorest segments of society which often can only afford the most destructive fishing gears, e.g. beach seining with mosquito nets, as well as some of the most affluent industrial processors. A sustainable level of exploitation which can maintain a desired species mix to be identified and a workable management plan to effect that exploitation level needs to be enacted.

Water hyacinth currently is affecting the efficient pursuit of the fishery and possibly other aspects although there is no clear consensus on whether the net effects on fish production are positive or negative. But, the immediate threat of this plant is to other socioeconomic activities such as transportation, domestic water intake, and spread of bilharzia and harmful human interactions with snakes and hippos. If the productivity and dispersion of this plant is not controlled then negative economic effects will increase.

Nutrient inputs have increased two to three-fold since the turn of the century, mostly since 1950. Inputs are the result of the increased human and livestock populations and the pressure they put upon the landscape. Locally this general pressure is aggravated by urbanization without appropriate sewerage and treatment during disposal although these sources are minor on a lakewide basis (Scheren 1994; Bullock et al 1995). As a consequence, algal abundances have increased 4 to 5 times since 1960 and now nuisance, colonial and filamentous blue-green algae, *Anabaena* and *Microcystis,* dominate continuously, having replaced the previously dominant species of green algae and diatoms (Mugidde 1993). This shift in composition and abundance causes clogging of water intake filters and increases chemical treatment costs for urban centres. For people and livestock taking water directly from the lake, these bluegreen algae are potentially toxic causing a range of ailments from stomach upsets, through diarrhea to neurological diseases. Non-treated sewage from urban centres itself locally poses increased disease risk of fish kills of Nile perch and *Rastrineobola* when deep water is rapidly mixed into surface waters. The heavy sediment and pollution load carried by streams and rivers will increasingly foreclose successful spawning, feeding, and nursery areas to valuable riverine fish such as *Labeo* which previously were a thriving commercial resource. Continuation of high nutrient flows will feed excessive growth of water hyacinth and diminish the effectiveness of other control strategies.

The loss of nutrients and soil by erosion of the land surface and the loss of wetlands which together are the most important sources of the increased nutrient to Lake Victoria will continue to be significant costs to the agricultural sector and to the biodiversity of the landscape. The loss of soil fertility from many areas already exceeds the economic capacity to restore it through artificial fertilization. Similarly an actively growing and expanding coastal wetland retaining sediments, pollutants and nutrients will not be affordably replaced in the near future by a water treatment plant. Benefit: cost analysis argues for the maintenance and sustainable use of these watersheds and wetlands. Stakeholders directly dependent on the lake for their well-being are already suffering the consequences of non-sustainable use; the next and following generation of agriculturists

will suffer greater poverty as the consequence of this generation's use of the land. Moreover, inaction in developing socio-economic alternatives to current practices will dictate that root causes of environmental degradation will continue, that costs of delayed remedial action will rise and that hope, the most precious commodity, will be lost. The people of the basin in their daily pursuits have unintentionally caused the changes in the lake, and there is no sustainable solution without their attention, commitment, and active involvement.

Management challenge and interventions

The Lake Victoria Environmental Management Program (LVEMP) is a comprehensive program aimed at rehabilitation of the lake ecosystem for the benefit of the people who live in the catchment, and the national economies of which they are a part. The program objectives are to maximize the sustainable benefits to riparian communities from using resources within the basin to: (a) generate food, employment and income; (b) increase value-added from the development of export oriented fish processing; (c) supply safe water and a disease free environment; and (d) conserve biodiversity and genetic resources. In order to address the tradeoffs among these objectives which cut across national boundaries, a further project objective is to harmonize national management programs in order to achieve, to the maximum extent possible, the reversal of ongoing environmental degradation.

Under GEF assistance of US$1.8 million, the three governments began the process of program preparation. The Tripartite Agreement (signed August 5, 1994) which set in motion a collaborative process of project preparation and implementation among the three countries, provided the establishment of three **National Secretariats**, to service the Regional Task Forces preparing the program. The Secretariat in Uganda serviced Regional Task Force I on fisheries and water hyacinth control. The Secretariat in Kenya serviced Regional Task Force II on water quality and land use management. The Secretariat in Tanzania provided overall project coordination - its Head is also Executive Secretary of the **Regional Policy and Steering Committee** which makes policy decisions regarding the entire program.

The project would support the following specific regional and national program activities: management of fisheries, including the establishment and operations of the Lake Victoria Fisheries Organization, improvement of fisheries research and the information base for fisheries, and strengthening of extension, monitoring and enforcement capabilities of national fisheries administrations; (b) management of lake pollution and water quality, including strengthening and harmonizing national regulatory and incentive frameworks and enforcement capabilities, and establishing a lake-wide water quality monitoring system, improvement of research and the information base for pollution control and water quality, and pilot investments in industrial and municipal waste management; (c) wetland management, including improving the information base, and pilot investments in sustainable management of wetland products; (d) management and control of the water hyacinth infestation; and (e) management of land use in the catchment, including

improvement of research and the information base for pollution loading from the catchment, and pilot investments in soil conservation.

The three National Secretariats would be continued into the project implementation phase. These three small groups, one in each country, would provide a day-to-day central contact point and information clearing house for all agencies implementing the program, and all donors supporting it. While the many implementing agencies would be responsible for progress on their own components, and for monitoring and reporting on that progress, the Secretariats would gather information from all the agencies in their respective countries, be responsible for overall monitoring, and prepare such progress reports as are required for decision making about the overall program. The Heads of the Secretariats would also, when necessary, organize tripartite meetings of officials responsible for various components of the program. The Regional Secretariat in Tanzania would organize meetings, when required, of members of the Regional Policy and Steering Committee, which would also remain in place, with the same membership as it has had throughout program preparation. The Committee would have many roles, perhaps the most important being the mechanism for resolution of any disputes arising during implementation of the program.

The program investments would be implemented by collaboration among many agencies, including the **Lake Victoria Fisheries Organization** (LVFO) which would be established under the program, Ministries of environment, water, fisheries, and agriculture and their associated institutes, universities, NGOs and local communities. The Lake Victoria Fisheries Organization would assume overall coordination for components associated with fisheries, while the Regional Policy and Steering Committee would be responsible for overall program coordination, including coordination between the fisheries activities as a whole and the rest of the program.

In view of the extensive scientific investments in the program, the worldwide scientific interest in Lake Victoria, and uncertainties associated with the dynamic lake ecosystem, it is also proposed to appoint a high level **Panel of Distinguished Scientists**, with 3-5 members, to serve as an overall steering group for the scientific studies in the lake. GEF funding of up to US$10 million, and IDA credit of US$ 45 million will be available for the implementation of the initial phases of the program. The Governments' contribution will approximately US$ 6.8 million.

Participatory Approaches

Project preparation has followed a participatory process that provided Government ownership and involvement of beneficiaries/stakeholders in determining design and management of the program. This is to be sought through the medium of Regional and National level seminars/workshops, appointment of NGOs as members of National Working Groups (NWGs), introduction of a systematic consultative process between members of the NWGs and the beneficiary/stakeholders within the overall guidance of the LVEMP National/Regional Secretariat. Community empowerment and eventual

ownership of the projects by the targeted beneficiaries are key to the long term sustainability of environmentally sound development interventions of the LVEM projects being proposed. Four strategies in respect of community mobilization are proposed, these include awareness creation, involvement, participation and motivation.

The project would be the first of its kind within the region, addressing a complex set of managerial, scientific/technical and institutional issues across three countries. It would aim to provide Government with the necessary skills, information, technical and financial resources, and legal framework to successfully carry out such an endeavor. It would build technical capacity to promote, assist and coordinate the various initiatives within a regional framework, and help design a comprehensive set of national policies and strategies based on lessons learned from field experience. An important lesson incorporated from past operations is to ensure that preparation be done by the countries themselves. The resultant ownership will have the usual national benefits, as well as being especially important in this program which crosses national boundaries, since the three governments have already gained valuable experience working together during preparation.

THE GANGES RIVER DISPUTE

By

S. Salman
Legal Department
World Bank

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The Ganges River Dispute

Introduction: The Ganges basin, known in India as the Ganga, is both an international river to which India, Bangladesh, Nepal and to a small extent China are the riparian states; and within India, an inter-state river shared by the States of Uttar Pradesh, Bihar, West Bengal, Haryana, Himachal Pradesh and the Union Territory of Delhi. It originates in the state of Uttar Pradesh where it is known as Bhagirathi, and is joined by a number of tributaries originating inside India such as the Yamuna, the Tons and the Gomti. It is also joined by other tributaries originating in Nepal such as the Kamala and the Bagmati, and the Nepal-China border (in Tibet) such as the Kosi and Gandak. The delta of the Ganges can be said to start from Farakka in West Bengal. About 20 miles south of Farakka the river divides itself into two arms: the Padma which flows eastward into Bangladesh, and the Bhagirathi which continues to flow south in West Bengal. After the Bhagirathi is joined by the Jalangi, it is known as the Hooghly river. Calcutta, the largest Indian city, one of the largest sea ports, and the capital of West Bengal, stands on Hooghly river. South of Calcutta, the Hooghly is joined by the Damodar river and flows into the Bay of Bengal.

In Bangladesh, the Ganges, which is known as the Padma, is joined by the Brahmaputra river, and later by the Meghna river, and then gets divided into a number of channels all flowing in the Bay of Bengal.

The total length of the Ganges is about 1,600 miles. About 80% of the Ganges basin is in India, about 18% in Bangladesh and about 1% is in Nepal. The Ganges basin is one of the most densely populated basins in the world, with a total population of about 280 million, of whom about 10 millions are in Nepal, 45 million in Bangladesh, and the rest in India.

At present there is no treaty amongst the riparian states for sharing the waters of the Ganges. There were a number of interim agreements entered into between India and Bangladesh, following the construction of the Farakka Barrage, and the latest such agreement expired in 1988.

The Farakka Barrage: The issue of sharing the waters of the Ganges between India and Bangladesh became a prominent one following the decision of India to construct the Farakka Barrage to address the shortage of water in Calcutta Port. The reasons given by India for construction of the Barrage, which are centered in saving of Calcutta Port, included:

(i) Because of siltation in the Hooghly river bed, there was a gradual shifting in the course of the Ganges which resulted in scarcity of water at Calcutta Port, thus adversely affecting navigational activities. India felt an urgent need to maintain water flow in the Hooghly river.

(ii) There was also the need for a strong current to flush down the silt deposited in the Calcutta Port.

(iii) Supply of fresh water is needed to overcome the problem of salinity. Fresh water is also needed for irrigation, industrial and domestic use.

The decision to construct the Barrage was taken in 1951. Work on the Barrage started in 1961 and was completed in 1971. The feeder canal from the Barrage was completed in 1975, and the Farakka Barrage came into operation on April 21, 1975. The Barrage is about 2,240 meter long, and the Feeder Canal is about 24 miles long. The Barrage was intended to ensure that the Hooghly river receives, even in the worst of the dry season, at least 40,000 cubic feet per second (cusecs) of water. It is assumed that the availability of water at Farakka in the lean season would be around 55,000 cusecs. After the needs of Calcutta Port are satisfied, 15,000 cusecs would be released to Bangladesh.

Pakistan consistently opposed the construction of the Barrage, and this situation did not change following the emergence of Bangladesh in 1971. In its objection, Bangladesh raised the following:

(i) The average lean flow of the Ganges of 55,000 cusecs is its normal requirements, and any decrease would affect its river basin development projects.

(ii) River navigation which is the basic transport system in Bangladesh would be affected if there is a decrease in the Ganges flow.

(iii) The Barrage would create scarcity of water for irrigation, affect fisheries production and lower ground water resources.

India, on the other hand, contended that Bangladesh was exaggerating the negative effects of the barrage on its navigation, irrigation, fisheries and ground water resources.

Agreements on Water Sharing: Despite India's determination to build the Farakka Barrage to supply the Hooghly river with 40,000 cusecs, on the one hand, and the opposition of Bangladesh to such construction and its contention of the negative impact on Bangladesh, on the other hand, a number of agreements were reached between India and Bangladesh on sharing the waters of the Ganges during the dry season. Unfortunately, those agreements were all interim agreements, lasting for a limited period of time. Those agreements were:

I. **The 1975 Agreement:** The commissioning of the Farakka Barrage on April 21, 1975 was preceded by an eleventh hour agreement between India and Bangladesh on the sharing of dry season flow of the Ganges, which was signed on April 18, 1975. The temporary allocation agreed upon was as follows:

TABLE - I

Sharing of Lean Season Flow at Farakka (Amount in Cusecs)

10 Days Period	Dependable Supplies at Farakka	Amount agreed upon for Hooghly	Remaining Flow for Bangladesh
21 to 30 April 1975	55,000	11,000	44,000
1 to 10 May, 1975	56,500	12,000	44,500
11 to 20 May, 1975	59,250	15,000	44,250
21 to 31 May, 1975	65,500	16,000	49,500

Under this Agreement, India's share was less than the 40,000 cusecs it initially demanded and varied between 20%-25% of the 55,000 expected lean flow. On the other hand, Bangladesh's share ranged between 80-75%. Although the agreement was a historical break through, it was a very interim arrangement. It expired on May 31, 1975.

II. The 1977 Agreement: At the urging of the Political Committee of the United Nations General Assembly, attempts were again made to try to reach an agreement. Those attempts resulted, two years later, in the signing of an agreement between the two countries in Dhaka, on November 5, 1977. The Agreement dealt with the sharing of the Ganges water at Farakka, and also included provisions for solving the long term problem of augmenting the flows of the Ganges. The share of each country between January 1 and May 31 was agreed upon as follows:

TABLE II

Sharing of Waters at Farakka Between the 1st January and the 31st May Every Year

1		2	3	4
Period		Flows reaching Farakka (based on 75% availability from observed data (1948-73)	Withdrawal by India at Farakka	Release to Bangladesh
		Cusecs	Cusecs	Cusecs
January	1-10	98,500	40,000	58,500
	11-20	89,750	38,500	51,250
	21-31	82,500	35,000	47,500
February	1-10	79,250	33,000	46,250
	11-20	74,000	31,500	42,500
	21-28/29	70,000	30,750	39,250
March	1-10	65,250	26,750	38,500
	11-20	63,500	25,500	38,000
	21-31	61,000	25,000	36,000
April	1-10	59,000	24,000	35,000
	11-20	55,500	20,750	34,750
	21-30	55,000	20,500	34,500
May	1-10	56,500	21,500	35,000
	11-20	59,250	24,000	35,250
	21-31	65,500	26,750	38,750

The Agreement provided for proportionate sharing of any excess or deficit of flow. Still, the Agreement included a "Guarantee Clause" for Bangladesh. The clause stated that "if during a particular 10 day period the Ganga flows at Farakka come down to such a level that the share of Bangladesh is lower than 80 percent of the value shown in column 4, the release of water to Bangladesh during that period shall not fall below 80 percent of the value shown in column 4". The Agreement set up a Joint Committee consisting of representatives nominated by the two governments. The Committee was responsible for implementing the arrangements contained in the Agreement. Any dispute would be referred to a panel of an equal number of experts nominated by the two

governments. The Agreement recognized the need to cooperate with each other in finding a solution to the long term problem of augmentation of the flows of the Ganges during the dry season. The Indo-Bangladesh Joint Rivers Commission (established in 1972) was entrusted with the task of carrying out investigations and studying schemes relating to augmentation of the dry season flows of the Ganges. The Commission was to submit the proposals within a period of three years. The Agreement was to be reviewed at the expiry of three years, with further reviews taking place six months before the date of expiration. It was to remain in force for five years, but could be extended further for a specified period by mutual agreement.

