Economic Instruments For Improved Water Resources Management In Egypt

McCauley, David and Anderson, Robert and Bowen, Richard and Elassiouty, Ibrahim and Mahdy, Elsayed and Soliman, Ibrahim

United States Agency for International Development/Egypt, nternational Resources Group, Ltd, Winrock International, Harvard Institute for International Development, Center for Naval Analysis Corporation;

30 April 2002

Contract No. PCE-I-00-96-00002-00

ECONOMIC INSTRUMENTS FOR IMPROVED WATER RESOURCES MANAGEMENT IN EGYPT

Prepared by
EPIQ Water Policy Reform Activity
Agricultural Policy Reform Program
Market-Based Incentives Team:

Dr. David S. McCauley (Senior Water Resource Economist, Task Manager)
Dr. Robert Anderson (Environmental Economics Consultant)
Dr. Richard Bowen (Water Economics Consultant))
Dr. Ibrahim Elassiouty (EPIQ Water Management Specialist)
Dr. Elsayed Mahdy (EPIQ Senior Water Resources Economist)
Prof. Dr. Ibrahim Soliman (Agricultural Economics Consultant)
Eng. Hisham Shehab (WPAU Civil Engineer)

April 2002

Prepared for

United States Agency for International Development/Egypt

Environmental Policy and Institutional Strengthening Indefinite Quantity (EPIQ) Contract
Partners: International Resources Group, Ltd.; Winrock International;
and Harvard Institute for International Development

Subcontractors: PADCO; Management Systems International; and Development Alternatives, Inc.

Collaborating Institutions: Center for Naval Analysis Corporation; Conservation International; KNB Engineering and Applied Sciences, Inc.; Keller-Bliesner Engineering; Resource Management International, Inc.; Tellus Institute; Urban Institute; and World Resources Institute

Acknowledgments

This report was prepared by a team assembled under the auspices of the EPIQ Water Policy Reform Program (EPIQ/WRRP), a joint activity of the Ministry of Water Resources and Irrigation (MWRI) and the United States Agency for International Development Egypt Mission (USAID/Egypt). It is carried out under the umbrella of the Agricultural Policy Reform Program (APRP), a program of cooperation between the Government of Egypt and USAID/Egypt. Implementation of EPIQ/WPRP is the joint responsibility of Winrock International, International Resources Group (IRG), and Nile Consultants through the Environmental Policy and Institutional Strengthening Indefinite Quantity (EPIQ) Contract, for which IRG serves as the lead organization.

The work of the Market-Based Incentives (MBI) Team began in late August 2001 and two previous progress reports have been prepared.* The team was comprised of the following individuals: Dr. David McCauley (EPIQ/WPRP Senior Water Resource Economist, Task Manager); Dr. Robert Anderson (EPIQ/WPRP Environmental Economist); Dr. Richard Bowen (EPIQ/WPRP Water Economist); Dr. Ibrahim Elassouty (EPIQ Water Management Specialist), Dr. Elsayed Mahdy (EPIQ/WPRP Senior Water Resources Economist); Eng. Hisham Shehab (WPAU Civil Engineer); and Dr. Ibrahim Soliman (Agricultural Economics Consultant).

The EPIQ/WPRP MBI Team is greatly appreciative of all those who contributed to this report. Numerous officials, experts and farmers were interviewed by the team to gain an understanding of the potential applications of MBIs to improving water resources management in the country. Important inputs were received from a large number of MWRI staff, including especially Eng. Gamil Mahmoud, Chairman of the MWRI/WPRP Steering Committee and Head of the MWRI Water Policy Advisory Unit. The Team also gratefully acknowledges the guidance received from the EPIQ/WPRP and environmental program managers at USAID, especially Mr. Alan Davis, Dr. Wadie Fahim Mankarious, Dr. Ross Hagan and Dr. Nadine Y. El-Hakim. Finally, the entire effort has been carried out under the able direction of Mr. Andrew Tczap, EPIQ/WPRP Chief of Party.

While desiring to give due credit to all those who have made this study possible, the team also would like to make clear that the views expressed herein are their own and do not represent those of the Government of Egypt or USAID. The MBI Team also takes full responsibility for any remaining weaknesses or inaccuracies in the report, and it looks forward to receiving the reactions of interested readers.

* David McCauley, September 2001. *Exploring the Potential of Applying Economic Instruments to Water Resources Management in Egypt*, EPIQ/WPRP; and David McCauley, November 2001. *Economic Instruments for Improved Water Policy in Egypt: Summary Progress Report*, EPIQ/WPRP (with supplementary note, December 2001).

List of Abbreviations and Acronyms

AGOSD	Alexandria General Organization for Sanitary Drainage
APRP	Agricultural Policy Reform Program
AWGA	Alexandria Water General Authority
BCM	Billion Cubic Meters
C&C	Command and Control
DRI	Drainage Research Institute
EEAA	Egyptian Environmental Affairs Agency
EEPP	Egyptian Environmental Policy Program
EHD	Environmental Health Department
EMOHC	Environmental Monitoring and Occupational Health Center
EPIQ	Environmental Policies & Institutional Strengthening Indefinite Quantity Contract
GARPAD	General Authority for Rehabilitation Projects and Agricultural Development
GDP	Gross Domestic Product
GOE	Government of Egypt
GOFI	General Organization for Industrialization
GOGCWS	General Organization for Greater Cairo Water Supply
GOSD	General Organization for Sanitary Drainage in Cairo
HAD	High Aswan Dam
IAS	Irrigation Advisory Service
IIP	Irrigation Improvement Project
IMT	Irrigation Management Transfer
IRG	International Resources Group, Ltd.
M&E	Monitoring and Evaluation
MALR	Ministry of Agriculture and Land Reclamation
MCM	Million Cubic Meters
MHNCPU	Ministry of Housing, New Communities and Public Utilities
MHP	Ministry of Health and Population
MIMW	Ministry of Industry and Mineral Wealth
MOSEA	Ministry of State for Environmental Affairs
MWRI	Ministry of Water Resources and Irrigation
NAWQAM	National Water Quality and Availability Management Project
NOPWASD	National Organization for Potable Water and Sanitary Drainage
NRI	Nile Research Institute
NVDA	New Valley Development Authority
NWQCU	National Water Quality Conservation Unit
NWRC	National Water Research Center
O&M	Operation and Maintenance
PSU	Policy Support Unit (of EEPP)
RIGW	Research Institute for Ground Water
SWREI	Soil, Water and Environmental Research Institute
USAID	United States Agency for International Development
WPAU	Water Policy Advisory Unit
WPRP	Water Policy Reform Program
WUA	Water User Association

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Egypt seems to be on the brink of a new era in water management. The Ministry of Water Resources and Irrigation (MWRI) has recognized the need for a different operational mode that is "water conservation oriented, decentralized, environmentally sensitive, private sector oriented, equitable and operationally efficient" (MWRI, 2001). Four approaches to positive change have been identified:

- ***expanded use of economic instruments:*** creating incentives and disincentives for water management to protect its quality and allocate and use it more efficiently.
- ***public-private partnerships:*** institutionalizing the role of water user associations, expanding private participation in environmental protection, and identifying mechanisms to ensure appropriate benefits for participating private sector partners.
- ***institutional adjustment:*** decentralizing decision making, institutionalizing environmental protection at MWRI, restructuring organizational structures to better reflect the changed role of MWRI, improving personnel policies and procedures, building capacity, and defining a more central role for MWRI in macro-level decision making regarding uses of the Nile River.
- ***public awareness and stakeholder participation:*** encouraging active stakeholder participation at all stages of policy formulation, implementation and assessment, and improving awareness of water resources and associated environmental issues in the public at large and in MWRI itself.

In response to the first of these four steps, it was decided that a broad-based review would be undertaken of the potential applicability of economic incentives to improved water resources management. The focus of this resulting study was on market-based instruments (MBI's) as complements to traditional command and control measures for managing water quantity and quality.

Prior to evaluating potential water MBIs, it was felt necessary to identify the water management problems that need to be addressed through policy adjustments. Key water management challenges noted are listed below:

Water Management Challenges Identified	
Water Quantity	**Water Quality**
Threat of water shortages	**By Location:**
Service delivery in municipal water supply	Lake Nasser pollution
Irrigation service delivery challenges	Nile River pollution above Cairo
Insufficient irrigation system upkeep	Water pollution in the Nile Delta
High on-farm water use	Pollution of lakes
Low user contribution to irrigation system upkeep	Groundwater contamination
Weak attention to in-stream flows	**By Impact:**
Nonrenewable groundwater management	Adverse effects on human health
Subsidies affecting water use efficiency	Reduced agricultural productivity
Rainfall capture and flash flood protection	Threats to aquatic ecosystems
Negative consequences of rising water tables	Negative impacts on aesthetics (incl. tourism)

Screening Process

A two-step screening process was developed and utilized to evaluate the likely success of alternative market-based instruments in response to one or more of water management challenges. The instruments were screened on the basis of economic efficiency and equity and other economic factors relating to the nature of the instrument itself (see below). They also were evaluated on the basis of criteria that considered the specific social, cultural, political and institutional context in which the instrument will be applied. The criteria are given below in summary:

Criteria Intrinsic to the Instrument	**Contextual Criteria**
Economic efficiency or cost-saving potential	*Political acceptability*
Environmental or resource management effectiveness	*Social and cultural acceptability*
Distributive/equity effects	*Geography and existing infrastructure*
Revenue raising potential	*Legal framework*
Institutional capacity	*Administrative ease of implementation*
Technological change and innovation	*Experience from other nations*

The screening process resulted in a preliminary list of economic instruments that then were presented at a concluding workshop for additional scrutiny. These were classified, respectively, as those primarily aimed at improving water quantity versus quality management.

Instruments with a Primary Goal of Improved Water Quantity Management:

Area-based Irrigation Charges for Smallholder Agriculture. Water service charges could be assessed on individual farms using the existing agricultural land tax or charges based on irrigated feddans. This would raise revenues that could be used to improve the delivery system and also might be structured to encourage water conservation.

Priority Water Delivery for Smallholder Agriculture. Water user associations (WUAs) formed at the branch canal or district level, could pay a fee for guaranteed supply of irrigation water akin to an insurance policy. This would encourage greater cost sharing by farmers and introduce limited conservation incentives.

Creating a Market for Irrigation Improvement and Management Transfer Programs. Areas such as *mesqas* within branch canals where WUAs have been established would be selected for further irrigation system upgrades on the basis of their willingness to accept faster and less subsidized repayment terms. This would allow the IIP, DIP and IMT programs to be extended more quickly to other areas, including those in greatest need of poverty alleviation.

Volumetric Charges Outside Toshka. Water delivery charges to large farmers or investors could be based on the quantity of water supplied, similar to contracts being written in Toshka. This would increase cost sharing between the government and these

farms for operation and maintenance as well as system improvements and provide incentives for more efficient use of water.

Tradable Groundwater Extraction Rights. Transferable rights for groundwater in the Western Desert could be used to create incentives for this water's allocation to the highest valued uses and for self-monitoring of groundwater pumping. The deep groundwater for the Nubian Aquifer is largely a non-renewable resource, and this could provide a means for the transition from continuous free-flowing wells to controlled pumping to the end of the wells' economic life.

Increased Tariffs for Urban and Industrial Water Service. Urban water rates would be increased to fund system O&M, rehabilitation and expansion in order to improve service and reduce leakage. Other objectives in tariff design would be to favor the poor and to ensure that basics needs are met. Industrial users with flat (unmetered) or low tariffs would be assessed a higher rate.

Groundwater Extraction Charges. Industries that pump groundwater could be assessed an extraction charge. With respect to Western Desert groundwater, extraction charges for irrigators and others would encourage conservation and prolong the economic pumping of the aquifer as well as raise revenue for system O&M. Extraction charges are an alternative to area-based charges or tradable extraction rights.

Subsidy for Imported Water Meters. Tariffs on imported water meters could be lowered or eliminated to bring higher quality meters into the marketplace. Their use would improve the basis for accurate accounting of water service charges.

Subsidized water conserving equipment *Tariffs on water conserving technologies in urban and agricultural uses could be reduced to encourage their adoption.*

Reduced Subsidy on Fuel. A gradual reduction in the subsidy on fuel, whose price is about half the world price, would increase the cost of pumping water for irrigation and encourage greater water use efficiency.

Instruments with the Primary Goal of Improved Water Quality Management:

Increased User Fees for Wastewater Treatment. Cost-sharing from users could be increased to enhance the ability of government entities to fund system rehabilitation and expansion to achieve improved service and reduced water pollution.

Subsidized Wastewater Treatment Facilities. Construction of wastewater treatment facilities would continue to be subsidized by the government with the primary objective of further expanding the collection and treatment of wastewater.

Subsidized Pollution Control Equipment. Water pollution control equipment could be subsidized by reduced tariff rates or price subsidy to encourage greater pollution abatement.

Increased Industrial Discharge Fees. Fees for industrial discharges could be increased to raise revenues and to encourage firms to reduce pollution.

Tradable Effluent Discharge Permits. Maximum discharges could be established for various types of discharges and tradable permits allocated among dischargers to lower compliance costs for achieving specified goals.

Voluntary Agreements for Environmental Improvements. Various options exist for the introduction of voluntary agreements between the Government and individual enterprises, municipalities, industry associations, community groups and other entities to encourage them to reduce their polluting behavior to below levels required by current law.

Subsidized Rural Sanitation. Technical assistance and possibly subsidized sanitation technologies could be provided to rural communities to encourage small-scale environmentally acceptable ways of disposing of household sewage in areas that are unlikely to be served by sewage treatment plants.

Environmental Damage Charges and Fines. Charges and fines could be assessed in relation to the amount of environmental damage caused with the objective of internalizing these costs and thereby positively affecting behavior.

Environmental Performance Bonds. Natural resource damage liability could be legally formalized for harm to national waters (surface and groundwater) to internalize these costs and positively affect environmental management behavior.

Public Environmental Information Disclosure. Greater disclosure of environmental information could be required—including data from EIAs and water monitoring efforts—to reduce uncertainty regarding releases of pollution and to empower agents in the labor, capital and product markets so that they may indirectly affect corporate decisions regarding the release of water pollution.

Most Promising Instruments

This study explored the applicability of economic instruments to help address Egypt's current water management challenges. It resulted in an initial evaluation of twenty instruments that seemed most promising. Screening criteria were developed and applied to assess the merits of each, and direction also was received from nearly 60 participants who attended the study's concluding Workshop on Economic Incentives for Water Resources Management.

The results of this evaluation are summarized in the table on the following page, which gives the overall assessment of each instrument as well as the major water management challenges it may help to address.

Summary Evaluation of Economic Instruments for Water Resources Management

Economic Instruments Considered	Principal Problems Addressed by the Instrument	Evaluation of the Instrument		
Water Quantity		**Warrants study & action**	**Deserves further study**	**Not presently applicable**
Area-based Irrigation Charges for Smallholder Agriculture	Irrigation service delivery Low farmer payment for upkeep		X	
Priority Water Delivery for Smallholder Agriculture	Threat of water shortages Irrigation service delivery			X
Create Market for Irrigation Improvement and Management Transfer Programs	Irrigation service delivery High on-farm water use		X	
Volumetric Charges Aside from Toshka	Threat of water shortages Irrigation service delivery		X	
Transferable Groundwater Extraction Rights	Non-renewable groundwater use Subsidies affecting efficient use		X	
Groundwater Extraction Charges	Non-renewable groundwater use Subsidies affecting efficient use	X		
Increased Urban and Industrial Water Service Tariffs	Service delivery in water supply Subsidies affecting efficient use		X	
Subsidized Urban Water Meters	Threat of water shortages Service delivery in water supply	X		
Subsidized Water-Conserving Equipment	High on-farm water use Rising water tables	X		
Reduced Subsidy on Fuel	High on-farm water use Subsidies affecting efficient use			X
Water Quality				
Increased User Fees for Wastewater Treatment	Pollution of river, canals and aquatic systems of Nile Delta	X		
Increased Subsidies for Wastewater Treatment Facilities	Pollution of river, canals and aquatic systems of Nile Delta	X		
Subsidized Pollution Control Equipment	Pollution of river, canals and aquatic systems of Nile Delta	X		
Increased Industrial Discharge Fees	Adverse impacts of industrial pollution throughout country		X	
Tradable Effluent Discharge Permits	Adverse impacts of industrial pollution throughout country			X
Voluntary Agreements for Environmental Improvements	Potentially address wide range of water quality problems	X		
Subsidized Rural Sanitation	Rural surface and groundwater pollution plus offsite impacts	X		
Environmental Damage Charges and Fines	Potentially address wide range of water quality problems		X	
Environmental Performance Bonds	Potentially address wide range of water quality problems		X	
Public Environmental Information Disclosure	Potentially address wide range of water quality problems	X		

Those water quantity management measures deemed of highest priority for follow-up analysis and possible policy action were:

Groundwater Extraction Charges –More immediately promising than area-based charges for surface irrigation water service or tradable extraction rights for groundwater, groundwater extraction charges were judged as holding potential to help create incentives for water conservation by both industries as well as farmers and also to raise revenues. It was noted at the workshop that new regulations are already in development to introduce extraction charges as tools for groundwater management in the Western Desert.

Tariff Reductions for Imported Water Meters and Water Conserving Equipment – The reduction of protective import tariffs on both water meters and water-conserving equipment was identified as meriting careful further analysis and possible policy action.

Other Measures Deserving Further Analysis – Though not chosen as the most immediately attractive instruments, several other measures were identified as warranting careful further analysis. These include: area-based irrigation service charges; volumetric water delivery charges for large agricultural enterprises; and increased user fees for the supply of urban and industrial water services.

Likewise, the most promising policy measures identified to address water quality problems were:

Increased User Fees for Wastewater Treatment – In response to an unquestionable need for better handling of organic wastes from both urban and rural settlements coupled with chronic revenue shortages for such investments, further increases in wastewater user fees were recommended for strong consideration.

Increased Subsidies to Finance Wastewater Treatment Facilities – As a potential corollary to enhanced revenues from higher service fees (and possible partial privatization), consideration of increased government subsidies for wastewater treatment system development—common in many countries—also was deemed to merit careful further analysis.

Subsidized Rural Sanitation –Groundwater contamination has been observed from leaking septic fields and the dumping of waste from rural cesspits into canals. It was considered timely for the government to explore provision of technical assistance and possibly subsidized sanitation technologies to rural communities to encourage small-scale environmentally acceptable ways of disposing of household sewage in areas unlikely to be served by sewage treatment plants.

Subsidized Pollution Control Equipment – Analogous to the subsidization of water-saving technologies, it was noted that the reduction of tariffs on the import of pollution control equipment could create incentives for increased pollution abatement and higher quality domestic production of environmental technologies.

Voluntary Agreements for Environmental Improvements – Various voluntary agreement options—such as enhanced self-monitoring of effluent discharges by industry—hold promise for introducing positive new relationships between the Government and individual enterprises, municipalities, industry associations, community groups and/or other entities to encourage less polluting behavior.

Public Environmental Information Disclosure – Greater disclosure of environmental information—perhaps starting with public dissemination of data from environmental impact assessments and ambient environmental quality data collected by various agencies—can be used to hold those damaging the environment more accountable to the public and their financiers.

General Lessons Learned

It is noteworthy that none of the twenty instruments examined were completely rejected by either the screening process applied or the majority of participants at the concluding workshop. While serious reservations were raised about the political feasibility of several measures, only three out of the twenty were tagged as not currently applicable. This shows a fairly wide acceptance—at least among government water management officials—of the usefulness of this type of policy tool. This result should not be too surprising, given that Egypt has in recent years been gaining increasing experience with a range of MBIs applied to environmental and natural resources management challenges. It also bodes well for the further development of such approaches.

The participants who reviewed the twenty potential policy measures clearly were more comfortable with applying MBIs to water quality as opposed to water quantity challenges. While there is no definitive means for determining the reasons for such a preference, there are at least two plausible explanations. First, interviews during the study and discussions at the workshop made it plain that water pollution is widely recognized as a serious and growing problem facing the country. Water management professionals, therefore, are eager to find new ways to address this burgeoning challenge. Second, most of the water professionals attending the workshop were water quantity as opposed to water quality experts. This largely mirrors the degree to which these topics are covered within MWRI, but it may well be that water quantity professionals felt easier about recommending that MBIs be applied outside of their immediate areas of responsibility. Moreover, water quality problems increasingly affect the quantity of water that is available because of extensive reuse of irrigation water.

Recommended Next Steps

This study was initiated because there was insufficient knowledge of the range of market-based incentives potentially applicable to addressing water management challenges in Egypt relative to other policy measures. Hopefully this report and the associated dissemination efforts—including the workshop held to receive feedback on preliminary findings—have helped to fill this perceived gap. The wide sweep of topics addressed by the study and short timeframe meant that the analysis was done in only an introductory manner, and this inevitably resulted in the study raising as many questions as it answered.

A certain degree of momentum now has been created at MWRI with respect to knowledge of and openness to the use of MBIs, and this should be maintained. At least three areas for follow-up work in a next phase of work on this subject seem advisable.

Integrating MBIs with other policy measures. The first priority should be to further refine the problem analysis presented in this report and to begin the process of blending this new understanding of MBIs into the mix of policy options available to the government to address its highest priorities for water resources management. It may well be that the best choices for policy responses will involve some mix of regulatory and market-based instruments, but this policy analysis must be done with respect to specific problems that need to be solved. A more thorough inventory of current policies and regulations relating to water—beyond the cursory legal and institutional review presented in this report—also would be a useful precursor to this exercise. This should yield a fuller understanding of regulatory options to be considered alongside the new range of MBIs identified in this report—again in the context of specific water management challenges to be addressed. As the "future visioning" exercise at MWRI continues to define and refine approaches to deal with the emerging new generation of water management challenges, the potential application of MBIs certainly needs to be incorporated into the policy dialogue.

Public acceptability. A recurrent objection to the wider application of MBIs in the water sector heard during the study and at the closing workshop relates to public acceptability. Assuming that the sample of water professionals represented by the study's workshop participants is generally representative of these professionals in Egypt, then their receptivity to the use of MBIs shows that such measures are acceptable to the officials who would be responsible for their implementation. What about the public? Strictly in the context of analyses to find appropriate policy responses to a specific water management challenge, it would be very useful to have real data on questions of public acceptability in contrast to largely anecdotal concerns that often are raised. Prior to the implementation of any MBI, careful study should be undertaken of both the ability and willingness to pay by those expected to bear the burden of new economic incentive measures. Public acceptability also should be tested from the standpoint of social and cultural suitability as well as administrative feasibility. This is particularly important in cases where legitimate equity concerns have been raised.

Institutional strengthening. Significant institutional adjustments are required that will take time to address and, therefore, warrant immediate attention. Within MWRI, there appears to be an acute shortage of professionals with training in resource and environmental economics requisite to the conduct of further MBI analysis. Further information is needed on the availability of such staff in the context of a broader needs analysis for institutional strengthening of this type. The same constraints and needs would seem to apply to other government agencies with water management responsibilities. In the meantime, consideration should be given to creating temporary capacity for economic analysis of this type within MWRI, perhaps by adding a water economics section to the Water Policy Advisory Unit led by a senior economist. This section could also be tasked with coordinating the needs assessment and even be drawn

upon to help with in-house training, where warranted. A second set of institutional adjustments is needed to build a stronger working network of agencies responsible for water management within the country. If acceptable, it would seem appropriate for MWRI to take the lead in this effort, but many of the MBIs identified in this study apply to problems that lie outside of the immediate mandate of MWRI. With MWRI remaining as the lead authority in the water sector, much stronger outreach to and engagement of at least three key ministries and their associated bodies—Ministry of Agriculture and Land Reclamation, Ministry of State for Environmental Affairs and Ministry of Housing, New Communities and Public Utilities—is needed if the recommendations relating to specific MBIs identified as promising are to be acted upon in the interest of improving water resources management in the country.

1 Introduction

1.1 Overview[1]

The Ministry of Water Resources and Irrigation (MWRI) is the primary government agency charged with the management of water resources in Egypt. Beginning in mid-2001, and with assistance from the USAID-supported EPIQ/WPRP, the MWRI embarked on a wide-ranging policy, program and institutional review aimed at developing a "future vision" of water management for the country. This Ministry-wide exercise was undertaken "to consider changes in policy orientation and to prepare an action plan consistent with Egypt's long-term needs and MWRI's own institutional mandate" (MWRI, 2001).

The desire to develop new approaches to water management in the country is in acknowledgement of high population growth coupled with shifts in the structure of the economy that are causing increased municipal, industrial and tourism water demands relative to agriculture—all placing ever greater and new strains on limited water supplies. Special attention has been given to "supply stretching" measures to: deal with deteriorating water quality (which is diminishing the available usable supply); and further increase the efficiency of water allocation and utilization. A draft "MWRI Future Vision Statement" has emerged that emphasizes "a future operational mode that is water conservation oriented, decentralized, environmentally sensitive, private sector oriented, equitable and operationally efficient" (MWRI, 2001). Four approaches to positive change have been identified:

- ***Expanded use of economic instruments.*** Assessing the use of economic incentives and disincentives for water management to protect its quality and allocate and use it more efficiently.

- ***Public-private partnerships.*** Institutionalizing and expanding water user associations to achieve irrigation management transfer, to expand private participation in environmental protection, and to identify mechanisms to ensure appropriate benefits for participating private sector partners.

- ***Institutional adjustments.*** Decentralizing decision making and institutionalizing environmental protection at MWRI to affect an organizational restructuring that will better reflect the changed role of MWRI, result in improved personnel policies and procedures, build capacity, and define a more central role for MWRI in macro-level decision making regarding uses of the Nile River.

- ***Public awareness and stakeholder participation.*** Encouraging active stakeholder participation at all stages of policy formulation, implementation and assessment, to improve awareness of water resources and associated environmental issues in the public at large and in MWRI itself.

[1] This section is based on: *MWRI Future Vision*, MWRI: Cairo (draft).

1.2 Background, Purpose and Scope

This report presents the findings of a study that was primarily initiated in response to the first action item given above calling for increased attention to the potential application of economic incentives for improved water resources management in the country.

Box 1. Environmental and Natural Resources Management Policy Measures

Command & Control Instruments:

Rationing water
Crop restrictions
Enforcement of pollution standards and penalties
Technology mandates

Mixed Instruments:

Pollutant discharge concentration limits
Management of delivery systems by WUAs
Public awareness or education programs
Voluntary measures to conserve water or pollute less

Market-based Instruments:

User fees and service charges
Input and output charges
Subsidies (for inputs, capital or behavior)
Pollutant discharge fees
Resource extraction charges
Tradable rights (to resources or to pollute)
Liability for environmental harms
Deposit/refund and performance bonding
Disclosure of pollutant releases

Interest in economic instruments[2] for improving water management is not new in Egypt. A variety of studies have been conducted over the past decade examining the potential for MBIs to address both water quantity and quality issues (see this report's list of references). With respect to water quantity management, notable USAID-supported analyses were conducted in the early 1990s by the Irrigation Support Program for Asia and the Near East (ISPAN) and a follow-on set of analyses in the mid-1990s by the International Irrigation Management Institute. Both studies dealt with the cost allocation of irrigation structures and canal systems and calculations to justify an irrigation service fee capable of recovering the costs of operating and maintaining the national irrigation system while simultaneously introducing incentives for more efficient use of irrigation water.

In response to growing water quality management concerns, attention has been paid by the World Bank and the Danish aid agency (DANIDA)—in cooperation with the Egyptian Environmental Affairs Agency (EEAA)—to MBI possibilities for pollution control. EPIQ/WPRP has been working for several years with MWRI to identify policies and practices for optimal drainage water reuse. The Dutch assistance program (APP) to MWRI recently has laid plans for the establishment of a Water Quality Unit at the Ministry. A study is currently underway by the USAID-supported Egyptian

[2] The terms "economic instruments" and "market-based instruments (MBIs)" will be used interchangeably in this report.

Environmental Policy Program (EEPP) Policy Support Unit (EEPP/PSU) on "using economic instruments as environmental management tools" (but it has specifically avoided giving much attention to water quality issues due to EEAA's lack of focus on this subject and the anticipation that EPIQ/WPRP would examine this topic).

The Government of Egypt has a range of policy options available to meet its water management objectives, of which MBIs are but a subset. Some examples of various policy instruments are presented in Box 1.

As will be observed in this report, there already is a growing list of MBI applications in Egypt—used in the water sector and addressing other natural resources and environmental management concerns. It is hoped that the review of potential MBIs as options for improving water quantity and quality management in the country will both inform the water policy dialogue and lead to the wider and more effective use of such instruments.

1.3 Organization of the Report

The report begins with a review of the policies and institutions governing water management in the country. Government agencies with water management responsibilities are described as is the legal basis for their mandates, and Chapter 2 also broadly reviews current water management policies.

This introduction is followed by an overview of water management challenges currently facing the country and covering both quantity to quality issues. Some readers very familiar with the Egyptian water sector may find Chapter 3 somewhat elementary, but the authors have been encouraged to retain this background review of water problems for those who are less well versed in the subject. It provides a necessary basis for understanding why policy reform may be necessary and the underlying demand for information on the possible application of MBIs to the water sector.

A general description of MBIs considered by the study is then presented in Chapter 4. Again, those familiar with the range of economic incentives employed in water management around the world may wish to skip parts of this section, but it lays the groundwork for the assessment of alternative policy measures.

Chapter 5 introduces and then applies a screening process for evaluating the pros and cons of alternative MBIs applied to solving water management problems. In all, twenty policy measures (10 each for water quantity and quality) are evaluated on the basis of their acceptability, efficiency, equitability, implementability and other criteria.

Conclusions and recommendations are presented in the final chapter, including a review of the most promising MBIs identified, observations on broader lessons that may be drawn from the study and some suggested next steps.

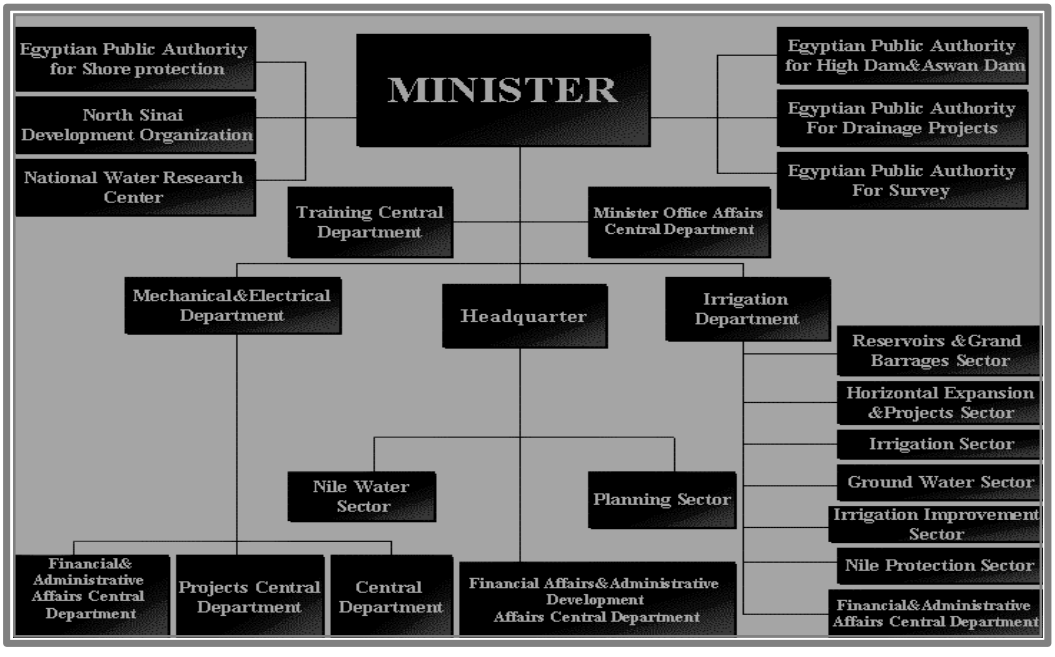
2 Water Management Institutions and Policies

2.1 Introduction

Prior to assessing the relative merits of alternative policy measures, it is necessary to have a firm understanding of the legislation, rules and regulations already in place. While a thorough review of Egyptian water law and policy is well beyond the scope of this study, this chapter briefly reviews the key institutions involved in various aspects of water management as well as the basic legal underpinnings of their mandates. It goes on to summarize some of the key elements of current water policy as the basis for a review of water management challenges facing the country as well as of new policy approaches that might be considered.

2.2 Key Government Institutions Charged with Water Management[3]

Ministry of Water Resources and Irrigation. The Ministry of Water Resources and Irrigation (MWRI) is the lead government body responsible for water resources management in the country. As such, it is charged with the regulation and distribution of water resources throughout Egypt as well as with the management of its quality. The ministry's most important responsibility is for management of the waters of the Nile River that flow through Egypt. Since completion of the High Aswan Dam (HAD) in 1968, the Nile has been managed for the multiple uses of irrigation, transportation, power generation, urban and industrial use, and in-stream uses (supporting navigation, fisheries and coastal ecosystem health). MWRI also is responsible for management of water outside the Nile basin—principally the deep groundwater resources in the Western Desert. The current organizational structure of MWRI is given below:



[3] This section draws heavily on the report: *Assessment of Present Status of Water Quality in Egypt*, March 1999, NWRC and Canadian Executing Agency.

MWRI has sole legal responsibility for water resources planning and management. With respect to water quality, it issues licenses to commercial, industrial, and tourist establishments for the discharge of liquid waste into inland waterways. According to Law 48/1982, industrial waste must receive treatment to the level of prescribed pollution standards before being discharged into inland water bodies, however this provision is often violated. MWRI is responsible for providing water of suitable quality to all users. To accomplish this goal, the Ministry must insure that appropriate measures are taken to protect water quality.

MWRI also handles surface water and groundwater quality monitoring through the National Water Research Center (NWRC), which operates under its authority. Within the NWRC, water monitoring activities are implemented by three bodies:

- **Drainage Research Institute (DRI).** With respect to water quality, the DRI is responsible for monitoring the quantity and quality of drainage water in the Nile system. One of DRI's responsibilities is to provide MWRI with data on the availability of drainage water for reuse in irrigation, mainly for land reclamation projects. In this context, DRI has prepared guidelines for drainage water reuse.

- **Nile Research Institute (NRI).** NRI is responsible for protecting and developing the Nile River in a sustainable manner by (1) monitoring water quality in the river channels; (2) assisting in the enforcement of pollution control laws affecting the Nile system; (3) evaluating and assessing impacts of new developments and interventions on water quality; and (4) operating and maintaining a database on water quality of the Nile. The monitoring network of the NRI has 34 stations along the Nile and 60 observation stations at key discharge sites.

- **Research Institute for Ground Water (RIGW).** The RIGW carries out field investigations of groundwater throughout Egypt. Initially responsible mainly for groundwater development, RIGW now is charged with monitoring groundwater resources in order to assure their sustainable use by agricultural, domestic and industrial users. RIGW has approximately 500 wells for observing irrigation water abstraction and plans to install about 150 observation wells for drinking water.

Ministry of Agriculture and Land Reclamation (MALR). The MALR is the most important government water management stakeholder outside of MWRI, since irrigation accounts for about 84 percent of the consumptive uses of water in Egypt (and agriculture accounts for about 20 percent of both GDP and total exports and about 34 percent of total employment). MALR is responsible for predicting cropping patterns and irrigation requirements used by MWRI to allocate water among the vast network of primary and secondary irrigation canals. This has become more critical with liberalization of the agricultural sector since market forces rather than government policy determines what is planted. MALR also participates with MWRI in the irrigation and drainage improvement projects with on-farm improvements such as laser land leveling and tiled drainage.

Through its Soils, Water and Environmental Research Institute (SWERI), the MALR also is responsible for performing research on the sustainable development in the agricultural sector. In this capacity, SWERI has several responsibilities regarding water quality management: establishing policies for fertilizer use, classifying water resources and soils; and monitoring soil and water quality for agricultural uses. SWERI has a modern laboratory for physical, chemical and biological analysis of soil and water.

Ministry of State for Environmental Affairs (MOSEA). After MWRI, MOSEA is the most important government body for the management of the country's water quality. Through the subsidiary Egyptian Environmental Affairs Agency (EEAA) and in coordination with the Ministry of Health and Population (see below), MOSEA is responsible for inspections regarding compliance with environmental and occupational health and safety regulations. Among the approximately 700 EEAA employees are 18 inspectors supplemented by a handful of additional inspectors in each of 8 local offices in the governorates, and they are charged with the oversight of compliance with all environmental and workplace standards. If inspectors find a problem, their options range from assessing a citation and levying a fine on the spot to granting a probationary period of 60-90 days to correct the problem before re-inspection. If the problem has not been corrected after the probationary period, a request is filed with the Ministry of Interior to write a citation. Governors and the State Minister for Environment can shut down severe polluters, however it is relatively easy for facilities to obtain a court order to reopen based on concerns over job loss and adverse economic impact (Khaled Fahmy, Monitoring, Verification and Evaluation Unit for EEAA, personal communication October 2001).

Facilities are chosen for inspection based on a master plan prepared by MOSEA but also in response to governors' requests and citizen complaints. There are approximately 23,000 industrial establishments in Egypt, however only about 400-500 are major polluters. In 2000, approximately 235 of these were inspected, but thousands of smaller establishments are inspected rarely, if at all (Fahmy).

In most new industrial cities (e.g., 10th of Ramadan, 6th of October, and Sadat City) industries already are generally meeting discharge standards, and compliance is improving elsewhere. Along the Nile, for example, all industries now at least have effluent discharge facilities (per. comm., Samia Galal Saad).

Ministry of Health and Population (MHP). MHP has a central role in water quality management, particularly with respect to standard setting for: quality of potable water sources (the Nile and canals); drain waters that can be mixed with fresh water; industrial and sewage treatment plant discharge; and wastes discharged from river vessels.

In addition to developing standards, the ministry must sample and analyze all industrial, municipal, and wastewater treatment plant effluents. Two departments have the principal responsibility. The Environmental Health Department (EHD) under the Ministry is responsible for sampling intakes to drinking water treatment plants as well as discharges from wastewater treatment plants and industry. The Environmental Monitoring and Occupational Health Center (EMOHC) is responsible for environmental monitoring (air, water and soil).

Since 1998, the EMOHC has monitored Nile River and main canal waters in cooperation with the Egyptian Environmental Affairs Agency.

Ministry of Industry and Mineral Wealth (MIMW). MIMW is responsible for overseeing the licensing and operation of firms in Egypt. Within the Ministry, the General Organization for Industrialization (GOFI) supervises pollution control activities, as well as safety and health issues. GOFI does not perform any inspections or verify whether industries are in compliance with license requirements. The Environmental Management Department within the Ministry is in charge of providing advice to industrial firms regarding compliance with a 1982 ministerial decree that all industrial facilities must install and operate water pollution control equipment in conformance with Law 48. According to Law 93/1962 and its Amending Decree 9/1989, industrial wastewater must receive pretreatment before discharge to public sewer systems.

Ministry of Housing, New Communities and Public Utilities (MHNCPU). MHNCPU is responsible for planning and developing water supplies and wastewater treatment facilities. MHNCPU and its affiliate agencies oversee construction of sewers and wastewater treatment facilities throughout Egypt. The regional wastewater authorities and other bodies affiliated with MHNCPU that are responsible for both water and wastewater treatment include:

- The National Organization for Potable Water and Sanitary Drainage (NOPWASD);
- The General Organization for Sanitary Drainage in Cairo (GOSD)
- General Organization for Greater Cairo Water Supply (GOGCWS
- The Alexandria General Organization for Sanitary Drainage (AGOSD)
- The Alexandria Water General Authority (AWGA)
- The Suez Canal Authority; and
- A number of private companies for wastewater treatment in Damietta, Kafr El Sheikh and Beheira.

NOPWASD is responsible for the potable water and wastewater treatment systems outside of Cairo and Alexandria. These government organizations get their water from the Nile and from groundwater. In addition, groundwater-based systems are operated by various city councils. Water sources in industry vary according to the nature of the industrial activity. Food and pharmaceutical industries, for example, require clean water, so they either tap municipal supplies or make use of their own groundwater wells. Other industries may use Nile or canal water directly for cooling or washing purposes.

Ministry of Scientific Research. The Ministry of Scientific Research is responsible for monitoring a small number of water and wastewater treatment plants in the Greater Cairo area and a handful of pumping stations. The primary purpose of these activities is to assure environmental protection from industrial wastes and the protection of potable water.

Ministry of Electricity and Energy. The Ministry of Electricity and Energy is responsible for power generation and coordinates with MWRI to maximize hydropower generation without harming irrigation. Power generation and transportation are non-consumptive uses but their needs are factored into decisions on Lake Nasser water levels

and releases at the HAD. The ministry also operates two thermal power plants that draw water from the Nile for cooling.

Ministry of Transportation and Ministry of Tourism. These two Ministries are stakeholders interested in maintaining "in-stream flows" of the Nile River to provide sufficient depth for commercial and recreational navigation as well as for aesthetic purposes. The River Transport Authority of the Ministry of Transport manages navigation activities along the course of the Nile River below the Aswan Dam and on main canals in coordination with MWRI.

Ministry of Interior. In coordination with technical agencies and the courts, the Ministry of Interior is charged with enforcing laws and with the collection of fines, including some relating to water extraction, pollution or other impacts.

2.3 Legal Framework for Water Management

MWRI derives its legal mandate as the lead governmental body for the water sector from Law 12/1984 on Water Management (primarily dealing with water for agriculture) and Law 48/1982 on Protection of the Nile River and its Waterways from Pollution. The Ministry of State for Environmental Affairs and its subsidiary body the EEAA also exert considerable influence over water quality management through authorities vested through Law 4/1994 on Environmental Protection. The principal laws governing water management include:

- **Water Quantity Resources Management.** Law 12/1984 and its supplementary Law 213/1994 provide the basic legal structure for water quantity issues. The basic law defines the use and management of the public and private sector irrigation and drainage network structures, including main canals, feeders, drains and tile drains. It also provides legal direction for the use and maintenance of public and private canals and specifies arrangements for cost recovery in irrigation and drainage works. In addition to Nile surface water delivery, the law also regulates:
    - groundwater and drainage water;
    - protection against flooding;
    - navigation; and
    - coastal protection.
- **Nature Protection.** Law 102/1983 delineates nature protection areas, forbids actions that lead to destruction of the natural environment, including marine and freshwater, and proscribes fines and penalties for violators. Under this Law, the Government can pursue damage assessments for harms to the environment.
- **Wastewater Discharges into the Sewerage System.** Law 93/1962 establishes standards for wastewater discharge into the sewer system.
- **Regulation of Water Resources and Treatment of Wastewater.** Law 27/1978 regulates public sources of drinking water. It instructs and empowers the MHP to set standards for potable water.
- **Protection of the River Nile and Its Waterways.** Law 48/1982 regulates the discharge of waste and wastewater into the Nile and its waterways and sets standards for the quality of effluents. The law establishes the responsibilities of the MWRI and

the MHP in monitoring the quality of effluents discharged into the Nile River (and its associated drainage system, lakes and groundwater) to ensure that water quality standards are met. Industrial establishments are required to obtain pollution discharge licenses. A bond is required with the license application and a fee of L.E. 0.1 (one piastre) per cubic meter of effluent is levied according to Article 82 of the implementing regulations. Under this Law, the MHP has the obligation to carry out periodic sampling and analysis of wastewater and waste discharge from establishments that are licensed to discharge to waterways.

- **Environmental Protection Law.** Law 4/1994 delineates the roles and responsibilities of EEAA, including its financing through the Environmental Protection Fund. The Law authorizes use of incentives for managing the environment and supports the provisions of Law 48 regarding the management of water resources.

2.3 Principal Water Management Policies and Programs

2.3.1 Nile Irrigation Management

Most recent water policy analysis and practice has been directed primarily toward achieving increases in the effective supply of irrigation water and associated expansions of irrigated lands (see Box 2 for a brief history of water plans since 1977). The current operating policy framework dates from 1997, when a Horizontal Expansion Plan was put forward. As shown in Table 1 below, this plan envisions an increase in irrigated lands of some 3.4 million feddan over a 20-year period.

Table 1. Increases in Irrigated Land per the 1997 Water Management Plan

Water Source	Area Served (million feddan)	Location
Surface water and reuse of agricultural drainage water	1.20	To be reclaimed from previous plans
	0.55	Sheikh Zayed Canal (Toshka)
	0.50	Southern Egypt
	0.05	West Delta
	2.30	**Subtotal for Surface Irrigation & Reuse**
Groundwater in the Western Desert and Sinai	0.50	Western oases, east of Owainat & Darb El-Arbeen
	0.10	Sinai
	0.60	**Subtotal for Groundwater**
Treated sewage water from Greater Cairo and Alexandria	**0.25**	Greater Cairo: areas between Ismailiya & Suez Desert Roads and each side of Cairo-Alex Desert Road to the southern boundaries of Sadat City; Greenbelt contouring Southern Borg El-Arab City
Water available after completion of the Joungli Canal Project	**0.25**	Middle Sinai
TOTAL	**3.40**	**Increase in Area Cultivated Nationally**

Source: Southern Egypt Development Project, 1998.

To meet the irrigated area expansion plans, savings have been projected to come from existing uses of Nile waters. Improved cropping patterns with limited use of high water-consuming crops and introduction of short age varieties of crops have been projected to save 3 BCM. Irrigation improvement projects, including land leveling, improvements of surface irrigation in old lands, and use of drip and sprinkler irrigation in new lands, orchards and vegetable fields have been projected to save a further 4 BCM. Reduced losses in domestic water use are projected to save 1 BCM.

Box 2. Recent Evolution of Egyptian Water Policy

1977–Horizontal Expansion Policy: An ambitious plan to increase national cultivated area by about 2.80 million feddan from 1997 to 2000, of which 0.50 million feddan were to utilize deep groundwater in the New Valley.

1981–National Water Master Plan (NWMP): To implement the 1977 policy, the NWMP took a 20-year planning horizon and evaluated alternatives for water supply augmentation and water conservation in agriculture, municipal use and industry.

1982–Water Policies to Implement the NWMP: MWRI reset its water policy according to the results of the NMWP based on a goal of making 11.7 BCM of extra water available to satisfy future water demands.

1994–Horizontal Expansion Policy: An agreed comprehensive and ambitious plan of horizontal expansion to 2025 that set total targeted agricultural expansions through 2000 at 2.2 million feddan, comprising: 1.7 million feddan irrigated with Nile water, agricultural drainage, and the groundwater aquifer of the Nile Valley and Nile Delta; 0.3 million feddan using deep groundwater water; and 0.2 million feddan using treated waste water. An additional 1.0 million feddan were to be developed during 2000-2025.

1997–Draft Water Resources Strategy of Egypt to 2017: Based on a water balance analysis examining all sources in 1995/1996 and totaling approximately 73 BCM—with 61 BCM used in agriculture and 12 BCM in other sectors—the strategy lays out plans for meeting alternative 2017 water demand scenarios, the maximum being 97.8 BCM.

Source: Allam, 2001.

Most of the responsibility for implementing the Horizontal Expansion Plan undertaken by the Government falls to the Irrigation Department under MWRI, which operates and maintains irrigation systems throughout Egypt. This Department includes the following departments/sectors:

- Reservoirs and Grand Barrages
- Horizontal Expansion and Projects
- Irrigation
- Groundwater
- Irrigation Improvement
- Nile Protection
- Financial and Administrative Affairs

The Irrigation Sector is divided into a Central Directorate for Canal Maintenance and a Central Directorate for Water Distribution. Water is managed by a hierarchical structure of administrative units:

- 23 Irrigation Directorates: 250,000–500,000 feddan each
- 64 Irrigation Inspectorates: 100,000–200,000 feddan each (2-3 per Directorate)
- 202 Irrigation Districts: 30,000–70,000 feddan each (3-5 per Inspectorate).

Each District Office is headed by a District Engineer responsible for operation and maintenance of the secondary level branch canals, which serve approximately 5,000-10,000 feddans on average.

Farmers are responsible for the operation and maintenance of *mesqas*, the tertiary canals from which farmers draw water for irrigation. *Mesqas* are considered to be privately owned. The traditional Below Grade System (BGS) of irrigation canals delivers water below the level of the farmers' fields, requiring farmers to lift water onto their fields. Farmers primarily use pumps, although the traditional *saqia* is still used, mostly in Middle and Upper Egypt. Informal farmers' organizations have developed along some *mesqas* for maintenance and to resolve problems.

Formal *mesqa* Water User Associations (WUAs) are being encouraged through the Irrigation Improvement Program (IIP). A pilot program assisted by EPIQ/WPRP also is helping to build WUAs at the branch canal level, and it has now become government policy to extend this approach to the entire Nile Delta. Branch canal WUAs have been organized in four pilot sites, but neither the planned improvements nor the full transfer of management has yet occurred. In other branch canals, Water Boards are being established on a pilot basis. Water Boards are modeled after the Dutch system of organizing stakeholders to coordinate and manage water resources within the Boards jurisdiction.

The IIP program funds a package of improvements to the delivery system and on-farm facilities in order to improve agricultural productivity and irrigation efficiency. The package includes renovation and improvement of branch and distributary canals, downstream water level control, conversion from rotational flow to continuous flow, *mesqa* improvements, and water management technical assistance through the Irrigation Advisory Service. In old lands, the *mesqas* are raised and pumps installed so that water is delivered to farm plots by gravity flow. In some new lands, pressurized pipelines deliver water underground to the field for use in drip and sprinkler irrigation. WUAs are established and given the responsibility for maintaining the *mesqa* and managing for an equitable distribution of water from head to tail reaches.

The WUAs are also responsible for collecting payments needed to pay for the IIP improvements. Law 12/1984 establishes the terms for repayment: a 3-year grace period; zero interest payments; 10 percent administrative charge; and 20 years of constant annual payments. Even in the absence of inflation (an heroic assumption), this constitutes at least a 32 percent subsidy on the capital provided for these investments. The MWRI has authority to place repayments into a special fund to cover the costs of additional improvement projects.

Supplementary Law 213/1994 provides the legal foundation for involvement of landowners at the *mesqa* and farm level for improving irrigation systems and establishes a fund to finance improved *mesqas* in Irrigation Improvement Project areas. Law 213 presently provides for WUAs above the *mesqa* level only on new lands. Proposed Revised Law 12/1984 would allow for WUAs at the branch and district canal levels.

2.3.2 Nile Basin Drainage and Groundwater

A significant proportion of Nile Valley and Delta lands are experiencing waterlogging problems, and MWRI has a Tile Drainage Improvement program to address this issue. Drainage Collector User Associations (CUAs), the counterpart of *mesqa* WUAs, are being established to maintain the on-farm underground drains. Fees payed by participants in this program are collected by the Ministry of Finance and are remitted to the State Treasury.

Conjunctive use of groundwater and drain water as a supplement to surface irrigation is common in the Nile Valley and Basin (see the next section for a discussion of drainage water use for irrigation). To sink a well, a permit must be obtained from MWRI, and wells are prohibited in areas improved under Irrigation Improvement Program.

Law 20/1953 specifies fees that owners of private pumps may charge and confers upon irrigation engineers the powers to enforce the regulations on all water-lifting machines. This law was enacted due to concerns that private well owners were overcharging farmers for irrigation water (APRP Report No. 48).

2.3.3 Mega Projects

There are two large horizontal expansion projects underway that utilize Nile waters that are not returned to the Basin. The purpose of these so-called "mega projects" is to increase agricultural production, improve national income distribution, and generate employment opportunities in the project areas.

- **North Sinai Agricultural Development Project.** This mega-project envisions cultivation of 620,000 feddan on both sides of the Suez Canal. The source of water will be fresh Nile water mixed with drainage water at a 1:1 ratio and delivered via the El Salam Canal. When completed in 2002 or 2003, the project will utilize a total of 4.45 BCM of Nile and drainage water.

- **South Valley Development Project (3 components)**

  Toshka Project: Water will be lifted via a pumping station on the left bank of Lake Nasser, 200 km south of the High Aswan Dam, into the 70 km Shiekh Zayed Canal, which will deliver water by gravity flow into four branch canals. The pumping stations are expected to be operational in October 2002. The first branch of the canal is devoted to the reclamation of 100,000 feddan allocated to a principal investor, who is expected to complete full reclamation by 2010 (ArabNews.com, *9/27/2000)*. Large investors are being recruited to implement the other three branch canal reclamation areas.

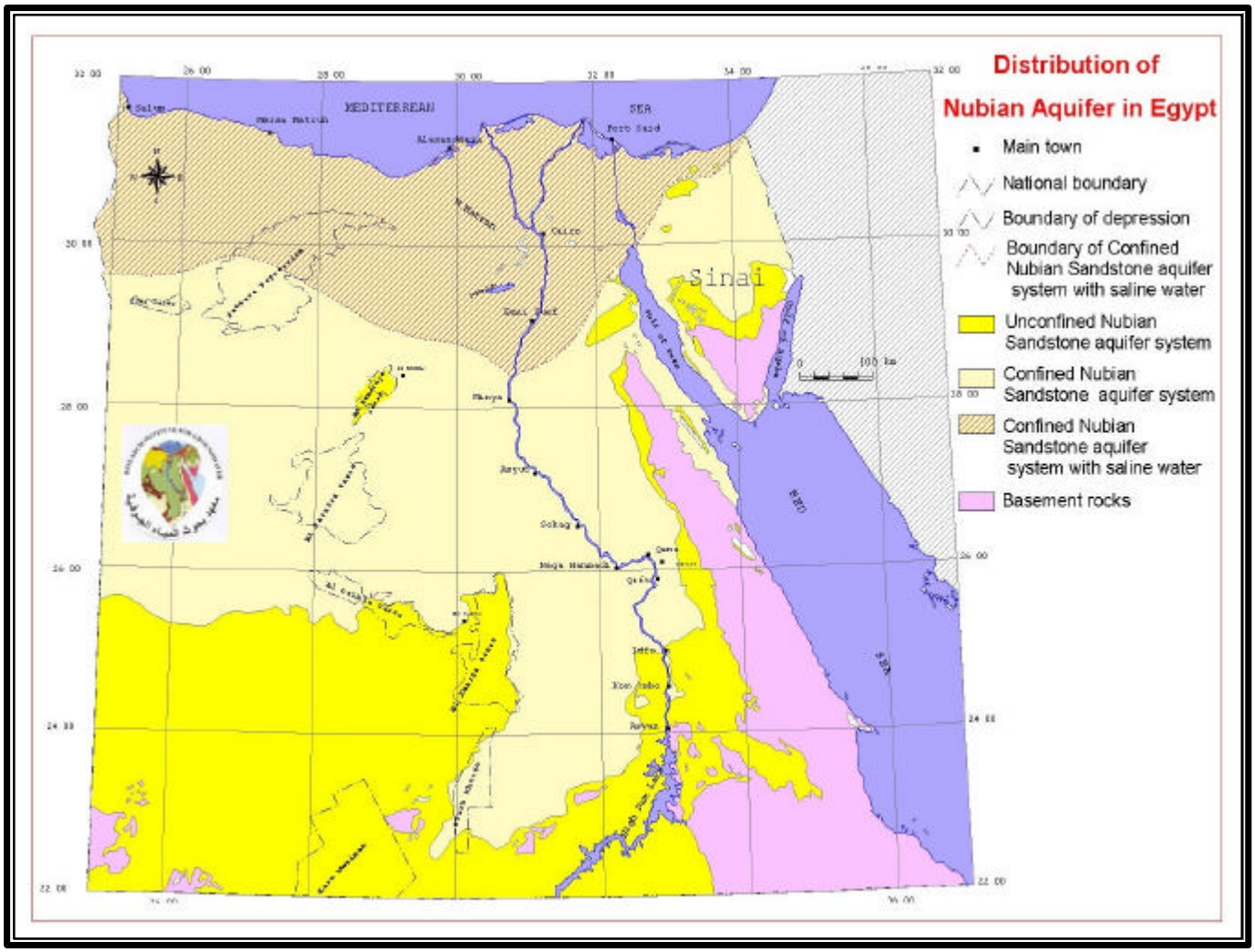
  South Valley Wadies: The *wadies* in El Nokra, Kobbania, Lakita, Saaidi, Komombo will be directly fed by Nile waters with a total area of cultivation projected to reach 500,000 feddan.

New Valley Groundwater: Areas to be irrigated are in East Owainat, Darb El Arbien and the key oases (Kharga, Dakhla, Farafra, Baharia and Siewa) totaling about 500,000 feddan. This is discussed further in the section that follows.

2.3.4 Western Desert Groundwater [4]

The major natural resource in the Western Desert is deep groundwater from the Nubian Sandstone Aquifer. This is a vast aquifer underlying parts of Egypt, Chad, Libya and Sudan as depicted in Figure 1. The aquifer was formed over 8,000 years ago, is considered non-renewable, and much of it is under artesian pressure.

FIGURE 1



[4] Adapted from EPIQ/APRP, 1999a.

Prior to 1960 the water supplied by springs was supplemented by construction of shallow wells with depths of 50-70 meters. After 1960, wells between 300-1200 meters in depth were drilled to provide water for proposed large scale irrigated agriculture and new settlements in the New Valley. Groundwater extraction increased from 273 MCM to 950 MCM from 1960 to 1997 (APRP, 1999a).

The Government has established the following development objectives for the Western Desert:

- Settling population away from the overcrowded Nile Valley and Delta.
- Maximizing the use of existing natural resources in the isolated, vast desert areas.
- Connecting these areas to the rest of the country.
- Creating new job opportunities for unemployed youth.

The General Authority for Rehabilitation Projects and Agricultural Development (GARPAD) of the Ministry of Agriculture and Land Reclamation (MALR) was responsible for reclamation plans until 1994. GARPAD instituted a policy that the area which the well can irrigate is determined by the production rate the well can efficiently maintain over its economic life (20-25 years). Wells should be designed to accommodate the future required and expected pumping levels over the economic life of the well. The newly reclaimed lands were then offered to small farmers, graduates, cooperatives and investors.

The New Valley Water Resources Department under MWRI was created by Presidential Decree in 1994 with the responsibility for planning, operation, maintenance, management and monitoring of groundwater resources in the Western Desert. Since 1997, MWRI also has had the overall responsibility for issuing well drilling and use permits.

GARPAD is still responsible for design and implementation of desert reclamation schemes which are transferred to the private sector. Since 1997, the Government has encouraged private sector participation in different development sectors, such as land reclamation and mining activities in the Western Desert. A total of 235,000 feddan were allocated to be reclaimed by the private sector.

The New Valley Development Authority (NVDA) of the Ministry of Housing, New Communities and Public Utilities (MHNCPU) is responsible for the planning and construction of drinking water facilities, but design and construction of drinking water wells in Western Desert settlements is carried out by the Research Institute for Groundwater (RIGW) of the NWRC financed by NVDA. MWRI is responsible for operation and maintenance of wells, well pumps, and the main irrigation and drainage networks and for replacement of wells in the old reclaimed areas tenured to graduates and small farmers (5-7 feddan).

Policies for managing free-flowing groundwater in reclaimed areas were developed in 1999 and comprise the following elements:

- Free-flowing well discharge will be adjusted monthly to match crop irrigation requirements within the command area of each particular well, with the maximum discharge not exceeding the well's design future pumping rate.
- Nighttime well flow will be stored on the land surface, either in the existing canals or new storage facilities, and daytime well flow will be controlled.
- MWRI will establish a program of continuous groundwater monitoring for all wells (private and public).
- Operating criteria will be defined for transition from free-flowing to pumped conditions of the wells.
- MWRI will continue the program for establishment of water user organizations in accordance with Law 213.
- No growth of unofficial irrigation will be allowed.
- A working group with members from MWRI, MALR, and MHNCPU, chaired by the representatives of MWRI, will be established to provide continuing review of issues/conditions and policies for managing the groundwater resources in the Western Desert.

Implementation of these policies is projected to lengthen the time period for economic pumping and use of deep groundwater to 100 years, though there is apparently no specific set of development plans to deal with the gradual loss of economically viable irrigation supplies in the oasis areas.

3 Principal Water Management Challenges

3.1 Managing Water Supplies

3.1.1 Threat of Water Shortage

A looming water shortage represents perhaps the greatest medium-term water management challenge currently facing the country. Agricultural water demand is projected to remain roughly steady in the Nile Delta and to expand in the new lands even as municipal, industrial and other uses continue to increase. The ambitious plans for North Sinai and Southern Egypt will extract up to 10 BCM of Nile Basin water. This represents almost 20 percent of Egypt's internationally negotiated share of the annual storage releases from Lake Nasser. None of this water will return to the Nile Basin for reuse (though there may be some limited reuse of drainage water within the mega-projects). The International Water Management Institute (IWMI) has classified all countries based on the degree of their likely water scarcity in 2025, and Egypt was placed in the group of countries likely to experience *absolute* water scarcity (Seckler, et al., 1998).

To grasp the impact of shifting demands on the Nile's water resources, Table 2 presents water budgets estimated for 2000 and 2017, using pessimistic and optimistic assumptions (Allam, 2001). Both sets of assumptions include implementation of the entire 1997 3.4 million feddan horizontal expansion plan. Assumptions are:

Source	***Pessimistic***	***Optimistic***
Joungli Canal	Not completed	Completion of Phase 2
Rainfall used in agriculture	No change	Increase via water harvesting
Desalinization	No change	Develop 0.5 BCM capacity
Irrigation efficiency	No change	Major improvements
Urban and industrial use	High population growth	Low population growth
System evaporation losses	No change	Reduction of 1 BCM

Major plans for increasing irrigation efficiency in Nile-fed agriculture include:

- Restriction of rice and sugar cane cultivation to a limited area
- Conversion of irrigation in new lands, orchards and vegetable fields to modern systems (drip & sprinkler)
- Improvement of surface irrigation in old lands
- Encouragement of night irrigation and land leveling
- Recycling of drainage water, treated sewage and industrial effluent.
- Change of cropping patterns and planting and harvesting dates of crops
- Introduction of short age varieties of crops.

Table 2. Water Balance Scenarios for 2000 and 2017 with Alternative Assumptions

Water Sources and Uses	Year 2000 Estimate (BCM)	Year 2017 Pessimistic Assumptions (BCM)	Year 2017 Optimistic Assumptions (BCM)
Nile Water Sources:			
- Nile Allocation	55.50	55.50	55.50
- Joungli Canal	0.00	0.00	2.00
- Utilized rainfall[1]	0.50	0.50	1.00
- Desalinization[1]	0.00	0.00	0.50
TOTAL SOURCES	**56.00**	**56.00**	**59.00**
Nile Consumptive Uses:			
- Nile Valley and Delta Agriculture[1]	(38.00)	(38.00)	(34.00)
- North Sinai Project[1]	0	(4.20)	(4.20)
- Toshka Project, Phase 1[2]	0	(4.50)	(4.50)
- Urban & Industrial Sector[1]	(1.75)	(4.50)	(4.00)
- Evaporation losses[1]	(3.00)	(3.00)	(2.00)
TOTAL CONSUMPTION	**(42.75)**	**(54.20)**	**(48.70)**
Net Flow to N. Lakes and Sea	**13.25**	**1.80**	**10.30**
Flow needed to maintain Northern Lakes[1]	(8.00)	(8.00)	(8.00)
SURPLUS OR (DEFICIT)	**5.25**	**(6.20)**	**2.30**

Sources: [1] Allam (2001); [2] MWRI/NWRC (1998).

Aggressive expansion of irrigated lands will reduce the allowable margin of error for allocating water throughout the Nile irrigation system. Many of the improvements mentioned above need to occur to have sufficient water to serve existing users as well as planned new uses. If not, the table above shows that there will be less than 2 BCM of base and return flow reaching the Northern Lakes and sea. If all planned water savings and increased efficiencies are realized, then the water balance table shows a 2.3 BCM surplus of water over the 8 BCM assumed to be needed to maintain northern lakes and coastal ecology and to keep sea water intrusion in check.

There also are risks to the long-term supply of water from storage in Lake Nasser. From 1998 up to the present, Egypt has enjoyed a supplemental allocation of HAD water releases due to a wetter than average climatic pattern (see Table 3 below, and the trend continues). However, the estimates given above assume that a more typical climate will be realized, resulting in a release to Egypt from HAD storage equal to the agreed 55.5

BCM annually. Prolonged drought could reduce Nile Basin rainfall to be utilized and also increase evapotranspiration losses. Therefore, Egypt could experience moderate to severe shortages of water under conditions of prolonged drought within the next few years even if the most optimistic water balance scenario described above comes to pass. Base flows to the Northern Lakes would be inadequate in quantity and quality to maintain the coastal ecosystem's balance and keep sea water intrusion into coastal groundwater within acceptable bounds. Acute irrigation water shortages also could be expected for farms at the tail end of irrigation canals.

Table 3. Annual Releases from Lake Nasser, 1990-2000 (in million cubic meters)

Year/ Month	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00
Total	53,795	54,245	55,295	55,465	55,500	55,500	55,970	55,500	71,435	67,060

Source: MWRI, Irrigation Department Data (2001).

3.1.2 Service Delivery Problems in Municipal Water Supply Systems

Despite rapid population growth, the percentage of the population with access to municipal water supply has increased substantially over the past two decades. An estimated 95 percent of households in urban areas and almost 70 percent of households in rural areas now have access to piped water (Table 4). This remarkable extension of the municipal water and wastewater system, however, has not been accompanied by adequate attention to maintenance—resulting in very high seepage losses of 40-50 percent. These losses have, in turn, caused a rise in the groundwater table, creating considerable environmental problems (described in subsequent sections of this report).

A recent review of the municipal water supply sector identified three primary causes of piped water service deficiencies (Hoehn and Krieger, 1996):

- inadequate water treatment capacity and deteriorating treatment plants;
- inadequate storage capacity; and
- deteriorating transmission and distribution networks that cannot withstand the pressures needed to provide reliable water service without rupturing.

High system losses increase the strain on an already overburdened wastewater collection system and are a waste of costly treated water. Leaks also allow contamination of the water delivered, defeating much of the purpose of providing treated supplies.

Municipal water and wastewater services are heavily subsidized by the government. Estimates are given in Table 4 of delivery cost, level of subsidy, and revenue raised. In the municipal areas outside of Greater Cairo and Alexandria, the subsidy level is almost 75 percent. Low recovery of costs from consumers reduces revenues generated that water and wastewater agencies can use to repair leaks and improve service.

Table 4. Municipal Potable Water Systems in Egypt, Rates and Customer Base

System	NOPWASD[1] (Municipalities)	GOGCWS[2] (CAIRO)	AWGA[3] (ALEXANDRIA)
L.E. per m^3			
Estimated Capital, O & M costs	1.0	1.1	NA
Subsidy	0.8	0.9	NA
Average User Fee[5] (tariff)	0.2	0.2	0.3
Rate: piastre per cubic meter [4, 5]	15–25	15–25	25–35
% Of Customer Base			
Distribution of Customers Base			
% Served by House Connections[5]	**Urban 92** Rural 70	95	96
% Multi–Unit Meters	**Urban 55** Rural 30	50	48
% Single–Unit Meters	**Urban 20** Rural 10	33	40
% Not connected legally or connected but meters are not working [5, 6]	**Urban 18** Rural 30	12	8
% Served by Stand posts / donated	**Urban 2** Rural 14	1	1
% Unserved [7]	**Urban 6** Rural 16	4	3

Sources:

NOPWASD, 1991. Water Supply and Sanitation Sector Study for Egypt.
NOPWASD, 2000. Cost of Producing Potable Water.
Personal Communication from Eng. Magda Gadalla of NOPWASD.
Personal Communication from Dr. Adel Ramadan of GOGCWS.
Personal Communication from Dr. Hanaa Aref of AWGA.
World Bank, 1999. Rural Water Supply and Sanitation in Egypt: Issues and Options.

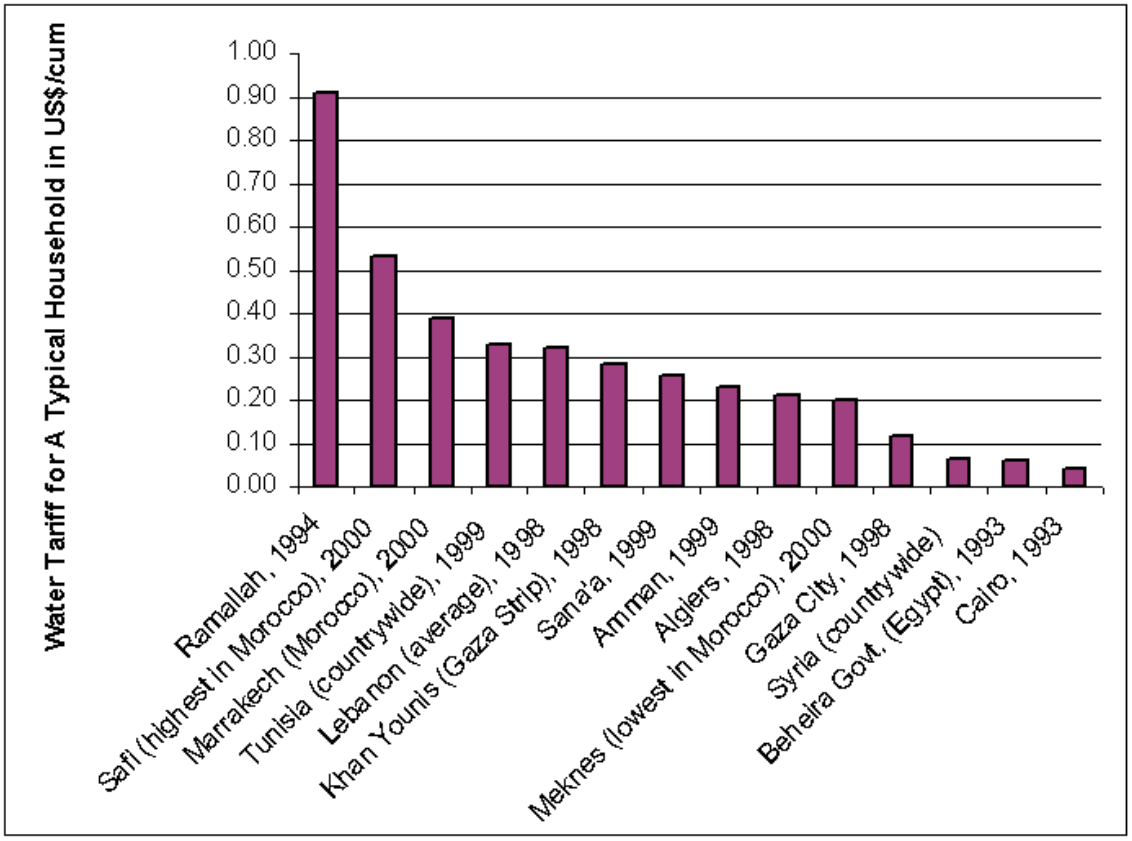
Notes:

1. National Organization for Potable Water and Sanitary Drainage.
2. General Organization for Greater Cairo Water Supply.
3. Alexandria Water General Authority.
4. Wastewater tariff is 20% of water tariff for Cairo and 35% for Alexandria.
5. These are applicable to the residential units, which have water meters. Those who do not have meters, or their meters are not working, pay a fixed monthly charge for water consumption (L.E. 5–20 monthly/unit). The charge changes with house area.
6. No service charge for meters' maintenance if meters are not working, it is difficult to repair. In Alexandria there is monthly maintenance charge for meters (a lump sum of 50 piastre). The life span of a meter is 7 years and costs L.E. 300 for ½ inch pipe. In most cases when meter is not working, the client pays an estimated fixed charge.
7. Unserved people extract either polluted groundwater or surface water from the Nile, canals or drains.

Some of the problems with weak revenue generation and collection stem from deficiencies in the metering of water use. There are three types of problems: some users have no meters; others have faulty meters, which forces the use of flat rate charges for water service; and multi-unit meters are in wide use, which reduce the economic incentive for individual units served by the meter to conserve water.

As noted, even where metering does exist, tariff rates remain low. For comparative purposes, municipal water tariffs in Europe and in the United States are in the range of US$ 1 to 5 per cubic meter—higher than anywhere in the Middle East and North Africa. But even within this region, Egyptian municipal rates are the *lowest*, as shown in Figure 2. Though the rates given are for 1993, they remain less than $0.10 per cubic meter.

Figure 2. Water Tariffs in the Middle East and North Africa



Source: World Bank, March 2001.

The public municipal water and wastewater agencies are caught in a vicious cycle of low tariffs and poor service. Revenues generated are insufficient to adequately maintain the existing water system—let alone provide for improvements or reconstruction. There is good evidence that many people are willing to pay much more than they do now for reliable service. For example, research by Hoehn and Krieger (1996) found that many Cairo households respond to unreliable service by investing in water-improving technologies such as storage tanks and electrical pressure boosting pumps. They pay L.E.

3-5 per week for such measures, representing between 1.5 and 2.4 percent of average household monthly income. This indicates both a willingness and ability to pay higher municipal water tariffs provided they are accompanied by good service.

3.1.3 Irrigation Service Delivery Challenges

Despite an abundant supply of water released from the HAD, feedback from farmers indicates that water is not being distributed efficiently. A 1998 survey sponsored by USAID (Greencom/APRP; El-Zanaty and Associates) asked farmers about water resources practices and attitudes. A similar USAID-sponsored survey was recently conducted by EPIQ/WPRP, for which preliminary data is available.

A comparison of selected findings from the two surveys shows a significant drop in the proportion of farmers whose main concern is mistimed arrival of water to their fields (see Table 5 below). However, the proportion of farmers concerned about the availability of clean water has increased three-to-four-fold among both men and women, and men also are increasingly concerned about salinity and the cost of irrigation.

According to the 1998 survey, water shortages are a function of season and location on the *mesqa*. Farmers report a shortage of water more frequently in summer than in winter (85% versus 42%) and at the end of *mesqas* rather than the beginning (46% versus 35%). However, they indicate that significant shortages still occur in the winter and at the beginning of *mesqas*.

Additional evidence of shortages occurring is found in the investments made in wells for groundwater use and pumping from drains that farmers have made in some areas. Wells are expensive, and pumping either groundwater or drain water incurs significant energy costs. Yields also may be reduced from poorer quality water. In all, 7 percent of farmers reported irrigating from well pumps in the 1998 survey.

The reason for irrigation shortages does not appear to be inadequate water availability at the higher system levels. The cause more likely can be attributed to the deteriorating conditions throughout the entire irrigation delivery system, as discussed below.

Table 5. Comparison of Farmer Attitudes about Water, 1998 and 2001

Questions	**Men**		**Women**	
	1998	**2001**	1998	**2001**
Greatest concern for the future:				
Water doesn't arrive	76.4	**57.7**	64.9	**54.5**
Availability of enough clean water	15.5	**43.3**	11.7	**41.9**
Salinity	3.1	**9.0**	4.3	**3.9**
Cost of irrigation water	1.9	**10.9**	1.6	**8.6**

Source: El-Zanaty and Associates (1998); Preliminary data from EPIQ/WPRP Survey (2002).

3.1.4 Insufficient Irrigation System Upkeep

It always seems easier to raise funds and to gain political support for the construction of new infrastructure than to operate, maintain, monitor and improve existing infrastructure. When you factor this in with the generally revenue-starved condition of the Egyptian Government, it is easy to understand how the main elements of the Nile irrigation system could fall into disrepair. Some of the signs of system neglect are:

- *Existing canal cross sections exceed the original design by an average of 25 percent.* This is due to over excavation during mechanical cleaning, erosion, and misuse of canal banks that contributes to changes in water levels and canal discharges.
- *Seepage losses from the irrigation system vary from one area to the other.* Average conveyance losses between the irrigation outlets to the field are estimated at 10% while between the main canal and irrigation outlets are about 25%. Canal lining in some areas has been proven to be feasible.
- *Aquatic weeds are a major concern for efficient water management.* In 1990, an estimated 13,000 km of canals and drains were infested by submerged aquatic weeds, and another 1,900 km were covered by water hyacinths. Water losses by transpiration are immense.
- *The recording and transmission of data such as water levels and discharges still depend on old methods.* Gradual improvement of the old system is taking place. Both automatic recording gauging stations and telemetric systems now exist in some locations.
- *In the absence of adequate maintenance of the physical infrastructure of water delivery, neglected systems deteriorate.* Needless to say, deteriorated systems are unable to meet water delivery schedules.
- *Water quality has a direct effect on the quantity available for specific uses.* As the quality of water diminishes, its scope of use narrows, thereby reducing supplies and intensifying shortages, resulting in increased competition.

3.1.5 High On-farm Water Use

The Nile irrigation system was designed to deliver water below the grade of farmers' fields, requiring the farmer to lift water from the *mesqa* to the field. Water is delivered on a rotational basis, adjusting water levels in the branch canals to get water into the *mesqas*. The typical type of irrigation practiced by farmers in the old areas is flood irrigation, which requires a relatively high rate of water application, though the cost of pumping provides some incentive against extravagant water use.