III. The 1982 Memorandum of Understanding: The Joint Rivers Commission was not able to agree on any proposals on augmenting the flow of the Ganges during the dry season. As 1977 Agreement expired on May 31, 1982, the two governments felt the pressure to avoid a sudden resurgence of a vacuum during the next dry season and thereafter. Accordingly, on October 9, 1982, a Memorandum of Understanding (MOU) was signed in Delhi, by the two governments. This MOU was short, with the opening paragraph criticizing the 1977 Agreement and observing that "it had not proved suitable for finding a satisfactory and durable solution, and that with its termination fresh efforts were necessary to arrive at such a solution". Very minor adjustments were made to the amounts to be withdrawn by India at Farakka and the releases to Bangladesh. Those adjustments were in the range of 500-250 cusecs, with the total monthly allocation to each country remaining the same. The two sides acknowledged that the basic problem was one of inadequate flow of water in the Ganges available at Farakka. They further agreed that the long term solution lay in augmenting the flow available at Farakka, and directed the Joint River Commission to complete the pre-feasibility study and decide upon the optimum solution within 18 months of the date of the MOU. Such augmentation proposals would be implemented by the two governments. In the case of exceptionally low flows during either of the next two dry seasons, the two governments would hold immediate consultations and decide how to minimize the burden to either country. This provision terminated the special guarantees provided to Bangladesh in the 1977 Agreement that Bangladesh's share would not fall below 80% of the agreed amount of release.

This MOU expired on May 31, 1985. The 18 months given to the Joint River Commission expired earlier without the carrying out of the pre-feasibility study on augmentation of the flow of the Ganges during the dry season.

IV. The 1985 Memorandum of Understanding: Again, to avoid a sudden resurgence of vacuum after the 1982 MOU expired, India and Bangladesh signed another MOU in Delhi on November 22, 1985. The MOU confirmed the need for a joint study for working out schemes for augmentation of the flows of the Ganges at Farakka, and for identifying alternatives for the sharing of the available river water resources common to both countries. The study would be undertaken by a Joint Committee of Experts (JCE) and would be completed within 12 months from the date of the MOU, with a ministerial review at the end of the first six months. At the end of the twelve month period, a

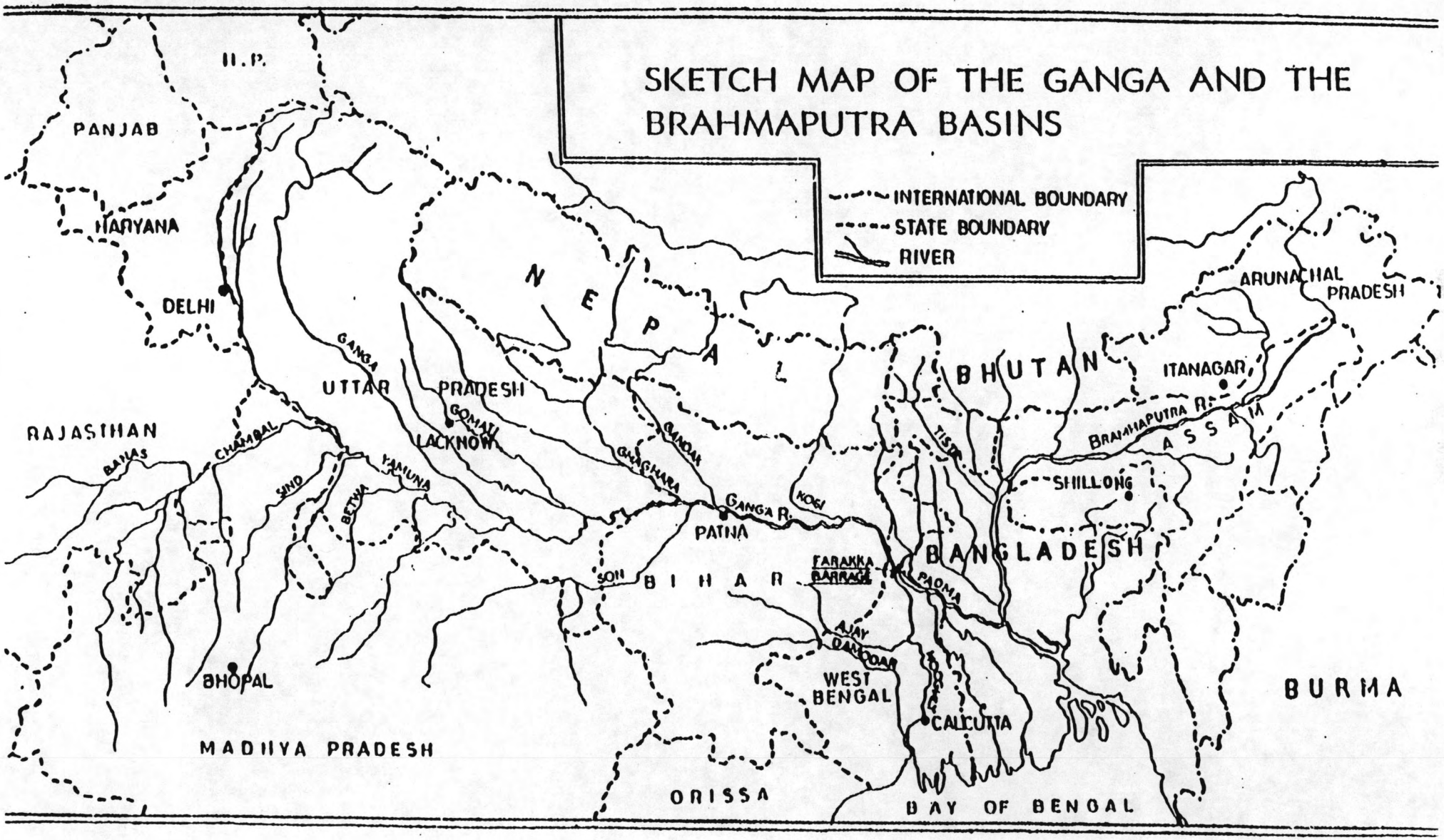
summit level meeting between the leaders of the two countries would be held to take a decision on the scheme of augmentation of the flows of the Ganges at Farakka, and the long-term sharing of the river proposed by the JCE. The MOU set the releases of the Ganges water available at Farakka for the next three years at the same levels as those set by the 1982 MOU. The immediate consultation clause in case of exceptionally low flows of the 1982 MOU was reiterated in this MOU, reconfirming the end of the special guarantees provided to Bangladesh under the 1977 Agreement.

The 1985 MOU expired on May 31, 1988. The joint study proposed by this MOU was not carried out because of the failure to arrive at common grounds for this study. Each side proposed a different scheme for augmenting the flow of the Ganges available at Farakka. India proposed a plan to construct a link canal across Bangladesh to connect the Brahmaputra River with the Ganges at a point above the Farakka Barrage to augment the Ganges flow during the dry season. This was rejected by Bangladesh, who, instead, proposed building storage dams in the upper reaches of the Ganges in India and Nepal which would store water during the monsoons, for release during the dry seasons. In turn, this proposal was rejected by India.

CONCLUSIONS: Although India and Bangladesh were able until 1988 to reach agreements on the sharing of the waters of the Ganges during the dry season, those agreements were all interim. The last one expired leaving behind a vacuum that still prevails. Those agreements did not address any of the other larger issues concerning the basin such as flood control during the monsoon season (when water sharing is not an issue) bank erosion, pollution, hydroelectric power schemes and the environment. However, more apparent was the failure of the parties to reach an agreement on schemes for augmentation of the dry season flow which is the major issue facing them, and the failure to keep the momentum for another agreement for sharing the waters of the Ganges during the dry season, after the 1985 MOU expired.

THE GANGES RIVER DISPUTE

- THE RIVER
- ROOTS OF THE DISPUTE
- ATTEMPTS TO RESOLVE DISPUTE
- CURRENT STATUS


SKETCH MAP OF THE GANGA AND THE BRAHMAPUTRA BASINS
INTERNATIONAL BOUNDARY
STATE BOUNDARY
RIVER
H.P.
PANJAB
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
GANGA
GOMATI
LACKNOW
CHAMBAL
BANAS
SIND
BETWA
YAMUNA
GHAGHARA
GANDAK
KOSI
GANGA R.
PATNA
SON
BIHAR
FARAKKA BARRAGE
PADMA
AJAY
DAMODAR
WEST BENGAL
CALCUTTA
BHOPAL
MADHYA PRADESH
ORISSA
BAY OF BENGAL
NEPAL
BHUTAN
ITANAGAR
ARUNACHAL PRADESH
BRAHMAPUTRA R.
ASSAM
TISTA
SHILLONG
BANGLADESH
BURMA

THE GANGES

- **Length: About 1,600 Miles**
- **Basin Area:** **About 80% in India**
  About 18% in Bangladesh
  About 1% in Nepal
- **Basin Population:** **About 280 million:**
  10 million in Nepal
  45 million in Bangladesh
  225 million in India

THE ROOTS OF THE DISPUTE: THE FARAKKA BARRAGE

- **INDIA WANTED THE BARRAGE BECAUSE, ACCORDING TO INDIA:**
  - **Siltation in the Hooghly River Bed Caused Gradual Shifting in Course of River, Resulting in Water Scarcity at Calcutta, and Affecting Navigation**
  - **Need Strong Current to Flush Silt at Calcutta Port**
  - **Need Fresh Water to Overcome Salinity**
  - **Need Water for Irrigation, Domestic, Industrial use**
  - **Would Withdraw 40,000 out of the 55,000 available CUSECS**
- **BANGLADESH OBJECTED BECAUSE, ACCORDING TO BANGLADESH:**
  - **55,000 CUSECS its Normal Requirement**
  - **Any Decrease Would Affect its River Basin Development Projects**
  - **Any Decrease Would Affect Navigation Which is the Basic Transport System**
  - **Any Decrease Would Affect Irrigation, Fisheries and Groundwater**

- **THE BARRAGE**
  - **Decision to Construct in 1951**
  - **Construction Started in 1961**
  - **Barrage Completed in 1971**
  - **Feeder Canal Completed in 1975**
  - **Barrage Commissioned on April 21, 1975**
  - **2,240 Meters Long**
  - **Feeder Canal: 24 Miles Long**

ATTEMPTS TO RESOLVE DISPUTE

Four Agreements were Reached

1. **THE 1975 AGREEMENT**

   - **Water Allocation; 41 Days**

2. **THE 1977 AGREEMENT**

   - **Water Allocation**
   - **Proportionate Sharing of Excess and Deficit**
   - **Clause Guaranteeing Bangladesh Minimum of 80% of its Share**
   - **Joint Rivers Commission (JRC) to Carry Augmentation Study**
   - **Review - 3 Years; Expiry - 5 Years, but can be renewed**

3. **THE 1982 MOU**

   - **Water Allocation**
   - **Augmentation Study to be Completed by JRC in 18 Months**
   - **Abolishing Guarantee Clause**
   - **Consultation in Case of Exceptional Low Flow**

4. **THE 1985 MOU**

   - **Water Allocation**
   - **Augmentation Study to be Carried Out by Joint Committee of Experts (Not JRC) Within 12 Months; Review within 6 months**
   - **Consultation in Case of Exceptional Low Flow**

Sharing of Lean Season Flow at Farakka (Amount in Cusecs)

10 Days Period	Dependable Supplies at Farakka	Amount agreed upon for Hooghly	Remaining Flow for Bangladesh
21 to 30 April 1975	55,000	11,000	44,000
1 to 10 May, 1975	56,500	12,000	44,500
11 to 20 May, 1975	59,250	15,000	44,250
21 to 31 May, 1975	65,500	16,000	49,500

Sharing of Waters at Farakka Between the 1st January and the 31st May Every Year

1		2	3	4
Period		Flows reaching Farakka (based on 75% availability from observed data (1948-73)	Withdrawal by India at Farakka	Release to Bangladesh
		Cusecs	Cusecs	Cusecs
January	1-10	98,500	40,000	58,500
	11-20	89,750	38,500	51,250
	21-31	82,500	35,000	47,500
February	1-10	79,250	33,000	46,250
	11-20	74,000	31,500	42,500
	21-28/29	70,000	30,750	39,250
March	1-10	65,250	26,750	38,500
	11-20	63,500	25,500	38,000
	21-31	61,000	25,000	36,000
April	1-10	59,000	24,000	35,000
	11-20	55,500	20,750	34,750
	21-30	55,000	20,500	34,500
May	1-10	56,500	21,500	35,000
	11-20	59,250	24,000	35,250
	21-31	65,500	26,750	38,750

- **AUGMENTATION STUDY NOT CARRIED OUT BECAUSE OF DIFFERENCES IN APPROACH:**

  - **INDIA: Proposed construction of link canal across Bangladesh, connecting the Ganges and Brahmaputra to augment Ganges flow during dry season**

  - **BANGLADESH: Proposed building storage dams in the Upper Reaches of the Ganges in India and Nepal, which would store water during monsoon season for release during dry season**

  - **Each Rejected the Other's Proposal**

CURRENT STATUS

- **ALL AGREEMENTS WERE INTERIM ARRANGEMENTS; LAST ONE EXPIRED IN 1988 LEAVING A VACUUM**

- **OTHER MAJOR ISSUES THAT HAVE NOT BEEN ADDRESSED:**

  - **Flood Control (water sharing during monsoon is not an issue)**

  - **Erosion**

  - **Pollution and Environment**

  - **Hydroelectric Power Schemes**

- **NO AGREEMENT ON AUGMENTATION METHODS**

1995
WORLD BANK
WATER SEMINAR

Theme II
Group 1

Water Rights and Water Markets

Topic: Mexico
Speaker: Douglas Olson

Paper Unavailable

DECEMBER 11–13, WESTFIELDS INTERNATIONAL CONFERENCE CENTER
CHANTILLY, VIRGINIA

1995 World Bank Water Seminar

Recent Developments in the Office du Niger, Mali

By Djibril Aw[1] and Chantal Dejou[2]

I. A HUGE POTENTIAL, BUT 50 YEARS OF DISMAL RESULTS (1932-1982).

1. Located in the heart of Mali, the Office du Niger (O.N.) is one of the oldest and largest irrigation schemes in Sub-Sahara Africa. It was created by the French in 1932 after the discovery of a large fossil delta in the area (see Box 1). It was projected to develop about a million hectares over a period of 50 years. Its objective was twofold: i) to supply the French textile industry with a large share of its needs in cotton; and ii) to significantly contribute to food security for the whole Sahelian region of the French Empire with a modern and commercial rice production system.

2. Fifty years after its creation, however, the O.N, in 1982, was far from meeting this objective.

i) only 6% (60.000 ha) of the target area had actually been achieved;

ii) the infrastructure was poorly maintained; as a result one third of the area developed was abandoned;

iii) cotton production had been discontinued in 1970 because rainfed production systems in the South of the country proved to be more cost effective;

iv) average yield of paddy had reached its lowest level, with just 1.6 t/ha; and

v) settlers were disgruntled over their poor conditions.

3. In short, O.N was a model White Elephant which had drained huge public resources with little results to show. Under these circumstances, a great deal of optimism was required to consider rehabilitating such a parastatal. Yet, optimism and a decade of careful preparation and implementation were the key ingredients to what can be cited as a project well on its way to becoming a success story.

II. SPECTACULAR SUCCESS OVER A DECADE

4. The Green Revolution in rice production initiated in Asia in the mid 1960's, with the widespread adoption of modern high-yielding varieties (HYV), did not reach West Africa until the beginning of the 1970's. The initial tests consisted of pilot projects spread across several countries, carried out with Chinese assistance. The results were impressive, with yields of 4-5t paddy/ha. It was also a time when a

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[1] Djibril Aw is presently a senior agriculturalist with the World Bank. From April 1993 to April 1995 he was responsible for the restructuring of the Office du Niger, on an external service assignment with the Government of Mali. Prior to this, he served as Chief Agronomist and Deputy Director General of the O.N. from 1962 to 1972.

[2] Chantal Dejou is a senior economist with the World Bank. She was assigned the task managership of the IDA-assisted project on O.N. for the past five years.

severe drought hit the Sahel. The conjunction of these two facts highlighted how valuable the vast irrigation facilities of the ON could be. From 1975 to 1977 the Malian Government, with the assistance of West Africa Rice Development Association (WARDA), prepared a master plan for the rehabilitation of the ON. This study served as the basis for a World Bank identification mission in 1977 and a technical assistance/engineering project in the following year. Soon thereafter other donors joined the efforts. The first physical rehabilitation pilot project were undertaken in 1982 with Dutch assistance. There are now a group of six donors assisting the ON.

Box No. 1

Origins, characteristics and development principles of the Inner Delta of the Niger River

1. Millions of years ago, a succession of earthquakes created a huge basin of around 3 million hectares located approximately between the actual cities of Segou and Timbuktu in Mali. This basin was more than 60 meters deep on its northern side and was used as a delta by a river which corresponded to the upper portion of the actual Niger river, exactly in the same way as Lake Chad is today the inner delta of the Logone and Chari rivers. When this basin was completely filled by sediments from the river thousands of years ago, the overflooding of the river resulted in the capture of this river with another one which had its source in the Sahara mountains during a humid period of the climate in that region. This capture gave the actual lay-out of the Niger river, going from the Fouta Djalon mountains in Guinea to the Gulf of Guinea in Nigeria. This capture also resulted in the drying out of the inner delta.

2. The discovery of this fossil delta was made in 1925 by Emile BELIME, a French engineer, and confirmation came accidentally that same year when an exceptional flood permitted to observe a natural re-watering of former stretches of the ancient delta. The advantages of such a discovery appeared immediately to BELIME, who had been working since 1919 on a land development project for the Niger valley between Bamako and Timbuktu. The objectives of this project were to reduce, or even suppress, the dependency of the French textile industry for the supply of cotton. As a matter of fact, the existence of an inner fossil delta permits the irrigation of this vast area of rich soils by simple gravity.

3. As in all deltas, the river stretches called defluents are in elevation with respect to the land and are separated by bank strips. By flooding the ancient defluents, they are transformed in primary canals for gravity irrigation.

4. The discovery of the ancient delta and application of the development principles summarized above led BELIME to prepare a delta development Project for which the Office du Niger was created in 1932. The initial project consisted of 960,000 hectares, but further studies led to increase the area to 1,105,000 hectares. Since the construction of the Markala dam, completed in 1947, it is possible to irrigate by gravity more than a million hectares. However, as of now, only 60,000 hectares, or 6% of the potential, have been actually developed. The Inner Delta of the Niger River represents provably one of the largest underdeveloped reserve of alluvial land that could by irrigated by gravity.

5. The overall result of the rehabilitation is an impressive turn-around: cf Table 1. It would be worthwhile to highlight that between 1983 and 94:

i) average paddy yields tripled; they rose to 5t/ha, which compares favorably with the Green Revolution achievements in Asia;

ii) about 10,000 ha, or a fourth of total area cultivated, were lands previously abandoned, since no new land development has been undertaken for rice since 1966;

iii) settler population grew by 222%, while it would have grown only by 35% with the country overall annual population growth of 2.8%;

iv) per capita production of paddy rose from 0.9t to 1.6t; the combination of settler population and productivity increases made a significant contribution to poverty alleviation and food security for the overall country.

III. FACTORS OF SUCCESS

6. The causes of the success of the Office du Niger project are many, and can be divided into two categories: technical and institutional/economic.

Technical factors

a) Water management: Adequate delivery and disposal of excess water as well as maintenance of an optimum level of water in the paddy field are essential to rice intensification. They are prerequisites to the use of dwarf HYVs, the effective use of fertilizers and labor-intensive practices. Water control has been achieved by the physical rehabilitation of the irrigation and drainage network. Taking into account that this has been so far completed only on 40% of the total cultivated area, there is still a significant margin for raising the average yield and the overall production. For instance, in the Niono zone, where nearly all the land has already been rehabilitated, the average yield reaches about 7t/ha. By contrast in the Molodo zone, where rehabilitation has not yet started, the yield is only about 3t/ha. However, even this represents a doubling of the average yield in the last decade because farmers partly succeeded in improving the water control by themselves with bunding and land leveling by hand and animal traction.

b) Availability and extension of a comprehensive package of improved technological messages: These include, inter alia, pre-tested high yielding varieties, optimum plant density, age of seedlings, date of sowing, fertilizer formulas specially adapted to the constraints of the zone and to local capacities. In the past many of these technologies were not adopted either because preconditions- such as water control- had not been met, or because a constraining economic context- such as Government price fixing or monopsony buying of paddy production by the Office du Niger- created enormous disincentives to production. A good example of a production technology that suddenly became attractive once water control and favorable macroeconomic conditions were achieved is transplanting (see Box 2). The adoption of improved technologies by large numbers of producers was greatly facilitated by an improved agricultural extension service based on the fundamental principles of the Training and Visit System (T&V).

Box No. 2

Adoption of rice transplanting in the Office du Niger

Transplanting is a very ancient and widespread technique in rice cultivation in Asia. It is only in countries where the cost of labor is high that alternative techniques have been experimented and are now employed. The main advantages of transplanting are that it gives the paddy seedlings an edge in its competition with weeds, and also it allows double-cropping in the same year. Extension of this technique to farmers failed in the 1960's, when farmers strongly refused the change and turned it into derision with arguments such as "No progress can be made by moving backwards" by reference to the fact that transplating is performed walking backwards in the paddy fields. Liberalized prices and improved infrastructure, this technique was massively and rapidly adopted, as follows:

Campaign	82/83	83/84	84/85	85/86	86/87	87/88	88/89
Transplanted Area (hectares)	0	5	37	529	869	1,857	2,721
Campaign	89/90	90/91	91/92	92/93	93/94	94/95	
Transplanted Area (hectares)	4,166	6,766	21,462	22,797	25,893	29,488	

Today transplanting is widespread throughout the region, with the exception of those areas where topography or other conditions for irrigation and drainage are particularly bad. Although, the technique has only been adapted in recent years, Malian rice farmers have become strong adepts of its use, and were able to reach the same level of productivity in this respect than traditional rice-growing countries in Asia. The spreading of rice transplanting clearly illustrated the technical revolution

c) **Appropriate agricultural mechanization:** The rapid increase in yields caused serious problems of absorptive capacity in threshing and processing activities which were previously the monopoly of the ON. Fortunately, it was possible to make rapidly available to farmers small threshers and milling machines which were appropriate for them both financially and technologically. This small motorization also permitted farmers to benefit from price and trade liberalization measures undertaken as of 1985 (see Box 3).

Box No. 3

Artisanal paddy processing displaces large commercial mills

The evolution of rice processing organization at the Office du Niger can be summarized with a few figures:

Year	Average paddy yield (Kgs per ha)	Paddy production (tons)	Paddy collected by large commercial mills (tons)	% of production
1983/84	1,751	64,663	43,148	67
1993/94	4,899	225,147	8,379	4

The percentage collected by the "modern"sector has collapsed, from 67% of paddy production in 1983/84 to around 4% in 1993/94. The unformal "sector", which was almost non-existing a decade ago has now taken a major share of the business. This results of a series of factors, the first one being the decision taken by the government in 1986 to liberalize marketing of paddy, which was before a State monopoly. At the same time, small milling machines were introduced. It was not before 1990/91 that they became competitive with the rice mills. Over time, artisanal milling has become more and more efficient, and able to take a larger share of the market, due to the following factors.

- depreciation charges and overheads remain high for large rice mills
- yields of artisanal milling machines have increased in recent years from 63 to 67% and can now match that of industrial rice mills
- the same applies to quality of the rice produced (thanks to the use of vacuum fans), with no significant advantage nowadays to large mills
- they are very mobile, which permits saving in transport costs and recuperation of the by-products by the farmer (used to feed the cattle)
- because of competition, processing costs charged to farmers have gone down.

d) **Liberalization of paddy marketing and processing**: initiated in 1985, liberalization measures allowed farmers to obtain significantly greater returns on their production, despite certain cases where individual farmers lost important sums by entering into contracts with dishonest traders.

e) **Land tenure security**: for which the principal instrument was the granting of usufruct right on land which can be inherited, provided water fees are regularly paid and the plot is correctly farmed.

f) **Access road construction**: which has had a substantially positive impact on production and sales in the areas now accessible year-round by asphalt roads. It also demonstrates the urgent need for such roads in the area where access is still very difficult.

IV. RESTRUCTURING THE ON: AVOIDING ROADBLOCKS AND THE RISK OF BACKSLIDING

7. At its inception, the Office du Niger was intentionally designed to be a very integrated system, directly responsible for undertaking studies, carrying out all types of civil works, organizing farmers'

settlement, providing agricultural services, marketing and processing, agricultural credit and producing farm equipment. Like most public enterprises, it faced serious problems of overstaffing which contributed to enormous deficits, and thus prevented the ON from fulfilling its vital functions such as operation and maintenance of the irrigation and drainage infrastructure.

8. To tackle this situation, the Office du Niger restructuring effort was initiated in early 1993. A law was passed which streamlined the functions of the ON by restricting them to the provisions of key public services. These services include: i)delivery of water; ii) operation and maintenance(O&M) of the infrastructure through contracting instead of by force account; iii) administration of land; and iv) agricultural extension. All the units which were previously carrying other activities have been or are being liquidated, contracted out or privatized.

9. The streamlining of ON functions, combined with a careful analysis of the number of staff positions necessary to carry out these functions, led to a drastic reduction (more than 70%) in personnel. These social impact of these measures have been mitigated by the payment of a severance package equal to 3 years of salary paid by donors, and the implementation of an assistance program aimed at helping the laid-off workers establish themselves as independent farmers or providers of associated services (threshing or milling contractors, network maintenance or customer services for agricultural machinery). Because of the fair, transparent and participatory processes used in selecting the staff to be retained, the severe downsizing has been carried out without much disruption.

10. The reduction of the salary burden will enable the Office du Niger to allocate a much greater share of the revenues generated from irrigation fees to the operation and maintenance of the network, and thereby ensure their sustainability. More importantly, users committees have been established to ensure that settlers are treated as full partners in all decisions regarding the utilization of water fees collected from them. As a result, fee collection has improved dramatically, reaching an unprecedented level of about 97% in 1995. It has also been possible, in the last 2 years, to raise the fee by 43% in order to get a full recovery of O&M costs.

V. PENDING PROBLEMS AND PROSPECTS FOR THE FUTURE

11. In spite of this spectacular progress, significant problems still remain unsolved. Of major concern are the technical risks associated with soil degradation as a result of salinization, in addition to the impact of a wide range of rice diseases. Agricultural credit still suffers from years of lax behavior in the past during which farmers rarely repaid their loans. Even today, despite the increased income and production security generated from rehabilitation and higher yields, the level of unpaid loans remains very high, with the risk of declining use of essential inputs and appropriate machinery.

12. Because the first rehabilitation programs were very costly, there was a question as to their cost effectiveness, and hence, their expansion and sustainability. However, the willingness on the part of the farmers to do a significant part of the maintenance and civil works previously done by the Office du Niger has not only lifted that concern, but has made it possible to expect that all the land area presently developed will be totally rehabilitated by the year 2000. This will most likely require a new approach in which the beneficiaries will be responsible for a significant portion of the rehabilitation, and no longer be the recipients of a turnkey operation.

13. The prospects are promising for Mali to become not only self-sufficient in rice production, but also to export throughout the sub-region. The still embryonic double-cropping technique is taking hold throughout the rice growing region, irrigation rehabilitation is proceeding actively, new land developments

are underway, and economic competitiveness has been restored after the CFA devaluation. All this points to a future full of promise for the Office du Niger and for Mali, with the prospect of fulfilling the long-standing goal of becoming the "rice basket" of West Africa. The former white elephant is indeed mutating into a lion.

December 1995

Evolution of Key Indicators of the Office du Niger from 1983-1994 (Excluding off-season crop)

Year	Area cultivated (ha)	Area rehabilitated (ha)	Production (t paddy)	Average yields (Kg paddy/ha)	Settler Population
1982/83	35.181	450	56.524	1.607	62.895
1983/84	36.920	1.773	64.663	1.751	67.122
1984/85	38.154	3.778	64.086	1.680	77.820
1985/86	39.433	5.886	82.957	2.104	99.038
1986/87	39.910	7.898	88.011	2.205	109.185
1987/88	42.125	9.617	98.194	2.331	110.954
1988/89	43.352	9.880	97.796	2.256	104.640
1989/90	44.251	10.872	106.593	2.409	111.941
1990/91	43.872	12.452	143.938	3.281	118.358
1991/92	44.435	14.637	180.909	4.071	123.276
1992/93	44.843	16.870	208.541	4.650	132.235
1993/94	45.442	18.455	222.634	4.899	139.926

Worldwide Distribution of Irrigated Lands in 1987

	Millions of hectares	Percent of World Total	Percent of Cultivated Area
Asia[3]	128	56	33
Middle East and North Africa	14	6	25
Sub-Saharan Africa	6	3	4
South and Central America	15	7	9
North America	25	11	8
Europe and Russia	37	16	9
Australia and Oceania	2	1	4
World	227	100	15

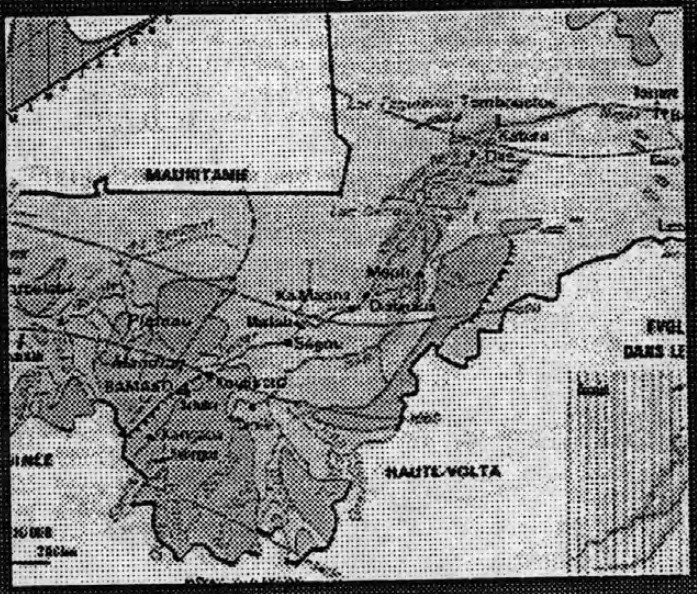
[3] Excluding the Middle East and Russia

The Office du Niger Restructuring Experience in Mali

- 1-Background: Area, Dream and Nightmare of ON
- 2-The ON restructuring
- 3-The results with a new Office du Niger
- 4-Main lessons of the restructuring experience