High on-farm water use leads to high water tables, waterlogging and increased soil. Reduced irrigation would lessen but not solve these problems in the slowly draining soils of the Nile Delta and upstream depressions. Year-round irrigation is the primary culprit for these problems, as there is not sufficient time for the soils to drain and dry out. Thus a drainage system is needed even if farmers become more efficient in water use.

The Irrigation Improvement Program, discussed in the previous section, changes the method of delivery to gravity flow with raised *mesqas* or pressurized pipes, which shifts the cost of lifting from the individual farmer to the water user association that is responsible for equitably distributing the water. In a properly operated "improved" system, irrigation costs per feddan are about half of what they were before the IIP investments (APRP Water Policy Reform, Report # 7). Costs are shared among farmers by area served, so that a farmer only recognizes a fraction of the cost each time he irrigates. Under the new system, farm demand can be limited by rules set by the WUA.

IIP-sponsored investments have been shown to be cost effective (Allam, 2001). Benefit-cost ratios have ranged from 1.3 to 1.9, depending on the area and the type of raised *mesqa*. The higher cost of underground pressurized PVC pipelines in some areas have resulted in lower ratios, ranging from 0.9 to 1.5. However, a more recent study (APRP Water Policy Reform, Report # 7) was not able to draw strong conclusions on cost effectiveness due to incomplete implementation of IIP in the areas studied. The drawbacks to IIP are its high initial costs, slow rate of implementation, and the long period allowed for repayment (resulting in less than full cost recovery).

When water is short, it is extremely difficult to provide a more efficient or equitable distribution of water along the *mesqa* in Egypt's below grade system of delivery. Shortages occur even more frequently when the canals are poorly maintained. WUAs at either the *mesqa* or branch canal levels may be able to provide a more equitable allocation if they are empowered to do so.

3.1.6 Inadequate Farmer Contributions to Irrigation System Upkeep

Prior to the socialist period in Egypt's political history and construction of the High Aswan Dam, farmers were heavily involved in the management of irrigation and flood control systems. The HAD was constructed and an extensive system of canals and drains was developed to provide water for irrigation the year around. Later, responsibility for operating and maintaining the system of canals and drains was taken over by the central government, and farmers were only responsible for maintaining the *mesqas*.

While farmers have never paid directly for irrigation water service, they previously were heavily taxed on their output. Prior to agriculture sector liberalization, which began in 1986, farmers were forced to grow government-mandated crops and to sell them at prices well below the world price. While most inputs (fuel, fertilizer, seed, water) were subsidized, the revenue from output "taxes" easily exceeded the cost of subsidies. Thus farmers were making a large contribution to the government's ability to maintain the irrigation system. Further, government policy during these times was to shift a portion of the net resources generated out of the agriculture sector to finance industrialization.

The policy shift toward a market-based economy that started in the mid-1980's has fundamentally altered this situation. Farm prices and incomes per feddan have risen dramatically. While liberalization has yet to be completed, government taxation of farmers is now far less than the cost of remaining subsidies. Controls on crops largely have been eliminated, and the tax burden is light. Remaining market distortions are in the form of government-guaranteed floor prices (rice and wheat have such arrangements).

Substantial subsidies on farming inputs also continue. First and foremost, there is no service charge on the delivery of irrigation water. There also remain fuel subsidies (of about 50%) and fertilizer subsidies (on the order of 30%). In addition, farmers are provided with highly subsidized irrigation and drainage system improvements as described above.

Egyptian farmers are only lightly taxed, with the agricultural land tax at almost a negligible level (Annex B). Yet this tax is expensive to administer, with collection costs representing about half of the revenues generated. There have been repeated recommendations in recent years to either eliminate the tax or to increase it to make it more efficient.

Egyptian agriculture policy, therefore, has moved from a long history of heavy effective taxation of the sector to significant subsidization over the past two decades. Farm incomes per unit of land have increased substantially, yet it remains politically difficult to remove remaining subsidies, including the introduction of charges for the delivery of irrigation water.

Agriculture in the old lands is characterized by very small, highly fragmented parcels. Average farm size in the old lands is about 1 feddan, and it has been falling as land passes to succeeding generations. High birth rates and a shortage of non-agricultural employment alternatives contribute to this trend. Use of traditional farming practices at this size with no off-farm income can barely support a family; hence most farmers in Egypt remain poor. This helps to explain the political reluctance to impose new financial burdens on farmers.

At present, rather than introduce water service charges, the Government of Egypt is attempting to reduce its costs by transferring more responsibilities to the farmers themselves. Experience now is being gained in projects that establish water user associations at the branch canal level for purposes of transferring management authority. Successful irrigation management transfer models of large, decentralized irrigation systems that exist in the United States, Mexico, and Turkey among other places are being emulated.

In the same farm surveys reported above, attitudinal data show an increase in farmers' willingness to share in the cost of upgrading irrigation and drainage systems as shown in Table 6, though willingness to cost share is higher among men than women. A slight decline was registered in the proportion of farmers willing to join a WUA, but the proportions remain high among men.

Table 6. Comparison of Farmer Attitudes about Cost Sharing, 1998 and 2001

Questions	**Men**		**Women**	
	1998	**2001**	1998	**2001**
Willing to share in costs of:				
Upgrading irrigation system?	76.4	**85.0**	50.0	**67.7**
Upgrading drainage system?	72.7	**82.7**	47.3	**65.9**
Would join if a WUA was formed nearby?	77.7	**74.7**	36.7	**24.0**

Source: El-Zanaty and Associates (1998); preliminary data from EPIQ/WPRP survey.

The alternative to irrigation management transfer is to attempt to raise revenue directly from farmers. While there have been many proposals made in the past concerning the introduction of area-based water charges, these have not been implemented. The major reason is the widespread concern that smallholder and resource-limited farmers could not afford to make such payments (though there is little hard evidence to test the validity of this assertion). Average farm size nationwide is an estimated to be 2.2 feddan, which means that many farm families have less than one feddan to cultivate. Collection cost is another issue, since parcels in old lands are not only small but also are highly fragmented (a farm family with only 1 or 2 feddan of land may manage this land in three or more separate parcels). This can lead to high collection costs (as experienced by the agricultural land tax).

3.1.7 Weak Attention to In-stream Flows

It often is forgotten that maintaining the base ("in-stream") flow of the Nile River and minimum flows of irrigation and drainage canals has a value of its own (and should be considered a "use or user" in its own right). In-stream flows primarily affect the Northern Lakes and coastal ecosystem as well as fishing and navigation on the Nile. As irrigation delivery efficiency improves, the salinity of drain water comprising a large proportion of these base flows will increase. The diversion of water for horizontal expansion plans means less water will be available for discharge to the river and lakes. Finally, drainage water is becoming increasingly polluted with sewage and industrial wastewater. The latter concern will hopefully decrease over time as the government expands its efforts to improve water quality. But the quality and quantity of water to support the Northern Lakes will decline as land reclamation projects are implemented.

An inadequate allocation of fresh water for the Northern lakes may occur in the future. About 50 percent of the national fish catch comes from the Northern Lakes and the fish farms around these lakes (Allam, 2001). Estimates by Imam and Ibrahim (1996) place the base flow needed to sustain environmental conditions conducive to a healthy fishery to be 8 BCM of drainage water with reasonable quality per year flowing to the sea via the Lakes.

Navigation depends on the volume of water in the river and the depths along the navigation course in addition to the operation of locks on the river and canals. The volume of boat traffic using the river is over 1400 transport units and nearly 600 steam launches. Nile tourism activities also have expanded, and there now are 310 tourist ships and floating hotels (Allam, 2001). Generally, releases from Lake Nasser and drainage discharges have been sufficient to enable navigation, but there has been recent experience with insufficient flows.

3.1.8 Non-renewable Groundwater Management in the Western Desert

The oases of Egypt's Western Desert are completely dependent upon deep and non-renewable groundwater supplies for their survival. There are three major problems concerning these supplies: uncontrolled free-flowing wells; how to effectively control groundwater extraction over the long-term; and insufficient cost-sharing by farmers.

Because of problems with collapsing wells due to high back pressures during rapid valve closure, free-flowing wells can not be shut off even though irrigation does not occur at night. The result is a high degree of water wastage, water logging and soil salinization in these arid regions. MWRI's policy is to control well output where it can, and for those wells that cannot be controlled, nighttime flows are to be stored in the canals or in new storage facilities. This policy negatively affects farmers that irrigate from ponds that have been created by the excess flows.

Over time, exploitation of the deep groundwater resources decreases artesian pressures. For most wells, water is initially free-flowing but increased abstraction eventually results in the need for pumping. Evidence of falling pressures can be seen in records showing that the average daily discharge of free-flowing deep wells has decreased from 3,600 m^3 in 1960 to 1,400 m^3 in 1999. As the level of groundwater drops, pumping costs increase. Eventually it will no longer be economical to pump water for agricultural use.

The policy used to control groundwater extraction is to issue permits both for existing and new wells. Extraction of groundwater in 1997 was an estimated 0.7 BCM per year. The present estimate of the maximum economic extraction rate is 2.4 BCM, which would be more than a three-fold increase from the current level. Most of the additional water use would come from East Oweinat, which is outside of the New Valley. Within the New Valley, an annual extraction rate of 0.6 BCM in 1997 compares with the estimated available economic rate of 1.0 BCM.

Estimates of optimal use of deep aquifers will likely change over time as better information and models are developed. At some point in the future, the four countries that overlie the aquifer—Egypt, Sudan, Libya and Chad—also may reach an agreement that defines Egypt's share of the Nubian Aquifer. Whatever the optimal rate of withdrawal, enforcement of laws related to water has been weak throughout Egypt and may indicate that rules will be poorly enforced here as well. This raises doubts as to whether private well development and use can be effectively controlled by a permitting process.

Cost sharing is another issue that will need to be addressed. Presently the operation and maintenance of wells, pumps and main canals is solely the responsibility of government. MWRI is promoting the formation of associations of groundwater users to improve irrigation water delivery in accordance with Law 213. The first three Water User Unions were formed in the West Qasr El-Farafra area in 1999. A November 1998 survey conducted in El-Farafra Oasis found support for granting user associations responsibility

for scheduling and distribution of well water and other functions. However, nearly all respondents wanted the government to continue its role in operation and maintenance and replacement of wells and pumps. Reducing operating subsidies will not be popular, but the cost will only grow as the pumping requirements expand over time.

3.1.9 Subsidies Affecting Water Quantity

A number of subsidies affecting water supply already have been mentioned. For example, energy is heavily subsidized in Egypt. In the urban water sector, pumping is a major component of the cost of delivery. The present subsidy of urban water delivery costs would be even higher if energy prices were not subsidized. In the agricultural sector, increasing mechanization has led to greater consumption of diesel fuel, particularly for the operation of tractors and irrigation pumps. Diesel fuel is sold for about half of the world price. The subsidy amounts to 14 to 60 percent of net income across various crops, and its removal probably would increase net irrigation water use efficiency (see Annex B). Pumping is also a large expense for MWRI in Middle and Upper Egypt, where water must be lifted from the Nile or Lake Nasser to supply the adjacent agricultural lands. Reducing the subsidy on energy would provide an incentive for urban water supply agencies, farmers, and MWRI to conserve on energy use and hence increase the efficiency in which water is conveyed and consumed.

3.1.10 Rainfall Capture and Flash Flood Protection

Autumn and spring rainfall in Northern Egypt and Sinai causes flash flooding. Up to now, the preparation for and response to such events has been entirely a government responsibility. Rainfall harvesting schemes have been started in the *wadis* of desert areas and could be expanded. Studies have indicated that enhanced rainfall harvesting could have a significant impact on water supply on a localized level.

3.1.11 Negative Consequences of Rising Water Tables

Year-round irrigation, high on-farm water use, canal leakage, and high urban water system losses have caused ground water tables to rise in recent years. In some areas, the foundations of buildings and antiquities are being damaged.

The expansion of irrigated agriculture, especially on the fringes of the Nile Valley and the Delta, and the construction of the High Aswan Dam have raised water tables significantly. High water tables allow salts to migrate to the surface where they damage and eventually destroy limestone. Whether this is termed a water quantity problem (from excessive use leading to high water tables) or a water quality problem (because of the salt content), the damage to structures—including irreplaceable antiquities—is severe and sadly disappointing in some areas. For example, at the Luxor Temple, several of the Sphinxes are disintegrating into powder, and nearly all are crusted in white near their base.

3.1.12 Institutional Constraints to Water Quantity Management

There are numerous laws and rules prohibiting certain water use and abuse activities. Yet enforcement remains weak. This is a principal institutional constraint to improved water management. For example, according to government regulations farmers are not allowed to grow rice outside designated areas. Yet thousands of feddans of rice are illegally grown with penalties rarely being assessed. Another example is the payment of electricity bills by farmers. In one area in the Delta using pressurized pipes, farmers at the tail end of the system refused to pay their share of the WUA's electric bill, since they weren't getting a fair share of water. The whole WUA followed suit, and did not resume payments until the pumps were upgraded. Enforcement of rules imposed on farmers is a problem in most countries, and Egypt is no exception.

Other institutional constraints relate to the need for retooling of skills in key water management agencies—especially to reflect a better balance between engineering and socio-economics. Past attention of MWRI and other agencies involved with water management has centered on organizing the physical aspects of the water delivery system. Water professionals in Egypt now recognize that their strong engineering skills will not be sufficient to deal with the emerging next generation of water management challenges that are the subject of this report—requiring much greater attention to social, economic and environmental dimensions of water management. The section which follows centers on one of these aspects, namely, growing concerns over pollution and water quality management in the country.

3.2 Water Quality Management Challenges

3.2.1 Overview

Water quality problems in Egypt vary with location and depend on factors such as: water flow rates; water uses; population densities; sanitation systems; industrial discharges; demands for navigation; and agricultural runoff.

There is increasing concern about the rising costs of environmental degradation to the country—including water misallocation and declining water quality. Table 7 presents some preliminary figures associated with a range of environmental problems. The point of presenting this data here is not to focus on the specific values, but rather to give a good indication of the potential magnitude of social costs associated with environmental degradation and the importance of attention to reducing these pressures on the economy.

Table 7. Costs of Environmental Degradation in Egypt

Sector	Economic Loss LE Billions	Percent of GDP
Air		
Morbidity and mortality	8.4	2.3
Aesthetics (including tourism)	2.9	0.8
Water		
Water pollution	4.6	1.3
Water allocation inefficiencies	18.0	4.9
Water system losses	2.6	0.7
Land		
Productivity losses	5.8	1.6
Urban encroachment	4.0	1.1
Waste		
Solid waste	2.2	0.6
Hazardous waste	0.1	0.0
Amenity and tourism impacts	1.3	0.3
Biodiversity losses	2.4	0.7

Source: Pillet, Gonzague, 2001. Cost Assessment of Environmental Degradation in the Mashreq and Maghreb Countries: Egypt Case Study, World Bank.

It is useful to review the principal water quality patterns in the main waters of Egypt as a backdrop to the discussion of problems and possible solutions. This brief survey begins upstream with Lake Nasser and concludes with the situation in the Nile Delta and along the Mediterranean coast including the Northern Lakes.

3.2.2 Lake Nasser Pollution

The most important "pollution" problem facing Lake Nasser is sediment deposition. When the high dam was constructed, the expectation was that the lake would have a useful life of at least 250 years. However more recent calculations predict the lake will fill with sediment within approximately 100 years (USAID-IRG, Nile Basin Initiative ETOCA Study, 2000). Sediment dredging may be required before the end of the 21st Century to maintain irrigation and hydropower capacities of the high dam. In fact, there are already discussions within the Government of Egypt to deal with this issue and develop markets for any dredged material.

The Nile River water quality monitoring program within the National Water Quality and Availability Management Project (NAWQAM) collects samples at four locations in the lake within the territory of Egypt during the summer and winter seasons. In addition, the Nile Research Institute and the High Aswan Dam Authority collect water samples twice a year in both the Egyptian and Sudanese portions of the Lake. All samples show good

water quality that meets the water quality standards of Law 48, but growing human settlements on the shores of the lake may threaten water quality in the future.

3.2.3 Nile River Water Quality from Aswan to Cairo

Between Aswan and Cairo, water quality meets standards in several locations, but there also are areas where polluters are failing to meet established discharge standards. NAWQAM monitors ambient river water quality at several locations along the river. Ambient water quality generally meets standards (set in Decree 8/1983), but there also are areas where pollution levels are higher than the established norms. These polluted stretches of the river are primarily associated with industrial discharges. Some 34 large industrial facilities discharge into the Nile between Aswan and Cairo. All of these facilities now have installed effluent treatment facilities. However, as of February 2000, ten of these facilities still were not in compliance with some of the effluent concentration discharge standards set in Law 48 (see Table 8).

A comparison of ambient water quality data collected for this part of the Nile under different monitoring programs in 1977, 1986 and 1991 suggested that water quality had deteriorated slightly but remained satisfactory for most uses. NAWQAM data for the late 1990s are not strictly comparable, so it is impossible to say much about recent trends. With respect to individual water quality parameters, effluents from sugar factories, pulp and paper and other industries contribute to the BOD load, but water quality remains within the standards of Decree 8/1983, which is 6 mg of O_2/l. High loads of COD originate at a bottling plant, onion drying factories, and sugar mills, but water quality remains within the standard for this parameter (10 mg O_2/l). Suspended solids demonstrate a slow but steady increase from Aswan to the Delta Barrage (Cairo). Dissolved oxygen does not decline below the standard of 5 mg/l all of the way to Cairo. Oil and grease is a growing problem, which is caused by the heavy use of the Nile as a waterway, and standards are exceeded for this parameter. Heavy metals are present in trace quantities but remain within the standards. At the Delta Barrage water has an average salinity of about 255 ppm.

Table 8. Discharges of Nile River Industries Out of Compliance with Law 48

	Law 48 Limits & Recorded Discharge Levels (exceeded standards in bold)								
Source of Pollution	**PH (6 – 9)**	**BOD 30 mg/l**	**COD 40 mg/l**	**TDS 1200 mg/l**	**TSS 30 mg/l**	**Oil & Grease 5 mg/l**	**Nitrate 30 mg/l**	**Inorgan Phosp 1 mg/l**	**Fe 1 mg/l**
Kima Factory (Aswan)	**9.4**	4	**55**	**1920**	15	**6.4**	**450**	0.20	0.11
Kom Imbou Sugar Factory	5.7	**83**	**657**	410	**67**	**9.3**	2.1	0.06	0.85
Idfou-1 Sugar Factory	**9.3**	**410**	**1440**	365	**65**	**5.6**	2.2	0.04	0.23
Idfou-2									

	Law 48 Limits & Recorded Discharge Levels (exceeded standards in bold)								
Source of Pollution	**PH (6 – 9)**	**BOD 30 mg/l**	**COD 40 mg/l**	**TDS 1200 mg/l**	**TSS 30 mg/l**	**Oil & Grease 5 mg/l**	**Nitrate 30 mg/l**	**Inorgan Phosp 1 mg/l**	**Fe 1 mg/l**
Sugar Factory	5.2	**81**	**600**	225	**42**	**5.6**	1.3	0.04	0.74
Qous Sugar Factory	7.5	**77**	**189**	240	22	--	1.0	0.15	0.40
Sohag Oil Factory	7.6	8.5	33	**1374**	**145**	**7.3**	3.5	0.04	0.39
Coca Cola Bottling Factory	**11.3**	**83**	**256**	737	**39**	**5.9**	3.5	0.14	0.27
Elhwamdia Sugar Factory	1.1	**440**	**3850**	**8192**	**60**	**17.6**	10	**7.50**	--
Salt and Soda Factory	--	**130**	**155**	--	**387**	**9.4**	--	--	--
Talkha Fertilizer Factory	**10.2**	**98**	**204**	**1350**	**67**	**7.6**	**128**	--	--

Notes: Data as of February 2000; dash (--) indicates information not available.
Source: Ministry of Water Resources & Irrigation. March 2001, "A Memorandum to be presented to the Ministerial Committee for River Nile Protection from the Pollution of Canals, Drains and Groundwater" (in Arabic).

3.2.4 Water Pollution in the Delta from Cairo to the Sea

Irrigation canals in the Nile Delta region are becoming increasingly polluted, particularly those that pass through villages, towns and residential areas. Because of a lack of alternative disposal options, both solid and liquid wastes routinely are dumped into irrigation canals in violation of existing laws. As explained below, they are also receiving increasing volumes of polluted drainage canal water under official drainage water "reuse" programs meant to supplement irrigation supplies.

Untreated and partially treated municipal wastewater and industrial wastewater from the Giza area is discharged directly into the Muheet and Rahway Drains. Toxic chemicals are discharged by industry at Kafr El-Zayat Drain that takes the effluent down the Rosetta Branch to be discharged to the Sea above Alexandria. Many villages discharge raw or partly treated sewage into irrigation and drainage canals. The Damietta Branch receives nutrients (primarily in the form of ammonia) and organics from the Delta Company for Fertilizer and Chemical Industries (in Talkha) and saline agricultural drainage water in the vicinity of the Faraskour Dam. Raw sewage from Al-Kholei village also drains into the Damietta Branch. Water quality for the Damietta and Rosetta Branches deteriorates rapidly downstream of Cairo, and is especially acute during low flow conditions. At

about 120 km downstream from Delta Barrage, the Rosetta Branch receives polluted inflows from five drains (El Rahawy, Sabel, El-Tahreer, Zaweit El-Bahr and Tala).

The principal purpose of the agricultural drainage system is to maintain proper soil moisture levels in fields and to remove accumulated salts. In Upper Egypt, the drainage network discharges directly to main canals of the Nile Valley and to the Nile River. In the Nile Delta, the network collects irrigation drainage water and transfers salts (as well as sediments and other accumulated pollutants) from the soils of cultivated lands to the Northern Lakes in the coastal region and through Rosetta Branch Canal to the Mediterranean Sea.

Since the 1980s, efforts have been underway to extend available irrigation water supplies by mixing drainage water in the Delta with fresh water. When this policy was first conceived, the principal goal was to supplement irrigation canal waters with drainage water of low enough salinity levels to allow—through mixing—for better and additional irrigated lands. Salinity of drainage water upstream of the Delta is relatively low (below 1,000 ppm), but it increases in downstream drains to 2,000-5,000 ppm. Since uses of water for irrigation become quite limited at salinity levels exceeding 2,000 ppm, Delta drainage water must be "mixed" with "fresh" canal water before use.

In practice, many drains in the Delta region are used to collect not only irrigation and stormwater run-off but also industrial and municipal wastes, and this has seriously complicated implementation of the drainage water reuse policy. For example, in Shoubra El-Kheima, a heavy concentration of industry—including metal fabrication, food processing, textiles finishing, paper production and detergent and soap manufacturing—discharges large volumes of wastewater into agricultural drains. The water contains chemical and biological pollution that can seriously limit its reuse potential for agriculture.

The Drainage Research Institute has established 140 stations for monitoring agricultural drains. Monthly samples taken at these stations are analyzed for 32 elements such as salinity, BOD, COD, organics, heavy metals and DO. Levels of COD and BOD exceed national ambient water quality standards at every monitoring station, and there also is a deficiency of DO relative to these standards. Certain locations have been deemed so polluted as to pose hazards to public health. The consequence has been the closure of some drainage canal mixing stations or of water treatment plants with intakes on main canals receiving polluted drainage water. An extensive network of 25 mixing stations has been established in the Delta to transfer drainage water back into irrigation canals for reuse, but five reuse stations have had to be closed due to these excessive pollution levels (see Table 9). Several others are threatened with closure (MWRI, 2001).

Table 9. Mixing Stations for Drainage Water Reuse in Nile Delta and Fayoum

Pumping Station	Drain	Mixing Location	Annual Discharge (MCM)	Current Status
East Delta:				
Wadi	Qaliobia	East Wadi	200	Shut down
Bahr Elbaqar	Bahr Elbaqar	Elbateekh	20	Operating
Belad Elayed	Belad Elayed	East Wadi	150	Operating
Hanout	Hadous	Bahr Mouis	250	Operating
Geneina	Emoum Elbeheira	Elbahr Elsaghir	215	Operating
Saft	Saft Elbahry	Daffan	130	Operating
Elmahsama	Elmahsama	Ismailia	200	Shut down
Upper Elserw	Serw	Damietta Branch	275	Operating
Elsalam 1	Lower Serw	Elsalam	650	Operating
Elsalam 3	Hadous	Elsalam	1350	Operating
Middle Delta:				
Upper (1)	Number 1	Damietta Branch	60	Shut down
East Menoufia	Elqarenein	Abbasi Rayah	50	Operating
Mahalet Rouh	Mahalet Roh	Mit Yazid	90	Operating
Elhamoul	Gharbia Main	Bahr Tira	400	Operating
Elgharbia Drain	Gharbia Main	Bahr Tira	800	Operating
Elmahalla Elkobra	Omer Bey	Damietta Branch	100	Operating
Boteita	Gharbia Main	Elzawia	100	Shut down
West Delta:				
Elemoum	Elemoum	Nobaria	1000	Shut down
Itay Elbaroud	Itay Elbaroud	East Khandak	60	Operating
Idkou	Idkou	Mahmoudia	90	Operating
Dalangat	Dalangat	Elhager	235	Operating
West Khandak	West Khandak	Abou Deyab	60	Operating
Bostan	Bostan	Nobaria	55	Operating
Dalangat Extension	Dalangat Ext.	Nobaria	80	Operating
Mariout	Elemoum	Nobaria	60	Operating
Fayoum:				
Elbats	Elbats	Bahr Wahbi	80	Operating
Eltagen	Elwadi	Bahr Elnazla	100	Operating
Elgharak	Elgharak	Bahr Elnazla	45	Operating

Source: Ministry of Water Resources & Irrigation, March 2001.

Each year a total of about 5 BCM of drainage water is reused in the Delta, and another 4.7 BCM of agricultural drainage water returns to the Nile upstream of Cairo. Official reuse in the Delta is expected to rise to about 7 BCM over the near term and 9 BCM by 2017. In addition to threatened agricultural water supplies, unauthorized use of polluted drainage water to irrigate fields also constitutes a growing health concern. Farmers

illegally remove approximately 3-4 BCM of drainage water annually to apply to their fields. When contaminated with human waste and/or toxic and/or heavy metals, this poses troublesome health issues. It also adds to rising salinity and pollution levels in agricultural drainage water of the Delta, presenting one of the most important water management challenges facing the country.

As noted in the previous section, the government is now attempting to implement a new policy on "intermediate reuse" of drainage water that emphasizes the recycling of water upstream of significant pollution discharge points to reduce problems of cross-contamination and the accumulation of pollutants in drainage canal water that is used to supplement irrigation water.

3.2.5 Pollution of Lakes

The Northern Lakes are the eventual sink for most of the Nile's agricultural drainage, and they also receive untreated municipal and industrial waste from Cairo and Alexandria. Lake Manzala and Lake Mariout receive the majority of these wastes with resulting dramatic declines in their water quality in recent years. These lakes were reduced in size by approximately 75 percent during the 20th Century as part of an explicit program to increase agricultural land area. All of the Northern Lakes previously were important fisheries, however catch has decreased by 70-90 percent over the past twenty years—causing dislocations in the communities previously dependent upon these fisheries for their livelihoods and giving a good indication of the extent of the pollution problems. In sum, the water quality situation in the country's main lakes is as follows:

- Lake Mariout is highly polluted. It receives untreated municipal wastewater from Alexandria as well as industrial effluents from over 60 factories that discharge directly or indirectly to the lake. The Lake has high concentrations of heavy metals, fecal coliform and a high BOD. Mercury levels in fish have been recorded at over 1,000 ppm compared to a World Health Organization norm of 1 ppm (Cedare, 1998).

- Lake Manzala in the Eastern Delta near Port Said receives untreated municipal and industrial wastewater from Cairo through the Bahr El-Baqar drain and from other settlements in the Delta.

- Lake Qarun, the drainage sink of the Fayoum area, once served as a popular tourist destination, supported a fishery and was an important habitat for migratory waterfowl. Over the years, use of the lake as a depository for drainage water and largely-untreated municipal wastewater has had severe adverse effects on all of these former uses.

- Lake Bardawil (now called the Zaranik Protected Area) on the Sinai coast of the Mediterranean contains one of Egypt's two internationally-recognized wetland sites (under the Ramsar Convention). Lake Burullus is the other Ramsar site, and is located on the Mediterranean coast in the central portion of the delta where it receives industrial effluent principally through the Nashart Drain.

3.2.6 Groundwater Contamination

Groundwater in the Delta, largely a shallow underground aquifer fed by of the Nile river, receives pollution from a variety of sources. Excessive withdrawals, especially from coastal aquifers, increases groundwater salinity with negative long-term impacts on water use and soil pollution. Along the Mediterranean coast, high salinity levels occur from seawater intrusion when groundwater withdrawals exceed recharge capacity. In newly reclaimed areas of the Delta's fringes, shallow soils do little to protect the aquifer from pollution seeping from agricultural drains and irrigation canals. Groundwater salinity in reclaimed lands—such as El Busstan, North of Tahreer and El Salhyiah—is more than 1,500 ppm. Salinity levels along the coast are even higher. Industrial waste sometimes is discharged into unlined lagoons (as in 10th of Ramadan City) where it easily leaks into shallow aquifers. Bacterial contamination of groundwater from raw sewage also is common in many parts of the densely populated Delta. Nitrate concentrations in reclaimed areas range from 70-100 ppm, which poses additional health concerns.

In the Nubian Sandstone Aquifer formation of the Western Desert, iron concentrations are high at El Farafra Oasis, and the lower part of the reservoir has high salinity. Control of groundwater withdrawals at Siwa Oasis is necessary to protect groundwater quality as well as its availability.

3.3 Institutional and Policy Issues Affecting Water Quality Management

3.3.1 Institutional Constraints

A number of institutional limitations, budgetary constraints, and other factors limit current capacity to adequately address water quality concerns. For example, planning and development of water and wastewater plants has not been guided by a comprehensive assessment of Egypt's environmental protection needs. While a relatively large share of GDP has been invested in the construction of municipal wastewater plants, the impacts of these investments on the environment have been limited by their inefficiencies and other factors. Rural water supply and sanitation as well as industrial pollution control have received low policy attention. Charges for municipal water supply and wastewater service, while recently increased, cover only about one-third of operating and maintenance costs—suggesting that the financial viability of these systems is doubtful. Some recent interest in privatization has been directed at solving this problem—the theory being that rate increases and staffing reductions might allow for break-even or even profitable operations.

Law 4 directs EEAA to supervise and operate the national water quality monitoring network through an Environmental Information Center within EEAA. Law 48 appears to assign the same responsibility to MWRI, creating duplicative requirements for data collection, processing and analysis that require resolution. Within both EEAA and the MWRI, there is limited capacity to enforce water quality regulations. Government-owned enterprises, which are the main industrial polluters, often appear to receive special

treatment because they are difficult to fine or otherwise force into compliance with water pollution standards. Many of these enterprises also fail to pay what they should for water deliveries. The primary reason given is the fear of creating unemployment should they be closed or their production inhibited. The gradual privatization of some enterprises (notably cement) has improved the situation modestly, but privatization efforts are moving slowly.

Many wastewater treatment plants in the Delta (some of which are partly or wholly financed by external donors) are only partially completed, and others are finished but lack discharge permits from the Ministry of Health and/or MWRI. Finding financing to complete these plants is a high priority as is the permitting of those ready to operate—even if their discharges cannot meet present standards (even limited treatment will certainly be better than none).

In general, better coordination and communication is needed among Government of Egypt initiatives to improve water quality management. Some examples of concurrent efforts follow:

- The High Committee for the Nile, chaired by the Minister of MWRI and represented by MOI, MALR, MHP, MIMW, MHNCPU and MOSEA, is responsible for protecting the quality and quantity of the entire Nile system.
- The National Water Quality Conservation Unit (NWQCU), is the focal point on water quality information in Egypt and attempts to bridge between entities that generate data and users of information.
- The National Water Quality Conservation Program Advisory Committee was instituted to guide the program of the NWQCU and has representatives from EEAA, DRI, RIGW, NRC and other government agencies.
- The Central Directorate for Waterways Maintenance in the Irrigation Sector of MWRI, which has responsibility for issuing licenses (permits) for sources of municipal and industrial wastewater discharge under Law 48, supervises irrigation and drainage to prevent inappropriate activities by other parties and carries out the necessary legal follow-up actions.
- The Water Communication Unit attached to the MWRI has responsibilities for raising public awareness regarding water scarcity and the risks of polluted water resources.
- EEAA oversees implementation of requirements under Law 4 for the conduct of Environmental Impact Assessments of projects with the potential to cause significant adverse environmental impacts, including the operation of industrial and wastewater treatment plants.
- A new Water Quality Unit is being established under the Minister's Office in MWRI partly to address some of these coordination issues.

3.3.2 Budgetary Considerations

The Government's current Five Year Plan allocates L.E. 26 billion for environmental management, about half of which is for municipal water supply provision and wastewater

treatment. This amounts to approximately 1.2 percent of GDP each year, an amount that compares favorably with countries such as China, but is lower than the U.S. and most Western European nations (which average 1.5% to 2%). About 0.4 percent of this budgeted amount is for EEAA. Limited resources are currently allocated for water quality management in MWRI's budget.

3.3.3 Subsidies Affecting Water Quality

Fuel price and water delivery cost subsidies affect water use and, indirectly, water quality. Diesel and mazut (No. 6 Fuel Oil) are priced domestically at approximately one-half of their world prices. Water is delivered free to agricultural users. Large industrial users located on the Nile pay only modest prices for their water deliveries. In the past, fertilizer and pesticides were heavily subsidized, leading to high use and water quality impairment, and some market distortions and resulting pollution still remain.

Water service is very cheap for some of the largest industries, so it is not surprising that they often meet required limits on effluent discharge concentrations through dilution rather than actual pollution load reductions (Samia Galal Saad, per. comm.). As noted in the previous section, the free provision of irrigation service in the agricultural sector leads to excessive use and contributes to a range of problems, including waterlogged soils.

3.4 Summary of Key Water Management Challenges

A number of important water management challenges have been identified relating to both water quantity and quality management. With respect to water quantity management, it has been noted that the inability to adequately maintain the irrigation infrastructure because of funding constraints will make it increasingly difficult to distribute water efficiently or equitably. The areas where shortages will be most felt are in old lands where irrigation improvement programs have yet to be implemented. Where there is no effective WUA, farmers at the end of *mesqas* also will suffer disproportionately when there are water shortages. Improved areas are more likely to have formal WUAs and are physically and institutionally better able to distribute water equitably. There remains a strong reluctance to ask poor farmers to pay for water service, and there also is a high cost of collecting revenue. However, the low level of cost sharing for irrigation service has reduced the ability of government to maintain the delivery system. Some of the water quantity challenges identified reflect an immediate problem faced in the field while others relate more to the underlying causes of water management problems. In contrast, the presentation of water quality issues has been arranged largely by the locations where problems are currently being experienced or may be in the future. Water pollution and related management problems have been reviewed from upstream to downstream along the Nile as well as in the country's lakes and groundwater reservoirs. Finally, inadequate enforcement of both water quantity and quality regulations has been identified as an important cross-cutting concern affecting any discussion of new policy approaches.

In sum, the following challenges have been highlighted:

Table 10. Summary of Egyptian Water Management Challenges

Water Management Challenges Identified	
Water Quantity	**Water Quality**
Threat of water shortages	**By Location:**
Service delivery in municipal water supply	Lake Nasser pollution
Irrigation service delivery challenges	Nile River pollution above Cairo
Insufficient irrigation system upkeep	Water pollution in the Nile Delta
High on-farm water use	Pollution of lakes
Low user contribution to irrigation system upkeep	Groundwater contamination
Weak attention to in-stream flows	**By Impact:**
Nonrenewable groundwater management	Adverse effects on human health
Subsidies affecting water use efficiency	Reduced agricultural productivity
Rainfall capture and flash flood protection	Threats to aquatic ecosystems
Negative consequences of rising water tables	Negative impacts on aesthetics (incl. tourism)

4 Alternative Economic Incentives for Improving Water Resources Management

4.1 Overview

As noted in Chapter 1, there is a wide range of policy approaches and options available to address the water management challenges facing Egypt. Market-based Instruments (MBIs) are nothing new in Egypt, and there already are a number in use. The challenges of their use or the implications for associated institutional reform should not be minimized, but it is useful to note the Egyptian experience that already exists. MBIs currently being applied in the water sector include:

- Water quantity management:
  - Charges for municipal water supply
  - Charges for industrial water supply

- Water quality management:
  - Charges for wastewater services
  - Performance bonds and fees for point source pollution
  - Grants and soft loans from EPF and SDF for water quality improvement
  - Reduction/elimination of input subsidies on fertilizer and pesticides

MBIs also are in widespread use outside of the water sector, including:

- Liability for coral reef damage
- Subsidies for natural gas use
- Subsidies for field drains and charges for their cleaning
- Tariff reductions for the import of environmental equipment
- Voluntary deposit refunds (for bottles and batteries)
- Cement production fee for government-owned producers (for pollution control)

The remainder of this report will focus on identifying and evaluating market-based incentives as potential water policy tools. This chapter presents a brief description of potential MBIs for water management. Chapter 5 then goes on to introduce and apply an evaluation or screening process to appraise the merits of alternative policy approaches. Chapter 6 presents the main conclusions and recommendations reached by the study.

4.2 MBIs for Water Quantity Management

4.2.1 Area-based Irrigation Service Charges

Area-based charges are the most common method of recovering operation and maintenance costs in irrigated agriculture. Under this mechanism, users are charged for the area irrigated. Rates often vary according to crop choice, the extent of crop irrigated,

irrigation method and season. This method is relatively easy to implement and administer and is best suited to areas where water already is equitably distributed. A fixed irrigated land charge is the easiest to administer. Varying the rate by crop and basing it on crop water consumption can provide some efficiency benefits, but it requires greater administrative effort, since reliable records of crops planted each year or season are required. The equivalent of area-based charges in municipal systems is a periodic (e.g., monthly) flat rate for water service, independent of the amount used. Flat charges are necessary when the volume used cannot be measured (e.g., because there are no working meters), but they create no incentive to conserve.

4.2.2 Volumetric Service Charges

Volumetric pricing methods charge for water service using a measurement of the volume of water delivered, consumed or withdrawn. In municipal systems, a precondition is that consumers' use is metered. Municipal water tariffs often are either flat or vary by volume-based blocks. Block tariffs that increase by the volume of water used (charging very low or no fees up to a certain threshold of use) have become more popular, particularly in developing countries. In irrigation, volumetric charges require information on the volume of water delivered to each user or group of users or some other way to infer a measurement of water consumption. Implementation costs associated with volumetric pricing are relatively high and require the central water authority or water user association to set the fee, monitor use, and collect revenue. Volumetric pricing is most feasible under demand-based or closed pipe irrigation systems. It is difficult under a rotation system and nearly impossible under a continuous flow system.