1 -Background : Area, Dream and Nightmare of ON

The Office du Niger area in Mali



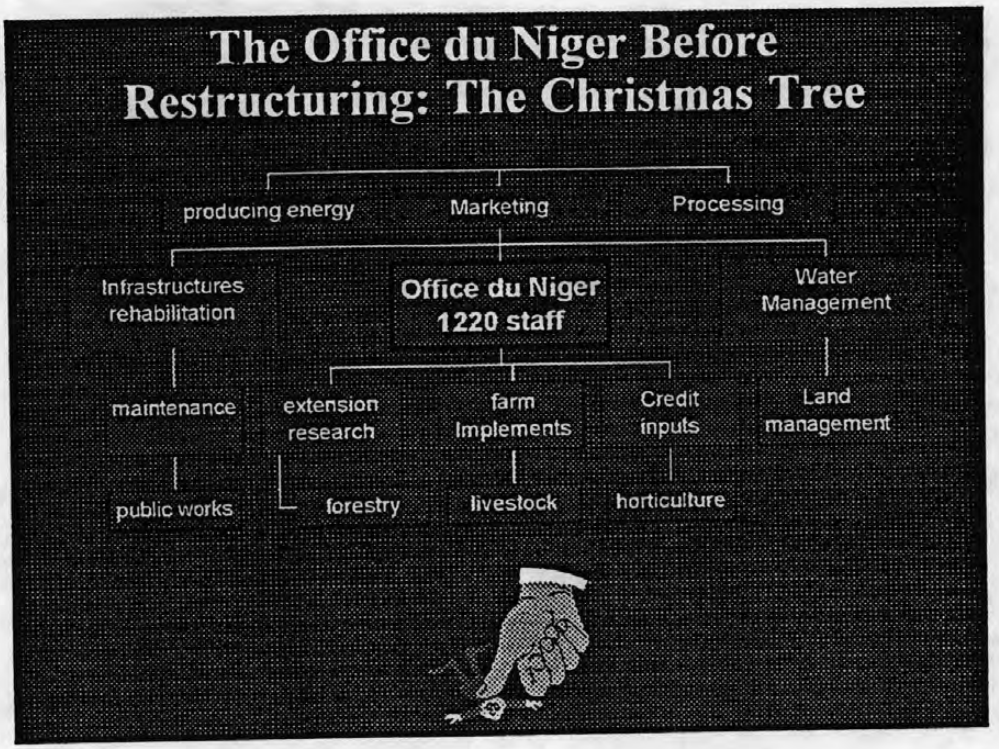
The Office du Niger Empire from the 30's to the 80's

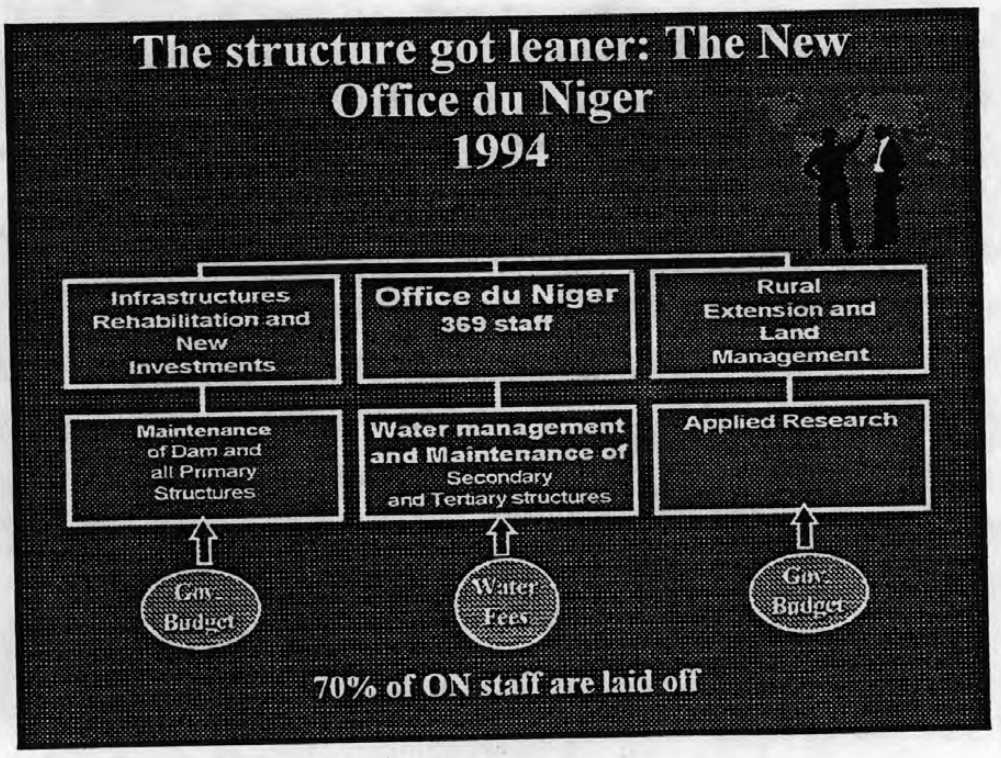
- **The Office du Niger Area**, a huge potential: 1,105,000 ha of flat and deep alluvium (former inner Delta) irrigable by gravity.
- **The Dream** of a French colonial engineer of the 1930's:visionary, technological, top down, use forced labor
- **The Nightmare up to the 1980's:**
  - A 50 000 ha Gravity Irrigation Scheme developed as today (only 5 - 10% of the potential) and poor maintenance
  - production and yield stagnate by the mid-80s , farmers are passive and ON is losing millions

The 80's: Steps to the turnaround of Office du Niger

- 1 - Economic Policy: Liberalize rice production, processing and marketing
- 2 - Investments for water control and technical package for intensification
- 3 - Institutional reform: Streamline ON Functions and Staff, Restructure ON Finances, Involve Farmers and Secure Land Tenure

2-The ON restructuring: major changes

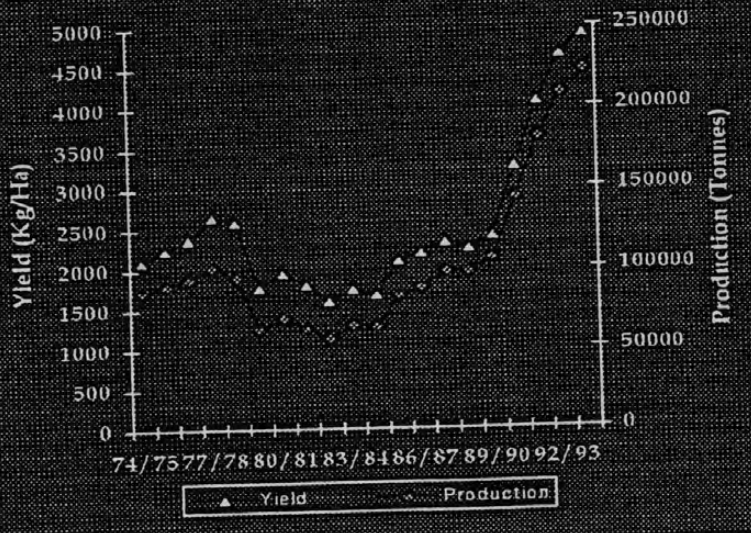

The Office du Niger Before Restructuring: The Christmas Tree
producing energy
Marketing
Processing
Infrastructures rehabilitation
Office du Niger 1220 staff
Water Management
maintenance
extension research
farm Implements
Credit inputs
Land management
public works
forestry
livestock
horticulture


The structure got leaner: The New Office du Niger 1994
Infrastructures Rehabilitation and New Investments
Office du Niger 369 staff
Rural Extension and Land Management
Maintenance of Dam and all Primary Structures
Water management and Maintenance of Secondary and Tertiary structures
Applied Research
Gov. Budget
Water Fees
Gov. Budget
70% of ON staff are laid off

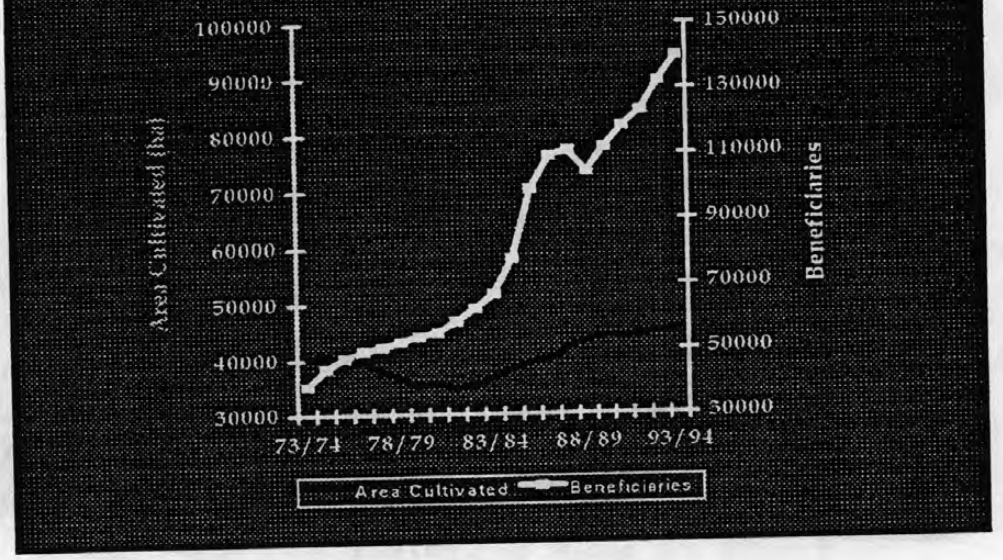
A new partnership with producers - the "contrat plan"

- Farmers and traders take over processing and marketing of paddy
- Farmers and ON resolve tough issues: setting and recovering water fees, enforcing payments, managing water, discussing new investments
- ON, Government and farmers set up mechanisms to secure land tenure: the "decret de gérance"
- Farmers participate in managing water maintenance and they discuss ON cost structure and management

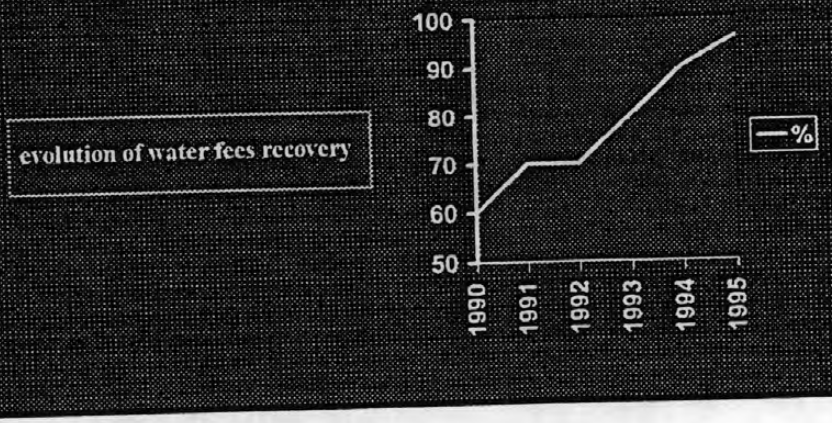
3-THE RESULTS : Paddy Production and Yields Shoot up



Number of Beneficiaries Doubles in 10 Years



Costs are recovered, ON books are balanced, investments are maintained, and rice marketing and processing are in private hands



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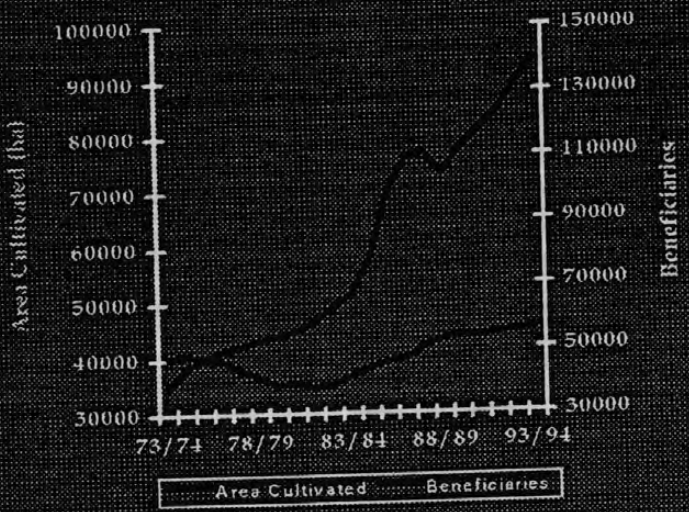
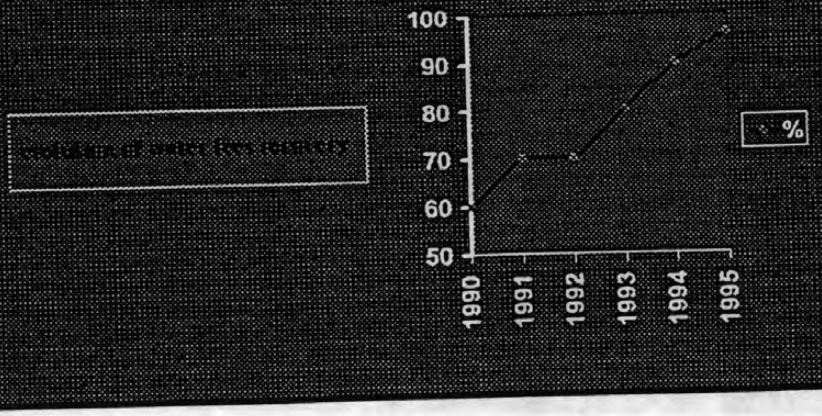


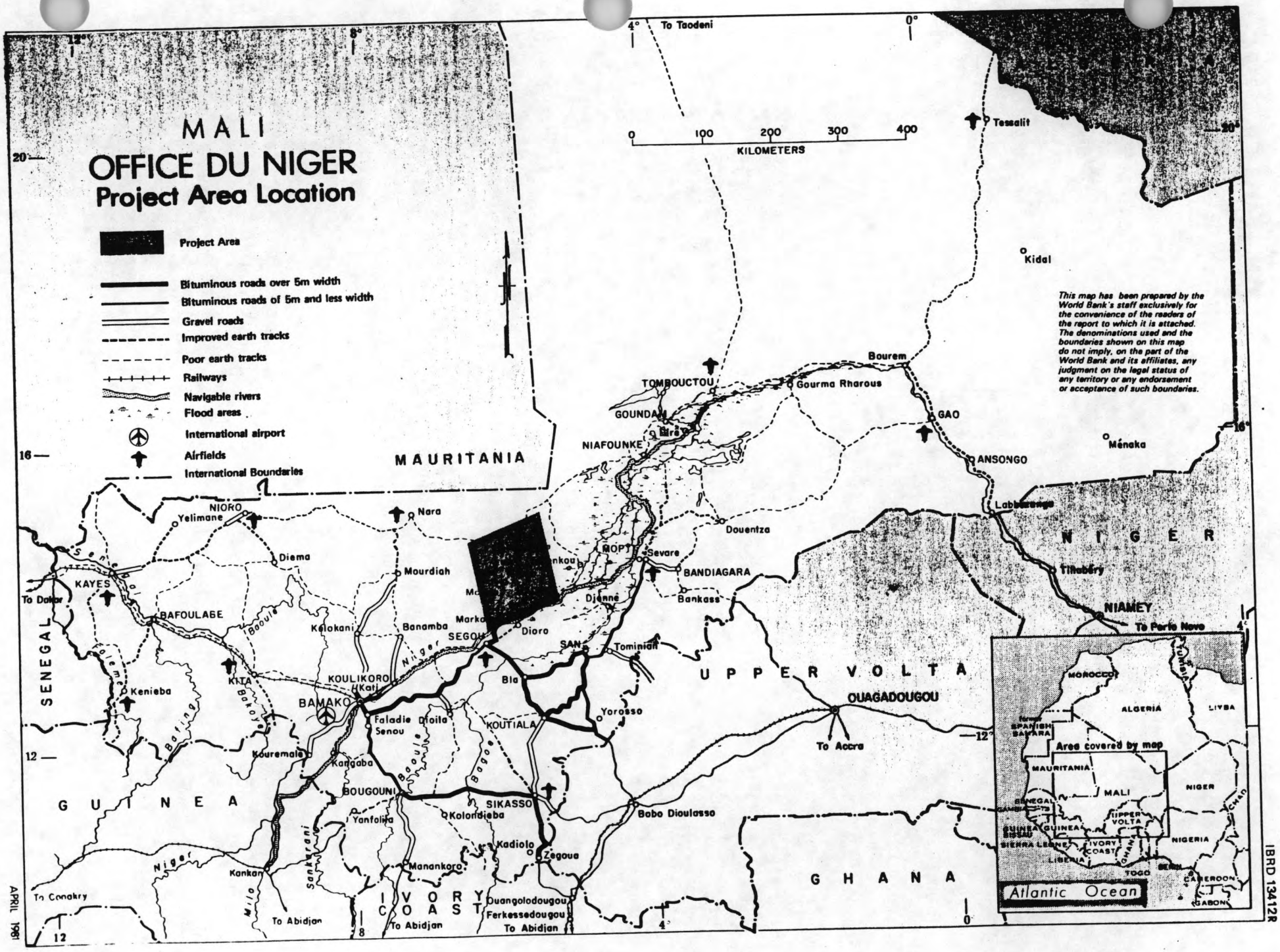
Costs are recovered, ON books are balanced, investments are maintained, and rice marketing and processing are in private hands