4.2.3 Formal and Informal Water Markets–Water Rights and Use Permits

Water markets can be distinguished on a spectrum from informal to formal. Water markets often are established informally when scarcity occurs. Typically such informal trades consist of farmers making some economic arrangement for the trade or transfer of surplus ground or surface water for a period of time (often a crop season) to a neighboring farm or town. For formal water markets to work there must be buyable and sellable water rights. A transferable water permit or right can provide permission to use a specified amount of water and the right to sell that right at a price which is determined by the market. Markets can provide a more flexible and efficient mechanism to allocate water than administrative means.

Tradable rights and permits address the "tragedy of the commons" problem (whereby individual users lack a conservation incentive even though such action would clearly serve the common good) by rationing access to the resource and privatizing the resulting access rights. The first step involves setting a limit on user access to the resource. For a given source of water supply, this would involve limiting the amount of water that can be extracted. This limit defines the aggregate access to the resource that is authorized. These access rights are then allocated on some basis to potential individual users, and they can either be made transferable to other users and/or bankable for future use. Users who exceed limits imposed by the rights they hold may face penalties, including the loss of the

right to participate in the scheme.

Water access rights can be financially valuable if the resource is managed efficiently such that owners of these rights acquire substantial economic returns. Protecting the value of that right motivates the holder to regulate others. But the ethical issues raised by the distribution of wealth among completing claimants are a significant source of controversy. Externalities, such as the effect of water withdrawals on downstream users, also must be considered in right transfers.

4.2.4 Charges for Groundwater Use

Groundwater charges are sometimes applied in areas where the seepage of irrigation water into aquifers replenishes groundwater pumped by another party. The distributor of the irrigation water, which may be an individual or an irrigation association, may seek to recover some of the (downstream) benefits enjoyed by the groundwater user. For example, some California water districts have been given statutory authority relating to groundwater extraction and groundwater re-charge. That authority allows the districts to raise revenues through assessments to groundwater users as well as by charging fees for groundwater extraction and for groundwater recharge.

4.2.5 Subsidies, Tax Reductions or Fees on Inputs

Subsidies can be given for the use of inputs that improve water management and/or economic efficiency. Examples include state support to water users for the installation of water-saving devices such as: water-efficient toilets; low-flow showerheads; low-flow faucet aerators; or drip irrigation equipment. Imported water meters are subject to a tariff designed largely to protect domestic meter manufacturers. However, in the absence of competition, Egyptian meters are poorly made and quickly fall into disrepair. Reducing the tariff on meters should increase the availability of better quality equipment—either through imports or from Egyptian manufacturers who upgrade quality of their products. Tariffs were reduced significantly recently on solid waste transport equipment. Similar tariff reductions could be given to a wide range of pollution control and water saving devices.

Subsidies or taxes on efficiency-reducing inputs also can be removed or reduced. For example, fuel subsidies result in a price to consumers of only about 50 percent of the world price equivalent. Increased fuel prices would raise the cost of pumping water in agriculture and create an incentive to reduce water use. Reducing present subsidies for the growing of sugar cane, a crop that requires relatively large amounts of water, also would create water saving incentives by encouraging the planting of less water-intensive crops.

Many nations impose fees, charges and taxes on inputs to production and on emissions and effluents. In most cases these fees are set at a level intended to generate a predetermined stream of revenue, with the funds collected earmarked to cover administrative costs and related program activities—especially natural resources

management or pollution control. Only rarely are fees set high enough to exert a significant impact on the choice of input, the nature of the production process, or the use of pollution abatement measures.

Input charges can be used to influence the choice of crop and indirectly affect the demand for water. For example, seed costs could be increased for water-thirsty crops. Input fees also can be designed to influence pollution. For example, placing a surcharge on fertilizer prices would tend to reduce its use and lessen pollution from fertilizer runoff.

4.2.6 Effluent Fees

As noted, effluent fees are another common use of economic incentives to discourage polluting behavior. Like input fees, they must be set high enough to make it cheaper for polluters to abate than to pay the fee if they are to positively influence environmental quality, but even low levels of charges can raise significant amounts of revenue. Egypt already has in place a form of effluent fee. Industrial discharge to the Nile and to drainage canals that meets standards of Law 48 currently are subject to a fee of one piastre per cubic meter. This fee is scheduled to increase fifteen-fold according to a proposal awaiting legislative approval to become a reality. To be effective as a deterrent, the fee should be based on the total pollutants discharged and not on the concentration levels of discharges (per the current system). Such fees are a direct means of affecting polluting behavior, however they require careful oversight and enforcement as well as routine measurement of both the volume and concentration of effluents.

4.2.7 Priority Water Users

Similar to the manner in which postal service, airplane service and rail passenger services differentiate by quality of service, with better service commanding higher fees, water deliveries could be made first in times of shortage to those who are willing to pay for priority treatment. The intent of this instrument would be to create two or more different classes of water delivery service, with a fee imposed for priority service.

Currently users in Toshqa pay a fee of LE 100 per feddan for guaranteed water delivery of 4,000 to 7,000 m^3 per year. This is equivalent to approximately L.E. 0.025 per cubic meter at the low end of the guaranteed delivery. A priority users' contract (akin to an insurance policy) would extend the Toshqa guarantee approach to others (probably WUAs) who are willing to pay a premium for guaranteed delivery even during periods of drought.

4.2.8 Financing Wastewater Treatment

Expanded wastewater treatment plant construction, operation and maintenance is of high priority in Egypt because of the high levels of untreated organic sewage currently finding its way to irrigation and drainage canals as well as directly into the Nile. Presently residential users (who account for about 80% of average system use) pay only about 35 percent of the operation and maintenance costs attributable to their use and nothing

toward the capital costs of sewage treatment plants. These payments must rise if existing plants are to be properly maintained and be able to provide service throughout their useful economic lives. Privatization is being tested as to its political acceptability for increasing these user fees and assuring long-run maintenance. The capital costs of wastewater treatment plants presently are financed mainly through donor grants and loans. If the collection and treatment system is to be expanded, prospective users and the government will need to assume a larger share of the burden to meet public health needs.

4.2.9 Tradable Permits

Relative to command-and-control regulatory alternatives, tradable discharge permits can reduce the costs of achieving a given level of pollution control. They operate as follows. Sources are required to meet limits on the quantity of effluent they may discharge. A pollution control authority distributes (through auction, allocation to permitted sources, or other means) tradable permits to discharge a fixed total quantity of pollution. Sources then are free to buy or sell permits among themselves provided they have permits for the total quantity of effluent they discharge over a year.

Tradable permits reduce compliance costs because pollution sources with low abatement costs will abate more than is required and sell the excess permits to sources with high abatement costs, who find this cheaper than reducing their pollution discharges. Trading requires a knowledge of the total mass of effluents that a water body can tolerate and still meet applicable water quality standards. Trading also requires the regulation of mass releases of specific pollutants from individual sources. At present, Egyptian Law 48, which governs the discharge of industrial effluents to Egyptian waters, specifies concentration limits for a wide range of pollutants. Concentration requirements can be met by reducing pollution discharge or by increasing the volume of wastewater (i.e., dilution). Law 48 and its implementing regulations would have to be revised to specify both concentrations and volumes of discharge if an effluent trading program were to be implemented.

To date, just the United States and Australia have fully implemented tradable discharge permit programs, and then only in relatively narrow geographical areas (though pilots are underway in several other countries, including the Philippines and Sri Lanka). It also should be noted that trading in these programs is much less than had been anticipated when the programs were established. The principal reason is high transaction costs. Effluent trading would appear to impose too many administrative burdens to be feasible in Egypt at this time, but it still should be considered alongside other options.

4.2.10 Damage Charges or Fines

Unless environmental regulations are in place and enforced, sources do not bear the costs of the pollution they release. As a result, they have little motivation to reduce pollution. One solution is to make sources liable for the damage they cause. The purpose is twofold: to make sources more careful about the pollution they release; and to compensate those who are harmed. Damage can be assessed on a case-by-case basis or according to a

predetermined schedule of fines. If sources are liable and must pay for the damage they cause, they will control pollution to the point where the marginal pollution damage equals the marginal costs of control. At this point their total payments for controlling pollution and compensating for harm will be minimized.

Many nations have environmental laws that establish liability for harm to natural resources and the environment or set forth a schedule of fines and penalties for exceeding permitted releases. Annex A to this report describes a number of programs of this nature, including coral reef damage assessment in Egypt. One option for wider application of this approach in Egypt would involve expanding damage assessments authorized by statute in Law 102/1983 (for protected areas) to include harm to surface water bodies or groundwater resources.

4.2.11 Voluntary Agreements

Voluntary pollution control agreements feature prominently in the United States, several nations of Western Europe, Japan and elsewhere. Such agreements attempt to motivate firms and individuals to reduce pollution, promote conservation of materials, water and energy, and increase recycling.

There are several reasons for the popularity of voluntary programs. First, a voluntary approach gives the pollution control authorities a means of seeking improvements in areas where statutory authority is nonexistent or already fully implemented. Second, voluntary programs are thought to have low cost, because firms and individuals undertake measures on a purely voluntary basis. They would be unlikely to agree to costly measures that are not otherwise mandated by law and regulation. Third, voluntary programs are sometimes used to experiment with new approaches to pollution control. If successful, the experiments may be mandated later by law and regulation.

What incentives do firms and individuals have to participate in a voluntary program? For some programs, such as curbside separation of solid waste for recycling, the incentive is limited to the reward of doing a good deed. In some voluntary programs participants receive free technical advice -- on topics such as energy conservation and cleaner production options. Other voluntary programs offer more tangible rewards, such as accelerated permitting or public recognition.

Potential applications for water quality improvement in Egypt could take many forms. For example, industry could be encouraged to improve the quality of its water discharge monitoring in terms of the frequency at which effluent samples are taken, the number of substances that are monitored, and the accuracy of equipment that is used for measuring pollutant concentrations. Rewards could be in the form of public recognition for firms that both improve monitoring methods and meet all applicable discharge limits. Another approach would be for government to provide education and free technical assistance to small rural communities regarding environmentally sustainable methods for disposing of household sewage. Currently households pay to have sewage pumped from cesspits, however those hired to do the pumping often find it convenient and less expensive to

dump their loads in drainage (or irrigation) canals instead of sewage treatment facilities. Discouraging this practice would provide significant public health benefits.

4.2.12 Performance Bonds

Some countries require performance bonding of firms that engage in mining, timber harvesting, oil and gas exploration and production and other activities on government-owned lands. Performance bonding also is commonly used at construction sites. The purpose of the performance bond is to assure that environmental and other requirements are satisfied. A baseline is established, and then once the activity is completed, the oversight authority conducts an inspection. The bond is refunded (normally with interest) if all operating and remediation conditions are satisfied.

Performance bonding has the potential to be applied to a wide range of activities in Egypt including barges and cruise ships that ply the Nile, ships transiting coastal waters and the Suez Canal, oil and gas exploration and production, and mining.

4.2.13 Public Information Disclosure

Information disclosure regarding pollution can be structured as a voluntary measure but more commonly is made a requirement through laws and regulations. The approach is to disclose information regarding the environmental characteristics of products, of emissions from a factory, or of workplace conditions to reduce uncertainty and improve the functioning of labor, capital, and product markets. With better-informed consumers, workers and lenders, firms will more likely bear the true costs of their pollution and thus have an incentive to make appropriate improvements in environmental performance.

Mandatory reporting of toxic releases was first instituted in the United States in the mid-1980s and now is found in at least a dozen developed and a handful of developing countries. Environmental labeling is required in many developed and developing nations. Categorization of firms according to their environmental record is an easily-understood format (by color-coding, from green/best to black/worst) and was first implemented in Indonesia. It now is being used in the Philippines and parts of India and China.

Specific environmental disclosure initiatives that could be considered in Egypt include public access to environmental impact assessments filed with EEAA, disclosure of routinely measured ambient environmental quality (e.g., the River Nile, irrigation and drainage canals, the Northern Lakes and Lake Qarun), disclosure of the magnitude of discharge of various substances by individual industrial sources, and disclosure of the compliance status of individual sources with respect to their effluent discharges.

5 Evaluating Alternative Policy Instruments

5.1 Criteria for Evaluating Instruments

Policy approaches to water management—using command and control, market-based incentives and mixed mechanisms—will vary in terms of their costs, environmental consequences, administrative requirements and in other important respects. Thus, it is useful to evaluate the pros and cons of different policy tools using some common criteria or parameters. It is suggested that these criteria be divided into two groups: those that relate primarily to the nature of the instrument itself; and those that are a function of the circumstances in which it would be applied.

However, prior to applying this two-step screening process, the proposed policy measure should be subjected to a superceding test of its ***consistency with national economic and social policy goals***. Any policy initiative is highly unlikely to go forward if it undermines one or more of the four current overriding policy goals of the Government: increased employment; more stable currency value; increased exports; and increased tourism. Beyond neutrality, a new water management measure preferably would directly contribute to the accomplishment of one or more of these broad policy goals. Subsidiary goals—such as privatization, improved education, and increased agricultural output—also may be important. Instruments that fail at this stage probably should receive no further analysis.

The purpose of the overall screening process is to narrow down the number of potential MBIs to those deemed to be intrinsically superior or dominant to others, and then to submit this shorter list of measures to a subsequent and more detailed set of quantitative and other analyses as well as a thorough vetting by stakeholders. Within the present study, this process of analysis and vetting began with a draft report that screened potential MBIs applied to water management. It continued through the convening of a workshop of stakeholders to review and revise the initial findings, the results of which have been incorporated into this final report.

5.2 Screening Process

The screening process involves two steps. First, each instrument is evaluated in terms of its intrinsic characteristics and qualities. Assuming that the proposed policy measure passes the first tests, the instrument is then submitted to a second review in which it is evaluated in terms of its ease, cost and likelihood of being implemented.

Screen 1: Criteria Intrinsic to the Instrument. The first set of evaluative criteria concern the intrinsic characteristics of a particular MBI that can be compared to and evaluated against a purely command-and-control (C&C) mechanism. Five such criteria are suggested:

1. Economic efficiency or cost-saving potential. What are the real resource gains or savings from using an economic instrument alone or in conjunction with a C&C

measure rather than a purely C&C alternative? Included in this criterion would be costs (private as well as governmental) for administration and enforcement.

2. Environmental or resource management effectiveness. Does the economic instrument result in the same or greater protection of the environment or wise natural resource management relative to the "pure" C&C alternative? If there are uncertainties, what are the tradeoffs between cost savings and potential environmental degradation or resource management?

3. Distributive effects. Who bears the financial costs of the economic instrument versus the C&C alternative? How are resource and environmental gains distributed by income group and by location under the alternative approaches?

4. Revenue raising potential. What impact does the economic instrument have on governmental budgets compared to the C&C approach?

5. Technological change and innovation. Sometimes termed "dynamic efficiency," this criterion asks whether the mechanism for securing resource management and environmental improvement is likely to stimulate the search for more effective and/or less expensive approaches. Does the C&C alternative offer any stimulus to innovation and technical change?

Screen 2: Contextual Criteria. A second set of criteria is related more to the institutional setting in which the MBI or C&C alternatives would be instituted. These seven contextual criteria (numbered in sequence following from the previous set) include:

6. Political acceptability. Assuming the instrument has passed through the superseding test of consistency with overarching government goals, who might be politically opposed to the policy and what obstacles would this present? Who would favor using the instrument? Are the winners or the losers well-connected or politically powerful? Is the proposed system perceived as fair?

7. Social and cultural acceptability. Social and cultural traditions place limits on the acceptability of various policy instruments.

8. Geography and existing infrastructure. These considerations can affect how much control one has over the system into which the MBI would be placed.

9. Institutional capacity. Are institutions capable? What additional burdens, if any, would an economic instrument approach place on the government's capabilities and capacities compared to the C&C alternative? Can private sector institutions help?

10. Legal framework. Are existing laws adequate, or would new legislation or implementing regulations be required? If new legislation would be needed, what is the prognosis for successfully passing it?

11. Administrative ease of implementation. Would new regulations be required for the economic instrument? How much effort would be required? What about monitoring requirements? How would compliance be accomplished, and what will be the likely enforcement requirements?

12. Experience from other nations*?* What does the record in other countries reveal regarding probable institutional burdens, potential pitfalls, and the ultimate probability of successful implementation?

5.3 Application of the Evaluation Process

This screening process was applied as described below to twenty MBIs holding the potential to improve water management in the country. To ensure that the pre-test of consistency with broad national goals is met, the main objectives of each instrument are first reviewed. This is followed by an application, in turn, of the first and second screens described above (reference numbers to the 12 screening criteria are given in the text).

Initial recommendations are given for each candidate MBI followed by a summary of the guidance received at the stakeholders' workshop. The participants at that meeting were drawn from all parts of MWRI and from a number of other agencies involved with water management in the country. Their suggestions were recorded through plenary discussions, four small group discussions (two each on water quantity and water quality issues) and on individual questionnaires (see Annex C for further workshop information).

5.3.1 Instruments with a Primary Goal of Improved Water Quantity Management

Area-based Irrigation Charges for Smallholder Agriculture

Description/Objective: Water delivery charges could be assessed on individual farms using the agricultural land tax or charges based on irrigated feddans. For the latter, the rate could vary by type of crop and region to account for differences in delivery cost, water quality, and other factors. The primary objective is to generate revenue to fund irrigation system rehabilitation and improved maintenance, resulting in increased agricultural productivity, though some incentives for water conservation may be built into the policy.

First screen: (1) slight improvement in efficiency benefits over C&C if crop charges are tied to water consumption of the crop; (2) resource management impact is positive if improvements in the distribution system result from increased revenue; (3) distributive effects are negative for very smallholding and resource-limited farmers, who have limited ability to pay; (4) revenue raising is excellent, but link between charges paid and quality of service is severed if the Ministry of Finance collects revenue and doesn't earmark for MWRI; (5) impact on technological change and innovation – slight, and only in the case where charges are linked to the water consumption of crops. ***On balance, the instrument receives only a low pass for this screen.***

Second screen: (6) Politically difficult to assess poor farmers; (7) resistance from all farmers to paying without improved service, (8) works with present system of irrigation supply; (9) no new capability needed if the Ministry of Finance collects the fee as an add-on to agricultural land tax, but requires new capability if collected by MWRI, and can expect poor enforcement capability; (10) law would probably need to be revised to allow

for government assessment of irrigation user charges; (11) administrative cost significant if MWRI collects, moderate if collected by Ministry of Finance as part of the agricultural land tax; flat land charge inexpensive; crop-based charges more expensive; (12) international experience supports most of the conclusions drawn above. ***This screen detects significant barriers to implementation.***

Recommendation*:* None prior to workshop, though it was considered still a potentially attractive MBI option.

Workshop results: There were mixed impressions expressed by workshop participants on the potential applicability of the instrument. Some felt it would only be useful as a means for WUAs to raise revenue to finance O&M. It was suggested that ways might be sought to link MBIs to ongoing privatization efforts in the agriculture and water sectors and the empowerment of resource users, including the possible widening of authorities for WUAs to assess fees and organize the use of revenues collected for irrigation system operation, maintenance and improvement. Others recommended adapting the existing agricultural land tax—considered too low and in need of reevaluation—to include an area-based charge linked to water.

Priority Water Delivery for Smallholder Agriculture

Description/Objectives: WUAs could pay a fee for guaranteed supply of irrigation water, as an insurance policy of sorts. This would encourage greater cost sharing by farmers.

First screen: (1) fair for efficiency-enhancing; (2) no significant impact on resource management; (3) areas with larger, higher income, better educated farmers will adopt faster, so there is risk of adverse distributive effects (or certainly the perception of same); (4) good for revenue raising; and (5) impact on technological change and innovation – none. ***The instrument receives a pass using this screen.***

Second screen: (6) Politically difficult since it could negatively impact poorer farmers; (7) in times of water shortage, poorer farming areas will suffer larger water cutbacks and reduced yields; (8) could elevate head-tail disparities to the branch canal level; (9) MWRI would need to establish a special fund and collect revenue from WUAs; (10) would need legal changes to implement; (11) moderate administrative cost; (12) there is little directly relevant international experience except crop insurance schemes. ***The instrument receives a low pass of the second screen.***

Recommendation: In need of careful review at the workshop and probably a less attractive MBI option.

Workshop results**:** Workshop participants were supportive of this instrument only in the mega-projects, due to equity implications. Some recommended further study for use with small farmers and in the delta. Individual participant evaluations were unsupportive, with nearly two-thirds rating the instrument as not presently applicable.

Creating a Market for Irrigation Improvement and Management Transfer Programs

Description/Objectives: This MBI package would involve selecting areas for IPP, DIP or IMT programs—such as *mesqas* within branch canals where WUAs have been established—on the basis of their willingness to accept faster and less subsidized repayment terms for participation in these programs. Faster repayment would increase domestic funding available for IIP, DIP or IMT programs—some of which could be used to target the poorest agricultural communities for participation in the programs. The objective is to more finely tune the supply of these services/investments with demand, resulting in better management of the irrigation delivery system, increased agricultural productivity and greater ability to allocate scarce water efficiently.

First screen: (1) good potential to enhance efficiency via improved distribution of water; (2) positive effect on system O&M and on ability to manage water under scarcity; (3) distributive effects – good; (4) revenue raising – lowers government O&M costs; and (5) impact on technological change and innovation – none likely. ***The instrument receives a pass for this screen.***

Second screen: (6) politically acceptable; (7) organizational difficulties in areas of conflict; (8) potential to improve present system of irrigation supply; (9) Need to invest in development of WUAs; self-enforcement of rules; (10) Revised law 12 needed to authorize district WUAs; (11) administrative costs shifted to private sector; capacity of water user associations to manage irrigation systems in Egypt still being tested; (12) successful applications in United States, Mexico, Turkey. ***Second screen finds no significant barriers, and gives a pass to this instrument.***

Recommendation: Deemed to merit further detailed analysis for use in smallholder agriculture as a potentially attractive MBI.

Workshop results: Both break-out groups recommended the MBI for further study. It was noted that cost savings from implementing government programs in areas where subsidies are reduced should be channeled to support expansion of IMT and other programs—especially to poorer communities.

Volumetric Irrigation Charges Aside from Toshqa

Description/Objectives: Water delivery charges to large farmers or investors could be based on quantity of water supplied, modeled after contracts being written in Toshqa. Further study would identify those areas with sufficiently large farms to allow for cost-effective implementation. The objective is recover at least O&M costs and perhaps part of the infrastructure costs of water delivery. A secondary objective is to provide incentives for more efficient use of water.

First screen: (1) efficiency-enhancing potential – excellent; (2) unsure of in how many areas outside of Toshqa the instrument can be applied; (3) charges on wealthier investors, so distributive impacts are excellent; (4) revenue raising – excellent; and (5) impact on

technological change and innovation – excellent. ***The instrument receives a pass using this screen.***

Second screen: (6) unsure if local investors will oppose or support; (7) socially and culturally acceptable, since dealing only with large farmers and investors; (8) metering can be cost-effective for large users; (9) within Government capability; (10) water delivery charges are negotiated and formalized in contracts; (11) low administrative cost; (12) successful international implementation in in other countries. ***Second screen finds no significant barriers and gives a pass to this instrument.***

Recommendation: Deemed to merit further detailed analysis as a potentially attractive MBI for use in mega-projects.

Workshop results: There were mixed reactions to the instrument among workshop participants, with some finding this policy measure not applicable because of concern over potentially high transactions costs. Others recommended that it be given further study.

Transferable Groundwater Extraction Rights

Description/Objectives: Deep groundwater in the Nubian Aquifer is largely a non-renewable resource. MWRI is looking for alternative institutional approaches to wisely manage the transition from continuous artesian free-flowing wells to controlled flow by pumping and eventually to the end of their economic life. The establishment of transferable groundwater extraction rights could create value for permit or rights holders, thereby creating incentives for them to better manage the resource, including the monitoring of groundwater pumping and violations by others.

First screen: (1) fair efficiency-enhancing potential; (2) resource is being mined, but instrument could slow the process and reduce other negative environmental impacts; (3) distribution of benefits favors early users; (4) revenue raising – none; (5) impact on technological change and innovation – fair. ***The instrument receives a low pass using this screen.***

Second screen: (6) probably politically acceptable as long as distinctions are drawn between rights to water versus extraction; (7) Traditional practices in oases indicate likely social acceptability, though some controversy possible; (8) appropriate to nonrenewable groundwater use; (9) needs institutional development for recording of trades and legal foundation; (10) legal changes probably needed to develop formal markets; (11) modest administrative cost; (12) successful implementation in fisheries, oil extraction. ***Second screen finds no significant barrier.***

Recommendation: Deemed to merit further detailed analysis as a potentially attractive MBI option.

Workshop results: Both working groups at the workshop found this instrument worthy of further study. Some proposed using newly formed holding companies for implementation, while others suggested investigating how rehabilitation of wells would be managed and financed. Privatization of well construction and management also was suggested as an alternative approach.

Groundwater Extraction Charges

Description/Objectives: Industries that pump groundwater could be assessed an extraction charge. With respect to Western Desert groundwater, extraction charges for irrigators and others would encourage conservation and prolong the economic pumping of the aquifer as well as raise revenue for system O&M. Extraction charges are an alternative to area-based charges or tradable extraction rights.

First screen: (1) efficiency is unknown. (2) instrument is likely to have a positive impact on management of the resource; (3) distributional impacts are acceptable for use with industries but may not be acceptable in Western Desert agriculture; (4) good for revenue raising; (5) impact on technological change and innovation is good, since it encourages investments in water conserving technologies. ***This instrument receives a pass using this screen.***

Second screen: (6) large industries have political clout to resist additional charges; instrument may not be considered fair if applied differentially to desert farmers versus Nile farmers; politically difficult in Western Desert since GOE is encouraging greater use of groundwater for irrigated agriculture; (7) cultural resistance to paying for water service by farmers and desert population groups; culturally more acceptable by industries; (8) see notes above on geographic factors; (9) no further institutional development needed; (10) some version of this is already in use, so legal issues should not be binding; (11) modest administrative cost to monitor groundwater extraction and collect revenue; (12) successful implementation in many places around the world, though not commonly used in agriculture. ***The instrument receives a pass for application in industrial extraction, but for use in desert groundwater extraction, the instrument fails this screen.***

Recommendation: Deserving of careful and critical review at the workshop as a still promising instrument. Separate consideration should be given to its use in urban industrial extraction versus in desert agricultural areas.

Workshop results: Participants raised questions about this instruments applicability, but they also found it warranting further study. One working group favored its application to industry and urban withdrawals but not for Western groundwater. The other small group questioned how rehabilitation of wells would be managed and financed.

Increased Urban and Industrial Water Service Tariffs

Description/Objectives: Urban and industrial water rates could be increased to fund system O&M, rehabilitation and expansion in order to improve service and reduce leakage. Another objective for urban supplies would be to ensure provision of basic water requirements to the poor through the use of increasing block rates or similar alternatives.

First screen: (1) fair for efficiency-enhancing but potential is limited by poor metering (2) should reduce environmental health risks; (3) favorable distribution of cost across income groups, with wealthier paying more, though literature is split over whether increasing block rates help the poor; (4) good for revenue raising; (5) impact on technological change and innovation is good, since it encourages investments in water conserving technologies. ***Despite limitation of poor metering, the instrument receives a pass using this screen.***

Second screen: (6) politically difficult; (7) resistance to paying more for water deliveries more in poorer areas with poor service; (8) appropriate for metered areas; (9) no further institutional development needed; (10) no new legislation anticipated to be needed; (11) modest administrative cost; (12) successful implementation in many cities of the region and around the world. ***Despite political and equity concerns related to charging the poor, the instrument receives a pass using this screen.***

Recommendation: Deemed to merit further detailed analysis and consideration as a potentially attractive MBI.

***Workshop results*:** Workshop participants generally were supportive of this instrument. One break-out group favored investigating the whole tariff structure, while the other was more specific in advocating a tariff like in electricity pricing, where increasing block rates are used. Individual evaluations were supportive of further study, with about one-half favoring action.

Subsidized Urban Water Meters

Description/Objectives: Tariffs on imported water meters and water-conserving devices would be lowered or eliminated to encourage water conservation and to achieve greater cost recovery.

.

First screen: (1) efficiency impacts are good; (2) will reduce water consumption and increase revenue to utilities; (3) unknown distributional effects; (4) revenue loss in import tariffs but increases in municipal user fee collection; (5) impact on technological change and innovation is good. ***The instrument receives a pass using this screen.***

Second screen: (6) could be politically difficult to remove protective tariffs due to resistance from domestic meter manufacturers; (7) not at issue; (8) not at issue; (9) no further institutional development needed; (10) revised import duties would need to be

agreed; (11) easy to administer; (12) international experiences in tariff reductions are favorable in terms of improving product quality. ***Despite political concerns related to protection of domestic manufacturers, the instrument receives a pass using his screen.***

Recommendation: Deemed to merit further detailed analysis as a potentially attractive MBI option.

Workshop results: Workshop participants generally found this instrument to be applicable to Egyptian circumstances.

Subsidized Water-Conserving Equipment

Description/Objectives: Cost recovery and conservation of urban water could be improved by reducing protective import tariffs on water conserving equipment or introducing other means to subsidize the purchase of such equipment.

First screen: (1) good for improving efficiency in water use; (2) good for improved resource management; (3) non-issue for distributive impacts; (4) revenue loss to government; (5) good for encouraging investments in water conserving technologies by users. ***The instrument receives a pass using this screen.***

Second screen: (6) can be politically difficult to remove protective tariffs if there are influential domestic beneficiaries, but this may not be an issue in this case; (7) not an issue; (8) not an issue; (9) further institutional development not needed; (10) revised import duties would need to be agreed; (11) easy to administer; (12) international experiences in tariff reductions are favorable in terms of improving product quality and adoption of less expensive technologies. ***Despite potential political concerns related to protection of domestic manufacturers, the instrument receives a pass using his screen.***

Recommendation: The instrument was deemed to merit further detailed analysis as a potentially attractive MBI option.

Workshop results: Workshop participants generally found this instrument to be applicable to Egyptian circumstances.

Reduced Subsidy on Fuel

Description/Objectives: A gradual reduction in the subsidy on fuel, currently sold at about half the world price, would increase the cost of pumping water for irrigation and encourage greater water use efficiency. As differentiated fuel pricing schemes are impractical, this would need to be implemented economy-wide

First screen: (1) fair for efficiency-enhancing when applied in all sectors, (2) within water sector, modest improvement in water use efficiency; (3) equity concerns for small, poor farmers; (4) increases central government revenue (foregone subsidies), but provides no direct revenues for MWRI; (5) impact on technological change and

innovation is good–encourages investments in energy and water conserving technologies. ***The instrument receives a pass using this screen.***

Second screen: (6) politically extremely difficult since it is broadly unpopular; (7) concerns may be raised by transportation industry and about poor farmers facing higher energy costs; (8) little effect; (9) very simple to implement; (10) no known legal barrier; (11) low administrative cost; (12) successful implementation in many countries around the world. ***Due to unlikely political feasibility at this time, this instrument does not pass the second screen.***

Recommendation: The instrument was included in workshop discussions with recognition of constraints, though it was not considered to be an attractive option at this time.

Workshop results: Workshop participants generally evaluated this instrument as infeasible at present.

5.3.2 Instruments with the Primary Goal of Improved Water Quality Management

Increased User Fees for Wastewater Treatment

Description/Objectives: There is an undoubted need for greater sewerage coverage in the country and increased wastewater treatment capacity. One way to help finance this would be to increase wastewater user fees—namely greater cost-sharing from residential and industrial users to fund wastewater treatment system operation and maintenance.

First screen: (1) cost saving potential – some; while this initiative would not reduce wastewater treatment costs in the short run, it should increase significantly the useful life of existing plants; (2) should result in lower municipal wastewater pollution, so environmental effectiveness is good; (3) distributive effects are likely to be favorable, since those receiving service are likely to be in higher income groups than those that do not yet have service, and those unconnected to the system also benefit from improved water quality resulting from keeping plants in good operating condition; (4) excellent for revenue raising; (5) will provide funds, but not incentives, for technological improvements. ***On balance quite good, and instrument passes this screen.***

Second screen: (6) likely to have some political difficulties; (7) resistance to paying higher rates in the absence of good service; (8) should favor relatively well off service areas; (9) should largely make use of existing institutional capacity; (10) no new legislation anticipated to be needed; (11) administrative ease of implementation is below average due to difficulties with measurement of use and collecting amounts due; (12) successful implementation in many cities of the region and around the world. ***The instrument receives a pass using his screen.***

Recommendation: The approach was deemed to merit further detailed analysis as a potentially promising measure.

Workshop Results: The instrument received a generally favorable evaluation by workshop participants.

Increased Subsidies for Wastewater Treatment

Description/Objectives: While the general notion of increasing government spending on a particular program may not seem at first glance to have much to do with MBIs, this issue under consideration is whether the proposed increase in user fees described above is the best approach relative to government subsidization—common in many countries—of these investments and other costs.

First screen: (1) significant efficiency gains when viewed from the perspective of social costs and social benefits; (2) significant improvements in environmental quality; (3) impacts on individuals at varying levels of income are difficult to determine without detailed analysis; (4) potentially large cost burden to the GOE; (5) no impacts expected on technological change and innovation. ***The instrument is quite attractive except for the GOE budgetary cost. More analysis is warranted.***

Second screen: (6) political implications are difficult to assess, particularly given the potentially large budgetary impacts; (7) consistent with social and cultural values which tend to favor subsidies for worthwhile activities; (8) highly site specific in terms of impacts; (9) minimal institutional challenges; (10) no significant legislative or regulatory requirements; (11) no significant administrative challenges; and (12) many successful applications elsewhere in the world as well as related activities in Egypt. ***On balance the instrument receives a passing score on this screen.***

Recommendation: The measure was deemed to require further analysis, especially relative to or possibly in combination with other options.

Workshop Results: The measure received highly positive support from the workshop participants.

Subsidized Rural Sanitation

Description/Objectives: The Government could provide technical assistance and possibly subsidized sanitation technologies to rural communities to encourage small-scale environmentally acceptable ways of disposing of household sewage in areas that are unlikely to be served by sewage treatment plants. This responds to the realities of widespread groundwater contamination from leaking septic fields and the dumping of waste from cesspits into canals.

First screen: (1) should be cost-effective since all actions are voluntary; (2) could result in major improvements in environmental quality; (3) no measurable impacts on income distribution; (4) costs the government a modest amount; and (5) has minimal impact on innovation and technological change. ***The instrument passes the initial screen.***

Second screen: (6) politically acceptable since everything is voluntary; (7) acceptable; (8) not applicable; (9) institutions could implement rather easily; (10) seemingly would not require legislative or regulatory changes since many voluntary programs already exist in Egypt; (11) low administrative costs; and (12) many examples exist elsewhere (however few can claim to be having a large impact on pollution). ***The instrument passes this screen.***

Recommendation: The instrument was deemed worth pursuing, even if the expected results are modest.

Workshop Results: Participants supported further study leading to action that would implement this instrument.

Subsidized Pollution Control Equipment

Description/Objectives: Analogous to the subsidization of water-saving technologies with respect to water quantity management, increased pollution abatement and higher quality domestic production of environmental technologies could be encouraged through the reduction of tariffs on the import of pollution control equipment.

First screen: (1) modest to possibly significant efficiency gains through the use of more advanced pollution control technologies, (2) modest to significant improvements in environmental quality; (3) minimal impacts on the distribution of income; (4) would cost the government some foregone revenue; and (5) modest to possibly significant impacts on innovation and technological change. ***The instrument passes this screen if the foregone revenue is not too large.***

Second screen: (6) should be acceptable politically since related examples already exist, namely the reduction in solid waste hauling equipment; (7) seems to be consistent with social and cultural values by subsiding worthwhile activities; (8) not applicable; (9) minimal institutional challenges; (10) would not require legislative and/or regulatory changes; (11) no significant administrative challenges; and (12) many successful applications elsewhere. ***The instrument passes this screen.***

Recommendation: Deemed to merit further detailed analysis as a potentially promising MBI option.

Workshop Results: The measure received generally favorable support from the workshop participants.

Increased Industrial Discharge Fees

Description/Objectives: Fees for industrial discharges to Egyptian waters as governed by Law 48 could be adjusted. A proposal currently under consideration would increase these fees from 1 piastre per cubic meter to 15 piastres per cubic meter.

First screen: (1) no anticipated cost savings; (2) some environmental benefit however the response of industry to the proposed level of charges is unknown. A greater impact may arise in terms of water use by firms that take water from the Nile and canals.; (3) distributive impacts likely favorable since this impacts industry first; (4) would raise revenue; (5) potential for modest impacts on technical change and innovation. ***The instrument passes this screen.***

Second screen: (6) political acceptability uncertain as large state owned industries may object; (7) social and cultural values appear to be consistent with the measure; (8) probably not relevant; (9) no impact since it would build upon an existing instrument; (10) adjustments to Law 48 are in process, though any switch to load-based fees probably would require new legislation; (11) administrative burden need not be high; (12) there is limited experience from several countries on which to draw.

Recommendation: Deemed to merit further analysis as a potentially promising MBI option.

Workshop Results: As there already is a well vetted proposal for increased fees under consideration, workshop participants were generally supportive of this instrument.

Tradable Effluent Discharge Permits

Description/Objectives: Tradable discharge permits could offer a means of lowering compliance costs for industrial dischargers, and they would appear to be consistent with broad themes of GOE policy, namely finding low cost means of improving the environment.

First screen: (1) high marks for improving efficiency -- or in this case improving cost effectiveness; (2) neutral with respect to environmental impact; (3) should have no adverse impacts on income distribution; (4) no revenue raising potential; (5) generally positive impact on incentives for technical change and innovation. ***The instrument receives a passing score on this screen, however the anticipated cost savings are likely to be illusory in the absence of effective enforcement of existing discharge regulations.***

Second Screen: (6) politically should be acceptable; (7) no obvious social or cultural obstacles; (8) not applicable; (9) difficult to implement because it would require mass-based permitting; (10) would require changes to laws and regulations; (11) uncertain administrative costs; and (12) few examples worldwide of successful implementation. ***On balance, the instrument fails this screen due to significant new program requirements.***

Recommendation: Considered premature for now, though at a later date, when compliance costs are much higher than they are today, the measure would be worth revisiting.

Workshop Results: The instrument was presented to but not evaluated by workshop participants.

Voluntary Agreements for Environmental Improvement

Description/Objectives: Various options exist for the introduction of voluntary agreements between the Government and individual enterprises, municipalities, industry associations, community groups and other entities to encourage them to reduce their polluting behavior to below levels required by current law. The specific instrument evaluated was enhanced self-monitoring of discharges by industry.

First screen: (1) could induce some low cost voluntary pollution reductions; (2) potential for environmental improvement; (3) no obvious distributive impacts -- burden falls on industry; (4) no impact on GOE revenues; and (5) modest positive impacts on technical change and innovation due to availability of better information. ***The instrument passes this screen.***

Second screen: (6) likely to be politically acceptable; (7) appears to be socially and culturally acceptable; (8) no obvious geographical implications; (9) some institutional issues regarding standards and protocols; (10) probably would not require legislative or regulatory changes since the program would be voluntary; (11) minor administrative costs; (12) some similar examples of this type of instrument found elsewhere. ***The instrument passes this screen.***

Recommendation: No significant barriers were identified, and this instrument was deemed promising.

Workshop Results: The initiative was supported strongly by workshop participants as meriting study and action.

Environmental Damage Charges and Fines

Description/Objectives: Natural resource damage liability could be formalized for harm to national waters (surface and groundwater). The purpose of this instrument would be to internalize the cost of pollution and thereby affect polluting behavior. Improving environmental quality without adversely affecting employment, exports and other key parameters is consistent with GOE policy.

First screen: (1) having polluters bear the cost of pollution should enhance efficiency; (2) should result in improved environmental quality; (3) positive impact on income distribution if victims are compensated and neutral otherwise; (4) provide a source of government revenue and also a means of providing compensation to victims; and (5)

provides some positive incentives for improving pollution control technology. ***On balance the instrument passes this screen.***

Second Screen: (6) politically this is acceptable since it already is used to some extent; (7) may be difficult to apply to government-owned firms, some of which are major polluters; (8) not applicable; (9) hard to apply to government-owned firms and to the thousands of small firms; (10) exists to some extent already so legal changes might not be large; (11) moderate to high administrative costs; and (12) many examples of successful implementation worldwide. ***The instrument passes this screen.***

Recommendation: The instrument was deemed highly promising.

Workshop Results: It received favorable support from workshop participants who recommended that the instrument should be evaluated further, particularly with respect to necessary legislative and regulatory changes.

Environmental Performance Bonds

Description/Objectives: The definition of environmental damage liability expressed in Law 102/1983 could be modified so that entities must put up a bond that would be forfeited if harms to surface and groundwater are not mitigated. The objective is to ensure that firms perform according to agreed upon conditions when operating on public lands and carrying out other permitted activities.

First screen: (1) modest improvement in efficiency expected; (2) modest improvement in environmental quality expected; (3) no measurable impacts on income distribution; (4) provide no government revenue; and (5) have no impact on technological change and innovation. ***Instrument passes this screen.***

Second screen: (6) politically acceptable -- the instrument already is used for point sources; (7) no obvious social or cultural issues; (8) not applicable; (9) institutions could implement rather easily since one such instrument already is in use; (10) possible would require legal or regulatory changes depending upon the application; (11) relatively low administrative costs; and (12) successful applications found elsewhere in the world. ***The instrument passes this screen.***

Recommendation: The instrument was deemed to be promising.

Workshop Results: It was recommended for further study by workshop participants.

Public Environmental Information Disclosure

Description/Objectives: Greater disclosure of environmental information could be required, likely starting with EIAs and ambient environmental quality data and gradually expanding over time to cover data on releases from individual sources and compliance information on individual sources. The goal would be to reduce uncertainty regarding

releases of pollution and to empower agents in the labor, capital and product markets so that they may indirectly affect corporate decisions regarding the release of water pollution.

First screen: (1) modest to significant improvement in economic efficiency can be expected; (2) modest to significant improvement in environmental quality can be anticipated; (3) no adverse impacts on income distribution; (4) no affects on government revenue, and (5) modest impacts on innovation and technological change. ***The instrument passes this screen easily.***

Second screen: (6) could have serious political problems and would need further investigation; (7) unclear regarding interface with social and cultural values; (8) not applicable; (9) would seem to impose few requirements on existing institutions; (10) might require legal or regulatory changes; (11) relatively low administrative costs; and (12) many successful applications elsewhere in the world. ***The instrument needs further evaluation because of uncertain political and social acceptability.***

Recommendation: The instrument was deemed potentially applicable but in need of further evaluation due to potential political and social acceptability problems.

Workshop Results: Workshop participants, however, generally supported this instrument, with only three of the individual responses suggesting that it was not acceptable.

6 Conclusions and Recommendations

6.1 Summary of Instruments Evaluated

6.1.1 Overview

This study has explored the applicability of economic instruments to help address Egypt's current water management challenges. It has resulted in an initial evaluation of twenty of those that seemed most promising. Screening criteria were developed and applied to assess the merits of each, and direction also was received from nearly 60 participants who attended the study's concluding Workshop on Economic Incentives for Water Resources Management.[5]

The results of this evaluation are summarized in Table 11 on the following page, which gives the overall assessment of each instrument as well as the major water management challenges it may help to address.

6.1.2 Most Promising Water Quantity Management Instruments

Those water quantity management measures deemed of highest priority for follow-up analysis and possible policy action were:

Groundwater Extraction Charges –More immediately promising than area-based charges for surface irrigation water service or tradable extraction rights for groundwater, groundwater extraction charges were judged as holding potential to help create incentives for water conservation by both industries as well as farmers and also to raise revenues. It was noted at the workshop that new regulations are already in development to introduce extraction charges as tools for groundwater management in the Western Desert.

Import Tariff Reductions for Imported Water Meters and Water Conserving Equipment – The reduction of protective import tariffs on both water meters and water-conserving equipment was identified as meriting careful further analysis and possible policy action.

Other Measures Deserving Further Analysis – Though not chosen as the most immediately attractive instruments, several other measures were identified as warranting careful further analysis. These include: area-based irrigation service charges; volumetric water delivery charges for large agricultural enterprises; and increased user fees for the supply of urban and industrial water services.

[5] Held on 24 March 2002.

Table 11. Summary Evaluation of Economic Instruments for Water Resources Management

Economic Instruments Considered	Principal Problems Addressed by the Instrument	Evaluation of the Instrument		
Water Quantity		**Warrants study & action**	**Deserves further study**	**Not presently applicable**
Area-based Irrigation Charges for Smallholder Agriculture	Irrigation service delivery Low farmer payment for upkeep		**X**	
Priority Water Delivery for Smallholder Agriculture	Threat of water shortages Irrigation service delivery			**X**
Create Market for Irrigation Improvement and Management Transfer Programs	Irrigation service delivery High on-farm water use		**X**	
Volumetric Charges Aside from Toshka	Threat of water shortages Irrigation service delivery		**X**	
Transferable Groundwater Extraction Rights	Non-renewable groundwater use Subsidies affecting efficient use		**X**	
Groundwater Extraction Charges	Non-renewable groundwater use Subsidies affecting efficient use	**X**		
Increased Urban and Industrial Water Service Tariffs	Service delivery in water supply Subsidies affecting efficient use		**X**	
Subsidized Urban Water Meters	Threat of water shortages Service delivery in water supply	**X**		
Subsidized Water-Conserving Equipment	High on-farm water use Rising water tables	**X**		
Reduced Subsidy on Fuel	High on-farm water use Subsidies affecting efficient use			**X**
Water Quality				
Increased User Fees for Wastewater Treatment	Pollution of river, canals and aquatic systems of Nile Delta	**X**		
Increased Subsidies for Wastewater Treatment Facilities	Pollution of river, canals and aquatic systems of Nile Delta	**X**		
Subsidized Rural Sanitation	Rural surface and groundwater pollution plus offsite impacts	**X**		
Subsidized Pollution Control Equipment	Pollution of river, canals and aquatic systems of Nile Delta	**X**		
Increased Industrial Discharge Fees	Adverse impacts of industrial pollution throughout country		**X**	
Tradable Effluent Discharge Permits	Adverse impacts of industrial pollution throughout country			**X**
Voluntary Agreements for Environmental Improvements	Potentially address wide range of water quality problems	**X**		
Environmental Damage Charges and Fines	Potentially address wide range of water quality problems		**X**	
Environmental Performance Bonds	Potentially address wide range of water quality problems		**X**	
Public Environmental Information Disclosure	Potentially address wide range of water quality problems	**X**		

6.1.3 Most Promising Water Quality Management Instruments

Likewise, the most promising policy measures identified to address water quality problems were:

Increased User Fees for Wastewater Treatment – In response to an unquestionable need for better handling of organic wastes from both urban and rural settlements coupled with chronic revenue shortages for such investments, further increases in wastewater user fees are recommended for strong consideration.

Increased Subsidies to Finance Wastewater Treatment Facilities – As a potential corollary to enhanced revenues from higher service fees (and possible partial privatization), consideration of increased government subsidies for wastewater treatment system development—common in many countries—also was deemed to merit careful further analysis.

Subsidized Rural Sanitation –Groundwater contamination has been observed from leaking septic fields and the dumping of waste from rural cesspits into canals. It was considered timely for the government to explore provision of technical assistance and possibly subsidized sanitation technologies to rural communities to encourage small-scale environmentally acceptable ways of disposing of household sewage in areas unlikely to be served by sewage treatment plants.

Subsidized Pollution Control Equipment – Analogous to the subsidization of water-saving technologies, it was noted that the reduction of tariffs on the import of pollution control equipment could create incentives for increased pollution abatement and higher quality domestic production of environmental technologies.

Voluntary Agreements for Environmental Improvements – Various voluntary agreement options—such as enhanced self-monitoring of effluent discharges by industry—hold promise for introducing positive new relationships between the Government and individual enterprises, municipalities, industry associations, community groups and/or other entities to encourage less polluting behavior.

Public Environmental Information Disclosure – Greater disclosure of environmental information—perhaps starting with public dissemination of data from environmental impact assessments and ambient environmental quality data collected by various agencies—can be used to hold those damaging the environment more accountable to the public and their financiers.

6.1.4 General Lessons Learned

It is noteworthy that none of the twenty instruments examined were completely rejected by either the screening process applied or the majority of participants at the concluding workshop. While serious reservations were raised about the political feasibility of

several measures, only three out of the twenty were tagged as not currently applicable. This shows a fairly wide acceptance—at least among government water management officials—of the usefulness of this type of policy tool. This result should not be too surprising, given that Egypt has in recent years been gaining increasing experience with a range of MBIs applied to environmental and natural resources management challenges. It also bodes well for the further development of such approaches.

The participants who reviewed the twenty potential policy measures clearly were more comfortable with applying MBIs to water quality as opposed to water quantity challenges. While there is no definitive means for determining the reasons for such a preference, there are at least two plausible explanations. First, interviews during the study and discussions at the workshop made it plain that water pollution is widely recognized as a serious and growing problem facing the country. Water management professionals, therefore, are eager to find new ways to address this burgeoning challenge. Second, most of the water professionals at the workshop were water quantity as opposed to water quality experts. This largely mirrors the degree to which these topics are covered within MWRI, but it may well be that water quantity professionals felt easier about recommending that MBIs be applied outside of their immediate areas of responsibility.

6.2 Recommended Next Steps

This study was initiated because there was insufficient knowledge of the range of market-based incentives potentially applicable to addressing water management challenges in Egypt relative to other policy measures. Hopefully this report and the associated dissemination efforts—including the workshop held to receive feedback on preliminary findings—have helped to fill this perceived gap. The wide sweep of topics addressed by the study and short timeframe meant that the analysis was done in only an introductory manner, and this inevitably resulted in the study raising as many questions as it answered.

A certain degree of momentum now has been created at MWRI with respect to knowledge of and openness to the use of MBIs, and this should be maintained. At least three areas for follow-up work in a next phase of work on this subject seem advisable.

The first priority should be to further refine the problem analysis presented in this report and to begin the process of blending this new understanding of MBIs into the mix of policy options available to the government to address its highest priorities for water resources management. It may well be that the best choices for policy responses will involve some mix of regulatory and market-based instruments, but this policy analysis must be done with respect to specific problems that need to be solved. A more thorough inventory of current policies and regulations relating to water—beyond the cursory legal and institutional review presented in this report—also would be a useful precursor to this exercise. This should yield a fuller understanding of regulatory options to be considered alongside the new range of MBIs identified in this report—again in the context of specific water management challenges to be addressed. As the “future visioning”

exercise at MWRI continues to define and refine approaches to deal with the emerging new generation of water management challenges, the potential application of MBIs certainly needs to be incorporated into the policy dialogue.

Second, a recurrent objection to the wider application of MBIs in the water sector heard during the study and at the closing workshop relates to public acceptability. Assuming that the sample of water professionals represented by the study's workshop participants is generally representative of these professionals in Egypt, then their receptivity to the use of MBIs shows that such measures are acceptable to the officials who would be responsible for their implementation. What about the public? Strictly in the context of analyses to find appropriate policy responses to a specific water management challenge, it would be very useful to have real data on questions of public acceptability in contrast to largely anecdotal concerns that often are raised. Prior to the implementation of any MBI, careful study should be undertaken of both the ability and willingness to pay by those expected to bear the burden of new economic incentive measures. Public acceptability also should be tested from the standpoint of social and cultural suitability as well as administrative feasibility. This is particularly important in cases where legitimate equity concerns have been raised.

Finally, significant institutional adjustments are required that will take time to address and, therefore, warrant immediate attention. Within MWRI, there appears to be an acute shortage of professionals with training in resource and environmental economics requisite to the conduct of further MBI analysis. Further information is needed on the availability of such staff in the context of a broader needs analysis for institutional strengthening of this type. The same constraints and needs would seem to apply to other government agencies with water management responsibilities. In the meantime, consideration should be given to creating temporary capacity for economic analysis of this type within MWRI, perhaps by adding a water economics section to the Water Policy Advisory Unit led by a senior economist. This section could also be tasked with coordinating the needs assessment and even be drawn upon to help with in-house training, where warranted. A second set of institutional adjustments is needed to build a stronger working network of agencies responsible for water management within the country. If acceptable, it would seem appropriate for MWRI to take the lead in this effort, but many of the MBIs identified in this study apply to problems that lie outside of the immediate mandate of MWRI. With MWRI remaining as the lead authority in the water sector, much stronger outreach to and engagement of at least three key ministries and their associated bodies Ministry of Agriculture and Land Reclamation, Ministry of State for Environmental Affairs and Ministry of Housing, New Communities and Public Utilities—is needed if the recommendations relating to specific MBIs identified as promising are to be acted upon in the interest of improving water resources management in the country.

References

Abu-Zeid, Mahmoud. 2001. "Water Pricing in Irrigated Agriculture." *Water Resources Development*, Vol. 17, No. 4. pp. 527-538.

Advisory Panel Project on Water Management and Drainage (APP), 2001. A Short Introduction to the APP, mimeo.

Anderson, Robert C., 2001. *Developing Country Experience with Economic Instruments*, Egyptian Environmental Policy Program (EEPP), Policy Support Unit.

Allam, Mohamed Nasr. 2001. " Water Resources: Utilization and Management" (mimeo).

Allam, Mohammed Nasr. Undated. Analysis of Surface Irrigation Improvement in Egypt. Faculty of
Engineering, Cairo University, Egypt.

APRP Water Policy Program. 1998. *Egypt's Irrigation Improvement Program.* Report No. 7.

APRP Water Policy Program. 1999a. *Free-Flowing Groundwater Management in the Western Desert*. Report No. 16 Main Document.

APRP Water Policy Program. 1999b. *Establishment of Branch Canal Water User Associations in the Egyptian Irrigation System*. Report No. 17 Main Document.

APRP Water Policy Program. 2001. *MWRI Policy on Irrigation Management Transfer*. Report No. 47 Main Document.

ARD Raise, 2000. *An Assessment of the Agricultural Policy Reform Project in Egypt*, ARD Raise Report to USAID/Egypt.

Boland, John J. and Dale Whittington. The Political Economy of Water Tariff Design in Developing Countries: Increasing Block Tariffs versus Uniform Price with Rebate. Chapter 10 in The Political Economic of Water Pricing Reforms, World Bank, 2000. edited by Ariel Dinar. Oxfor University Press.

Bowen, Richard L. 1982. *Allocative Efficiency and Equity in Charging for Irrigation Water: A Case Study in Egypt*. PhD Dissertation, Department of Economics, Colorado State University.

Cedare. 1998. "Degradation and the Environment, a Case Study of Lake Mariout's Fishermen, Alexandria, Egypt"

Cestti, Rita E, 1995. *Strengthening Irrigation Management in Egypt: A Program for the Future*, International Irrigation Management Institute in cooperation with

Ministry of Public Works and Water Resources and the US Agency for International Development, Cairo.

Chemonics International, 1999. *Proposed Framework for Water/Wastewater Sector Reform in Egypt*, Legal, Institutional and Regulatory Reform of the Egyptian Water and Wastewater Sector Project, Cairo.

COWIConsult, 1995. *Inception Report: Economic Instruments Study in Egypt*, Ministry of Foreign Affairs and DANIDA, Cairo.

EEAA. 2001. *The National Environmental Action Plan of Egypt 2002/17* (draft version dated October 22, 2001)

Elassiouty, Ibrahim M. 1984. *Pricing of Irrigation Water in Egypt.* Final Report. Supreme Council of Universities.

El-Zanaty & Associates, 1998. *Knowledge, Attitudes and Practices of Egyptian Farmers Toward Water Resources: A National Survey*, GreenCom Egypt III of the Water Policy Reform Program in Collaboration with the Water Communication Unit, Agricultural Policy Reform Project, USAID/MWRI Ministry of Public Works and Water Resources: Cairo.

Emam, E. and Ibrahim, K., "Minimum Nile Drainage Needs for Sustainable Estuarine Ecosystem," National Water Research Center, Cairo, 1996.

EPIQ/PSU, 2001. *Environmental Economic Instruments Strategy Report: The Nature and Role of Economic Instruments (Chapter 2–Draft)*, EPIQ/PSU/USAID: Cairo.

ERM Economics, 1996. *Study of Market Based Instruments for Water Pollution Control at 6th October City: Scoping Report*, Egyptian Environmental Affairs Agency and World Bank.

ERM Economics, 1997. *Economic Instruments to Improve the Environmental Performance of Key Polluting Industries in Egypt: Scoping Report*, Egyptian Environmental Affairs Agency and World Bank.

Engineer Hussein Elwan, Head of Irrigation Sector, MWRI. personal communication

Environmental Resources and ERM, 1998. *Economic Instruments for Industrial Pollution Control in Egypt: Policy Findings and Recommendations (Final Report)*, Egyptian Environmental Affairs Agency and World Bank.

Government of India. 1992. *Report of the Committee on Pricing of Irrigation Water*. Planning Commission.

Hoehn, John P. and Douglas J. Krieger. 1996. "Economic Benefit Assessment, Volume

I: Main Report." Environmental Policy and Training Project (EPAT). Midwest Universities Consortium for International Activities (MUCIA), Michigan State University.

IRG, 2001. "The Nature and Role of Economic Instruments" in *Environmental Economic Instruments for Egypt* (draft), Egyptian Environmental Policy Program (EEPP), Policy Support Unit.

International Irrigation Management Institute, 1995. *Irrigation Service Cost Recovery in Egypt: Report on a Workshop*, International Irrigation Management Institute in cooperation with Ministry of Public Works and Water Resources and the US Agency for International Development, Cairo.

International Irrigation Management Institute, 1995. *A National Water Services Cost Sharing Program: Proposed Mechanisms and Phasing for Implementation*, International Irrigation Management Institute in cooperation with Ministry of Public Works and Water Resources and the US Agency for International Development, Cairo.

Irrigation Support Project for Asia and the Near East (ISPAN), 1993. *Irrigation Water Cost Recovery in Egypt: Determination of Water Costs*, US Agency for International Development, Cairo.

ISPAN. 1993. *Irrigation Water Cost Recovery in Egypt: Determination of Water Costs.*

ISPAN, 1994. *Tradable Water Rights: Experiences in Reforming Water Allocation Policy*, US Agency for International Development, Washington.

Kelly, R. A and James Welsh, 1992. *Egypt Water Quality Management Action Plan–Phase II*, Project in Development and the Environment, US Agency for International Development Near East Bureau.

Khouzam, Raouf F., 1995. *Future Municipal and Industrial Water Use Projection for 2025, National Water Resources Plan for Egypt: Water Quality and Pollution Control*, National Water Research Center, EPAT/Winrock International Water Resources Strategic Research Publication Series No. 17-4.

Mahdy, El-Sayed. 1998. "Pattern Changes in the Economic Value of Irrigation Water During the Era of Agricultural Policies Reform 1986-1996," *Egyptian Journal of Agricultural Economics*.

Mahmoud Abdou Mabrouk, Hossam El Refaay and Mohammed Hindawy. 1994. "Nile Water Quality Management in Egypt," Environmental Management Course, American University in Cairo.

McCauley, David, 2001. *Exploring the Potential for Application of Economic Instruments to Improved Water Management in Egypt*, EPIQ/WPRP.

Ministry of Public Works and Water Resources, 1995a. *An Action Plan for Strengthening Water Resource Management in Egypt*, International Irrigation Management Institute, Strengthening Irrigation Management in Egypt Report No. 3.

Ministry of Public Works and Water Resources, 1995b. *Water Resources, Irrigation Operations and Institutional Issues: An Analysis of the Ministry of Public Works and Water Resources, Government of Egypt*, International Irrigation Management Institute, Strengthening Irrigation Management in Egypt Report No. 2.

Ministry of Public Works and Water Resources, 1996a. *National Level Strategies and Policies for Utilizing Egypt's Water Resources*, Water Resources Strategic Research Activity Publication Series No. 1.

Ministry of Public Works and Water Resources, 1996b. *Agricultural use and Management of Low Quality Water: Sewage Effluents (Part I)*, National Water Resources Plan for Egypt: Water Quality and Pollution Control, National Water Research Center, Winrock International Water Resources Strategic Research Publication Series No. 17.

Ministry of Public Works and Water Resources, 1996c. *Municipal and Industrial Wastewater Reuse Potentiality*, National Water Resources Plan for Egypt: Water Quality and Pollution Control, National Water Research Center, Winrock International Water Resources Strategic Research Publication Series No. 15.

Ministry of Public Works and Water Resources, 1997. *Review of Egypt's Water Policies*, Water Resources Planning Working Paper INS02: Cairo.

Ministry of Public Works and Water Resources, 1998. *Southern Egypt Development Project*, Water Resources National Water Research Center: Cairo.

Ministry of Water Resources and Irrigation, 1998. *National Policy for Drainage Water Reuse*, EPIQ Water Policy Program Report No. 8.

Ministry of Water Resources and Irrigation, 1999a. *Revision of Law 48 of 1982 for the Protection of the Nile River and its Waterways from Pollution, Tranch III Water Benchmark C8 Report*, EPIQ Water Policy Program Report No. 21 (Final Draft).

Ministry of Water Resources and Irrigation, 1999b. *Revision of Law 48 of 1982 for the Protection of the Nile River and its Waterways from Pollution: Appendices*, Tranch III Water Benchmark C8 Report, EPIQ Water Policy Program Report No. 21.

Ministry of Water Resources and Irrigation, 2000a. *North Sinai Development Project*, North Sinai Development Organization: Cairo

Ministry of Water Resources and Irrigation, 2000b. *National Water Resources Plan for Egypt: Water Quality and Pollution Control*, Delft Hydraulics NWRP Technical Report No. 5.

Ministry of Water Resources and Irrigation, 2000c. *Policies and Procedures for Improved Urban Wastewater Discharge and Reuse*, EPIQ Water Policy Program Report No. 34.

Ministry of Water Resources and Irrigation, 2000d. *Task Force on Water Quality Priorities and Strategies*, Advisory Panel Project on Water Management and Drainage Project Document.

Ministry of Water Resources and Irrigation, 2001. *Strengthening of the Water Quality Unit within the Ministry of Water Resources and Irrigation (Draft)*, Advisory Panel Project on Water Management and Drainage Project Document.

Ministry of Water Resources and Irrigation. March 2001b. "A Memorandum to be presented to the Ministerial Committee for River Nile Protection from the Pollution of Canals, Drains and Groundwater" (in Arabic).

Mohieddin, Mohamed M., 1995. The Land Tax System in Egypt: A Descriptive Report of Its Historical, Legal and Organizational Aspects, International Irrigation Management Institute in cooperation with Ministry of Public Works and Water Resources and US Agency for International Development, Cairo.

Mollinga, Peter (ed.), 1998. *Water Control in Egypt's Canal Irrigation: A Discussion of Institutional Issues at Different Levels*, Wageningen Agricultural University, Liquid Gold Paper No. 3.

NOPWASD, 1991. Water Supply and Sanitation Sector Study for Egypt.

Perry, C.J., 1995. *Egypt: Water Services Charges to Agriculture*, International Irrigation Management Institute in cooperation with Ministry of Public Works and Water Resources and US Agency for International Development, Cairo.

Perry, C.J., Michael Rock, and D. Seckler. 1997. *Water as an Economic Good: A Solution, or a Problem?*
Research Report 14, International Irrigation Management Institute.

Perry, C.J. 2001. *Charging for Irrigation Water: The Issues and Options with a Case Study from Iran.*
Research Report 52. International Water Management Institute.

Royal Haskoning, 2001. *Round Table Conference on Institutional Reform between MWRI and Leading Donors in the Water Sector: Briefing Note*.

Samia Galal Saad, Personal Communication. Ministry of State for Environmental Affairs, January 2002.

Seckler, David, Upali Amarasinghe, David Molden, Radhika de Silva and Randolph Barker. 1998. *World Water Demand and Supply, 2000-2025*. International Water Management Institute (IWMI), Research Report 19.

US Agency for International Development/Egypt, 2000. *USAID/Egypt Strategic Plan FY 2000–2009: Advancing the Partnership*, USAID: Cairo.

Water Research Center and Winrock International. (WRC/WI) 1992. "Roundtable on Egyptian Water Policy."

Wolf, Peter (undated). "Reuse of Drain Water in Egypt - Status, Limitations and Challenges", Witzengen Germany.

World Bank. 2000. *Water Pricing Experiences: An International Perspective*. Edited by Ariel Dinar and Ashok Subramanian. Technical Report No. 386.

World Bank. 2000. *The Political Economy of Water Pricing Reforms*. Edited by Ariel Dinar. Oxford University Press.

WPWWR. 1995. *Irrigation Service Cost Recovery in Egypt.* Report on a Workshop. 24-27 May, 1995 Alexandria, Egypt.

WPWWR/USAID. 1995. *A National Water Services Cost Sharing Program: Proposed Mechanisms and Phasing for Implementation*. Report Number

ANNEX A

International Experiences with Economic Instruments For Managing Water Quality and Water Quantity

Prepared for EPIQ Water Policy Program

Robert C. Anderson
November 17, 2001
Revised February 11, 2002

TABLE OF CONTENTS

INTRODUCTION

Market Based Instruments (MBI), and Economic Incentives (EI) more broadly, have a number of advantages over traditional CAC methods for controlling pollution. One, these tools give those responsible for sources of pollution (hereafter referred to as "sources" or "polluters") an incentive to reduce pollution below permitted amounts when it is relatively inexpensive to do so. That feature, in turn, provides a motivation for sources to become smarter regarding pollution control options and costs. Technological improvement and innovation will be stimulated, resulting in greater opportunities to reduce pollution at low cost. Finally, MBI are uniquely well suited to many of the pollution problems the world now faces. The more widely dispersed and smaller the sources, the more difficult it is to rely on traditional CAC methods of source-specific limits, inspections and enforcement. MBI harness forces of the market to give all sources, large and small, the motivation to find the least cost means of limiting their polluting activities. In principle, environmental inspections and enforcement become less necessary as sources pursue their own self interest and control pollution.

MBI also are widely used for allocating natural resources to competing users. Long ago, farmers in England recognized the problem of communal grazing lands. Without charges to control use, or fences to delineate private property, the common grazing lands were over grazed and unproductive. Similarly, groundwater tables in many parts of the world are declining rapidly because the water is free except for the cost of operating one's pump.

This paper reviews a number of worldwide experiences with MBI for managing water quality and water quantity. As revealed in Table 1, the guiding definition of MBI for this paper is quite broad: any instrument that makes the responsible party pay for part or all of the cost of pollution or the cost of providing a natural resource such as water. This definition includes fees, charges and taxes, charges on polluting inputs and outputs, tradable permits, subsidies, deposit-refund systems, as well as reporting requirements, and liability for harms.

Worldwide experience with these instruments is quite extensive. A truly comprehensive treatment could occupy several large volumes. Because the resources available for this review were limited, the review is limited to a few examples of each type of instrument. The intention is to provide some depth of treatment for each of those examples to provide the reader with an understanding of how the instrument is designed and how it performs. Among the instruments mentioned in the introduction, deposit-refund systems have been omitted from the review since they appear most applicable to solid waste management and have only indirect connections to water and water quality.
The paper concludes with a brief assessment of the potential applicability of these tools in Egypt.

Table 1. Economic Instruments for Managing the Environment

Instrument	Situation Where Instrument Works Best	Examples	Pros and Cons
Pollution charges, taxes and fees	• Damage function relatively flat • Monitoring data available	• Emission charge • Effluent charge • Sewage charge • Solid waste charge	**Pros:** • Stimulates new technology • Useful if damage per unit of pollution varies little **Cons:** • Limited control over the quantity of pollution • Potentially large distributional effects
Input or output charges, taxes and fees	• Numerous sources • No monitoring data • Damage function relatively flat • Linkages between input or output and environment	• Carbon tax • Leaded gas tax • Fertilizer tax • Water user fee • Sewer fee • CFC tax	**Pros:** • Simple to administer • Raises revenue **Cons:** • Weak incentive effects for pollution control • Potentially limited environmental impacts
Subsidies for environmentally friendly activities	• Monitoring data available • Subsidy is not likely to stimulate new entrants	• Industrial pollution control • Agricultural activity • Municipal sewage plant	**Pros:** • Politically popular **Cons:** • Potentially large budgetary cost • Uncertain effects • May stimulate too much of the activity
Removal of environmentally harmful subsidies	• Environmental harms from the subsidies can be documented • Political will exists to remove subsidies	• Fuel subsidies • Agricultural subsidies	**Pros:** • Should improve efficiency and welfare **Cons:** • Unpopular with those receiving subsidies
Deposit-refund	• No monitoring data • Recyclable product	• Beverage container • Lead-acid batteries • Automobile bodies	**Pros:** • Deters littering • Stimulates recycling **Cons:** • High administrative costs

Instrument	Situation Where Instrument Works Best	Examples	Pros and Cons
Performance bonds	• Specific actions desired	• Mining • Timber harvesting	**Pros:** • Can stimulate desired actions **Cons:** • High administrative costs
Tradable permits	• Damage function steeply sloped • Precise control over amount of pollution important • Marginal control costs vary across sources	• Emission • Effluent • Water rights • Fisheries access	**Pros:** • Good control over amount of pollution • Stimulates technological change **Cons:** • Little control over amount spent on pollution control • Potentially large transactions costs
Liability	• Large impacts	• Natural resource damage assessment	**Pros:** • Strong incentive **Cons:** • High transaction costs • Difficult burden of proof
Information provision	• Recipients understand information	• Toxic releases • Product characteristics	**Pros:** • Low cost **Cons:** • Uncertain results
Voluntary mechanisms	• Firms willing to exceed applicable standards	• Energy conservation • Water conservation • Pollution prevention	**Pros:** • Low cost **Cons:** • Uncertain results

FEES CHARGES AND TAXES

A. Fees, charges and taxes for water and wastewater services

Many countries levy water service fees, however the fees vary substantially across user classes (agriculture, industry, and households). Eighteen of 21 industrialized countries surveyed by OECD (all but Austria, Iceland, and Japan) reported user fees for water. In the case of industrial users, water fees are usually based

on quantities of water consumed. Water charges for residential consumers are set at flat rates in some areas and based on amounts consumed in others.

Consumption-based rates are more likely to influence water use than flat rates, but relatively large price increases might be needed to induce changes in consumer behavior. A number of studies have found water consumption to be negatively related to unit-based prices. In 1982, for example, the Hunter and District Water Board in Australia replaced its fixed-rate pricing system with a pay-for-use system. Water consumption subsequently declined by 20-30%, a decline that allowed the deferral of water supply construction projects. Another study found that increases in water prices in Athens in 1990 led to significant decreases in water use. Although some of the decreases have been attributed to public education campaigns, the price increases have also been credited with significant incentive effect. In the Czech and Slovak Republics, increases in water charges since 1991 have led to significant falls in water consumption. In Bogor, Indonesia, water rates were increased by 200-300% in 1988 and a conservation campaign was implemented in 1989. Domestic and commercial water use fell by 30% within nine months. This implies a price elasticity of demand of -0.10 to -0.15.

Water charges are imposed for the cost of treating and delivering water to agricultural, industrial and household users. The World Bank recently completed a survey of water charges in 22 nations some of which were developed and others are still developing. The results of that survey are summarized in table 2, supplemented by data for additional countries from the World Bank web site. Industry generally pays the highest fees, followed by households. Agricultural users typically pay the lowest rates. A tremendous variation in rates charged is observed, however neither the state of development nor the availability of water appears to explain observed patterns. Water charges for domestic uses in Egypt are among the lowest in the world and well below prevailing rates in neighboring Middle East and North African countries.

Table 2. Water Charges (1996, in $US per m^3)

	Agriculture	**Domestic**	**Industry**
Country	(incremental use)	(incremental use)	(incremental use)
Algeria	0.019-0.22	0.057-0.27	4.67
Australia	0.0195	0.23-0.54	7.82
Botswana		0.28-1.48	
Brazil	0.0042-0.032	0.040	
Canada	0.0017-0.0019	0.34-1.36	0.17-1.52
Egypt		0.03-0.07	0.40-0.90
France	0.11-0.39	0.36	
India		0.0095-0.082	0.136-0.29 0
Israel	0.16-0.26	0.36	0.26
Italy		0.14-0.82	
Jordan		0.23	
Lebanon		0.32	
Madagascar		0.325-1.75	
Morocco		0.53	
Namibia	0.0038-0.028	0.22-1.38	
New Zealand		0.31-0.69	

	Agriculture	**Domestic**	**Industry**
Country	(incremental use)	(incremental use)	(incremental use)
Pakistan		0.06-0.10	0.38-0.97
Portugal	0.0095-0.0193	0.1526-0.5293	1.19
Spain	0.0001-0.028	0.0004-0.0046	0.0004-0.0046
Sudan		0.08-0.10	0.08-0.10
Taiwan		0.25-0.42	
Tanzania		0.062-0.241	0.261-0.398
Tunisia	0.020-0.078	0.096-0.529	0.583
Uganda		0.38-0.59	0.72-1.35
United States	0.0124-0.0438	0.40-1.50	
United Kingdom		0.0095-0.0248	

Source: Dinar and Subramanian (eds), 1997. *Water Pricing Experiences: An International Perspective*. World Bank Technical Paper 386;

Charges on surface and groundwater abstraction (withdrawal) differ from the water supply charges described above in that they can be regarded as taxes on the use of a natural resource rather than payments for services provided. Charges on surface and groundwater use have been imposed in several countries, including France, Spain, the Netherlands, and Denmark. The Netherlands imposes a ground water tax of 0.15 EUR ($0.14) per cubic meter, while Denmark imposes a tax on household and some service sector water users of 0.84 EUR ($0.72) per cubic meter. Both of these charge levels are thought to be high enough to influence behavior.

In the United States, fees are imposed on households and businesses for discharges of wastewater into Publicly Owned Treatment Works (POTWs). Frequently, the water and wastewater utilities that service a household or business are one and the same. When a single invoice includes both services, users may be able to distinguish discharge fees from water user fees only by careful attention to line items. Wastewater discharges are not directly metered in most cases; rather they are assumed to be equal in volume to water consumption, which is measured. Some discharge fees for larger businesses are based not only on water use but also on discharge toxicity, which provides them with a separate incentive to reduce the toxicity of their discharges.
With respect to water user fees, EPA's 1995 Community Water System Survey estimated that 95% of residential water customers and 98% of nonresidential water customers are metered. They pay water charges based directly on their use.

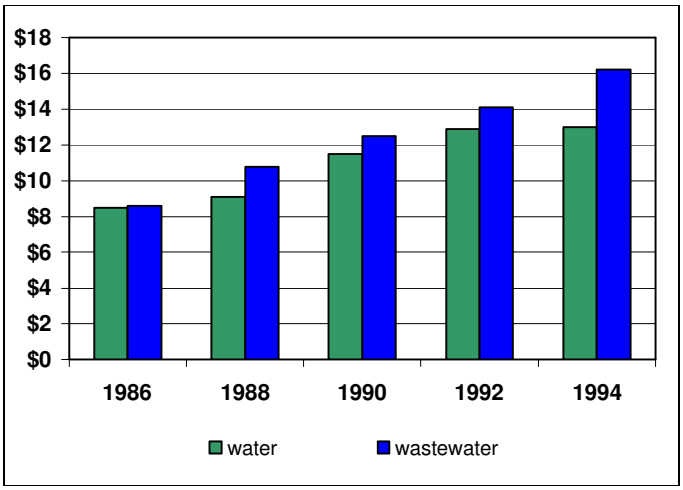
Whether a water user fee has a greater effect in terms of raising revenue or reducing a potentially polluting activity depends largely on the elasticity of the demand for water, that is whether demand is responsive to changes in price. If the demand is inelastic, an increase in user fees will raise revenue. User fees will not, however, affect consumption behavior in a significant way. If demand is elastic, however, consumption behavior is likely to be changed by a water fee, but the revenue-raising prospects are limited. Although water demand is often assumed to be inelastic, studies that separate water demand by season have found that household water demand is

inelastic in winter but elastic in summer. Others have found that water demand by industrial and agricultural users is sensitive to price changes.

To promote water conservation, many have suggested the use of rate schedules that impose higher rates per 1,000 cubic feet as use increases. Two periodic surveys give an indication as to the type of rates that water utilities use. The Ernst & Young survey focuses on only the largest urban utilities, while the EPA Community Water System Survey is a more comprehensive, random-sample survey that includes smaller utilities. The Ernst & Young survey of residential rates for about 130 utilities reported that 38% use decreasing rates, 37% use uniform rates, and 22% use increasing rates. It also shows two trends over time: a greater use of increasing rates and a lesser use of decreasing rates.