4-The main lessons from ON restructuring experience

- Restructuring needs right macro policy and right technology package
- Focus on water management with transparent financing is key for irrigation institutions
- Government Commitment and participative approach are crucial
- Strong donor coordination is essential
- Farmers can feel land secured without actual land property

Building a partnership with producers has high payoffs and can keep ON on the road to success


MALI
OFFICE DU NIGER
Project Area Location
Project Area
Bituminous roads over 5m width
Bituminous roads of 5m and less width
Gravel roads
Improved earth tracks
Poor earth tracks
Railways
Navigable rivers
Flood areas
International airport
Airfields
International Boundaries
0 100 200 300 400
KILOMETERS
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MAURITANIA
SENEGAL
GUINEA
IVORY COAST
GHANA
UPPER VOLTA
NIGER
To Taodeni
Tessalit
Kidal
TOMBOUCTOU
Gourma Rharous
Bourem
GAO
Ménaka
GOUNDAM
Tirè
NIAFOUNKE
ANSONGO
Labbezenga
Douentza
MOPTI
Sevare
BANDIAGARA
Bankass
Djenné
Tillabéry
NIAMEY
To Porto Novo
NIORO
Yelimane
Nara
Diema
Mourdiah
KAYES
To Dakar
BAFOULABE
Kolokani
Banamba
Marka
SEGOU
Dioro
SAN
Tominian
KITA
KOULIKORO
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Kenieba
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Senou
Diolla
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Yorosso
OUAGADOUGOU
To Accra
Kouremale
Kangaba
BOUGOUNI
Yanfolila
SIKASSO
Kolondieba
Bobo Dioulasso
Kadiolo
Zegoua
Manankoro
Kankan
To Conakry
To Abidjan
Ouangolodougou
Ferkessedougou
To Abidjan
Area covered by map
Atlantic Ocean
APRIL 1961
IBRD 13412R

World Bank Water Resources Seminar
December 12 & 13, 1995

Restructuring of the USBR [1] [2]

by

Sam Guy[3]

The U.S. Bureau of Reclamation (USBR) was created in 1902 to reclaim the arid western part of the U.S. by providing water for irrigation and other purposes. Bringing water to the arid part of the 17 western states facilitated settlement and economic development of that region. The USBR is best known for the major dams that it has constructed, including Hoover, Shasta, Glen Canyon and Grand Coulee dams. However, in addition to over 350 dams and diversion structures, the USBR has also constructed the necessary infrastructure including canals, tunnels, pumping plants, powerplants, and related facilities to distribute water to 240,000 farms and 40 million people.

It is the U.S.'s largest wholesaler of water and the 6th largest electric power producer. For the past 20 years or so the USBR has been feeling pressure for change. This has come from changing values and priorities of the American people as reflected by the U.S. Congress and the Presidents during that period of time. This has resulted in assessments and strategies for the USBR being developed within the agency as well as external pressure for change such as President Carter's Water Project hit list in 1978 and the increased influence of NGOs. The most extensive changes have occurred during the first three years of President Clinton's administration.

BACKGROUND AND HISTORICAL PERSPECTIVE

In addition to the original stated objectives for USBR, the agency, like most public works agencies in the U.S., are used by Congress and the Presidents to stimulate the economy and address social problems. Many of the peaks and valleys in USBR programs reflect historical events. Hoover, Grand Coulee, and several other major dams were built during the Depression of the 1930s. There was a rather substantial increase in USBR's program after WW II, followed by another decline in the mid-1950s. Then the last large increase began in the 1960s and lasted into the early to mid-1970s.

An example of the changing values of the people was the enactment of the National Environmental Policy Act (NEPA) in the early 1970s. This Act was the result of the very

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1 The views expressed in this paper are those of the author and are not presented as official or unofficial views of the World Bank.

2 To be presented at the World Bank sponsored Water Resources Seminar on December 12 & 13, 1995.

3 Mr. Sam Guy is an Agency and Project Management Specialist with the Asia Technical Department, Environment and Natural Resources Division, World Bank.

strong environmental movement in the U.S. at the time. NEPA required USBR and all other federal agencies to do a more thorough job of planning projects and considering alternatives. This prolonged the formulation and approval process of water projects which slowed the agency's responsiveness and also increased the costs of the projects. Another example of changing values was President Carter's 1978 hit list of water projects, including several of USBR's projects, that received rather wide-based support. Many of these projects which had been authorized by Congress still have not been completed to this date. During this time period it was becoming clear that the emphasis in USBR's mission was shifting from developing new projects to completing partially completed projects.

USBR staff conducted several assessments during this transformation period that laid the basic groundwork for the restructuring. In 1987, USBR undertook an agencywide self-assessment. The results predicted reduced budget, reduced construction, increased operation and maintenance (O&M) and reduced staffing levels. These predictions have come true. Some reductions were made and the number of regional offices were consolidated from seven into five. Then in June 1992, USBR released a strategic plan that defined the agency's new mission and identified new areas of program emphasis.

The program size remained rather stable through the 1970s and into the mid-1980s when the agency budget peaked at about $1 billion. The staff remained fairly constant as well, but did begin to reduce in the late 1980s from a peak of about 8,000 and was down to 7,600 at the beginning of 1993. In 1989, the construction budget peaked at over $750 million compared to about $190 million for Operation and Maintenance. During this same time of transition, the infrastructure was aging and in need of more resources devoted to O&M. The problem that USBR faced in early 1993 was that the staff had not been reduced in proportion to the reductions in budget, nor had sufficient staff been shifted from construction activities to O&M. The ratio between the Construction and O&M budgets has shifted from more than 3:1 to less than 2:1. For this year the budgets are $410 million and $273 million, respectively. The greatest impact from this shift was on the Denver Office because virtually all of the design work and quite a bit of support for construction was provided by that office.

ENVIRONMENT FOR CHANGE

In addition to the situation already presented, there were a number of other factors that led to restructuring. Shortly after President Clinton took office in early 1993, he asked Vice President Gore to lead a six-month study of the federal government. This report, referred to the "National Performance Review" (NPR), was completed and given to the President in September 1993. The NPR called for a long-term commitment to change in the federal government. Consistent with and responsive to this call, President Clinton's administration, supporters, and USBR Commissioner Daniel P. Beard felt there was a need to reform or restructure USBR to make it more responsive to present day values and priorities. Water resource policy in the western U.S. is undergoing fundamental changes. The changes are driven by different forces--population growth in urban centers, sensitivity to environmental issues, and economic issues. The time has come to take a hard look at the cost of developing new supplies versus reallocation or trying to find additional water through conservation. There is a very real desire by both Congress and the Administration to make government more efficient and less expensive. It is clear that there are less funds available to USBR, and that trend is predicted for the foreseeable future.

THE ASSESSMENT

When Commissioner Beard was appointed by President Clinton in May 1993, he recognized the need for USBR to focus on accelerating the transition and be more effective in using its resources to meet the new mission. The Commissioner, together with the President and the Secretary of Interior, made public their commitment to transform USBR from a civil works agency into the leading water resources management agency in the world. A new emphasis was placed on water conservation and reuse, environmental protection and restoration, dam safety, and increased efficiency of water use at USBR facilities.

The same month he was appointed Commissioner, he established the Commissioner's Program and Organization Review Team (CPORT), composed of seven middle and lower level employees from all segments of the organization to review USBR's programs and organizational structure and prepare a report on its findings and recommendations.

After carefully considering the CPORT Report, hundreds of individual employee comments, a report by the USBR Employees' Organization for Ethics and Integrity, recommendations made by USBR's Executive Management Committee, and discussions held at a USBR Managers Conference, the Commissioner published his decisions for broad sweeping changes in the *Blueprint for Reform.*

The *Blueprint*, adopted on November 1, 1993, established contemporary program priorities, functional realignments, and streamlined operating processes throughout USBR. The objectives outlined in the *Blueprint* reflected the four key NPR principles: cutting red tape, putting customers first, empowering employees to get results, and getting back to basics. Specifically, the *Blueprint* called for the redelegation of decisionmaking authority to the lowest practical organizational level, reduction in organizational layering and the number of supervisory personnel, streamlining regulations, and revision of program and budget execution processes to reflect the current mission and programs. Collectively, the implementation of these changes would enable USBR to become a more efficient, effective, and responsive agency.

The *Blueprint* established firm implementation milestones to ensure that the transition occurred rapidly for the well-being of both the employees and the organization as a whole. USBR's senior career executives were charged with developing implementation plans for effecting changes in functional alignments and processes by December 31, 1993. Employee teams were formed to examine USBR's activities to determine consistency with new organizational goals; review business processes and organizational interrelationships in order to identify unnecessary layers of bureaucracy, duplication, and inefficiencies; and make recommendations on ways to eliminate unnecessary reviews, excessive management oversight, and costly organizational layering.

ORGANIZATION CHANGES

On April 13, 1994, the Secretary of the Interior issued the order that authorized the implementation of USBR's organizational changes. The reorganization, formally completed in October 1994, reduced management layers from five to three and replaced two Deputy Commissioner and five Assistant Commissioner positions with positions that better responded to the new organization. The Commissioner's Office in Washington, D.C. was somewhat restructured to provide overall program and policy direction and work directly with Interior, Congress, the Office of Management and Budget, and other Federal

agencies. An executive level position was established within the Commissioner's Office with line authority over the Regional Directors.

USBR's Denver Office that performed policy development and program oversight and provided technical and support services, was reduced by 350 positions. The remaining 1,460 positions were restructured into the USBR Service Center that provides scientific, technical, research, and administrative services in support of USBR and some Interior programs. The Service Center also provides USBR-wide policy guidance for the administrative and human resources functions. It is composed of four major organizational units: Technical Service Center, Human Resources Office, Management Services Office, and Administrative Service Center that provides systems and support services to Interior agencies and other client agencies. Other than the reduction in staffing, the main change in the Denver office was a shifting of staff to disciplines that were required to support the new direction of USBR.

Significant changes also occurred in USBR's field structure. Each of the five Regional Offices developed and implemented their own streamlining plans to reduce organizational layering.

The 35 Project Offices, once responsible for the construction, operation, and maintenance of one or more water projects, were redesigned and consolidated into 25 Area Offices. The Area Offices have jurisdiction over USBR's entire geographic area of responsibility in the 17 western states and provide the first level program line of authority. Each Area Office is responsible for resolving water resources issues in a given geographic area that may include multiple water projects as well as areas that do not currently contain a USBR project.

Establishing the Area Offices reflects the changing nature of USBR's work and the need to delegate more authority to the field where most resource management decisions must be made and carried out. The Regional Directors provide leadership and oversight to the Area Offices and are responsible for formulating and executing USBR's program within their assigned regional areas. The boundaries of both the regional and area offices generally follow the boundaries of river basins rather than political boundaries.

CHANGES

Changes in organizational design and functional alignment were complemented by equally significant changes in functional processes. Three outdated, counterproductive processes were cited in the *Blueprint* as needing immediate improvement to allow employees to begin operating more effectively:

- First, the processes for policy development and oversight did not allow line managers adequate discretion in exercising their duties and the flexibility to develop innovative solutions to water resources problems.

- Second, the existing review and approval system added little value to the ultimate product or decision and contributed to organizational layering with its attendant costs and inefficiencies.

- Third, after-the-fact oversight reviews needed to be strengthened to provide constructive feedback and identify opportunities for improvement.

To ensure rapid change in these areas, the *Blueprint* called for the revision of all self-imposed oversight activities and the streamlining of all review and approval processes by

the start of fiscal year 1995. By the end of fiscal year 1995, all existing guidance was to be discarded unless it was affirmatively retained or revised and reissued prior to that time.

Implementation of changes in USBR's budget appropriation structure to reflect contemporary program areas, a necessary final step in institutionalizing USBR's reinvention, is targeted for the start of fiscal year 1997. The budget changes will be accompanied by corresponding changes to the accounting structure and a comprehensive set of performance measures.

USBR's reinvention addressed the problem of achieving necessary institutional change to shift focus away from civil works projects toward nonstructural solutions to a broad range of environmental and water resources management issues. It also embraced the NPR principle of forging a new customer service contract with the American people by incorporating newer constituencies, such as western urban areas, environmental interests, and Native Americans into agency work processes and client relationships.

The major impact to USBR employees was in the Denver Office because it was reduced by 350 positions. All USBR employees were offered early retirement, that is retirement at an earlier age and/or lesser years of service than normal but at a reduced annuity. They were also offered a separation allowance of up to $25,000 depending on their salary level and tenure. However, both of these incentives did not produce enough reductions in the Denver office. The reductions were also complicated by the fact that the skills mix needed for the new organization was somewhat different than for the existing organization. For example, there were too many civil engineer designers as compared to water resources specialists. Therefore a formal reduction process was implemented in mid-1994, resulting in reduced grade level for several employees but fewer than 50 were actually separated. In addition, some of the field offices also had to have layoffs. Layoffs and reductions are not that uncommon in specific offices of the USBR, happening more commonly in a construction office as the project is completed and turned over to O&M status. Frequently the employees can go to work for the water users association that will operate the facility or maybe another government agency. However the situation was made more difficult in that many other government agencies were also reducing, thus eliminating that option.

CURRENT STATUS

Both the early out authority and the separation incentive has been extended until March 30, 1997. The employee and management had to agree to a separation or retirement date by October 1994. This does two things: It extends the time the employee can work for up to two additional years after a decision to retire is made and it also gives management the knowledge of exactly when senior people will retire well in advance of their actual retirement date, thus allowing management to plan accordingly. The U.S. government does not have a mandatory retirement age.

Commissioner Beard retired in September 1995, saying that he had done his work in restructuring the USBR and he would leave the task of making it work to his successor and the USBR employees. President Clinton has selected Mr. Eluid Martinez as the new Commissioner of USBR, and he is awaiting confirmation by the U.S. Senate.

Former Commissioner Beard and the USBR have received a lot of requests to provide advice and assistance to the U.S. government agencies as they go about restructuring their organizations. This experience is also being made available through the USBR's international program. USBR has been named a winner of a 1995, "Innovations in American Government Award" by the Ford Foundation and the John F. Kennedy

School of Government at Harvard University. Also Vice President Gore has recognized Former Commissioner Beard for his leadership with the restructuring.