EPA's Community Water System Survey obtained residential rates from more than 1,000 systems: 49% use uniform rates, 16% use decreasing rates, and 11% use increasing rates. Since utilities could report more than one type of rate per class of customer, the total for all rate types is more than 100%. Taken together, these two surveys suggest that smaller utilities in general are less likely to use increasing or decreasing rates than larger utilities.

Figure 1. U.S. Water and Wastewater Charges
(monthly average fee)



Source: Ernst & Young. 1994. (3)

As shown in Figure 1, periodic surveys of selected water utilities indicate that water and wastewater fees have risen significantly since 1986. These price increases have exceeded the rate of inflation. In addition, EPA's Community Water System Survey notes the tendency for large utilities to raise rates more frequently than small utilities. Smaller utilities raise rates by a greater amount when they do raise rates, but the differences are less dramatic when reported in annualized terms.

In addition to water and wastewater charges, storm water charges have been imposed in a number of areas. Ernst & Young found that the number of utilities with such charges increased significantly from 1992 to 1994. Their use varies significantly across regions: They are used by over half of all utilities surveyed in the West but by none surveyed in the Northeast. In some areas, reduced storm-water fees are assessed in return for measures that promote storm water management.

Many other OECD nations and also a number of developing nations impose charges for the use of municipal sewer systems. As is the case in the US, wastewater discharge fees are based on metered water consumption since discharge itself is not measured.

B. Industrial Effluent Fees

Effluent discharge fees are found in many nations of Europe and also in a number of developing nations. This section describes systems in France, Germany and the Netherlands, as well as effluent discharge fees in several developing nations. The intent here is to describe systems where fees are set high enough to have a positive impact on environmental quality. Many effluent fee systems in Europe and the former Soviet Union impose very modest fees with revenue raising for administrative cost recovery the primary objective, not improving environmental quality.

France

France's six river basin authorities, each with a committee and an agency, have been levying effluent charges since 1968. Each river basin's committee functions like a parliament, while each agency serves as an executive body. Each river basin board sets its own charge rates annually, subject to approval by the basin committee.

The original basis for assessment was weight of suspended matter and weight of organic matter, since these two pollutants were relatively easy to detect and control. Charge parameters were later expanded to include salinity (1973), toxicity (1974), nitrogen and phosphorus (1982), and halogenated hydrocarbons, toxics, and other metals (1992). Discharges are estimated based on the emissions class and activity level of the discharger or, in the case of municipalities, on the basis of population and daily discharge per inhabitant. The basin authorities and dischargers may request actual measurement, the costs of which are borne by whoever makes the request.

The charge applies to all municipalities with more than 400 inhabitants and to all non-municipal facilities discharging at least 200 population equivalents a year. For facilities connected to a public sewage system, the charge applies only if discharges exceed 6,000 m3 per year.

It is not clear to what extent the charges have discouraged pollution since the charges are designed primarily as revenue-raising instruments. Charge levels are based not on perceived environmental costs of discharges but rather on the revenue needs of the river basin authority. The effluent charges, as well as fees for extracting ground and surface water, generate revenues that are used mainly to finance water pollution control investments by farmers, industry, and municipalities. Some of the assistance takes the form of low-interest loans, but most of it is grants that usually cover 30%-50% of the total cost of a given investment. During the period 1982-1991, $6 billion in assistance was provided for projects totaling $14 billion in expenditures. The 1992-96 action plan provided for $6.5 billion in assistance for projects costing a total of $15 billion.

Germany

Based on the 1976 Federal Effluent Charge Law, effluent charges have been collected by German states (Länder) since 1981. Although collection is left to the states, the charge calculation rules, charge amounts, and damage unit parameters are determined at the federal level. German states do not have the autonomy to set effluent charges that U.S. states have in setting the NPDES permit fees.

Effluent charges for point sources are based on "damage units" dependent on quantities and types of pollutants. One damage unit is defined as 50 kg organic matter (COD), 3kg phosphorus, 25 kg inorganic nitrogen, 2 kg halogenated hydrocarbons (AOX), 20 g mercury (and compounds), 100 g cadmium (and compounds), 500 g chromium, nickel or lead (and compounds), 1 kg copper (and compounds), or 3,000

m3 of wastewater divided by T(f), where T(f) is the dilution factor by which the waste water must be diluted in order to lose its acute toxic effect on fish. Separate assessment methods are used for stormwater and for discharges from inhabitants not connected to the sewage system.
Charge assessment is based on discharges allowed in state-issued permits. Dischargers without permits or with permits lacking discharge limits pay charges based on their declared discharges. Charges are raised if permitted discharge limits are exceeded. Most monitoring is left to polluters with random spot checks by the authorities. However, if a polluter declares in advance that its discharge levels will be at least 20% below levels allowed in its permit over a period of at least three months, the charge is assessed on the basis of the projected reduced discharge level.

The charge amounts can be reduced in several ways. If a discharger uses Best Available Technology for hazardous pollutants and Generally Agreed Technology Standards for non-hazardous pollutants, its charge per damage unit is reduced by 75%. In addition, investments in treatment facilities are rewarded by reduced charges for a period of three years prior to completion of the new facility, provided that the facility will reduce pollution by at least 20%.

The Netherlands

Introduced in the 1970 Pollution of Surface Waters Act, effluent charges in the Netherlands are believed to have significant incentive effect on polluters. For discharges into federal waters, charges are imposed and collected by the federal government. For discharges into regional waters and into sewerage, charges are imposed and collected by regional water boards, which are also responsible for building and operating wastewater treatment plants. Regional charges are the same for indirect as for direct discharges and vary by region. The main reason for the variation is not regional differences in impacts of pollution but rather differences in costs associated with wastewater treatment.

Charge revenues have risen significantly since they were first introduced. The revenues cover nearly all public wastewater treatment plant construction and operation costs. Charge administration costs have been estimated at 3.5% of revenues. Charges are based on pollution units. For oxygen-consuming substances, a pollution unit is defined as the average amount of oxygen-consuming material produced by one person in one day, which is further defined as 136 g of oxygen-producing material. For heavy metals discharged into federal waters, one pollution unit is defined as 100 g of the sum of mercury, cadmium and arsenic, and 1,000 g of the sum of copper, zinc, lead, nickel and chromium. For discharges to sewerage and regional waters, arsenic discharges are included in the latter group.

For charge assessment purposes, there are three groups of dischargers:
1. For households and businesses generating fewer than 5 pollution units per day, charges are usually fixed at 3 pollution units. This group accounts for about 65% of charge revenues.

2. For dischargers of 5 to 1,000 pollution units (in some industries, the maximum is 100 pollution units) of organic pollutants per day, charges are determined by combining an industry coefficient with easily obtainable data such as water use and amounts of raw materials. Facilities that believe they are being overcharged can, at

their own expense, conduct sampling and measurement and be charged according to the findings. This group contributes approximately 15% of charge revenues.

3. Industrial facilities and municipal sewage treatment plants generating more than 1,000 pollution units per day of organic pollutants or more than 10 pollution units of heavy metals are charged according to actual discharge, which they are expected to measure. Municipal treatment plants are not charged for discharges into regional waters and pay a reduced rate for discharges into federal waters. This group accounted for approximately 20% of charge revenues.

The first two groups face a pollution charge that is not directly linked to pollution. The third group, however, faces pollution charges directly linked to the quantity of pollution they discharge. For this group, the effluent fees are believed to have a significant effect on the quantity of pollution discharged.

Developing Countries

Egypt imposes effluent fees on industrial discharge equal to one piastre (about one-fourth of one U.S. cent) per cubic meter. Several Eastern European countries have imposed effluent fees on industrial discharge. These countries, as well as China and most of the former Soviet Union, also impose non-compliance charges for discharge in excess of certain specified amounts. Revenues from most of these charges are used to fund environmental protection activities, but Slovenia's charge generates revenues for the general federal budget.

Like other environmental charges in Eastern Europe and the former Soviet Union, many of the effluent charges are limited in their effectiveness by problems such as weak enforcement, polluters' inability or unwillingness to pay, and inflation. In 1993, for example, Poland's charge collection rate was only 53%. Slovak charge revenue fell in local currency by 28% from 1992 to 1993 because of polluters' financial hardships and recession. Lack of widespread interest in environmental issues, limited experience with incentive mechanisms, and complicated charge mechanisms have also been cited as problems with charges in Eastern Europe.

Four states in Brazil have introduced (or begun to introduce) charges for industrial sewage treatment based on pollution content. Sewage charges in Sao Paulo State, which are based on pollution content, have been found to have a significant impact on pollution. Reductions had been achieved through changes in production methods, use of cleaner inputs, and recycling. Having significantly underestimated the responsiveness of polluters to increased charges, the state sewage treatment company now suffers from excess capacity at a treatment plant.

China, India, Korea, Malaysia, the Philippines, and Thailand are among the Asian countries to have imposed effluent fees.

Malaysia

Palm oil and rubber factories in Malaysia have been subject to a variable fee for BOD discharge. For land discharges, the fee is purely volumetric; for water discharges, the fee is based on quantity of BOD discharged and varies with BOD concentrations. The fee is two-tiered: a low level up to the concentration standard, and a higher level above the standard. There is a minimum fee of RM150; charges are RM 0.05/ton of wastewater for land discharges; RM 10/ton of BOD for water discharges up to the standard; and RM 100/ton of BOD for water discharges above the standard. Starting

in the second year of the regulations, the standard became mandatory. The two-tiered charge system continued, but mills that violated the standard faced a real threat of being shut down (between 1991 and 1994, 27 crude palm oil mills had their licenses temporarily suspended for violations; in 1996 licenses of another 4 crude palm oil mills and 4 raw natural rubber factories were suspended). In 1995, effluent charges on crude palm oil and raw rubber generated RM 1,031,439, equal to 6% of the Department of Environment's annual budget.

The regulations produced a dramatic drop in BOD emissions: a 2/3 reduction in the first year, and a 99% reduction after 7 years. Vincent et al. (1997) argues that relatively little of this can be attributed to the effluent charges, however, as it was the threat of shutdown that appears to have motivated most action. Some mills might have reduced their concentrations below the standards due to the charges, but because of the minimum payment, this was probably negligible. There were several problems with the use of the BOD charges as an incentive to reduce emissions. First, due to the minimum charge, mills had no incentive to reduce water discharges below 15 tons. Second, when the standard became mandatory, the main instrument became the standard and threat of shutdown, not the charge. Third, charge levels were not linked to any estimate of marginal benefits and marginal costs of pollution abatement, but were instead based on agency estimates of the level that would reduce discharges without imposing a major burden on industry.

Philippines

Laguna de Bay, also known as Laguna Lake, covers 90,000 hectares making it the second largest freshwater lake in southeast Asia. Located partially within the confines of Metro Manila, the lake is an important fishing area for the local people, provides water for commercial, industrial and household use, and also serves as a disposal area for liquid wastes. Over time, the lake was overwhelmed with wastes, resulting in polluted water and large-scale fish kills. The Laguna Lake Development Authority (LLDA) was created by a Republic Act in 1966 as a quasi-governmental agency to manage development activities within the lake basin. A 1975 executive order expanded the role of LLDA to include environmental protection and sustainable development of the water, fisheries and shore lands.

LLDA's jurisdiction includes twenty-one river tributaries of Laguna de Bay, five provinces (referred to as CALABARZON), sixty-six municipalities, and nine cities (including the capital, Manila). Within this area, LLDA identified fifteen industrial estates with approximately 3,200 facilities, as well as about 10,000 stand-alone manufacturing facilities. Although the Philippine Department of Environment and Natural Resources supervises LLDA, it remains an independent body through a special charter. The government owns 94 percent of it and private investors own the rest. LLDA receives no funds from the national budget. As such, it retains, invests, and uses collected fees without turning them over to the national treasury.

A World Bank study conducted by Hagler Bailly reviewed effluent charge systems used in France, Germany, Malaysia, the Netherlands, and the United States as possible mechanisms for improving water quality in Laguna Lake. The study showed that charge systems can be very effective tools in stimulating effluent reductions. The bank recommended that LLDA be allowed collect fees at Laguna Lake because it is a government-operated and -controlled corporation with its own budget and board of directors. It is an attached agency of the Department of Environment and Natural

Resources (DENR), but unlike DENR, LLDA can directly use revenues from the fee to pay for the administration of the program and finance wastewater treatment programs.
Officially launched on January 29, 1997, the user's fee program focused on reducing the biological oxygen demand (BOD) of wastewater flowing into the lake by charging industries and commercial operations a pollution fee. Initially, the program targeted industries in sectors responsible for 90 percent of the industrial wastewater flowing into the lake and its major tributaries. These include food processing, beverage firms, hog raisers, slaughterhouses, and textile mills. Later, the program will also include major municipal and household sources of wastewater.

LLDA requires that firms pay their estimated user fees for the year before a discharge permit is issued. LLDA established its fee schedule using a numerical model of discharge activities and the objective of achieving a 50 percent reduction in the BOD load of the lake water within the first year of implementation. To achieve this reduction, the fees had to be higher than the incremental costs of pollution prevention or treatment for many sources.

LLDA assesses two concurrent fees at the plant level on pollution discharges based on both volume and pollution load, providing incentives for water conservation and pollution abatement. LLDA levies a fixed fee based on the volume of wastewater discharged by the facility and a variable fee based on the amount of BOD discharged. The fixed fee is P5,000 for daily discharge up to 30 m^3, P10,000 for discharges between 30 and 150 m^3 per day, and P15,000 per year for more than 150 m^3 per day (P35 ~ $1 at the time the program was implemented). For wastewater that meets the government Class C standard of less than 50 milligrams per liter BOD concentration, the variable fee is P5 for every kilogram of BOD released. Wastewater that does not meet the standard is charged P30 per kilogram. For existing industries, the P30/kg rate is higher than the cost of installing wastewater treatment facilities, giving firms a financial incentive to invest in treatment or pollution prevention.

LLDA maintains an environmental fund to help administer the system. Fee revenues are placed here to (1) subsidize owners' clean technology investments through grants or loans, (2) recover the costs of administering the system (data management, monitoring, and so on), and (3) obtain loans in the capital market to build domestic wastewater treatment plants. In 1998, LLDA collected P6.7 million ($174,000 at 1998 exchange rates) through its Environmental User Fee Program. As fees are collected, LLDA has hired more staff and added more firms to the system. By December 2000, 659 of the 4,000 firms in the basin were covered by the discharge fee system.
Relative to a 1993 baseline, the program had achieved a reduction in BOD of 73.6% by 1999. As of December 2000 the lake had maintained its Class C status -- indicating it was suitable for fish culture and industrial use.

The effort to improve environmental conditions in the Laguna Lake watershed also involves a number of voluntary efforts. LLDA enlists the support of local industries, communities, media, and NGOs to help improve the water quality of the lake and its twenty-one major tributaries. LLDA recruited industries along the tributaries to work with local governments, local fishing organizations, and environmental and church groups to devise and implement a rehabilitation plan for their adopted tributary. Activities include collecting baseline data, cleaning solid waste from the tributary and

its banks, planting vegetation along the banks, installing low-cost garbage traps at the mouth, and dredging where necessary.

China

The PRC initiated the pollution levy system in 1978, based on the "polluters pay principle". First stipulated in *the Environmental Protection Law of the People's Republic of China* (tentative) in 1979, the system is referred to in subsequent legislation on air pollution, water pollution and waste. In *the Tentative Regulation on Levying Discharge Fee* (1982) and *the Tentative Regulation on the Repayable Usage of Specific Fund for Pollution Sources Control* (1988), the State Council describes the levying targets, levying scope, levying standards, fee calculation methods, levying procedure, and fee management and use. The system now is operational in all the provinces, cities, and counties in the PRC. The pollution charge system may be characterized as a comparatively mature and effective environmental management system, though a number of reforms are planned.

From the outset, the PLS was viewed as a means of legitimizing the polluter-pays principle and providing a source of funding for provincial and local Environmental Protection Bureaus (EPB). Another important feature of the PLS is that a large portion of the funds that are collected are returned to the enterprises for pollution control investments.

The air and water laws establish a system of concentration-based standards for emissions and effluents from point sources. For effluents, pollution levies are imposed on all releases for the substance that exceeds the standard by the greatest amount. For emissions to the air, pollution levies again are applied to the substance most in excess of the standard and only to the above-standard amount. For example, a fee of 0.04 yuan/kg applies to SO_2, Cl_2, CS_2, CO, HCl, fluoride, and NOx emissions in excess of the standards. For coal dust and cement dust, the fee is 0.02 yuan/kg. Coal is charged a fee of 3.0 yuan/kg if emissions exceed standards by no more than four times. In 1993 the effective levy rate on wastewater discharges not meeting the standard was 0.13 yuan per cubic meter.

The first formal indication of interest in limiting SO_2 emissions in the PRC is the State Council's 1990 "Suggestions on the Development of Acid Rain Control." The document recommends the creation of two control areas or zones, one for acid rain in the south of the PRC where the pH of precipitation is below 4.5 and one for SO_2 in several industrial cities in the north where ambient concentrations exceed Class II standards. Together the two control zones cover approximately 11.2% of the territory of the PRC and include over three-fourths of the population. A total of 47 of the 275 municipalities within the two control zones were declared "key" and they are targeted for the most ambitious control efforts.

National minimum rates were increased once in 1991; however, many provinces impose higher rates. In the recently designated SO_2 and acid rain control zones, excess SO_2 emissions have incurred a fee of 0.20 yuan/kg since 1998. Several large cities in the SO_2 and acid rain control zones also have raised their rates above 0.20 yuan/kg. Beijing's is the highest at 1.2 yuan/kg (equivalent to $150 per metric ton and approximately the same price as SO_2 allowances in the US Acid Rain trading program).

Many of the important polluters in the PRC are state-owned enterprises (SOE) and many Township and Village Enterprises (TVE) operate in a financial collaboration with local government authorities. While the PRC has freed most internal prices, the profit motive of an SOE or a TVE that is run in cooperation with a local government cannot be as strong as in a private company. Consequently, the response of firms in the PRC to a pollution levy also may not be as strong as it would be in other economies. While the PLS seems to have been reasonably effective in reducing pollution, other factors such as responsibility contracts signed by enterprise managers and local government officials as part of the five-year planning process may be more important in determining the pollution intensity of industrial activity.

As originally implemented, the PLS had the following features:

- It applied to 113 items that belonged to one of five groups of pollutants: air emissions, effluents, solid waste, noise and radioactive substances.
- The amount of levy was based on pollutant concentrations at the point of release, rather than mass or volume. In 1993 volume became a determinant of the levy on wastewater and in 1998 mass emissions of SO_2 were subject to the levy.
- Generally the levy applies only to the portion of discharges whose concentrations exceed national or local emission standards, however this changed for effluents in 1993 and for SO_2 in 1998, as noted above, and now applies to all releases of these substances.
- For sources releasing several pollutants into the same medium, only the most highly-taxed pollutant was levied.
- The magnitude of the levy is much lower than incremental pollution control costs, suggesting that the levy itself cannot have a major influence on polluting behavior.
- The pollution levy was assessed only on industrial sources. Sources such as municipalities, hospitals and schools are exempt.
- Discharge concentration standards apply nationally, however provincial and local governments may adopt more stringent standards
- Other charges (known as the “four small pieces”) provide further incentives for sources to comply with the PLS.

Environmental supervision and management divisions of local Environmental Protection Bureaus collect the levy. Generally about 80% of the amount collected is returned to sources to help finance pollution control investments. The remainder is the principal source of income for local and provincial EPBs. The partial recycling of PLS revenue to polluting enterprises finances between 20% and 25% of total PRC investment in pollution abatement. The PLS revenue retained by local and provincial EPBs contributes importantly to environmental management capacity in the PRC.

Since the early 1990s, the PLS has been the subject of several evaluations by the Chinese Research Academy for Environmental Science (CRAES) and the World Bank. While recognizing its important positive role, these reviews have identified several deficiencies. The deficiencies may be grouped in three categories: 1) design of the pollution levy, especially the tax base and charge rate; 2) extent to which the pollution levy applies to polluters and pollutants; and 3) mechanisms of distributing levy revenues.

While many reviewers have criticized the Pollution Levy System, analysis of plant cost functions suggests that it should achieve positive results. A World Bank study (Dasgupta, Huq, Wheeler, and Zhang, 1996) shows that effluent charges as low as $1 per ton should induce an 80% abatement of suspended solids. If charges were $3, $15 and $30 per ton respectively for TSS, COD and BOD, firms would have an incentive to reduce effluent by 90%. This suggests that the current pollution levy should have a significant effect on cost-minimizing PRC firms, an effect that could be strengthened by increasing charge levels and, especially, applying charges to all effluents, not just effluent in excess of the standard. A recent paper by Wang and Chen (1999) notes that the recycling of about one-half of charge revenues for pollution control at the paying facilities should further increase pollution control efforts.

By 1996, the PRC had imposed pollution levies on 496,000 polluting units with charge collections that year of 4.1 billion yuan and accumulated charges of 29.06 billion yuan. About 25% of the country's industrial enterprises currently are levied. Collections and the number of firms levied are shown in the accompanying figure. Levy collections have not kept pace with the value of industrial output because the charge rates have been fixed while price changes have been significant. Also, some enterprises have complied with emission standards because of enforcement and as a result are not subject to levies for air pollution. Many Township and Village Enterprises (TVE) are not levied at all because local Environmental Protection Bureaus (EPB) do not have the resources to pursue all sources within their jurisdiction or find that the potential revenues from levying smaller sources does not justify the effort.

During the ten years from 1986 to 1995, charge revenue increased about four-fold in nominal terms, but just 2.13 times in real terms. In the whole country, the proportion of total charge revenue to the value of industrial output decreased from 0.106% in 1986 to 0.040% in 1995. For TVEs, the proportion of charge to TVE industrial output value decreased from 0.025% in 1986 to 0.009% in 1995. Since TVEs generally use less advanced technologies, one would expect them to be paying relatively more in pollution levies, not less than average. This suggests the desirability of increasing efforts to impose the pollution levy on a larger proportion of the TVEs.

C. Fees, Charges and Taxes on Inputs

1. U.S. Superfund Taxes

Until the end of 1995, the federal government imposed taxes on oil, chemicals, and business profits to fund the cleanup of inactive hazardous wastes designated under Superfund. This activity was financed by taxes on crude oil (9.7 cents per barrel), chemicals ($0.22-$4.87 per ton), and gross business profits (0.12% of amounts over $2 million). Congress did not extend the tax after its scheduled expiration. The oil and chemical taxes could be regarded as product charges or raw material input taxes. Their primary purpose, however, was to raise revenue, rather than to prevent pollution.

2. Charges on Agricultural Inputs

Several countries have imposed product charges on pesticides and fertilizers. Estimates of price elasticity of demand for these products vary widely, depending perhaps on the time period studied, crops, geographic area, and other factors.

However, some of these charges are more likely to have incentive impact than the relatively low charges imposed on these products by U.S. states. Norway has levied charges on fertilizers and pesticides since 1988. The fertilizer taxes are NKr 1.17 ($0.18) per kg of nitrogen and Nkr 2.23 ($0.35) per kg of phosphorous, resulting in average taxation of approximately 7% of the wholesale price. The pesticide tax is 13% of the purchase price. In Finland, charges of Mk. 1.5 ($0.32) per kg were imposed on phosphate fertilizers in 1990. Relatively low charges on fertilizers in Austria, which are no longer in effect, are reported to have had a significant impact on fertilizer use.

In Denmark, retail sales of pesticides are subject to a 20% tax. One study estimated the price elasticity of demand for pesticides in Denmark at -0.3. This estimate suggests that the 20% tax reduces pesticide use by roughly 7%.

Sweden imposed two different charges on fertilizers in the 1980s. At their highest level, in 1991, the charges equaled 30-35% of the sales price of phosphate and nitrogen. The charges have had a significant impact on fertilizer use with its use falling by more than one-third. The amount of land under cultivation has also decreased but not in the same proportion as fertilizer use. The reduction in use appears to be most significant during the period when the tax was at its highest. The Swedish Board of Agriculture administers the charge. Its annual administrative costs associated with the charge have been estimated at 500,000 SEK ($74,000), roughly 0.4% of total annual charge revenues. Revenues from the price regulation charge have been used to subsidize agriculture, while revenues from the environmental charge have been used to promote sustainable agriculture, including investments in manure management and research and educational programs. Some of the reductions in fertilizer use can probably be attributed to the educational activities funded by the environmental charge.

At least 46 states in the United States impose charges on the sale of fertilizers. Nebraska's fee of $4 per ton is one of the highest; most are below $1 per ton. Assuming fertilizer prices of $150–$200 per ton, the charges are too low to significantly influence the use of fertilizer. The most common use of these charge revenues is the inspection of fertilizers and fertilizer storage by state agencies.

TRADING

Trading Water Rights

Trading in water rights is a relatively new phenomenon, with most examples dating from the 1980s or 1990s. Three cases are discussed here: the Murray-Darling Basin in Australia, Chile, and California's Central Valley. Until a few years ago, tradable water rights were an important feature of water management at some of the oases in the Western Desert of Egypt.

1. Australia

The Murray-Darling Basin has tradable water rights and also has periodic water allocation auctions. These allocations are tradable. Volumes traded, although small compared to total water allocations, have increased steadily. Since temporary trading, or leasing of water entitlements was introduced in 1989 in the Goulburn Murray Irrigation District of Victoria the volume traded each year has increased. In New Zealand, water use permits may be transferred to another site provided that both sites are in the same catchment area, the transfer is allowed by a regional plan, and the transfer application has been approved by the permitting authority.

2. Chile

Under Chile's 1981 Water Code, water use rights are completely separate from land use rights and can be purchased, transferred, or sold. New water rights are awarded by competitive bidding. Partly because most water rights (perhaps 50%-65%) are traditional but not legally recognized, water leases are far more common than sales. In one area north of Santiago, the price of a three-month lease was estimated at $90-120 per liter per second. Transaction costs are said to be relatively high because of the need for infrastructure investments to transfer water, the need for approval from government authorities, and the lack of legally recognized water rights. In general, however, the system appears to promote efficient water allocation. Intra- and intersectoral gains-from-trade of water use rights have been significant.

3. United States

Water rights trading between states does not happen yet in the U.S.; however within some states active markets in water rights have developed, mostly in the arid western states. The most active market is in California. Cities have been buyers of water rights from farmers, while irrigation districts in the water short Central Valley regularly purchase water rights from other irrigation districts. CalFED has accelerated that process. CalFED, a state-federal program adopted in June 2000, calls for the creation of a new water market. In anticipation of that market, a large number of enterprises have been established to buy and sell water rights (e.g., Water Bank, Cadiz, Vidler Water -- a subsidiary of NYSE-listed PICO Holdings).

Water rights trading takes place in other states, but no comprehensive list of such initiatives was identified during the course of the research for this report.

B. Trading Effluent Discharge Requirements

1. United States Experiences

Despite many academic studies showing the potential benefit of effluent trading and considerable effort by EPA and the states to implement the concept, effluent trading has yet to live up to its full promise. While conceptually very similar to emission trading (which deals with emissions to the air), effluent discharge and its regulation also differ significantly from emission trading because effluent trading deals with emissions to the water.

Both point and non-point sources contribute to water pollution. *Point sources* discharge pollutants into surface waters through a conveyance such as a pipe or ditch. Primary point sources include publicly owned treatment works (POTWs) and industries. *Non-point sources* add pollutants from diffuse locations such as surface agricultural runoff or unchannelized urban runoff. The most important non-point source of water pollution is agriculture. The differences between emission trading and effluent trading have made it difficult to design practical programs that can capture the potential benefits of effluent trading. New efforts by EPA to implement its Total Maximum Daily Load (TMDL) program in areas with impaired water quality are expected to vastly increase the use of effluent trading. For current EPA efforts to promote effluent trading, see the following table.

Table 3. Effluent Trading Projects

PROJECT	WATER BODY	STATE	ACTIVITY DESCRIPTION	STAGE	TRADES/ OFFSETS APPROVED?	SAVINGS ESTIMATE AVAILABLE?
Grassland Area Tradable Loads	San Joaquin River	CA	Watershed trading program	Implementation	Y	N
San Francisco Bay Mercury Offset	San Francisco Bay	CA	Regional offset program	Under development	N	N
Bear Creek Trading Program	Bear Creek Reservoir	CO	Watershed trading program	Approved	N	N
Boulder Creek Trading Program	Boulder Creek	CO	Watershed trading program	Implementation	Y	Y
Chatfield Reservoir Trading Program	Chatfield Reservoir	CO	Watershed trading program	Approved	N	N
Cherry Creek Basin Trading Program	Cherry Creek Reservoir	CO	Watershed trading program	Implementation	Y	N
Dillon Reservoir Trading Program	Dillon Reservoir	CO	Watershed trading program	Implementation	Y	N
Long Island Sound Trading Program	Long Island Sound	CT	Large watershed trading program	Under development	N	Y
Blue Plains WWTP Credit Creation	Chesapeake Bay	DC	Single trade	Under development	N	N
Tampa Bay Cooperative Nitrogen Management	Tampa Bay	FL	Regional cooperation	Implementation	Y	N
Cargill and Ajinomoto Plants Permit Flexibility	Des Moines	IA	NPDES permit flexibility	Implementation	Y	N
Lower Boise River Effluent Trading Demonstration Project	Boise River	ID	Watershed trading program	Under development	N	Y
Specialty Minerals Inc.	Hoosic River	MA	Offset for one discharger	Implementation	N	Some
Town of Acton POTW	Assabet River	MA	Offset for one discharger	Under development	N	Some
Wayland Business Center Treatment Plant Permit	Sudbury River	MA	Offset for one discharger	Implementation	Y	Y
Maryland Nutrient Trading Policy	Chesapeake Bay, other MD waters	MD	Statewide trading program	Under development	N	N

Kalamazoo River Water Quality Trading Demonstration	Kalamazoo River, Lake Allegan	MI	Watershed pilot program	Implementation	Y	N
Michigan Water Quality Trade Rule Development	MI Waters	MI	Statewide trading program	Nearing completion	N	Y
Minnesota River Nutrient Trading Study	Minnesota River	MN	Watershed trading study	Completed	N/A	Y
Rahr Malting Plant	Minnesota River	MN	Offset for one discharger	Implementation	Y	N
Southern Minnesota Beet Sugar Plant	Minnesota River	MN	Offset for one discharger	Implementation	Y	N
Chesapeake Bay Nutrient Trading	Chesapeake Bay	multi	Large watershed trading program	Under development	N	N
Neuse River Nutrient Strategy	Neuse River Estuary	NC	Watershed trading program	Approved	N	Y
Tar Pamlico Nutrient Program	Pamlico River Estuary	NC	Watershed trading program	Implementation	Y	Y
Passaic Valley Sewerage Com. Effluent Trading	Hudson River	NJ	Pretreatment program	Implementation	Y	N
Truckee River Water Rights and Offset Program	Truckee River	NV	Offset for one discharger	Implementation	Y	N
New York Watershed Phosphorus Offset Pilot Programs	Hudson River	NY	Offset pilot programs	Implementation	Y	N
Claremont County Project	Little Miami River, Harsha Reservoir	OH	Potential regional trading project	Under development	N	N
Delaware River Basin Trading Simulation	Delaware River	PA	Watershed pilot program	Early discussion	N	N
Henry Co. Public Service Auth. And City of Martinsville	Smith River	VA	Single trade	Implementation	Y	N
Virginia Water Quality Improvement Act and Tributary Strategy	Chesapeake Bay, other VA waters	VA	Statewide trading program	Approved	N	N
Wisconsin Effluent Trading Rule Development	WI waters	WI	Statewide trading program	Pilots active	N	N
Fox-Wolf Basin Watershed Pilot	Green Bay	WI	Watershed pilot program	Approved	N	Y
Red Cedar River Pilot Trading Program	Tainter Lake	WI	Watershed pilot program	Approved	N	Y
Rock River Basin Pilot Trading Program	Rock River Basin	WI	Watershed pilot program	Under development	N	N

Source: EPA. Reinvention Activity Fact Sheets. Effluent Trading in Watersheds

2. Trading Salt Credits in Australia

Three states in Australia take part in the Murray-Darling Basin Commission, which manages water resources for an area in which over half of Australia's agricultural output is produced. The basin system is naturally saline, with some stream inflows saltier than the sea. Extensive irrigation activities in the upstream states of New South Wales and Victoria, encouraged by the sale of irrigation water to farmers at low prices, increased the flow of salt into the river system, reducing water quantity and quality to the downstream state of South Australia. Irrigation activity in South Australia further added to salinity levels of the water before it reached downstream urban users.

Under the Commission's salinity and drainage strategy, each state is responsible for its actions affecting river salinity and no actions are permitted that increase overall river salinity. Credits can be earned for investments that limit the entry of salt into the river system. The credits are used to offset debits for drainage into the system. These credits are transferable between states but not between individuals and businesses.

SUBSIDIES

A. Subsidies for Improving the Environment

Subsidies are the mirror image of emission taxes. Rather than taxes to encourage firms to reduce emissions, the subsidy approach offers cash payments to firms for reducing emissions. Polluters who release emissions forgo the cash payment. Under a subsidy system, polluters have an incentive to control all units of pollution whose marginal control cost is less than the subsidy. Subsidy systems for pollution control are especially popular in two sectors: farming and municipal government. Economists point out a major drawback of subsidy systems. While existing firms, farmers and the like, have an incentive to reduce their pollution, new entrants may be attracted by the higher profits earned as a result of subsidies. In some extreme situations this could have the perverse effect of increasing total pollution. Several examples of subsidy instruments in developing countries are summarized in the following table.

Table 4. Selected Environmental Subsidies

Country, instrument, and source of data	Description of instrument
Indonesia—tariff reductions for wastewater treatment equipment (O'Connor 1994)	Tariffs are reduced on imported wastewater treatment equipment.
Korea—low interest loans and income tax deductions for purchase of energy-saving equipment. (O'Connor 1994)	Under the Energy Utilisation Act of 1979, low interest loans are provided for a variety of energy-efficiency investments. Firms that produce energy-saving equipment receive a corporate income tax deduction of 10%; firms that import this equipment receive a deduction of 3%.
PR China -- reduced tariffs for pollution control equipment and other advanced technology goods	The PR China has made great efforts to encourage the use of imported high-technology goods, including pollution control equipment, through reductions and in some cases exemptions from tariffs and customs duties.

Country, instrument, and source of data	Description of instrument
Philippines—tax exemptions for pollution control equipment (ADB 1997a)	Exemptions of up to 100% of import duties and local taxes are given on anti-pollution devices for industries covered by the Investment Priorities Plan. (Before 1984, the exemption was for up to 50% of tariffs on imported pollution control equipment.) A tax exemption for pollution control devices of up to 5% of income is being considered. ADB (1997a) comments that the operating costs of pollution-control devices is typically greater than the expected value of existing fines for violating pollution standards. It is therefore unlikely that the policy has reduced pollution.
Thailand—import and income tax exemptions for pollution control activities (Anantanasuwong 1997)	Pollution control equipment not produced in Thailand is exempt from import duties, and foreign specialists working on pollution control activities are exempt from income taxes.

Source: HIID, 1999, and others.

B. Environmentally Harmful Subsidies

1. Developing Countries

Egypt subsidizes many activities, a number of which could be termed environmentally unfriendly. Some of these subsidies are being reduced or eliminated. For example, as a conditionality requirement for project lending, the World Bank succeeded in having Egypt reduce substantially its subsidies for agricultural fertilizers and pesticides.

In much of the world, forest resources, waste collection, water, and electricity are priced far below their long-run marginal cost. It has been estimated that tax benefits for businesses contributed to 5% of the total area deforested in the Brazilian Amazon. Fertilizers and pesticides, which are taxed in several European countries, are subsidized in parts of Asia. In much of the world, forest resources, waste collection, water, and electricity are priced far below their long-run marginal cost. Electricity is far cheaper in developing countries than in OECD countries. The World Bank has estimated that developing countries use about 20% more electricity than they would if consumers paid the true marginal cost of supply.

2. United States

In the United States, timber, minerals, water, and public grazing land have been priced below their true social cost and in many cases even below their private cost. For all of these resources, user fees have been assessed. However, to the extent that these fees are lower than the private cost of the resources or services on which they are charged, such resources and services are actually being subsidized to the detriment of environmental protection.

Livestock grazing fees on federal lands imposed according to a formula established by the 1978 Public Rangelands Improvement Act (PRIA) are widely believed to be below market value. Although fees have been between $1.35 and $1.98 per animal unit month (AUM) since 1986, the Bureau of Land Management (BLM) and Forest Service estimated that fair market values were $4.75 per AUM for sheep and varied across regions from $4.68 to $10.26 per AUM for cattle and horses. State and private fees are significantly higher than PRIA fees. Data from the National Agricultural Statistics Service indicate that in 1993, private fees in 17 western states averaged $9.80 and state government fees average $4.58.

U.S. Bureau of Reclamation irrigation water subsidies in selected areas ranged from 57% to 97% of the Bureau's full water delivery cost. Excessive irrigation has been associated with a number of environmental problems, including water shortages and contamination of water with natural pollutants and agricultural inputs.

3. OECD Review

Based on an analysis and review of the literature on environmentally harmful subsidies, a 1998 OECD report concluded[6]:

- A subsidy can be defined as environmentally harmful if it encourages more environmental damage to take place than that which would occur without the subsidy.
- The largest percentage of support has been implemented through minimum price regulations, which increase the marginal revenues of the producer at the expense of consumers and taxpayers.
- Support in the OECD countries is mainly given to inefficient firms in mature industries in order to protect them from foreign competition.
- The tax jurisdiction under which the support measures are applied has a significant effect on the economic and environmental aspects.
- Support measures consist of a combination of direct financial mechanisms and regulations. Removing only one element from such combination will often have only limited influence.
- Support measures may also represent a rather weak beneficial effect on income, growth and employment, while having adverse effects on the environment.
- It is difficult to calculate the exact environmental effect of support policies across the sectors. A brief analysis may be completed through an examination of the elasticity of demand and supply in a given sector, the point of impact of the support measure in the market exchange, and direct and indirect links between the point of impact of the support and resulting pollution or other adverse impact.
- The positive effects of the support removal will often become apparent only after relatively long time span. Any estimates of the environmental benefits of support removal will necessarily depend on assumed technical development and the time horizon examined.
- Because of the increasing benefits that accrue over a longer time period the total environmental benefits of support removal will be larger than estimates based on empirical evidence.

POLLUTION DISCLOSURE

A. Color Coding Firms

1. Indonesia

Under Indonesia's **PROKASIH** (or Clean Rivers Program), the largest polluters are encouraged to sign agreements to reduce pollution by specific amounts over a specific time period. In the first 2 1/2 years after the start of the program, about 1,000 polluters signed agreements, the majority of which took measures to reduce pollution. The government has released information on which signatories have complied and which

[6] Subsidy Reform - Improving The Environment Through Reducing Subsidies

have not and encouraged press coverage of signatories' performance under the program.

In Indonesia, the Environmental Impact Management Agency (BAPEDAL) created the Program for Pollution Control, Evaluation, and Rating (**PROPER**) to rate factories on their compliance with national wastewater discharge standards, then discloses the ratings to the public. The first of these surveys in June 1995 rated 187 factories. Five color categories are used to rate environmental performance: gold for firms that use best technology and reduce pollution to 5% of the national standard, green for firms that reduce pollution to 50% of national standards, blue for compliance with national standards, red for firms that fail to meet national standards, and black for those without pollution controls.

Formal as well as informal sanctions apply, depending upon the color class. For example, the Indonesian stock exchange will not list securities of firms that fall short of the blue classification. Cultural factors such as shame avoidance and citizen lawsuits also play a role in motivating polluters. Evidence suggests that this system is influencing behavior. In the first survey in June 1995, 35.3 percent of the 187 factories were in compliance with the government's water pollution regulations. Two years later, 49.2 percent of the factories were in compliance.

2. Philippines

The **Industrial Ecowatch Project** is a compliance monitoring system introduced by the Philippine Department of Environment and Natural Resources in 1995. The idea is to use public disclosure (to the extent that firms valued 'reputation') to pressure firms to manage their pollution. A "gold" rating means that the firm is practicing resource conservation and pollution prevention, using clean technology and implementing self-regulation beyond the requirements of environmental regulations. A "green" rating indicates very good performance. A "blue" rating refers to minimum compliance with all applicable environmental regulations for at least one year. A "red" rating refers to compliance that falls short of the standards. Lastly, a "black" rating pertains to the absence of any effort to comply with regulations and a pollution level that is damaging to the environment.

Ecowatch is being implemented in the jurisdictions of the Laguna Lake Development Authority and the DENR-National Capital Region. The ratings of seventy-two firms were calculated in the DENR-NCR area. Based on initial confidential disclosure to the firms, only 4 industries made it to the blue rating. Before disclosure to the public was made, 22 firms improved their performance to a blue rating. Former President Ramos honored firms with blue ratings in April 1998. These firms have benefited from the recognition as full-page advertisements were launched to announce their environmental achievement. It appears that resources invested in the Industrial Ecowatch Project will pay dividends in the future. The payback is not only to the environment but also to the firms that get good media exposure for their products. Sooner or later, this will translate to more demand for their goods. With color-coding, firms have an economic incentive to manage their pollution.

The success in the adoption of Ecowatch is partly attributed to the assistance of two World Bank divisions: the Agriculture and Environment Division - East Asia I and the Policy Research Department, Environment, Infrastructure & Agriculture Division. Furthermore, the industries' reception of Ecowatch was not adversarial due to the participatory framework used in planning the project's mechanics. The industries themselves were partly responsible for the design of the Ecowatch system, which

includes area coverage and criteria for rating & timing. Also, the country's larger industry associations came together and supported the launching of the project.
The database of Ecowatch will be merged with the databases of the Pasig River Rehabilitation Program and the MIS Division of the EMB. This integration of data gathered from monitoring activities will strengthen the regulatory network as inspection and reporting will become easier. Also, other users will be given the opportunity to tap into this information resource.
Similar programs are being developed in Mexico, Columbia and the People's Republic of China.

B. Pollutant Release and Transfer Registers (PRTR)

For certain kinds of environmental problems and in certain social and institutional situations, the best regulatory solution may be to encourage the generation and dissemination of information about a problem. This approach recognizes that disclosing information can put pressure on businesses indirectly (rather than directly through administrative penalties such as fines or closures), and encourages them to engage in low cost measures to address the environmental problem rather than seeing business always as “the problem” to be regulated. A good example of this is the United States experience with the Toxic Release Inventory, which requires business to report the amounts of toxic materials that they emit into the environment. The simple fact of reporting led to a large reduction in the release of toxic substances. U.S. Vice President Gore has termed the TRI disclosure program "the single most effective common-sense tool" of U.S. environmental policy.

The US Toxics Release Inventory reporting system dates from 1987. Since then several other nations have developed similar systems. Known internationally as Pollutant Release and Transfer Registers (PRTR), these programs have their origin in the 1992 Earth Summit, officially called the United Nations Conference on Environment and Development (UNCED). Chapter 19 of Agenda 21, the Summit's action plan, calls on nations to develop such programs. The OECD, the World Bank, and UNEP have developed PRTR guidelines and offer assistance in developing such programs.
The early PRTR programs include Canada's National Pollutant Release Inventory (1993), the United Kingdom's Chemical Release Inventory, and Australia's National Pollutant Inventory. The Czech Republic, Denmark, Egypt, Finland, France, Ireland, Japan, Mexico, the Netherlands, the Republic of South Africa, Sweden, Switzerland, and Trinidad and Tobago presently are in various stages of implementing PRTR programs. Currently, pollutant release data by facility and for geographic regions are available on the Internet for the United States, Canada, Australia, and the United Kingdom.
Recently, the Environmental Defense Fund, a U.S. NGO, created an Internet site it calls "scorecard," that facilitates access to the U.S. data and enables the user to express directly to plant managers concerns about pollutant releases and their impact on environmental quality. In its Sector Facility Indexing Program, the USEPA makes available on the Internet detailed information on pollution releases and permit violations at industrial facilities in five industrial sectors. For the five sectors, a concerned citizen can determine pollution releases at individual facilities, whether a facility is in compliance with its environmental permits, and what fines its owners have paid for permit violations.

C. Drinking Water Quality Reports

In an August 19, 1998, notice in the *Federal Register,* the USEPA required the suppliers of drinking water to provide households with information on the quality of their drinking water, beginning in 1999. The reports must contain the following information:

- the lake, river, aquifer, or other source of the water;
- a brief summary of the susceptibility of the local drinking water source to contamination;
- how citizens can obtain a copy of the complete water system assessment from the supplier;
- the level (or range of levels) of any contaminants as well as EPA's health-based standards for the contaminants;
- the likely source of any contaminants;
- the potential health effects of any contaminants;
- the water system's compliance with other drinking water-related rules;
- an educational statement for vulnerable populations about how to avoid *Cryptosporidium;*
- educational information on nitrate, arsenic, or lead in areas where they are detected in quantities e that are more than 50% higher than EPA's standard; and
- telephone numbers for additional sources of information.

EPA encourages water supply systems to post water-quality information online, and the Agency maintains links to this information on the Internet.

LIABILITY FOR HARM TO THE ENVIRONMENT:

Liability for damage to human health and the environment can be a powerful incentive to encourage good environmental behavior by corporations, as well as to compensate those who are injured. If liability rules make polluters pay for the damage they cause they will control pollution to the point where the marginal pollution damage equals the marginal costs of control. At this point, the total costs of pollution to society (costs for controlling pollution and costs of damage) are minimized. If liability rules fail to make polluters pay for the harms they cause, polluters will recognize only their pollution control costs as a cost of doing business and damage costs will be borne by the victims. The result will be inequities and excessive amounts of pollution.

Liability can take two forms: civil law and common law. Civil liability is expressly written into law. Many environmental statutes worldwide have liability provisions, though environmental liability actions in developing countries are relatively rare. Jurisdiction is one problem: Should a case be brought in the developing country where the spill occurred or in the home country of the concern that caused the spill? As the examples here suggest, there is no universal rule regarding jurisdiction. Moreover, in some cases individuals harmed by spills are not compensated due to unclear liability rules or inadequate financial guarantees prior to the start of operations.

The first set of examples concern releases at mining sites (Baia Mare in Romania, Kumar in Kyrgyzstan, Los Frailes in Spain, Ok Tedi in Papua New Guinea, Omai in Guyana, Taipan in the Philippines, and Yanacocha in Peru). The second set of examples concern damage assessments for coral reefs in Egypt, the US, Puerto Rico and Australia. The principal lessons are twofold. First, liability for damage to natural resources and the environment can be an important economic tool in encouraging firms to act responsibly. However, unless the firms are well financed or forced to post large performance bonds, firms may use bankruptcy proceedings as a shield against liability.

A number of reforms are being debated. The Australian government is considering legislation that would require Australian companies operating abroad to adhere to the same environmental standards that apply in Australia. Elsewhere there are calls for mining and other extractive enterprises to post bonds or insurance to cover potential liabilities. Otherwise, the full costs of environmental harms will not be borne in the event of a serious polluting incident.

A. Mining Cases

1. Baia Mare, Romania

The Baia Mare region of Romania is heavily polluted from past mining and industrial activity. The company Aurul SA was established to improve the environment by removing and treating waste from mine tailings sites while extracting residual gold and silver. Aurul SA is a joint venture 50% owned by Esmeralda Exploration, an Australian mining company, and 45% by the Romanian state company Remin, and the remaining 5% by another Romanian company.

On January 30 2000, following unusually heavy precipitation, a portion of the tailings dam gave way, spilling 100,000 cubic meters of liquid and mud. The material flowed across 14 hectares of farmland and into the adjacent Lapus river. The release was potentially quite toxic, containing 126 mg/l of cyanide and unquantified amounts of heavy metals. In retrospect, Aurul managers acknowledge that not only bad weather was involved. The dam was designed as a closed system with no water discharge, but this left no opportunity to release excessive accumulations of water.

From the Lapus river, the spill went into the Somes River and crossed the border into Hungary, before reaching the Tisza River, which flows through Romania and Hungary into the Danube River. At Satu Mare on the Somes, cyanide was measured at 7.8 mg/l, versus surface water standards of 0.01 mg/l. Several communities closed water intakes as the plume passed. As the contaminated water made its way down the Tisza river and into the Danube, the media reported that at least 1,240 tons of fish had died. The World Wide Fund for Nature (WWF) noted the upper Tisza River was inhabited by 19 of the 29 species of protected fish in Hungary. According to WWF Hungary, in practical terms the spill eradicated all life in up to 400 kilometers of the Tisza and rehabilitating the damage could take decades.

Almost immediately, Esmeralda denied responsibility for causing the spill, and claimed the extent of the poisoning had been exaggerated. Meanwhile, Hungary began identifying individual losses and cleanup expense in preparation for a mass damage claim. In April 2001 Hungary filed a claim for $102 million in the Budapest Municipal Court. Romanian authorities initially stated that they too would file a

damage claim but later appear to have had second thoughts due to Romanian participation in Aurul SA. Serbia also stated it would file a damage claim.

After it became clear that the release had caused damage and that it likely would be held responsible, Esmeralda offered compensation to landowners within the 14 hectare area that was contaminated as a direct result of the release. Esmeralda continued to deny the spill could have caused the damage claimed downstream and later declared bankruptcy to protect its assets.

Since the spill Aurul has cooperated with a Romanian Expert Committee, the Environmental Protection Authority, the Water Authority and the Public Works Authority and satisfied all requirements regarding remediation and precautionary actions. On June 13 2000, Aurul restarted the tailings treatment at Baia Mare, having received necessary regulatory approvals as well as support from the local community.

The amount of compensation to be paid by Esmeralda and/or the Romanian government likely will take years to resolve. Not only is the magnitude of the loss difficult to quantify in financial terms, but the assignment of liability and collecting any sums also are problematic. Three unrelated spills in same general area in the two months following the spill further complicate matters. The Romanian government is defiant that will not pay money to another nation as a result of the spill. Esmeralda is a small company operating under protection of bankruptcy, making the collection of substantial sums from it unlikely. A financial analyst's report from CIBC Wood Gundy Australia Limited prior to the spill projected that the tailings cleanup at Baia Mare would earn Esmeralda approximately $2.1 million (US) annually for a period of eight years, further underscoring the limited profitability of the venture and the difficulty the firm would have in paying a claim of over $100 million. Criminal proceedings have also been launched in Hungary and Romania for damage caused to the natural environment.

2. Los Frailes, Spain

In 1987, a Spanish subsidiary Boliden Aprisa of the Canadian mining firm Boliden Ltd. purchased the Anzalcollar mine about 45 km west of Seville in the Iberian Pyrite Belt. When the Anzalcollar mine was closed in the early 1990s, its ore concentrating facilities were used to process ore from Los Frailes, a lead, zinc and copper mine located one km to the west and also owned by Boliden Aprisa. In April 1998, the Anzalcollar tailings dam burst, polluting the Guadimar River with 5.5 million m^3 of tailings water and 1.5 million m^3 of tailings, covering about 2,600 of nearby agricultural lands with tailings, and threatening the Donana national park, one of Europe's leading nature reserves and a UN World Heritage site.

Without accepting legal responsibility, and in fact blaming the Spanish company Dragados for improper design and construction of the tailings impoundment in 1978, the company has spent approximately 42 million euros repairing damage to the mine,

restoring the area contaminated by the tailings and paying compensation to affected farmers. An official inquiry after the accident seemed to support the company as it found that deformation of the clay soils supporting the tailings dam had caused the failure. The mine was allowed to reopen in 1999 and in late 2000 Spanish court dismissed criminal charges against Boliden Aprisa.

The Los Frailes mine never was particularly profitable. In 1999 it produced 46,250 tons of zinc, 17,350 tons of lead, 1,219 tons of copper and 743,000 ounces of silver in 1999, worth about $25 million. Recently the owners announced that they could not proceed with the third phase of expansion and declared bankruptcy.

3. Kumtor, Kyrgyzstan

Located at an elevation of nearly 4,000 meters in the Tien Shan mountains of Kyrgyzstan, the Kumtor gold mine provides about nine percent of Kyrgyzstan's GDP. The Kumtor mine produces nearly 20 metric tons of gold annually and has some of the lowest gold production costs in the world -- about $90 per ounce. Pre-tax profits for the mine are approximately $130 million annually. The Kumtor mine and processing facility is two-thirds owned by Kyrgyzatlyn, a Kyrgyz company and one-third owned by Cameco, a Canadian mining company. The International Finance Corporation, an arm of the World Bank, lent $40 million to the operation, its first investment in Kyrgyzstan.

The IFC believes that the Kumtor mine represents an attractive economic opportunity for Kyrgyzstan: "Gold mining is one of the most promising areas of economic development in the Kyrgyz Republic and, potentially, the largest source of export earnings. The mine, with access roads, power transmission lines, an airstrip to transport the gold, and other associated infrastructure, will help open up a remote and inaccessible part of the country. The project will have a positive developmental impact through employment and transfer of management and technical skills."

On May 20 1998, a truck enroute to the mine with 20 one-ton packages of sodium cyanide tumbled into the Barksoon river, spilling the contents of one or two of the packages. The next day the company treated the spill area with sodium hypochlorite to neutralize the toxic effects. Kumtor also shut off the water supply to a local village as a precautionary measure.

For weeks after the incident, more than 5,000 individuals exposed to the chemicals sought medical attention, complaining of skin rashes, sores and other ailments. The Barksoon river empties into Lake Issy Kul, Kyrgyzstan's leading tourist attraction. Bookings were cancelled and revenues plummeted because of fears that the lake also was poisoned. Some 4,800 individuals were relocated temporarily from the southern side of Lake Issy Kul where the spill occurred to the northern side of the lake. Media reports indicated that several animals and at least two people perished. The company promised to pay for all costs of cleanup and medical costs for exposed individuals.

In July 1998, Kumtor officials announced preliminary figures regarding the compensation the company had paid. Nearly $500,000 was paid in compensation to more than 7,200 people in the village of Barksoon and 3,600 people in nearby Tamga village. About $580,000 was spent to relocate and rehabilitate villagers at north-shore resorts, $530,000 was spent to construct a new water supply system for Barksoon,

$100,000 for reconstructing the road to the mine, and $80,000 for tourism advertisements. Total expenditures will be about $2 million. In August the Kyrgyz government released a preliminary estimate of the damages of $4 million and in January 1999 Cameco agreed to pay the Kyrgyz government $4.6 million as compensation for the spill, including $3 million as compensation for local residents.

While some members of the Kyrgyz parliament complained that the compensation was inadequate, former environment minister Kulubek Bokonbaev published a book in 1999 that argued that all harmful effects of the spill had dissipated within 13 days of the incident and no mass poisonings occurred.

4. Ok Tedi Mine, Papua New Guinea

The Ok Tedi mine is located on Mt. Fubilan at the headwaters of the Ok Tedi river in the Star Mountains in western Papua New Guinea, not far from the Indonesian border. The Ok Tedi River flows 200 km to the south where it joins the Fly River. The Fly River meanders over 450 km of floodplain until it joins the Strickland River and empties into the Gulf of Papua, a large tidal estuary. The immediate area near the mine receives about 10 meters of rainfall annually. The mine is at an elevation of 1,800 m, in a geologically unstable region marked by frequent landslides and earthquakes.

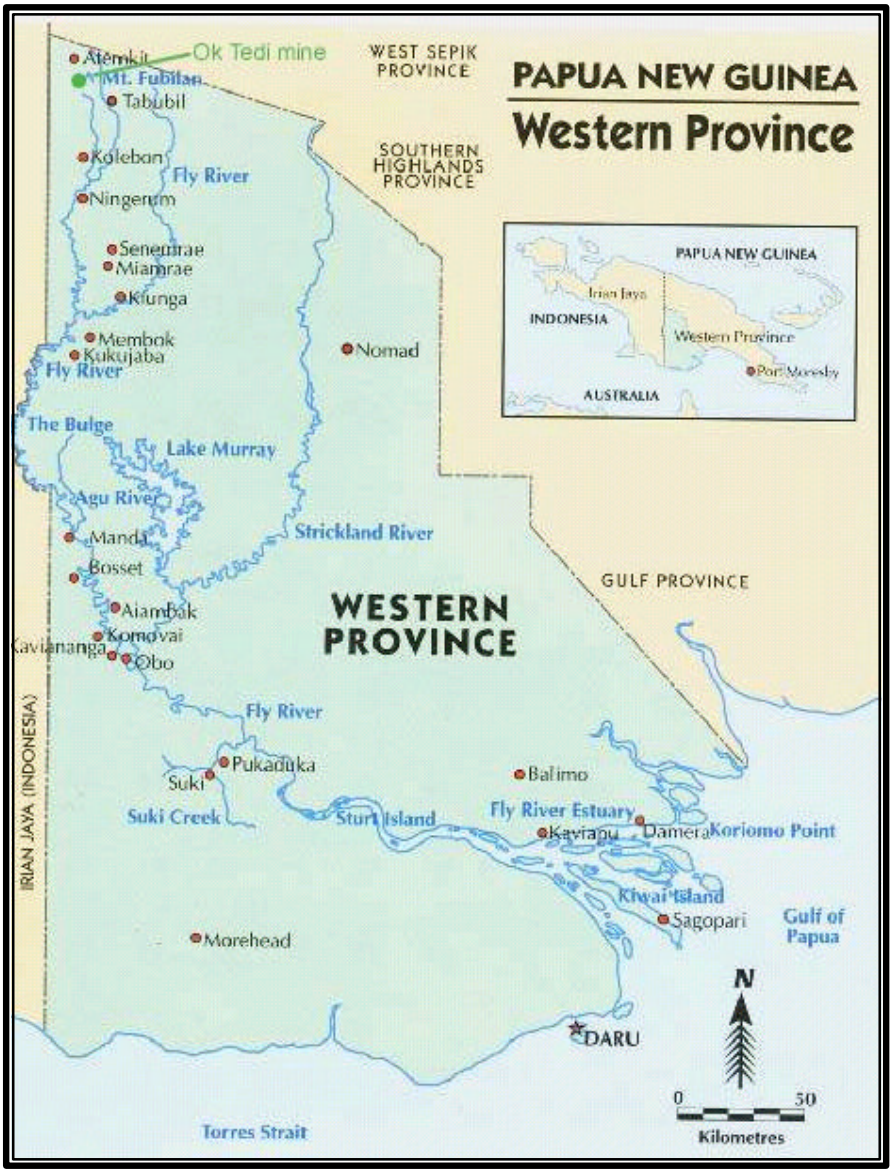
Originally the PNG government required in the Environmental Impact Statement that the mine have a tailings pond as a condition of operation. After foundations for the tailings dam were destroyed by major landslides in December 1983 and January 1984, OTML received permission from the government to dump some 65 million tons of tailings and waste rock annually into the Ok Tedi and Ok Mani rivers. The tailings are sand-sized and smaller, while the waste rock is gravel to boulder size. The waste material contains copper, cadmium, lead and other heavy metals.

The tailings and waste rock dumped into the Ok Tedi river system have caused much greater adverse impacts downstream than originally envisioned. The riverbed at Tabubil, where most mine employees live, has risen by approximately 4 meters. Downstream where the Ok Tedi flattens out and loses some of its velocity, sand has accumulated to the extent that the riverbed is six meters higher. Elevation of the riverbed has increased the frequency and severity of flooding, as well as contaminating the floodplain of the Fly River with heavy metals and sand. Several hundred square kilometers of formerly productive lands have experienced forest die-back and areas near the river are no longer suitable for cultivation. In the Ok Tedi, catches have declined by 90% from baseline (pre-mine) levels, while on the middle stretches of the Fly River, catches have declined by about 70%. It is important to note that fish and water quality both meet WHO standards, meaning that human health impacts have not been an issue.

There are at least six different compensation agreements designed to address environmental impacts. The first agreement covered land loss during construction of the mine. The first agreement also provided compensation in the event of unanticipated adverse environmental impacts within the area covered by the mining leases. The subsequent compensation agreements were the result of litigation by affected parties living outside the area covered by the mineral lease.

Courts in Papua New Guinea would not accept cases brought by those outside the original compensation agreement. As a result, plaintiffs filed suit in the Australian courts. BHP worked with the PNG legislature to draft legislation that would bar such suits and protect BHP and the other owners of Ok Tedi from liability for harm to people or the environment. Adverse publicity effectively stymied these efforts and eventually the Australian courts found that several groups of plaintiffs had been injured. The PNG legislature enacted the Restated Supplemental Agreement Act (RESA) also known as the Mining Act of 1995 to codify these settlements from the Australian courts.

Victories in the Australian courts enhanced the bargaining position of the affected landowners by providing them with resources necessary to hire outside legal representation and seek greater compensation. The 1995 act, in particular, is noteworthy because it provides compensation without proof of loss to communities deemed affected by changes to the river system.



A 1996 settlement agreement between BHP and 30,000 landowners has three elements: creation of a tailings pond to receive wastes from continued mining; rehabilitation of the Ok Tedi and Fly Rivers; and compensation of A 110 million ($ 70 million US) to the landowners. BHP will pipe tailings to unused land at the bottom of the mountain at a cost of between A 300 million and A 450 million. OTML agreed to dredge about 20 million tons of rock annually in parts of the Ok Tedi River to reduce siltation, erosion of the riverbanks and flooding of adjacent farmland. BHP also has agreed to pay the plaintiffs legal costs. While the compensation was paid, the mine continued operations while it conducted a risk assessment of the planned tailings pond and the ongoing dredging activities.

In August 1999, the PNG government asked the World Bank to review OTML's risk assessment for its waste disposal operations and to consider broader issues of environmental and social stewardship and responsibilities between the government and the peoples of the Western Province. The World Bank concluded that the best option from an environmental viewpoint was to close the mine immediately. However, there had been no preparations for closure in the affected communities and the World Bank pointed out that the social costs of closure needed to be considered since Ok Tedi is the principal source of employment in the region.

The PNG Government interpreted the risk assessment as supportive of continued mining until 2010, the date originally planned for mine closure. BHP recognized that the mine was an increasing liability and announced in May 2000 that it wanted to end its involvement in OK Tedi Mining Limited (OTML) by June 2001. Atlas Mining, a Philippine company, has emerged as the most likely buyer. The Papua New Guinea government has expressed concern regarding the sale, citing recent litigation by landowners in the Western Province where the mine is located and possible compensation that may be ordered by the Victoria (Australia) Supreme Court.

Certainly not all impacts have been adverse. Ok Tedi Mining Limited has been the principal agent of economic development in the Western Province. It employs 1900 people and at least four times that many jobs are created indirectly as a result of the mine. During its first 15 years of operation, infant mortality has fallen from 300 to 15 per 1000 live births, life expectancy has increased from 30 years to 50 years, and the incidence of malaria has fallen by at least two-thirds. Substantial sums have been paid in taxes and royalties to the PNG government, governments of the Western Provinces, and local landowners.

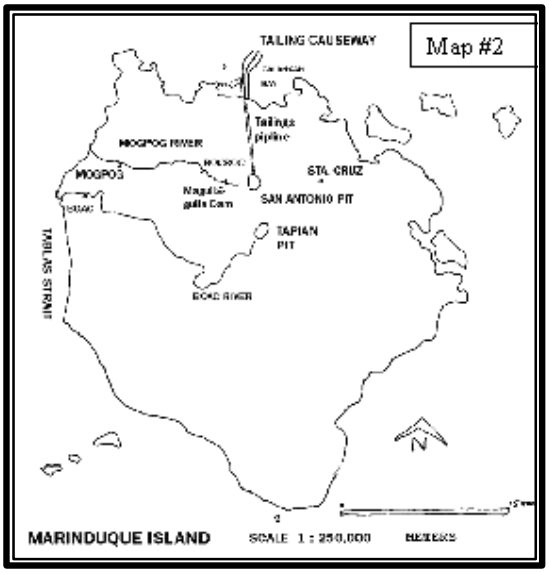
An important aspect of the litigation and settlement concerns what precedent it might have for mining operations of foreign companies and whether injured parties could seek redress in the home nation of the company. The fact that a mining company could be sued in its home country for damage caused in another country where it had operations is an important precedent. Moreover, that it could be found liable for environmental damage even when it complied with all environmental regulations and permit conditions of the host country also is remarkable. Compensation paid to adversely impacted parties in the host country have been substantial; the consequences of environmental damage were a major drain on corporate resources, enough so that BHP is trying to sell or otherwise dispose of its interest in the project.

5. Omai, Guyana

On August 9 1995, a tailings dam at the Omai gold mine in Guyana burst, releasing over 3 million cubic meters of cyanide contaminated mining waste into the Essequibo river and causing extensive damage downstream. The mine is 65% owned by Cambior, a Canadian mining company, and 30% by Golden Star Resources of Colorado, and 5% by the International Finance Corporation (IFC) and produced about 250,000 ounces (7 metric tons) of gold worth about $65 million annually. Shortly after the incident the government of Guyana absolved the companies of any criminal liability. Cambior and Golden Star Resources have denied any responsibility for the damage and contest the $100 million in claims that have been filed. A Canadian court remanded a lawsuit over spill damage to a court in Guyana, where the matter now resides. Cambior's recent financial statements indicate that it believes any amounts to be disbursed on these claims will not be material.

6. Taipan Mine, Philippines

Marcopper began mining operations at Mt Tapian on Marinduque Island in the Philippines in 1969. Placer Dome, a Canadian company, co-owned (39.9%) and managed the operation. Three Philippine mining companies controlled by then-President Marcos held the remaining interests until that share was privatized in 1994. Placer Dome extracted low-grade copper ore from an open pit mine and used a mechanical and flotation process to produce copper concentrates. The company disposed of its wastes on land until it obtained a permit in 1975 that allowed mine tailings to be dumped into Calancan Bay.



During the development of the Tapian orebody, a 2,000-meter tunnel was bored between the open pit and the Boac River catchment to drain storm water and seepage from the pit. Mining of the Tapian orebody was finished by 1990. The nearby San Antonio open pit mine began to be developed at that time and the Tapian pit was used for disposal of coarse mining wastes. Once ore concentration activities started, the plan was to dispose of fine tailings in the ocean, a practice permitted during mining of the Tapian ore body.

When the San Antonio pit commenced production in 1992, the Philippine government ordered that all tailing be disposed of in the Tapian pit until an alternative long-term tailing disposal solution was developed. In order to retain fine tailings in the pit, Marcopper designed and installed a concrete plug in the drainage tunnel.

The Tapian pit was used for tailing disposal until March 24, 1996, when rock holding the concrete plug weakened, perhaps caused by a small earthquake, releasing a heavy flow of tailings into the Boac River. Mining was suspended while emergency workers attempted to stop the leakage and assist people living near the river. Solid materials

from the pit halted the main flow of liquid after four days, however it wasn't until several months later that a permanent 20-meter long concrete plug, backed by another 40 meters of earth fill, was installed -- at a cost of over $8 million.

When the spill occurred, Placer Dome and Marcopper quickly acted to build new access roads to the villages, to provide medical attention, to develop new water supplies and to compensate people for loss of income. The company also relocated several houses to high ground because silt in the river channel increased the risk of flooding. Rather than dredge the river to reduce silt accumulation, Philippine authorities recommended that the company rely on natural action of the river to flush the sediments out to sea. In 1996 Placer Dome dredged settling basin in the delta of the river to capture tailings before they reached the sea. The total remediation cost incurred by Placer Dome is expected to reach $80 million. Because of its positive response to the problems, Placer Dome has been told by Philippine authorities that it would be a welcome investor in future mining projects in the Philippines. However, mining has not yet resumed at the San Antonio mine.

7. Yanacocha Mine, Peru

On June 2, 2000 a truck traveling from the Yanacocha gold mine spilled 151 kg of mercury between the villages of Choropampa and Magdalena. The truck driver allegedly went on to Lima without informing residents of the hazards posed by mercury. Local residents collected as much mercury as possible, believing it was valuable. According to Yanacocha sources, symptoms of mercury poisoning affected more than 900 individuals and several individuals were hospitalized.

Newmont Mining is a 51.35% owner of the mine, along with Minas Buenaventura with 43.65% and the International Finance Corporation, a private sector branch of the World Bank, with 5%. The Compliance Advisor Ombudsman (CAO), an evaluation unit of the IFC, investigated the accident and reported:

The mine had no emergency response plan for mercury spills outside its property
Newmont did not apply global standards for the transport of hazardous wastes
The mine did not follow safety procedures for loading and transporting mercury, and
The mine owners and the Peruvian government were not forthcoming about the dangers posed by mercury exposure.

Under protest Newmont paid a fine of 1.74 million soles (approximately $500,000) to the Peruvian government. The company also agreed to provide health insurance for five years for individuals with symptoms of mercury poisoning, to construct a number of public works projects in the affected area, and to respond to the recommendations of the CAO. Newmont took a charge of $10 million in 2000 to reflect these costs. The company acknowledged that it could not predict the magnitude of any future liability from the spill.

B. Coral Reef Damage Assessments

1. Egypt

On April 4, 1996 Cunnard Lines' *Royal Viking Sun* strayed from course and ran into a coral reef off Tiran Island near Ras Mohammed in the Red Sea. Before the vessel was freed, it damaged approximately 2,000 square meters of reef. Egyptian authorities impounded the vessel and demanded $23.5 million in compensation for lost tourism

revenues and damage to the environment. Cunnard Lines settled for that amount (equivalent to over $10,000 per square meter of reef).

2. Puerto Rico

On July 24, 1997 the 326-foot *Fortuna Reefer* went aground near a Nature Reserve off the west coast of Mona Island in Puerto Rico. The vessel damaged a barrier reef that extends about 10 miles from the eastern end of the island around the south coast and to the northwest. The reef contains large, branching elkhorn corals that were damaged by the grounding. Because of the remoteness of the site, salvage efforts were hindered and the vessel remained aground for ten days. While no fuel oil was spilled, the grounding and later salvage activities caused physical damage to an area approximately 900 feet in length by 50 to 100 feet wide.

Restoration experts advised reattaching the largest pieces of coral to reestablish the physical structure of the reef (Elkhorn coral often survive reattachment). In a September 11 settlement agreement with the Commonwealth of Puerto Rico and the National Oceanic and Atmospheric Administration, the ship owner, Rama Shipping Company of Thailand, agreed to pay $1,250,000 for natural resource damage (equivalent to about $190 per square meter of damaged reef). The settlement provides $650,000 for emergency reattachment of 400 large pieces of coral, to be conducted under NOAA leadership, and $400,000 for compensatory restoration to the Commonwealth. By September 20, NOAA had initiated emergency restoration efforts.

3. Florida

On August 10, 1994 the University of Miami's research vessel *R/V Columbus Iselin* went aground on an ancient coral reef in Looe Key National Marine Sanctuary (now part of the Florida Keys National Marine Sanctuary. The vessel remained grounded on the reef for 38 hours causing extensive damage to four spurs of the reef as well as significant debris in the area. The grounding destroyed 338 square meters of living coral and killed or displaced many sea fans, sponges, fish and other creatures. The National Oceanic and Atmospheric Administration (NOAA) sought damages to cover response costs, restoration of the reef, and lost recreational values, eventually settling with the University of Miami for $3.76 million ($11,120 per square meter). The settlement included a civil penalty of $200,000. A description of the restoration effort is available on the Internet.[7]

4. Australia

On November 2, 2000 the container vessel *MV Bunga Teratai Satu* ran aground on the northwest side of Sudbury Reef, a part of the Great Barrier Reef of Australia. The 22,000 ton, 184 meter long cargo vessel was registered to Malaysia International Shipping Corporation and carrying 1200 tons of fuel oil. After two days of effort, the ship was freed without loss of fuel or cargo, however the reef sustained considerable damage. The Australian government conducted a cleanup in two phases. The first phase involved a relatively small 50-meter by 30-meter scar from the ship in the coral. This area was heavily contaminated with a tin-based anti-fouling substance that had been applied to the vessel. At the end of the first phase of cleanup, several large blocks of reef were replaced to facilitate regeneration of the coral. The second phase

[7] www.sanctuaries.nos.noaa.gov/special/columbus/columbus.html

of cleanup involved a larger debris field 100 meters by 300 meters. The shipping company has agreed to pay the Australian government at least $2 million to compensate for the cleanup and restoration efforts and long-term monitoring. One of the other outcomes of the incident will be a thorough review of shipping practices near the Great Barrier Reef.

APPLICABILITY TO EGYPT

This review demonstrates that Egypt already is employing a number of MBI for managing water resources. Households and industry pay for water deliveries. Egypt's water delivery charges are low relative to most other nations, particularly those in the Middle East and North Africa. Households with sewer connections pay modest fees (between one-third and one-fifth of O&M costs) for that service. Firms must post a performance bond and pay fees for every cubic meter of treated effluent they discharge to Egypt's waterways. Environmentally harmful subsidies for fertilizer and pesticides were reduced or eliminated. Natural resource damage assessments have been used to seek compensation when ships cause damage to coral reefs.

With the exception of the New Valley project, Egypt does not impose charges for agricultural water deliveries. Efforts are underway to develop cost-sharing mechanisms for these services. In addition there are no fees for withdrawals from groundwater aquifers, despite the deflectable nature of some aquifers.

Trading of pollution rights would require measurements that currently are not made, in addition to fundamental changes in Law 4. The feasibility of trading water rights should be explored. Other water scarce regions are finding considerable success with such systems.

Egypt currently has no initiatives to report information regarding industrial releases of pollutants; however, it did participate for a time in an OECD PRTR initiative among developing nations. Likewise, Egypt has not implemented (or apparently considered) a color rating system for the environmental performance of firms. As this report notes, many developing countries now are using such systems with success.

Finally, Egypt has been successful in collecting damage assessments from ships that harm coral reefs in the Red Sea. The discussion of mining pollution in this paper revealed the difficulty of collecting for natural resource damages from small, poorly funded operators. Egypt could review the current situation regarding petroleum and mineral exploration and production on its territory to determine if the operators would be capable of paying compensation in the event of a major accident. If not, a system of performance bonding could be required to protect Egypt's environment.

ANNEX B

IDENTIFYING AND PRIORITIZING THE CAUSES OF IRRIGATION WATER USE AND ALLOCATION INEFFICIENCIES

BY
IBRAHIM SOLIMAN[8]

February, 14, 2002

[8] Professor and Chairman,
Department of Agricultural Economics,
Faculty of Agriculture, Zagazig University
Zagazig, Egypt,
Email: ibrahim@egyptonline.com

TABLE OF CONTENTS

OBJECTIVES

(i) Review current systems of agricultural taxation and their implications regarding the potential introduction of "Market- Based Incentives" (MBIs) in the irrigation sector.
(ii) Identify current subsidies remaining in the agricultural sector and specially their likely impact on crop choice.
(iii) Analysis of the impacts of the remaining subsidy policies in Agricultural Sector affecting irrigation demand and/or water supplies.
(iv) Identify and prioritize other causes of irrigation water use and allocation inefficiencies, and the basis for identification of potential (MBIs) applications in the agricultural sector.

INTRODUCTORY BACKGROUND

The economic cost of providing water as a natural resource might be much higher than the value of irrigation water as an agricultural input. In a normal (regular) market the economic value of water resource is its opportunity cost, which is the value in its best alternative use. However, the farmers, hardly, bare only the costs of lifting water to their field and/or partially the costs of maintaining the irrigation system network, and exclude the water economic costs from their budget. Therefore, when, the cropping pattern is determined according to the crop profitability and the economic allocation of water resource is not taken into account. Accordingly, it might be postulated that there is a sort of market failure in allocation of irrigation water
Accordingly, it is noticed that, the expansion in the acreage of high water use type of crops, such as sugarcane and rice; is not surprising, surpass the planned area, spite of the land allotment for water demanding crops (such as rice). The farmers usually violate that, even though the monetary penalties they might pay.

Annex (1) presents a flow chart that illustrates, in a comprehensive approach, the sequence of the irrigation water economic efficiency in relation to the supply and demand.

AGRICULTURAL TAXATION SYSTEMS IN EGYPT

This section presents specification of the types of agricultural taxation, causes of inefficiency of the taxation systems and their implications, particularly on irrigation water allocation.

3.1 Specification of The Systems

The Egyptian agricultural sector is taxed via three systems. The following section presents the profile of these systems and table (1) presents the composition of the central government taxes revenue.

3.1.1 Direct Tax Bases

The government of Egypt taxes, directly, the agricultural sector via three subsystems. They are: The traditional land tax, the corporate net profit tax and the Unified income tax on unincorporated farms

3.1.1.1 The Egyptian Agricultural land tax

It is a levy on presumptive agricultural income. Thus, it might be considered an income tax in the form of a land tax. On the other hand, it represents a somewhat roundabout method of taxing wealth (land ownership) via a tax on presumptive income flow.