SUMMARY AND CONCLUSIONS

The restructuring of the USBR has been 20 years or so in the making but was put on a fast track during the past three years. Most agreed that some restructuring or at least changing of emphasis was necessary due to shifting priorities and mission from new project development to water resources management. Indeed assessments and strategic plans had been prepared.

Career employees prepared the assessment and action plans with guidance provided by the Commissioner. The most significant results were:

- Shifting the USBR's focus,
- Reducing personnel,
- Reducing level of supervision and review, and
- Delegation of authority to field offices.

The real significance of these changes will not be known for several years. A number of senior employees will have left by March 30, 1997, taking a lot of technical and institutional knowledge and experience from the USBR in a relatively short period of time.

Water Resources Development and Management in Viet Nam

by H. E. Dr. Phan Sy Ky
Vice Minister, Agriculture and Rural Development, Viet Nam

at the World Bank International Water Seminar in Washington, December 1995

Mr. Chairman, Distinguished Delegates, Ladies and Gentlemen,

Please allow me to use this occasion to first express our grateful thanks to the World Bank for giving the Vietnamese delegation the opportunity to participate in this seminar.

Water resources has always been considered as valuable natural resources of our country. Many water infrastructure projects have been developed over the years to irrigate 5.5 million ha of paddy, 0.5 million ha of other crops, to drain nearly 1 million ha and to reclaim 0.7 million ha in the coastal areas. Also; infrastructure has been built to supply water to rural and urban areas. These projects serve important measures to store water and to prevent major floods and dike breaches during the last 20 years. These achievements have substantially contributed to the social and economic development in general and agriculture in particular. They have made Viet Nam from a country with insufficient rice to the third largest rice exporter in the world.

Viet Nam faces many challenges:

1. Existing irrigation, drainage and dike systems are old and deteriorated, due to backward technology used, low design criteria which have resulted in decreased capacity, and high costs of operations and maintenance.

2. The problem of water shortages in central Viet Nam and Mekong delta, waterlogging in the northern delta, salinity intrusion in the coastal areas of the Mekong delta have not been solved yet.

3. Mitigation of damage caused by floods in the Mekong delta has just been started.

4. Dikes are not strong enough to withstand big floods and typhoons, which threat life and property of ten million people.

5. The exploitation of hydropower potential has just been started.

6. Watershed degradation has caused negative impacts on environment and regulation of water resources.

7. Water supply to rural and urban areas, and mountainous regions is inadequate.

8. Water pollution in industrial and urban areas is increasing.

9. Water resources works to serve resettlement in order to limit the deforestation and use bare hills to alleviate poverty, for the mountainous and remote regions has not yet been systematically addressed.

To address the above concerns, our government has taken a number of legal, institutional and investment measures.

Legal

It is necessary to institute and implement laws in land and water. Viet Nam has promulgated Land law, Forest law, and Environmental Protection law. But Water Law is still under drafting. We have got financial assistance from the World Bank and the Japanese Government to finalize the Water Law. I hope that in 1996, the Law will be approved by the National Assembly and this law will create a comprehensive legal basis for water resources management.

Institutions

Previously, the task of protection and development of water resources is assigned to various agencies, of which Ministry of Water Resources is the main agency, dealing with both central and provincial levels. The management is not based on basins but on administrative boundaries.

Recently, the Government has decided to merge three ministries into one: Water Resources, Agriculture, and Forestry.

However, with the new Ministry, the work for management, protection and development of water resources at a macro national level, instead of dispersion as in the past, it should be gathered in a more focused manner. This is similar to many countries, such as India, China.

After the reorganization, the management must be implemented based on river basins, especially big rivers like the Red River and Mekong, in combination with management on administrative regions, and assignment of functions and responsibilities need to be clarified.

Investment

During the last decades, the Government of Viet Nam has had policy to give high investment to the water resources sector, appropriating 10 percent of National Budget for capital investment. At the same time, the Government has policy to mobilize people's contribution for construction of on-farm irrigational systems. This contribution estimated is 30-40 percent of total investment.

In the forthcoming years, our government still need to maintain in the same or higher rate of investment for water resources sector. Total investment needed to the year of 2010 (two thousand and ten) in 4-6 billion US$.

In the World Bank funded project of Irrigation Rehabilitation Project in Central Part, an amount of ten million US$ in the loan is located for farmers who will borrow for construction of their on-farm systems and farmers will have to repay capital cost. This policy made by World Bank has been accepted by our Government. So far, we have only just started and will not be able to show experience in this matter. For us, it is a new policy, but it is obviously, however, highly appreciated by the local authorities at different levels in Viet Nam.

Because of the climate conditions of Viet Nam, in order to regulate the water flow for increase water storage capacity, to reduce water shortage in any season and improve flood control capacity, the construction of reservoirs is very essential. I hope World Bank will share this view with Viet Nam.

With regard to the policy on resettlement of people affected by water resources protects according to the law of Viet Nam, land belongs to the state ownership, we are applying the appropriate policy on compensation for affected people, i.e., they will be compensated upon losses of their properties (house...) and crops estimated for three years and Government will make land available in the other areas.

With regard to internationally financed projects, Water Resources projects are given high priority by the Government in the coming years. At present we have only three loan financed projects for water resources sector. Two from ADB and one from World Bank. Capital investment should be placed reasonably to upgrade dike system for flood control and existing irrigation systems. Beside that, in view of the country as a whole, water resources developments should be given opportunity equally between the regions so as to enable them to implement poverty alleviation programs.

Policy on Water Fee

At present, water supply in Viet Nam is considered as a type of public service, not as a commodity. Therefore, financial policy for water resources sector in Viet Nam at present is:

- The Government provides finance for construction, maintenance and management of dike systems. People contribute labor for upgrading and rehabilitation, and contribute a small amount for the Fund of Flood Control.

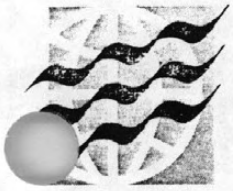
- The Government provides finance for the urban drainage in terms of construction, operations and maintenance cost.

- For irrigation projects, the Government provides finance for capital construction of headworks, main and secondary canals. The costs for O&M activities, depending on types of repairs needed, will be borne by government or by water fee. The construction and O&M costs of on-farm systems will be borne by farmers. The water fee has been calculated to cover small and regular repair. So far, however, the actual water fee collected through the country can reach to 50-60 percent of fixed level.

Distinguished delegates, I believe that at this seminar, we will receive many useful comments which will considerably contribute to the development and conservation of water resources in Viet Nam.

Once again, I wish to express my thanks to the Organizations Committee for its excellent preparation for this seminar. I would like to take this opportunity to express my grateful thanks to the World Bank for previous assistance to Dau Tien Irrigation Project and present assistance given to Irrigation Rehabilitation Project for Water Resources Sector Review and the Water Law of Viet Nam.

Finally, I wish all of you the best health. Thank you very much for your attention.



1995
WORLD BANK
WATER SEMINAR

Theme II
Group 4

Private Sector Participation

Topic: Argentina and Chile: Bank study tour report
Speaker: Guillermo Yepes

Paper Unavailable

CHINA - QUCUN AQUIFER (A Groundwater Recharge Scheme)

by **Usaid I. El-Hanbali,**
Sr. Irrigation Engineer,
Rural & Social Development Operations Division
China & Mongolia Department

ABSTRACT

This paper will detail the Bank's involvement in Qucun Groundwater Recharge Scheme in China. It will discuss the genesis of the scheme, its evolution during project processing and progress to date. The lessons so far: early Bank's involvement in project preparation and agreement with the borrower on the steps to implement the scheme has led to successful scheme implementation.

INTRODUCTION

Water Resources in China. In aggregate terms, China has immense water resources, with total annual precipitation of some 6,200 m^3 and total surface runoff of 2,700 billion m^3. There are many rivers, streams and lakes (Fig.-1). Precipitation is variable and concentrated in the summer wet season, and many areas are subject to frequent droughts and floods. The geographical distribution of water resources is uneven. Groundwater potential is estimated at 820 billion m^3, and more than 2.70 million diesel and electric wells have been drilled to extract groundwater for different usages.

There are severe periodic water shortages particularly in the north and west of the country, and there is growing macro water shortage in the Yellow River Basin, which is the primary source of water in the northern region.

Water resources in the form of surface and groundwater are public property belonging to the State. Their utilization and exploitation are in principle controlled by various State Laws and Regulations, which are overseen by the Ministry of Water Resources (MWR) and administered by institutions at provincial and county levels. Also, under MWR are seven basin commissions responsible for major river basins (Table-1), each is based in its respective basin.

Since 1949, vast investments in water resources works and development have been undertaken. Irrigated area expanded from about 20 million ha to nearly 50 million ha. Some 84,000 reservoirs for irrigation, flood control, power and water supply have been constructed with a combined gross storage capacity of 470 billion m^3. Development of groundwater for agriculture, domestic and industrial use have grown steadily since the 1960s especially in the North China Plain where more than 2 million wells exist and about 70% of all groundwater is extracted.

Despite past achievements, China is facing problems and constraints in the water and irrigation sector. These problems are becoming increasingly severe as the population grows and the economy expands and becomes more market-driven. Two critical, micro water resources issues are: (a) the growing large-scale water shortage in the North, particularly the Yellow River Basin; and (b) weak river basin authorities. The Bank, through more than 16 agricultural projects having major water resources components, has been assisting China meeting its objectives of efficient use of water resources and dealing with the above issues.

PROJECT BACKGROUND

In 1989, the Government of China requested the Bank assistance to finance an integrated agricultural development project in the Province of Henan (Henan Agricultural Development Project or briefly Henan ADP). The main objectives of the project were to assist the government in accelerating and diversifying agricultural development in order to alleviate poverty, raise farmers income and increase rural employment. The project included six components: water resources, agriculture, livestock, aquaculture, agroprocessing and agroindustry and institutional development. Water resources component amounted to 52% of the total project cost and included four Yellow River Diversion Schemes, flood control and drainage scheme, river training scheme, groundwater development scheme, storage and irrigation pilot scheme (Qucun Recharge Scheme), and irrigation support (Table-2). The project was preappraised in May/June 1990, appraised in October/November 1990, and declared effective in August, 1991.

There are three major water resources in the project area: Yellow River, groundwater and local surface water. The Yellow River (Fig.-2) is the main water resource with average annual diversions of about 4 billion m^3. Shallow groundwater is another source of water. Groundwater potential in the project area is estimated at 1.5 billion m^3, and demand for year 2020 is about 1.1 billion m3. Groundwater development in the project area has grown steadily in the last few years with the construction of more than 142,000 shallow wells irrigating about 0.5 million ha . The project would only use 0.038 billion m^3 from local surface resources because the usable amounts of these resources are limited.

However, and due to over-exploitation of groundwater in different aquifers in Henan Province and the growing deficits in irrigation water, Henan has launched a program for "groundwater compensation" or artificial groundwater recharge. This program calls for recharging a total of 360,000 ha of groundwater irrigated areas by diverting about 1.08 billion m^3 of the off-seasons flows (December, January, and February) of the Yellow River (Table-3).

While there is a scope for improving field water management (water application methods and rates, scheduling, etc.), groundwater deficits can not be eliminated without diverting surface water from the Yellow River for artificial recharge of the groundwater

aquifers and/or supplementing existing groundwater through the use of surface water for irrigation whenever it is available (conjunctive use of groundwater and surface water).

During processing of Henan ADP, the project management office (PMO) requested the Bank to include Puyang Groundwater Recharge Scheme in the project. Extensive technical discussions took place between the borrower and the Bank's missions. In these discussions the borrower participated actively and agreed on the alternative scheme which the Bank's mission carefully detailed (see the following paragraphs).

EVOLUTION OF QUCUN STORAGE AND IRRIGATION SCHEME

Due to the excessive exploitation of groundwater in the Puyang and Qingfeng counties in recent years, groundwater levels have dropped rapidly (about 0.70 m annually in the period from 1977-1990), and in some areas it dropped 20 m or more below original groundwater levels, resulting in increased lifting costs and difficulty in obtaining adequate water discharge. In those areas, a depression cone (funnel) in the groundwater table, for an area of more than 20 km^2 was formed in 1990 due to overdrafting of the groundwater. The situation would have become worse, if no countermeasures were taken.

During project reappraisal and appraisal, the Bank's missions had extensive discussions with the project management office (PMO) about the design and formulation and design of a charge scheme. At the beginning the PMO proposed the implementation of a full scale groundwater recharge scheme in Puyang area (about 67,000 ha) by direct recharge of the aquifer through the existing, and proposed new wells. The Bank reviewed the proposal and had two main concerns which were discussed with the PMO: (a) availability of water from the Yellow River for recharging the whole aquifer; and (b) effectiveness of the proposed method of recharge.

The Bank suggested that a pilot area be first studied before implementing a full scale scheme, in order to test different methods of groundwater recharge and to generate data needed for the design of a full scale recharge scheme. The Bank also outlined the steps needed to implement the pilot scheme (Annex-1). The other concern was about the long term availability of water from the Yellow River to recharge the aquifer. The PMO and the Bank were engaged in detailed discussions on the design and implementation steps of the pilot scheme. Finally, it was mutually agreed that effective groundwater recharge would only be achieved through the primary use of water diversions from the Yellow River for field irrigation and that starting scheme implementation of a pilot area rather than a full scale scheme, is a better approach to test the effectiveness of groundwater recharge. It was also agreed that the PMO will follow the steps outlined by the Bank to implement the pilot area. Assurances of Yellow River water availability (off-season flows) to Puyang recharge Scheme were given to the Bank during project appraisal.

DESCRIPTION OF THE SCHEME AND THE PILOT AREA

The proposed recharge scheme, as agreed, is to recharge groundwater in Puyang County by conveying about 50 MCM annually from the Yellow River to the deficit aquifers in this county (Fig.-2), mainly during off-season (December-February), while groundwater would supplement Yellow River water during the rest of the year (March-November). The use of groundwater would be reduced, surface irrigation water and stored water in the irrigation system would augment aquifers recharge. Qucun canal would be lined and water would be distributed on the fields through a network of earth channels. Industrial and domestic needs in the area would be satisfied in the same manner.

Prior to the implementation of the scheme, a pilot area of 6,700 ha (Fig.-3) would be first constructed where observation and experiments of groundwater recharge would be carried out. The Pilot Area would comprise one main canal, one branch canal, four laterals and field ditches (Fig-4). There will be 200 wells in the pilot area with depth from 50-80 m, and 91 of them will be used as observation wells.

The Pilot Area is located in the Yellow River alluvial plain. Average annual precipitation in the area is about 590 mm. It is the primary sources of groundwater recharge. There are there groundwater aquifers, shallow: 9-15 m below ground surface, medium: 32-34 m below ground surface, and deep: about 70 m below ground surface. Shallow groundwater depth in the Pilot Area is 15-16 meter (Fig.-4). Water quality is good with mineral contents of about 2 g/l.

The cost for the Pilot Area was estimated at Y 1.92 million, while the total cost of the recharge scheme was estimated at Y33.16 million.

PROGRESS OF IMPLEMENTATION OF THE PILOT AREA

Implementation of the pilot scheme started, as planned and agreed, on October 1991 with the construction of observation network for monitoring groundwater levels. Construction of the Pilot Area started in October, 1992. A draft progress report was submitted to the Bank in May, 1994 and a final draft report compiled in February 1995, was submitted to the Bank in June 1995. The Bank reviewed the final draft report and found it a comprehensive report that in most instances adequately addresses the issues intended under the pilot area. The Bank made several comments on that report and agreed that the PMO start implementing the full scale scheme. A summary of the main findings of the submitted reports and the Bank's comments on them are shown in Annex-2. Also, a socio-economic study was conducted in 1991/1992 documents conditions in the scheme area before scheme implementation, and later for scheme monitoring and evaluation.

CONCLUSION

The scheme has been implemented successfully by the borrower who has been **strongly** committed to implement the scheme as agreed upon with the Bank.

The study in the Pilot Area investigated recharge from three different sources, namely field percolation, canal seepage, and recharge from shaft wells (Fig.-5). However, the report rightly urges that recharge from shaft wells is not so effective. The integrated management of groundwater and surface has been more effective in recharging the aquifer.

The results of the pilot study clearly indicate that by the integrated management of canal seepage and well shaft recharge, and surface water from the Yellow River for irrigation, mining of groundwater in the pilot area can be **significantly** slowed. A typical assessment of recharge by different sources is shown in Table-4. Also, by utilizing available canal storage capacity through pumping, a positive water balance can be achieved by the year 2000. The only concern is the long-term availability of Yellow River water.

Good benefits have been achieved so far, from implementation of the Pilot Area, with 7% increase in grain yield in the last two years. Calculated ERR is 18.9%.

LESSONS LEARNED

A. Institutional

1. The partnership between the Bank and the borrower has led to the borrower's strong commitment to implement the scheme exactly as agreed upon with the Bank.

2. Early Bank's involvement is important and useful, especially when it includes innovative ideas that do enhance project design.

3. The way to introduce these ideas to the borrower and to convince him of the usefulness of such ideas is also important. This was done in Qucun Scheme through extensive discussions with the borrower. The borrower participated actively in those discussions; and agreement on the modified scheme design and implementation steps was reached accordingly. Through this process, project ownership was kept with the borrower.

B. Technical

1. Carrying out a pilot scheme before implementing large scale recharge schemes is crucial and imperative, because there are lot of variables and unknowns in such schemes that need to be identified before finalizing the design and starting full scale implementation.

2. Conjunctive water use (surface and groundwater), as an efficient means to manage water resources and save water; can also be a useful means to help recharge groundwater aquifer and/or reduce groundwater level drawdown. That was part of the modifications the Bank suggested on the design of the recharge scheme.

3. Establishing an adequate observation network for monitoring of groundwater levels is necessary to provide needed data for scheme design. Monitoring should also continue during and after scheme implementation.

REFERENCES

1. Henan Water Conservancy Research Institute, Research Team of Qucun Storage and Irrigation Scheme, Pilot Area, "Irrigation Research Work of Henan Agricultural Development Project, Study Report on Qucun Storage and Irrigation Scheme, Pilot Area, Part 1 (draft report)", May 1994.

2. Henan Water Conservancy Research Institute, Research Team of Qucun Storage and Irrigation scheme, Pilot Area, "Irrigation Research Work of Henan Agricultural Development Project, Study Report on Qucun Storage and Irrigation Scheme, Pilot Area (final draft report), February 1995.

3. The World Bank , "Staff Appraisal Report, China, Henan Agricultural Development Project", April 16, 1991.

IMPLEMENTATION STEPS FOR THE QUCUN STORAGE AND IRRIGATION SCHEME AND THE PILOT AREA

A groundwater recharge scheme is included in the irrigation and drainage component of Henan ADP, to irrigate and recharge groundwater in the Puyang Municipality and Qingfeng County. The mission reviewed the proposal submitted by the PMO, suggested some modifications and outlined the following implementation steps, which the PMO agreed upon:

(a) Install a monitoring system for the groundwater aquifers in the area. The data collected from this system would be used in the design of this scheme.

(b) Carry out a study for water resources, agriculture and socio-economic conditions in the scheme area. Henan PMO would coordinate the work on this study with the Xinxiang Farm Irrigation Research Institute, which has been undertaking a similar study for the Central Government to build a model for such development.

(c) Carry out experiments in the scheme area (a pilot area) to provide the data needed for the design of the proposed recharge scheme, and to test the effectiveness of the proposed works to recharge groundwater aquifers. This experimental program would continue for at least three years.

(d) Implement the full scale scheme in the fourth and fifth years of the project period, after acquiring enough information and data from the above steps.

(e) The PMO would keep the Bank informed on the progress of work on the above steps, and would submit a draft report two years after the project starting date, for review by the Bank. A final report would be submitted after three years of the project starting date. This report would include detailed water balance calculations based on a comprehensive model for the assessment of water resources in the scheme area.

(f) It was agreed that implementation of this scheme is contingent on the availability of the off-season water from the Yellow River to recharge and irrigate the areas of this scheme. The Yellow River Conservancy Commission would confirm this availability.

CHINA - QUCUN AQUIFER
MAIN FINDINGS OF FEBRUARY 1995 REPORT ON THE PILOT AREA

- Projected Water Use: The report outlines the projected water use figures for urban, industry, and irrigation only to the year 2000. This shows that demand will increase from 161.5 thousand m^3/sq km to 222.8 thousand m^3/sq km. This is a 38 percent increase in just 5 years. The Bank indicated that the planning horizon is too short. Water consumption projections should be extended out at least 15 years, and preferably 25 years, to give a realistic picture of the future demand and the likely competition among agriculture and urban and industry, given the limited availability of water from both surface and groundwater sources.

- Availability of Groundwater and Yellow River Water to the Pilot Area: The sustainable yield from groundwater is calculated at 86,600 m^3/sq km. The water balance calculations are based on the premise that the full entitlement of 230,000 m^3/sq km. of Yellow River will be will be available to the project area. Even if it is so up to year 2000, the requirement to meet continuing growth beyond 2000 is a major concern, and the Bank recommended that the medium- to long-term supply and demand scenarios (15 to 25 years out) need to be developed.

- Main Findings of the Study: The study showed that the demand for water in the year 2000 will be 222,800 m^3/sq km. The supply will therefore need to come from the following sources: (a) 73,000 m^3/sq km of groundwater, estimated safe yield, and (b) 230,000 m^3/sq km of Yellow River water to supplement irrigation and for groundwater recharge.

- Impact of Yellow River Diversion on Groundwater: The observed groundwater levels in the pilot area fell 0.61 m over the three-year trial while the corresponding levels in the adjoining area outside the pilot fell 1.73 m. Calculations on groundwater levels show that for the pilot area the levels should have risen 0.15 m over the three-year trial. There was good correlation between calculated and observed levels over the first year, but variations occurred in the second and third years. That is, the calculated rise in water table levels was greater than the observed levels. Some of the difference can be accredited to the formation of a groundwater mound in the pilot area that caused groundwater to flow outside the pilot area

- Storage of Water in Canals: The study found that significant volumes of water can be stored in canals within the scheme and investigated the feasibility of constructing a pumping station to fill canals above the level at which water is transferred from the Yellow River to utilize deep section of canals and hold water for irrigation. This would provide an estimated additional 1,640,000 m^3 of water in storage and thus provide 1,150,000 m^3 of water for irrigation and recharge of groundwater aquifer.

- Engineering Options Considered: Three basic options were considered, taking into account the various factors including effectiveness of recharge through seepage and wells, availability and reliability of Yellow River flows to the areas within the project, investment and annual costs of each option. The three options considered were:(a) Deep trench conveyance system with one stage lift for irrigation,(b) Deep trench conveyance system with one stage lift for storage and irrigation,(c) Two stage pumping and conveyance. The report discussed in detail the advantages and disadvantages of each and recommends a combination of (a) and (b) within the project area. The Bank agreed on this recommendation and indicated that all of the above options considered will involve a complex operational plan. There will need to be close monitoring of flows in the River as well as in the project area to take full advantage of available water for irrigation and storage within canals. Water quality will have to be closely monitored because of adverse affects on recharge from both canal seepage and well recharge. Even moderate silt loads in water entering recharge wells result in blockage requiring "back flushing" by stopping recharge and starting pumping to clear blockages. The Bank also recommend that the PMO consider these issues and make proper additional plans, especially regarding monitoring and evaluation, and staffing requirements.

TABLE - 1 MAIN RIVERS IN CHINA

Names of Rivers	Length (km)	Area of basin (1,000 km²)	Average annual runoff[1] (109 m3)	Population[2] (106 persons)	Area of cultivated land[2] (1,000 ha)	Annual runoff per capita (m3)
Changjiang Rive (Yangtze River)	6,300	1,800	965	368	24,000	2,622
Huanghe River (Yellow River)	5,464	750	59	88	12,400	673
Songhua River	2,308	550	62	49	12,000	1,273
Zhujiang River (Pearl River)	2,214	450	336	77	4,730	4,363
Haihe River and Luanhe River	1,967	300	28	105	11,400	262
Liaohe River	1,390	230	15	32	4,400	463
Huaihe River	1,000	270	61	131	12,200	466

1 from 1956 to 1979
2 from 1985

CHINA

TABLE 2 - HENAN AGRICULTURAL DEVELOPMENT PROJECT

IRRIGATION AND DRAINAGE COMPONENT

Base Cost

Scheme	Area ha	Base cost Y ('000)	Cost/ha Y	Cost/ha/a US$
1. Zhaokou West YRDS	71,900	163,174	2,187	463
2. Xianghuzhu YRDS	24,300	49,106	1,905	404
3. Shitouzhuang YRDS	17,200	24,965	1,397	296
4. Qucun YRDS	33,100	70,226	2,045	433
5. Groundwater Irrigation	83,700	66,110	756	160
6. Yu-Xia-Yong Drain	40,200	23,147	555	118
7. Dongshahe River Regul	11,500	28,107	2,353	498
Subtotal	281,900	424,835	1,507	319 (avg)
8. Qucun Pilot Storage and Irrigation	6,700	33,160/b	-	-
9. Irrigation support	-	2,195	-	-
Total Base Cost	-	460,190	-	-

/a Exchange rate Y 4.72/US$.

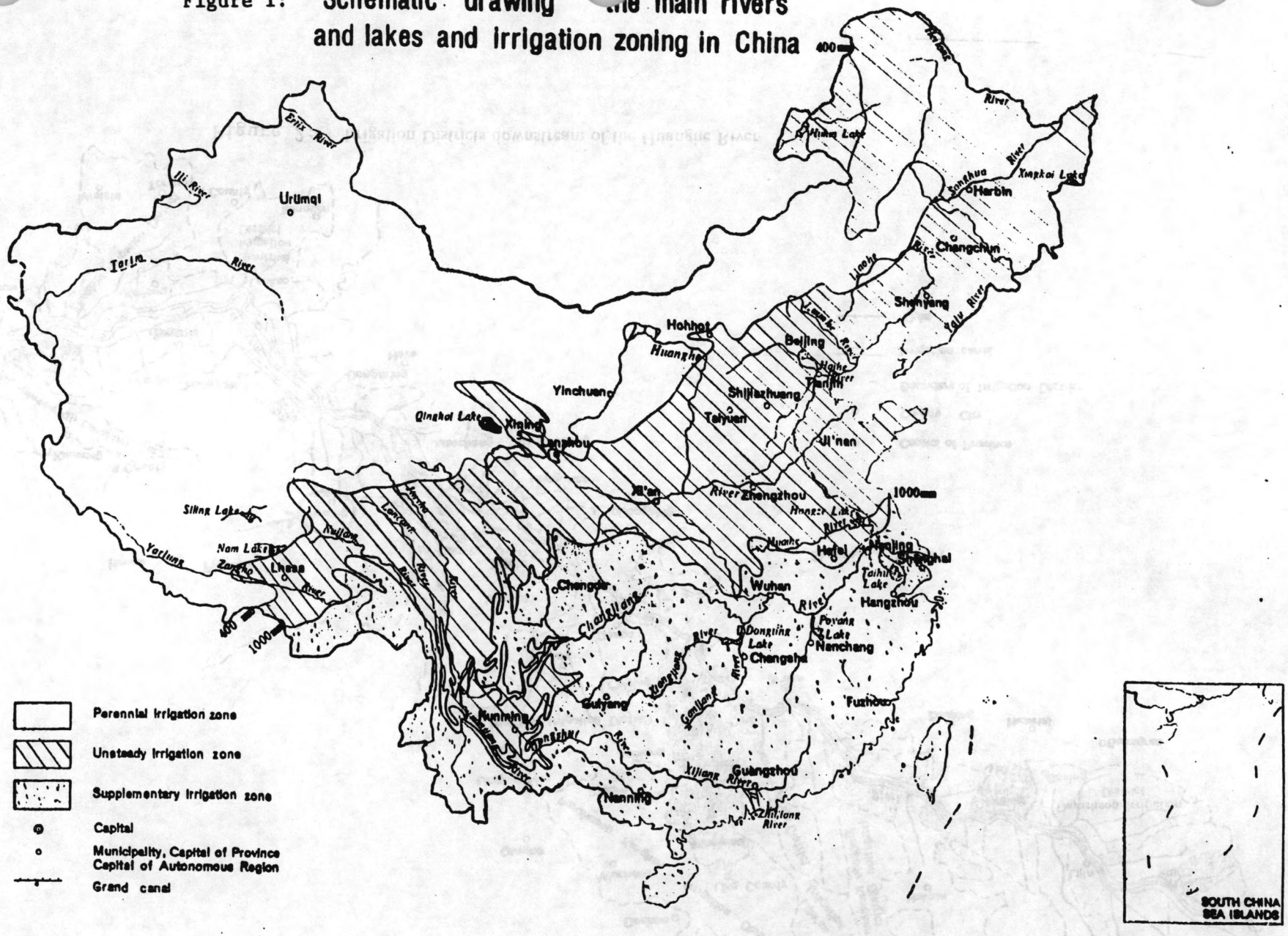
/b Cost include Y 13.135 million for lining of Qucun YRDS main canal.

CHINA - QUCUN AQUIFER

Table - 3 Groundwater Recharge Schemes in Henan

Municipilty	Irrigated Area (ha)	Diversion from Yellow River (mcm)	Implementation Period
Shangqui	86,700	260	90-95
Kaifeng	136,600	410	90-95
Puyang	66,700	200	90-95
Xingxiang	70,000	210	after 99
Total	360,000	1,080	

Figure 1: Schematic drawing the main rivers and lakes and irrigation zoning in China



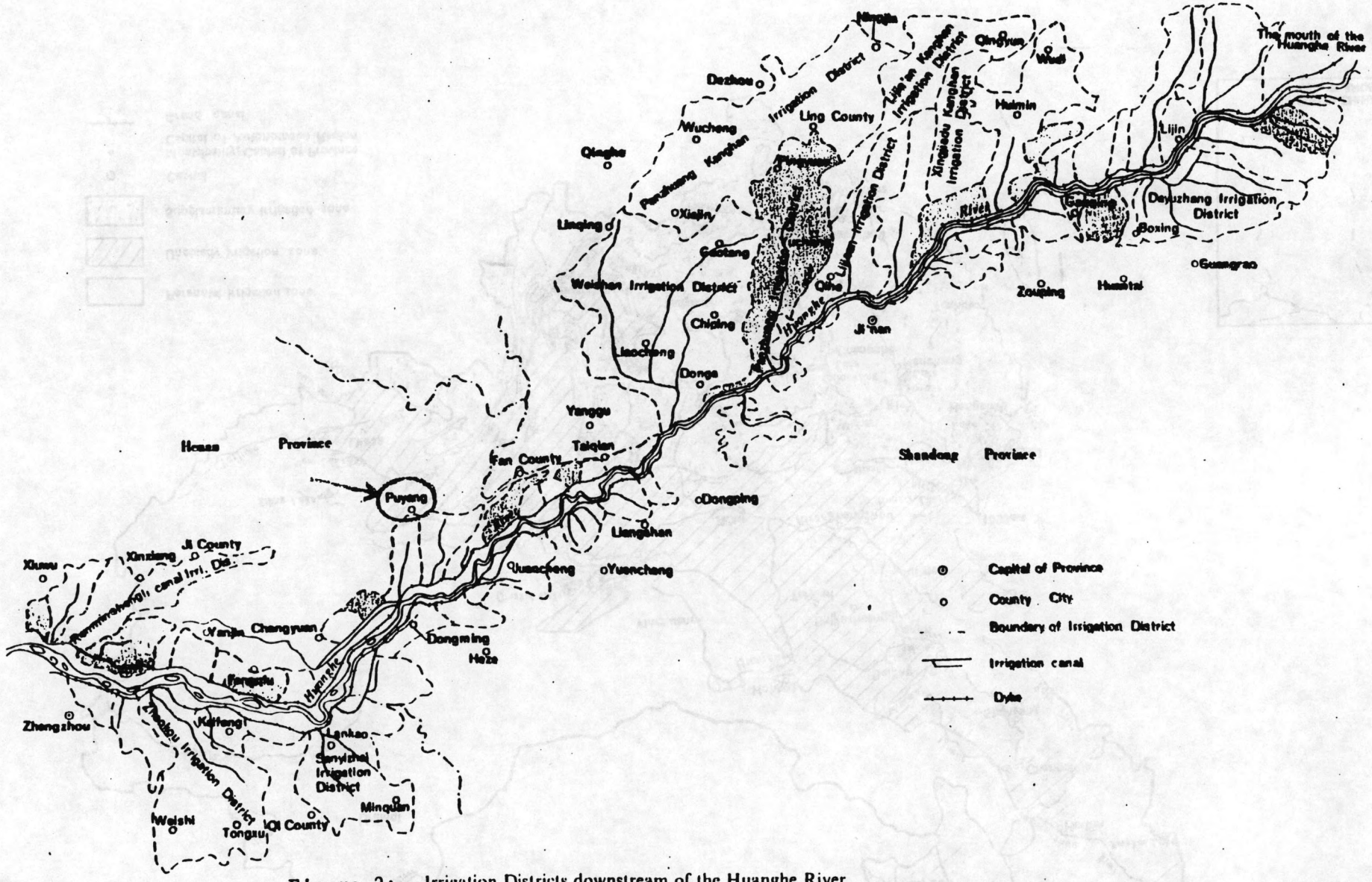


Figure 2: Irrigation Districts downstream of the Huanghe River

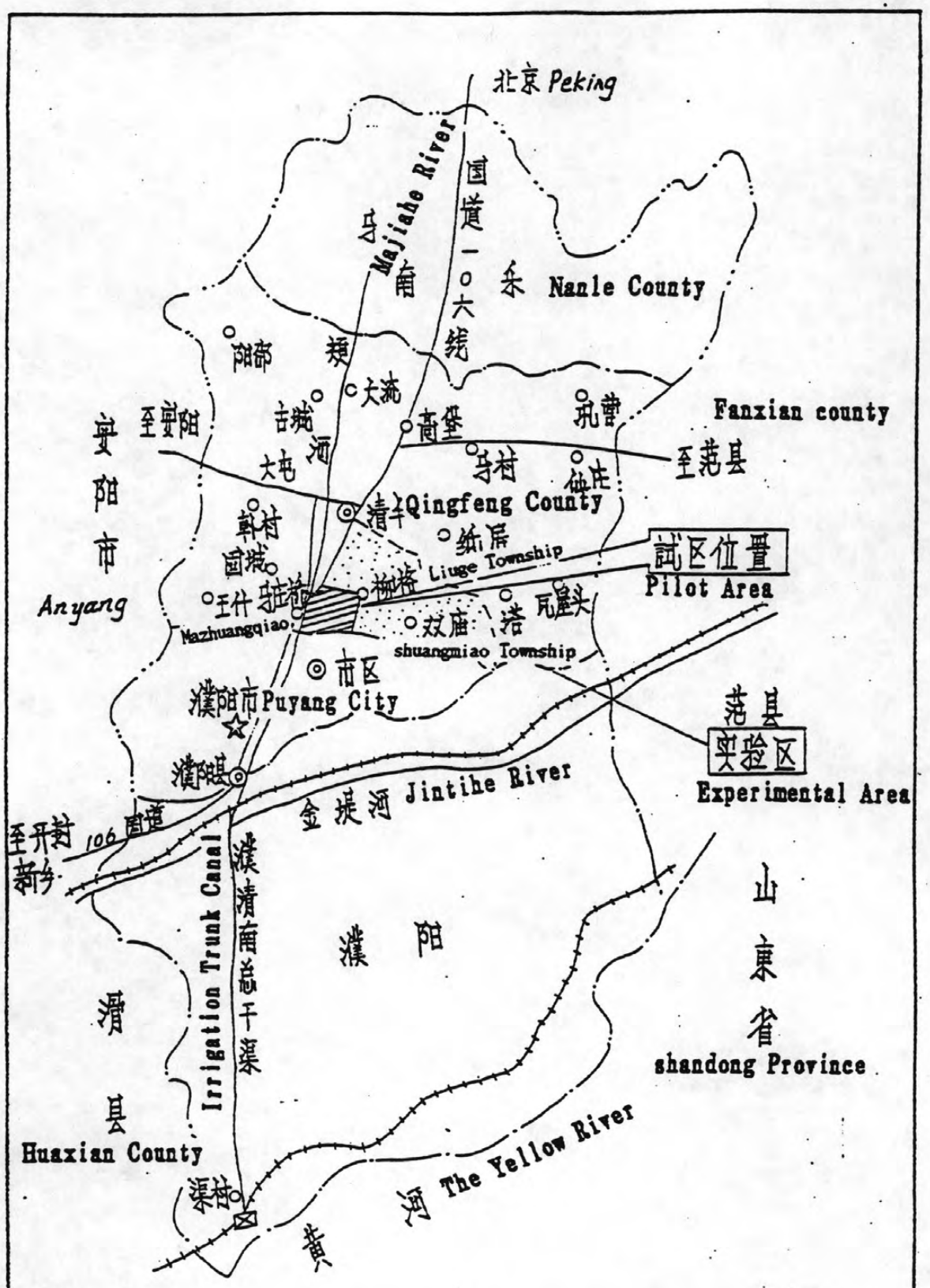


图 1-1 渠村蓄灌试区地理位置图

Figure 3: Qucun Storage and Irrigation Scheme Location Map

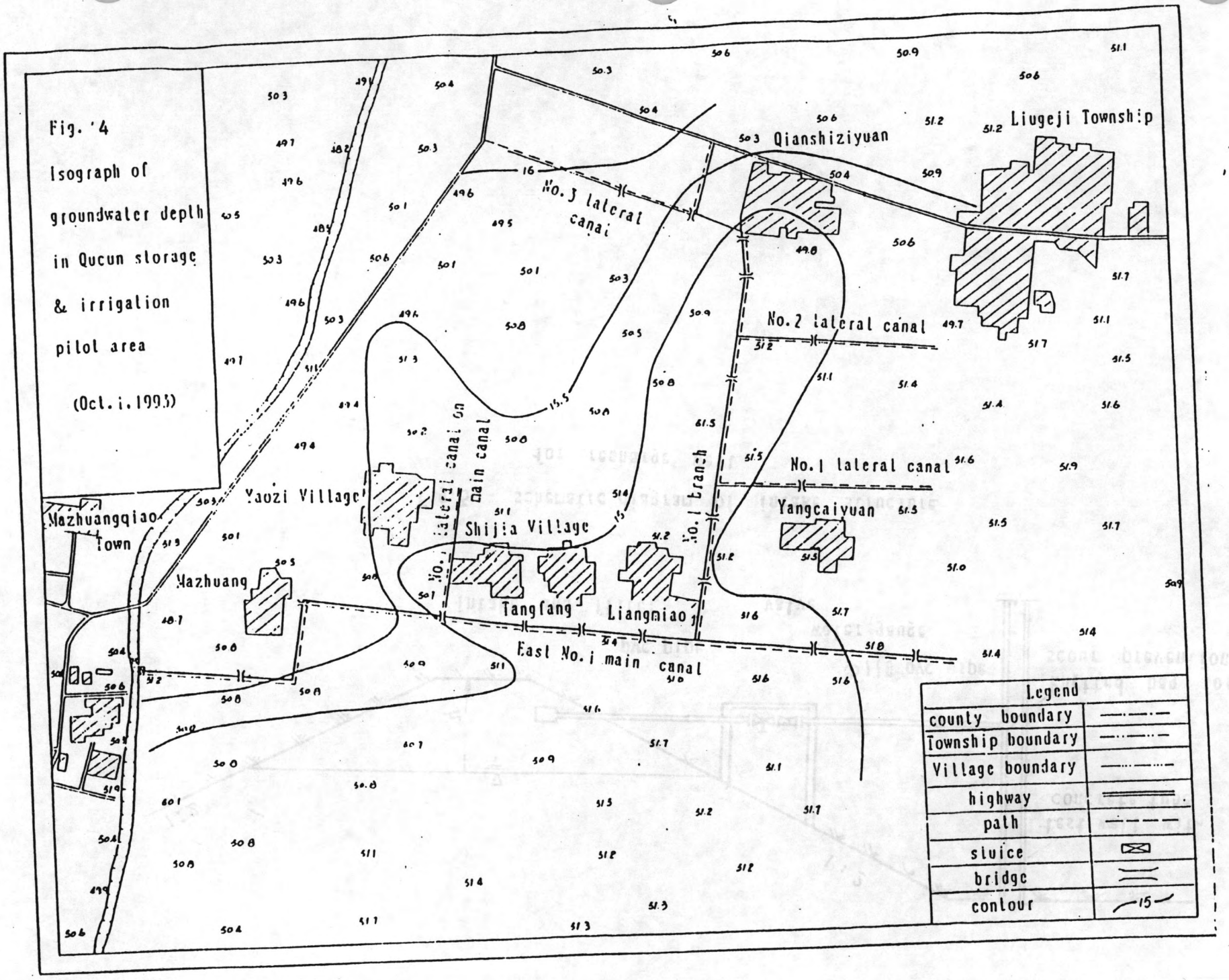


Fig. '4
Isograph of groundwater depth in Qucun storage & irrigation pilot area
(Oct. i. 1993)
Liugeji Township
Qianshiziyuan
No. 3 lateral canal
No. 2 lateral canal
No. 1 lateral canal
No. 1 branch
Main canal
Shijia Village
Yaozi Village
Mazhuangqiao Town
Mazhuang
Tangfang
Liangmiao
Yangcaiyuan
East No. i main canal
Legend
county boundary
Township boundary
Village boundary
highway
path
sluice
bridge
contour
15

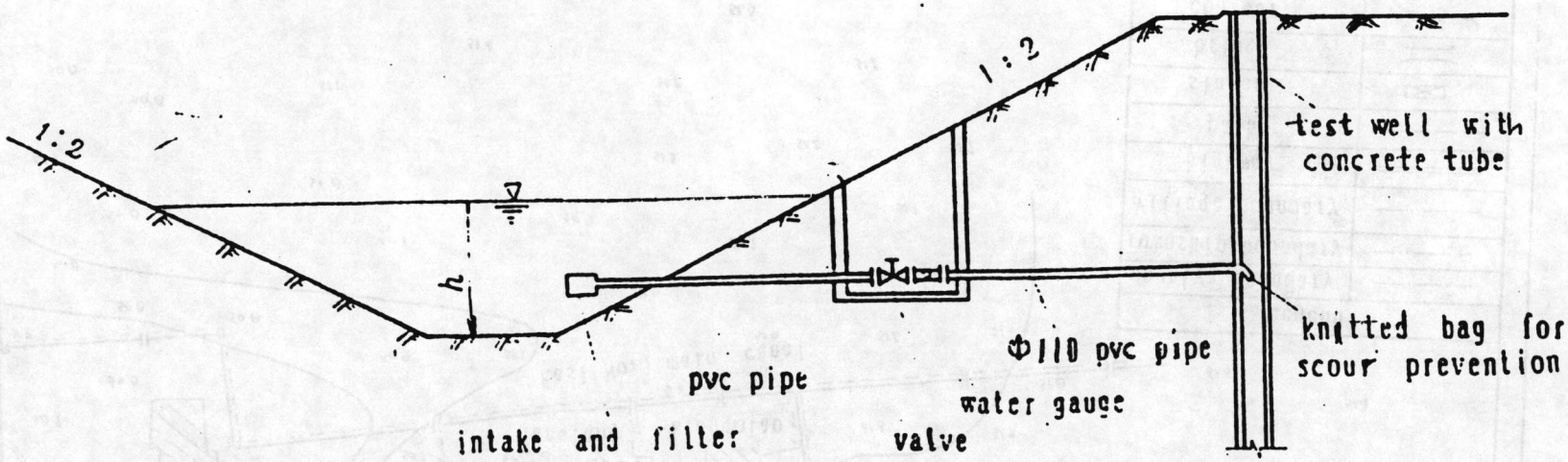


Fig.5 schematic diagram of intake structure for recharge well

CHINA - **Qucun Aquifer**

A Storage and Recharge Scheme

- How the Scheme Evolved?
- Results to Date.
- Lessons Learned.

Qucun Aquifer
How the Scheme Evolved?

- **Situation**
  - ↗Overexploitation of Groundwater
  - ↗Uncontrolled Use of Groundwater
  - ↗Availability of Surface Water
- **GOH Proposal**
  - ↗Full Scale Project Right Away
  - ↗One Method of Recharge

Qucun Aquifer
How the Scheme Evolved?

- **The WB Approach**
  - Try Pilot Scheme First
  - Test Several Recharge Methods
  - Follow up Implementation Steps

Qucun Aquifer
How the Scheme Evolved?

- **Implementation Steps**
  - Install Monitoring System
  - Carry out Study of Water Resources
  - Carry out Recharge Experiment (Pilot Scheme) in the First Three Years
  - Implement the Full Scale Scheme in the Fourth and Fifth Years
  - Submit Progress Reports
  - Assurance of Water Availability for Recharge

Qucun Aquifer Results to Date

- Scheme has been implemented successfully, as agreed;
- Integrated water management of surface and groundwater can significantly reduced dropping of GW levels, and eventually would raise GW levels:
  - ↗Groundwater level in the scheme area dropped less than areas outside the scheme (0.61m, 1.73m);
- Good Benefits. 7% increase in grain yield.
  - ↗ERR 18.9%

Qucun Aquifer Results To Date

Source of Recharge	% of Cont.. to Recharge*
Rainfall	69
Field Infiltration (from irrigation)	11
Canal Seepage	20

*The above is based on the assumption of conjunctive use of surface water from the Yellow River and GW (66% and 34%).

Qucun Aquifer Lessons Learned

- **Institutional**
  - Partnership is Important
  - Early Bank Involvement is Crucial
- **Technical**
  - Solutions should be innovative and based on experience
  - Pilot Scheme: imperative
  - Monitoring network must be set up

Qucun Aquifer
Table -1 Main Rivers in China

Names of Rivers	Length (km)	Area of basin (1,000 km²)	Average annual runoff1 (109 m3)	Population² (106 persons)	Area of cultivated land² (1,000 ha)	Annual runoff per capita (m3)
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1from 1956 to 1979

2in 1985

Qucun Aquifer

Table-2 Groundwater Recharge Schemes in Hunan

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