1.1.1.1.1 3.1.1.1.1 Types of Agricultural Land Tax

A tax is levied on all cultivatable agricultural land based upon its estimated annual rental value (Law No. 113/1939). The annual rent value is reassessed every 10 years by a committee process (law No. 53/1935). The present land tax is based upon assessed values from 1968-1988 that has become effective since 1989. The forthcoming estimate will most likely not be initiated until after 2001 and goes into effect by the year 2003.

The law No. 112/1997 issues an additional fee that differentiates the agricultural land holdings by utilization pattern. Such fee is of L.E.0.25 per feddan cultivated in traditional crops, LE.1 per feddan for vegetables and LE.5 per feddan for orchards.
1.1.1.1.2

1.1.1.1.3 3.1.1.1.2 Taxes due to Decentralization of Governmental Activities

A proportion of the taxes on agricultural land supposes to be allocated to the governorate authority. According to laws (No. 43/1979 and No. 145/1988), 25% of basic and additional taxes collected on agricultural land is returned to the governorates in which the property is located. The Local authorities suppose to allocate such value to the villages, which the taxed land locates within their respective boundaries. The remaining 75% are devoted to the towns.

Local government councils in most governorates suppose to charge the agricultural landholders an extra amount of 15% on the absolute value of the initial tax. Such amount represents a source of finance for the local governance.
Table (1) presents the composition of Central Government Tax System in 1996/1997. It is noticed tat the share of agricultural land tax in total revenue of taxes is very small, either for central government of for the governorate authorities.

Table (1) **Composition of Central Government Tax System in 1996/1997**

Type of Tax	**1996/1997**
Non –agricultural Corporate profits	30.27
Goods and Services	28.00
Customs Duties	20.10
Stamp Duties	7.80
Personal Income	4.30
Agricultural Corporate Profits	1.43
Land Tax to Central Government	0.40
Land Tax to Local Government Authorities	.27
Other Taxes to Local Government authorities	3.83
Others	3.60
Total	100

1.1.1.1.4 3.1.1.1.3 Types of Exemption

Full exemption is applied for total land holdings, which are not greater than 3 feddans, condition that this farm is the only source of income. However, many farmers pay the tax rather than submit to tedious process required getting exemption. Even though, many farmers would proceed this requirement if the cost of registry subdividing of the land among the legal owners were not so high. Permanent exemptions are granted on agricultural land owned by the state or dedicated to the common benefit of the village citizens. Exemption for 10 years after becoming productive are conferred to reclaimed, desert and fallow lands. Taxpayer whose annual land tax does not exceed LE.4 is totally exempt, (Law No. 370/1953).

3.1.1.2 The corporate net profit tax

The taxation rate on the net profit of the agricultural corporate varies by the type of corporation. In general there are three types: *Exporters and Manufacturers, Other Corporations,* and *Projects Enjoy Tax Holidays.*
1.1.1.1.5

1.1.1.1.6 3.1.1.2.1 Exporters and Manufacturers

Exporters and Manufacturers generating annual net profits above L.E. 18000 should be taxed on annual income base. They are taxed at a rate of 34%, of which 2% as development duty, on annual net profits.
1.1.1.1.7

1.1.1.1.8 3.1.1.2.2 Other Corporations rather than Exporters and Manufactures

They are subject to 42% taxation rate, of which 2% as development duty, on annual net profits.
1.1.1.1.9

1.1.1.1.10 3.1.1.2.3 Projects Enjoy Tax Holidays

Three types of agricultural projects enjoy tax holidays. The projects located in new urban communities enjoy tax holidays for 10 years. The corporations employing more than 50 workers enjoy tax holidays for 5-15 years. The investments in free zones enjoy tax holidays for infinite periods.

3.2 The Unified income tax on unincorporated farms

The unified Tax on income of natural persons is based upon (Laws No. 157/1981 and 187/1993 and amendment 90/1996, 226/1996, 162/1997 and 5/1998). It is levied on five categories of non-corporate income:

1) Wages and Salaries
2) Moveable Capital: Interest income and foreign dividends
3) Non-commercial professions
4) Net profits of all operations carried out by commercial and industrial entities whose owners are sole proprietorships: This category includes individuals engaged in the selling of agricultural inputs and/or the marketing of agricultural and industrial activities. All costs are generally deductible.
5) Sole, simple, limited and general partnerships
   However, if the taxpayer owns agricultural land and buildings, he or she is taxed according to the revenue of real estate wealth. The tax base is the same as that used for agricultural land tax.

3.3 Indirect Taxes

There are three subsystems for indirect agricultural sector taxation, which are: *Sales taxation (Value added tax*), *Exchange rate overvaluation* and *Import taxation.* However, such types do not serve the objectives of the study. Therefore, they were cited here just to complete the profile specification.

3.3 Causes of Taxation Systems Inefficiency

The agricultural land tax as presently constituted is deficient in almost every aspect: revenue generation, vertical and horizontal equity and administration.

1) The agricultural land tax is very expensive levy. Its collection cost approximates half of its gross collections.
2) One of the inefficiency causes of income taxation is the frequent underestimated report.
3) The taxpayer's protestation prolongs the appeals process; it is a tedious time consuming process. Even though, during which the initial tax liability cannot be increased.
4) The ministry of finance in Cairo collects all agricultural land tax payments. This is because the local governments are not fiscally autonomous. In spite of the existing laws that cites the proportion of the land tax that should be delivered to the local governance, it seems that very little goes to governorates, -Table (1)- and nothing goes to towns or villages.
5) Although "Real Estate Tax Department" collects numerous taxes, it is estimated that 50% of its working time is allocated to the overall administration of land tax. However, the share of this type of tax in government total tax revenue is very negligible.
6) Until now the Taxation Departments in Egypt continuos to carry out all their operations manually.
7) Egypt's property taxation, including agricultural land, is seriously deficient in most aspects, from tax base valuation to property registration and records keeping.
8) Although the upper-middle to high-income categories of farmers are subject to unified income tax, the real life practice showed that the proportion of them that actually pay this tax is minor, Table (1).

3.4 Implications of The Agricultural Taxation Systems

Although the Egyptian agricultural sector generates one-six of GDP and one-third of total employment, it bears a very small proportion of the overall tax burden. The following section presents the concluded major implication issues.

3.4.1 Implications of the agricultural land taxation system:

The impact of gross and net revenue of agricultural land tax on both total and tax revenue of the government is negligible, even after implementing the re-estimation of net rental value, beyond 2003. Given the very low level of agricultural land taxation it has insignificant impact upon investment incentives.

Therefore, some investigators propose to replace the agricultural land tax with an income tax regime, either unified income tax or corporate income tax, which adequately reaches into agricultural sector.

It is assuming that any new reform of the existing income tax system would not include the net incomes of low-income farmers, which form the bulk of all landholders. Accordingly, such reformed taxation would not be cost effective.

3.4.2 Implications of the Agricultural Income Taxation

The sum of both unified and corporate income taxes represent the bulk of government taxation revenue. Therefore, the two types of taxation may have some marginal impact on investment decision. However, given the existing high exemption and tax holidays, and that only 4.3% of agricultural land in Egypt are currently in corporate hands, this does not appear to be a major factor.

(1) The unified income tax of natural person is supposed to impose an income tax obligation on the net farm income derived from agricultural land. The base for this levy is the estimated annual rent value of the agricultural land, the same as agricultural land tax. The base of estimating the agricultural land tax will not change before the year 2003. In addition, the off-farm income is empirically detectable with much difficulty. Thereby it, severely, restricts the growth of tax revenue.

(2) However, if we would not look at this issue through a dark glass, we assume that, given the reform and liberalization measures, the share of private agricultural corporate will be significantly higher in the future via activation and simulation of land purchase and rentals market. Thereby, the corporate income tax, may be one of the major tax revenue.

3.4.3 Impacts of agricultural land taxation on equity aspect

The data of the 1997 Egypt Integrated Household Survey of the MALR, is the only available source that permits approximation of direct taxes paid by farmers according to income brackets. The data indicate that there is a reasonable positive associative trend between farm income (actually, expenditure) and farm size, region, and

cropping patterns. The data do not show any distribution of land tax burden across farmer income groups. A reasonable interpretation of such results assumes that, within the geographic jurisdiction of each rental value estimation committee there is a great deal of differences in cropping patterns, irrigation methods, distance from town center, etc.

The other issue of the role of land taxation in realizing the equity aspect is that the three feddans or less exemption clearly seeks to relief poorer farmers of the land tax burden. Under this assumption, the poorest of the farmers, in terms of net return to area cultivated, have the smallest landholdings. Therefore, the tax falls on richer farmers with above 3-feddan. Accordingly, this exemption policy applies the element of progressive agricultural land taxation system. However, the 1990 Agricultural census, shows that 37% of farmers with land holdings of less than 1-feddan have nonagricultural occupations income and therefore are disqualified from applying for the exemption in the first place. The percentages of land holdings 1-2 and 2-3 feddans with nonagricultural occupations are 20% and 15% respectively. The 5% of Egypt's cultivatable area are orchard, which does not benefit from exemption –Table (2).
On the other hand, the percentage of landholdings with nonagricultural occupations rises from 14% in 5-10 feddans class to 39% in the over 100 feddan interval. Most of these occupations are managerial, technical,

Table (2) Relative Frequency Distribution of Land Holding and Agricultural and Holdings with Nonagricultural Income in 1996/1997

Farm Holding Brackets in Feddans	0-1	1-	2-	3-	4-	5-	10-	50-	100+
% of Holdings with nonagricultural Occupations	37%	20%	15%	16%	18%	14%	27%	35%	39%
% of total Holdings	69%	13%	7%	4.2%	3%	2%	1.5%	0.2%	0.1%
% of total Agricultural land	18%	11%	10%	9%	7%	10%	19%	7%	9%

Professional, or administrative titles. The aggregate income received by such persons is much well above the average.

From all above, it seems that land tax effectiveness is achieved if measured against total income (farm and off-farm). However, It can be postulated that the land tax burden becomes a decreasing proportion of total income as total income rises. Only 5% of landholdings fall in the class 4-5 feddan. Less than 2% of landholders are found in the 10 feddan and above category.

AGRICULTURAL PRICE SUBSIDY POLICY IN EGYPT

Starting from 1986 important reforms have been introduced under the Economic Reform Program (ERP) to the agricultural sector. The broad context of these reforms was the redefinition of the policy regime from centrally controlled planned economy towards a free market economy. The major aim of such drastic transformation was to overcome the agricultural stagnation, which has been dominant for decades.

4.1 The Chronology of The Agricultural Policies Reform

Prior to 1986, the government of Egypt controlled nearly all aspects of the agricultural sector. The central planned economy imposed control on crop rotations, the area planted to most food and cash crops, producer and consumer prices, agricultural processing, marketing and trade, farm input supplies and credit.

Most of these policies were dismantled shortly after 1986. Since 1987, Egypt has engaged in an ambitious set of macroeconomic and market reforms, known as 'The Economic Reform Program ERP", when the MALR began removing both taxed and subsidized agricultural prices. . However, in 1992 Egypt undertook a more widespread policy reform designed to affect all sectors of the economy, which is still being implemented. The ERP consists of two major components, (1) stabilization policies (SP) and (2) a structural adjustment program (SAP).

The SP designed in consultation with the IMF. The policies were oriented to make reductions in expenditures to bring about an adjustment of domestic demand to reduce the level of dependency on external resources. Thus this component of the program would correct the fiscal and monetary policies, in order to cut the inflation rate, and allow both the interest and exchange rates to respond to market forces.

The SAP was planned in collaboration with World Bank and USAID. It was designed to improve the economic conditions of the supply, in order to reduce vulnerability to external shocks in the future. Such improvements include corrections of the

distortions in economic policies, improvement of domestic resources, and produce institutional transformations. The SAP consists of five components: (1) price reform measures, (2) private sector reforms, (3) foreign trade liberalization, (4) public sector reforms and (5) the social fund.

The ERP was supported by the World Bank loans, USAID finance program, approved standby agreement with IMF in terms of SDR, African development Bank and some other international financial organizations.

4.2 Policy reforms in agricultural sector since 1986:

The agricultural reform program, effectively began in 1986, has five major components

(3) Removal of government farm price controls
(4) Removal of government crop area controls
(5) Removal of government crop procurement controls
(6) Elimination of subsidies on farm inputs
(7) Removal of government constraints on private sector practices in processing and marketing of farm products and inputs.

Table (3) provides a summarized profile for the time schedule by year of implementation of the agricultural policy reform.

Table 3. Chronological Program of Implemented Agricultural Policy Reforms:

Year	Policy reform action
1986	Removal of compulsory procurement of all crops with the exception of paddy, cotton and sugarcane, because these three crops are the highest water consumptive crops in Egypt. Optional procurement with floor prices for wheat, maize and other crops.
1991	Removal of compulsory procurement of paddy. Optional procurement with floor price for rice. Elimination of exchange rate subsidy for imported inputs.
1992	Cotton procurement price raised by 66% of previous 5-years average of the world price. Elimination of all crop area controls except for minimum area requirements for cotton and rice.
1993	Elimination of all input subsidies with the exception of cotton pest control subsidy. Elimination of cotton area control. However, regional allocation of varieties stayed to be determined by government.
1994	While the conventional administrative marketing system of cotton was allowed permissions were given to private sector to compete with public sector in ginning, buying and selling cottonseed.
1996	The permissions given to the private sector to compete with public sector in exporting cotton were cancelled. The Government decided to provide incentives to the cotton farmers. These incentives are provided in terms of baring the costs of land preparation and/or insecticides and pesticides control when farmers face unfavorable conditions.

4.2.1 Institutional Reforms in Agricultural Sector:

Institutional measures have also been implemented in agricultural sector with the intent of liberalizing the policy environment. These measures are:

(1) Removal of government constraints on private sector practices in imports, exports and distribution of farm inputs to compete with Principal Bank for Development and Agricultural Credit (PBDAC).
(2) Removal of government constraints on private sector practices in importing and exporting agricultural commodities.
(3) Gradual transformation of (PBDAC) into financial institution.
(4) Selling Public ownership of the new reclaimed land to private enterprises, either individuals or companies.
(5) Liberalization of the agricultural land market. The law issued in 1992 cited to increase the official rent from a value of 7 times the land tax to a value of 22 times the land tax and after a transitionally period of five years, the land tenancy system had been completely liberalized in 1997. The rental value has become a resultant of the market forces.

4.2.2 Economic Changes in Agricultural Sector by target policy issue

The table number (4), summaries the major changes in agricultural sector by the type of policy, and corresponding target economic issue.

Table 4. Economic Changes in Agricultural Sector by target policy issue

Target Policy (Economic Issue)	**Policy actions**
Agricultural Production policies	Crop areas and rotations decided upon by farmers except that a maximum area of rice was retained and a minimum area of cotton was relaxed.
Input Delivery policies	Agricultural inputs are marketed freely
Input prices policy	Prices of agricultural inputs are market determined except: 50% subsidy on fuel, 50-75% subsidy on cotton seeds, 80% subsidy on cotton control costs and 15% tax on fertilizer imports.
Credit Policies	PBDAC is working on a competitive basis in finance market. Interest rate is not subsidized any more and includes 2% commission for PBDAC.
Agricultural output marketing	Optional delivery system is now applied for all crops except for cotton and sugarcane. Compulsory delivery system is still applied to cotton and sugarcane, where 100% of the output is delivered to government (Business Public Sector Companies). Whereas, the optional delivery of maize and rice associates with a floor price estimates, the government insists to keep the optional delivery of wheat delivery a floor price, usually, 20% higher than the world price (border price). The farm gate prices for cotton is determined annually by the official cotton committee for the ELS and LS varieties according to the forecasting study of the international market movements.
Exchange Rate Policy	After the stability of the free market exchange rate at about 0.3$/ LE. For one decade, by the onset of 21st century another devaluation occurred. It has reached L.E. 4.55 per 1- US$ at the banks and about 3% higher at the private sector exchange bureau. Currently it ranges between L.E. 4.75 to 4.85 / 1-US$. Such rate may reflect the real supply and demand conditions of the hard currency in the Egyptian economy.

TYPES OF CROP SUBSIDY LEFT BEYOND THE ECONOMIC REFORM PROGRAM

5.1 Development of Cotton Price Policy

Before the market season of 1994 all cotton procedures were required to sell all their cotton to the government of Egypt, which gave the government monopsony control over purchases of domestic cotton. The cotton border price as the domestic farm gate equivalent of the cotton export price was calculated and compared with the cotton procurement farm price. The difference showed that the former was higher than the later, which implies that there was an indirect tax paid by the farmers up to 1993. The average value of such indirect tax was about 30% over the period 1986-1991[9].

However, this tax was not collected on all the cotton purchased from the farmers, but only on what exported. Such tax was considered as a subsidy or transfer payment from the cotton sold to domestic textile industries.

In order to induce farmers to plant more acreage of cotton, the procurement prices, which were set by the administration, have increased since 1990/1991.
The government of Egypt for many years has administrated the export prices of Egyptian cotton. Export prices for each variety and grade are set each year by a joint decision of representatives of the ministry of economy and foreign trade, the cotton affairs holding company, and the five cotton trading companies, which are under the business public sector management). The government of Egypt past policy has been to set exports prices at the onset of each market season and hold to them for the entire market season. This policy has lead to depressing sales when prices were set too high. The export price of Giza 70 set by the government was on the average 59% above the world price of "US Pima" and Giza 75 was 90% above "SJV CA." over the period 1986-1992.

Although the export prices for Egypt's cotton were far above the prices of competing varieties during 1986-1992, it has resulted in declining the Egyptian cotton exports. Therefore, in response to the falling world prices and in attempt to regain the market share lost, Egypt has reduced cotton export prices since 1992/1993-market season.

Currently, the Cotton marketing and exportation policies are still under intervention practices by the government authorities. Fortunately, the differences between announced price and free market export price is diminishing as experience is gained. The high committee of cotton determines every year the price by variety according to the analysis of the export market price. The export price is forecasted in advance by this authority and announced in the international market.

Available data shows that the average annual export price was L.E.3696.7 per ton of crude cotton, before liberalization program (1980-1986) and increased to about L.E. 7514.1 in 1999. With respect to farmer's nominal profitability per feddan of cotton, it increased from about L.E.73 before economic reform era to more than L.E. 662 after

[9] O'mera, Gerald, Ibrahim Soliman; Emad El Hawary and Samir Mostafa, (1994). " The Cotton Supply Response: Agronomic and Economic Factors Affecting Cotton Production in Egypt". APCP/USAID PROJECT NO. 263-0202, PBDAC and Chemonics Int.

economic reform implementation. At constant price level such profitability also increased from L.E. 79 before economic reform and liberalization to more than L.E. 219 per feddan by application of the program. However, the government still provides incentives to the farmers to keep cultivation of cotton. In the unfavorable years some subsidizes to the costs of production are provided. These include baring a proportion, up to 80% of the cost of the land preparation and insecticides and pesticides control, as well as 50-75% of cottonseeds price. Unfavorable years include high infection by cotton worm or some other diseases or a sharp drop in cotton yield and/or price. The amount of such subsidy over the second half of nineties ranged between L.E. 100-250 per feddan. The government authorities determine the regions that are allowed to cultivate cotton and the cultivated variety. Early in nineties the experience with the private cotton export firms was not encouraging. Therefore, exportation of cotton has been restricted within the public business companies. AS shown earlier, the higher committee of cotton announces in advance the expected export price of cotton.

5.2 Sugarcane Price Policy

All Sugarcane Refineries in Egypt are still under what is called Public Business Sector. This sector is an adjustment pattern of the public sector management. The companies have more flexibility to take decisions towards making profit and reaching competitiveness under free market conditions. The Ministry of State for the Public Business Sector has the general supervision of these companies managerial performance.

The price of domestic produced refined sugar stills higher than imported one. This is mainly because the government provides a higher price for the sugarcane delivered by the farmers to the refineries than the international average price. The international price of refined sugar accounts 75% of the domestic price. To get the procurement sugar cane farm price requires calculating the equivalent border price of sugar at farm gate. Consequently, this procedure requires a set of data including costs of processing and values of by products. As sugar cane is the main agricultural activity of the Upper Egypt farmers, such subsidies are provided to compensate the high cost of sugarcane production.

5.3 Wheat Price Policy

The government of Egypt provides incentive to the farmers in order to encourage them to deliver more wheat to the Principal Bank of Development and Agricultural Credit (PBDAC) and/or the mills of the Public Business Sector. The objective of such policy is to maximize the share volume of local wheat in the processing of subsidized bread, as a social dimension of the economic development. Such incentive is in terms of purchasing wheat usually at higher price than the border price of imported wheat by 20%, i.e. the average price of the later is about 80% of the domestic wheat delivered to the official channels. The quantity delivered this year (2001/2002) suppose to surpass 2 million tons, i.e. about one third of the national production[10]

[10] Ibrahim Soliman Osman Gad and Mohamed Gabber, (1997). "Wheat Marketing Performance under Free Market System". Egyptian Journal of Agricultural economics, Vol.7, No.2.

5.4 Fuel Price Policy

Farm management studies have shown that almost 100% of the farms are using mechanization systems for land preparation, water pump to lift irrigation water to the their fields, and harvesting and threshing of grains. One-forth to one-third of the farmers use planter and drilling machines as well as laser leveling for soil. Recent studies concerning agricultural mechanization and fuel consumption have shown that the common type of water pump used in Egyptian agriculture of a horsepower about 16 HP and the common operating power for other farming operations is the tractor of 65HP[11]. They also, accounted the subsidy in the Diesel fuel price as 50%.

IMPACTS OF AGRICULTURAL PRICE SUBSIDY POLICY IN EGYPT

6.1 Impacts on Agricultural Sector Performance

The economic reform program impacts are presented here as the profile of the major findings of "A General Equilibrium Model Applied by IFPRI in 1995 to investigate the impacts of the structural adjustment program of Egypt on agricultural sector. Several policies of the Economic Reform Program (ERP) had already been implemented since 1990, as the base year of the model.

The analysis of that model was limited to the impact of the subsequent of the Economic Reform Program changes implemented between 1987-1994.

The changes of he concerned policies were introduced into the model as the "Base Solution" which was entitled "Full Liberalization with 1990 Export bounds". This solution corresponds to 1990 base year resource endowments, technology, prices and export bounds applied to 1994 policies. It detects what might have happened in 1990, assuming that the ERP had been fully implemented at that time.

The model's output showed that:

1) The ERP had, generally, negative impact on the agricultural sector.
2) The value of agricultural output declined by 8%
3) The producer surplus declines by 16%
4) The cropped area and production of individual commodities would not change very much.
5) Agricultural output prices decreased by 3 percent on average.
6) Input costs increased with the removal of subsidies.
7) Consumers gained 6% from the policies changes, because of decline in prices
8) The economy welfare as the sum of consumers and producers surplus would decrease by 0.5%
9) If the value of reduced input subsidies were accounted as less deductible burden from the taxpayer dues, so the net social payoff would be undoubtedly positive.

6.2 Impacts on Crop Choice

Table 5, provides some major indicators of crop choice associated with the ERP between 1986 and 1994. It is concluded that both the cultivated area and the cropped

[11] Ibrahim Soliman, Maisa Megahed, (1998). " Factors Affecting Fuel Consumption Efficiency of Agricultural Tractor in Egypt". The Egyptian Journal of Agricultural Economics, Vol. 8, No. 1, and Page: 73-82.

area increased annually by 2%, which resulted in slightly insignificant decrease in the cropping intensity. The substitution among seasonal crops was apparently significant. In winter, the area of long season berseem has decreased annually by 1% associated with an increase in both wheat and broad bean area by 9% and 3%, respectively. Also sugar beets area was almost doubled. In summer, whereas, the increase in both rice and maize area was apparently significant, i.e. by 8% and 5% per year, respectively, the area of cotton decreased per annum by 4%. Sugar cane area, Upper Egypt major crop, has also increased annually by 2%.

Two major conclusions has been recognized from, table 5, data analysis. First, surprisingly, neither the absolute level, nor parity profit and nor percent change in crop profitability could be considered as interpretative variable of the substitution among major crop acreage.

Secondly, the major increase in individual crop area was in favor of major highly water consumptive crops, i.e., rice and sugar cane.
To assure that these conclusions has been applicable up till now, the analysis was repeated for the year 2000 to be compared with 1994, as shown in table 6. The results of such table did not show any new significant conclusion, except that wheat and long season berseem as well as sugar beets have significantly replaced the broad legumes area particularly broad beans.

Table (5) Impacts of Economic Reform Program on Agricultural Land Use and Profitability[12] (1986-1994)

Comparative Item	1986		1994		% annual change	
	(000) Feddan	Real Net Income per Feddan L.E.[13]	(000) Feddan	Real Net Income per Feddan L.E.	(000) Feddan	Real Net Income Per Feddan L.E.
WINTER:						
Berseem (S)	870	141	737	101	-2%	-4%
Berseem (L)	1866	211	1785	244	-1%	2%
Wheat	1206	304	2111	199	9%	-4%
Broad Beans	307	349	373	53	3%	-11%
Sugar Beets	37	Na	42	78	2%	
Others	742	Na	808	na	na	na
Winter Total	5028	na	5856	na	na	na
Summer & Nilli:						
Maize	1231	146	2058	157	8%	1%
Rice	1008	447	1379	423	5%	-1%
Others	2023	na	1637	na		
Summer Total	4262	na	5115	na		
Cotton	1055	79	721	219	-4%	22%
Sugar Cane	262	553	301	405	2%	-3%
Perennial Total	1317	na	1022	na	-3%	na
ORCHARDS&PALM-DATES	529	Na	1002	na	11%	na
Cropped Area	11136	Na	12995	na	2%	na
Cultivated Area	6003	Na	7165	na	2%	na
Cropping Intensity	1.86	Na	1.81	na	0%	na

[12] Calculated from Annex 2

[13] Deflated at constant price, (1987/1988=100)

Table (6) Impacts of Economic Reform Program on Agricultural Land Use and Profitability[14] (1994-2000)

Comparative Item	1994		2000		% Annual Change	
	(000) Feddan	Real net income per feddan (L.E.)	(000) Feddan	Real net income per feddan [15] (L.E.)	(000) Feddan	Real net income per feddan (L.E.)
WINTER:						
Berseem (S)	737	101	525	350	-5%	41%
Berseem (L)	1785	244	1864	742	1%	34%
Wheat	2111	199	2463	293	3%	8%
Broad Beans	373	53	307	144	-3%	29%
Sugar Beets	42	78	136	236	37%	34%
Others	808	N/A.	1159		7%	NA
Winter Total	5856	N/A.	6454		2%	NA
Summer & Nilli:						
Maize	2058	157	1928	247	-1%	10%
Rice	1379	423	1569	412	2%	0%
Others	1637	N/A.	2883	NA	13%	NA
Summer Total	5115	N/A.	6380	NA	4%	NA
Cotton	721	219	518	374	-5%	12%
Sugar Cane	301	405	319	777	1%	15%
Perennial Total	1022	NA	837	NA	-3%	NA

[14] Calculated from Annex (3)
[15] Deflated at constant price (1987/1988 = 100)

OTHER CAUSES OF IRRIGATION WATER USE INEFFICIENCY

Outside the dilemma of the market failure[16], there are two other sets of causes behind the irrigation water use inefficiency. They are (1) physical male structure and deformation and technical deficiencies of the irrigation system network and (2) Socio-economic obstacles at farm management level of water use.

7.1 Some Socio-economic Causes of Irrigation Water Use Inefficiency

Some Socio-economic studies identified other causes, rather than taxation and subsidy policies, of irrigation water use inefficiency. Such causes were detected from sample surveys and field investigations, which are presented in this section: It is concluded from these investigations that at the farm management level, frequent, violations of the irrigation rules (quotas and schedule. etc.) are results and not causes of water supply deficit.

Usually the water distribution is conducted according to the area cultivated. Frequently, the actual discharge is less than the authorized (planned) quota, particularly during summer season.

(1) The discharge rate from the primary irrigation canal to the "Mesqa" is expressed as number of minutes/feddan. Therefore, it is, common, that the "Mesqas" at the end tail of a primary irrigation canal receive fewer water supplies. The total deficit in some governorates or regions may reach one-third.

(2) There would considerable waste in water, due to refilling the canal level between each two successive dates of irrigation. Therefore, the farm at the end tail of the canal bares the cumulative losses in water. If the approved schedule of irrigation dates, implies that the farmer at the beginning of the canal gets to irrigate first, followed the successive neighbor, the burden of the total accumulated water losses would be deducted from the last farmer's quota (the farmer at the end tail of the canal). To avoid such problem, the "WUA" can reschedule the irrigation dates on base of successive location of the farms, in order to distribute the waste of water evenly, among farms.

(3) The water is allocated on base of area holding. A significant proportion of agricultural land has been taken over time for urban used and/or infrastructure construction. . However, a significant portion of such area is still recorded as agricultural land. Therefore, it is accounted in water discharge allocation. Accordingly, some

[16] See Section 2-4 in this study.

regions or holdings may receive excess of water at the expenses of others.

(4) Usually the deficit in water supply occurs during the summer season, i.e. from Mid of May to the end of July. The farmers' complaint is less severing after that, starting from August and thereafter, when the irrigation of cotton and rice stops.

(5) Receiving the quota of irrigation water as a mix of agricultural drainage and pure water increases water salinity and soil salinity, which implies leaching of salt with excess of water, that magnifies the water deficit problem.

(6) Some farms located by a drainage canal, lift water from such canal to recover the deficit in irrigation water, even though they know the drawbacks of this action.

(7) Also, some other farmers install wells, which get water again from the seepage water that often leaks via the Nile branches, and some times such water is salty but not so polluted.

(8) Most of the farmers believe that poor leveling of the field lowers the irrigation efficiency. They also believe that although laser leveling, if available at low costs, is useful in saving irrigation water, it would be of negative results if it has been conducted inefficiently.

(9) Farmers are reluctant in clearing up the tertiary canal "mesqa" or side canal "Ganabya". Weeds block the water stream flow and consume a significant portion of water availability.

(10) *Violation of the irrigation rules in order to get self-reliance solutions that may overcome water deficit on individual base. Here are some real life practices under such umbrella*:

(a) Farmers intend to break some "Weirs" or open some bridges, which control the water discharge into the canal "Gessr-banks" to get enough water supplies for their areas. They find their ways with "Al Bahar" to avoid penalties associated with such violation. It could be done by individuals, or by a group of farmers, or by an individual farmer for a group of them.

(b) There are several approaches of exchanging water surplus among Farmers, in particular, during critical times of water shortage. E.g. Farmers with excess of water within their quota transfer it to their adjacent neighbors for free, but they give priorities to brotherhood (relatives); lend excess water, which is refunded when the donor is in need of water.

(c) Some powerful farmers in the village violate the schedule to get enough water for their own large farms, their relatives or sometimes for a group of farmers in the village. Penalties, in many cases are phased out.

It should be mentioned that The "WUA"S is established to manage institutionally such social types of water sharing.

7.2 Physical Male Structure, Deformation and Technical Deficiencies of the irrigation System:

The set of causes related to the irrigation system network are identified under section number 2.3 of this study. The existence of these defects affects the irrigation water supply. They cause either deficit in the effective supply reaching crops, or degeneration of the water quality, or raise the costs of water distribution and delivery or both. Here is the identification of some major ones:

(1) Water logged soil, (2) seepage or leakage of the water through the main canals. (3) Contamination of drainage water mixed wit irrigation water. (4) Contamination of irrigation water with heavy metals. (5) Lack of consistency between irrigation water discharge and drainage system capacity. (6) The impacts of the expansion of some plants and some weeds that grow and float in the Nile and its branched canals, which block the flow of water.

The projects included in the National Irrigation Improvement program (IIP) suppose to treat such obstacles and therefore increase the available water supply. Among their major benefits is expected decrease the cost per cubic meter of irrigation water

ESTIMATION OF IRRIGATION WATER ECONOMIC EFFICIENCY

8.1 Methodology

Estimation of the average economic efficiency for irrigation water was derived from the following equation:

Average Economic Efficiency of Water in Irrigation = (Average Return per One cubic meter of water)/ (Estimated shadow price of irrigation water).

If the resultant ratio was less than one, it implies that the irrigation water use was economically inefficient, because the return per 1-m^3 of water could not cover its economic price. Consequently, if it was greater than one indicates that there is an economic attractiveness towards expansion of such pattern via more water consumption.

The average return per one cubic meter of water was estimated by dividing the net income per feddan over the water consumptive use per feddan for each corresponding rotation. The water consumptive use of each crop was derived from the estimates of The Ministry of Public Works and Water Resources.

The available estimates of crop Evapo-transpiration as cubic meters of water per feddan by crop was used to estimate the water consumptive use per feddan according to an average irrigation efficiency of 70% for all crops, except for rice it is assumed as 50%.

Table (5) provides the real level of net income per feddan of each major crop. It was used to estimate the average income per feddan according to the most common crop rotation (pattern) in Egypt, as presented in Table 6. All were biannual rotations (winter and summer crop), except the case of sugar cane rotation; it was a triple-years rotation, and e.g. sugar cane as perennial crop that lasts for 3 years on the field, with three annual

harvesting. Hence, the associated rotated crops were assumed berseem in winter and maize in summer (wheat could be substituted with berseem).

The shadow price of one cubic meter of irrigation water was deducted from the major findings of a General Equilibrium model applied by IFPRI in 1995 to investigate the impacts of the structural adjustment program of Egypt on agricultural sector. It was 5.7 Egyptian piasters per one cubic meter of irrigation water. Accordingly, the above shown equation was applied.

From the same General Equilibrium model the irrigation water demand (price) elasticity was estimated as 0.37[17]

8.2 Irrigation Water Economic Efficiency at current Price Policies

Form table 7 the sugar cane rotation is an uneconomic pattern of water consumption use because the return per one cubic meter of irrigation water is less than the shadow price per 1-M^3. However, the socio-economic impacts of cultivating sugar on the Egyptian economy should be thoroughly studied to judge its feasibility.

It should be mentioned that both berseem-rice and wheat-rice rotations have the highest economical efficiency of irrigation water use, followed by sugar-beets rice rotation. The water consumptive use for cotton rotation is almost economical.

Once the irrigation water demand (price) elasticity is 0.37, a saving in available water for irrigation use by 10% (about 3.8 billions cubic meters of water) would not raise the shadow price of water more than 3.7%. Then there is all possible probability for growth in area and yield of berseem, rice, wheat, maize and even cotton (under current economic policies), with a charge for water use by the farmers.

[17]The price elasticity was estimated by rerunning the model under the assumptions of 5% increase of irrigation water availability and another iteration with 5% decrease in the irrigation water supply. The change in the shadow price of water estimates was used to calculate the arc elasticity.

Table (7) Economic Efficiency of Irrigation Water Under Current Economic Reform Policies

Crop Rotation	Real net income/feddan L.E. [1]	Consumptive Use of Water/feddan (m^3) [2]	Income/m^3 water Egyptian Piasters (EP) [3]	Economic Efficiency of irrigation water [4]
Sugar cane-maize-berseem	*304*	*6312*	*4.82*	**0.85**
Sugar beets-rice	501	5841	8.58	**1.51**
Berseem-rice	774	5598	13.82	**2.42**
Berseem(L)-maize	401	5385	7.45	**1.31**
Berseem(S)-cotton	320	5338	5.99	**1.05**
Wheat-rice	620	5274	11.76	**2.06**
Wheat- maize	300	4929	6.08	**1.08**

[1] Source: Table (5) and the table of Annex 2
[2] Calculated from: Hussein, Z., Seckler, D. and El-Kady, M. (1994). " Crop Substitution for More Efficient Water Use in Egypt". Working Paper Series No. 1-14. Cairo Strategic Research Program, where the available estimates of crop Evapo-transpiration (m^3 of water per feddan) by crop and then by rotation was divided by an aggregate average of irrigation efficiency of 0.7, except for rice it was assumed as 05.
[3] =[1]/[2]
[4] = [3]/ (shadow price of 1(m^3) of irrigation water.
The shadow price of water used is 5.7 Egyptian piasters[18]

[18] Hazzell, Peter, N. Perez, G. Siam and Ibrahim Soliman. (1995). "Impact of The Structural Adjustment Program on Agricultural Production and Resource Use in Egypt". EPTD Paper No. 10. Environment and Production Division, International Food Policy Research Institute. Wash. D.C. USA.

8.3 Impact of Fuel Free Price on The Economic Efficiency of Irrigation Water:

8.3.1 Methodology:

As mentioned earlier (5-4), the subsidy of fuel price is about 50%. Diesel is the common type of fuel used for operating agricultural machinery. The tractor of 65 HP and irrigation pump of 16 Hp are the common types of power used. Numbers of operating hours by crop by farm operation are derived from available field surveys[19, 20, 21]. Chemonics Int. for the "MALR" to cover the agricultural year 1992 derived the estimated costs and revenues of each crop[22].

The estimates for the fuel consumption for each crop was derived from the model generated by Ibrahim Soliman et, al., and published in (1998)[23]. The model estimates the fuel consumption as a response of the Horsepower, Loading Factor and the Number of hours of the machinery operation. The loading factor estimates the weighted share of each farm operation according to an index that reflects the level of energy (power) needed to conduct each farm operation. Table (8) shows the estimated cost of fuel consumption by crop.

The costs and revenue of the concerned crops were taken from three sample surveys for the agricultural year 1994[19,20, 21, 22], because They include also the corresponding data of machinery operating hours by farming operation for each crop. Table (9) presents the estimated decrease in net income, as fuel price subsidy would have been phased out. Such decrease ranges between 23% of cotton net income to 60% of rice and short season berseem.

Recalculation of the irrigation water inefficiency was conducted under free price of fuel, using the same procedure shown in section (8.1).

8.3.2 Economic Efficiency of Water at Free Price of Fuel:

---

[19]Ibrahim Soliman, Mohamed Gaber and Ali Ibrahim, (1994). "Socio-Economic Impacts of Application of Non-Conventional Mechanization for Wheat Crop: A case Study in Kafr Al Shaikh". Minia J. Agric. Res. & Vol. 16, No. 3, P: 958-980.

[20] Ibrahim Soliman, Mohamed Gaber and Ali Ibrahim, (1994). "Socio-Economic Impacts of " The Bio-Mechanical Technological Package Applied for Sugar Cane Development: A case Study in Minia Governorate". 5th Conf. Agric. Dev. Res., Fac. Agric., Ain Shams Univ., Cairo, Egypt. Page: 1-22.

[21]G. O'mera, Ibrahim Soliman, Emad El Hawary and Sari Mostafa, (1994). " Agronomic and Economic Factors Affecting Cotton Production in Egypt: The Cotton Supply Response Project, Chemonics/ PBDAC, and USAID Project No. 263-0202.

[22] Agricultural Production and Credit Project: A Sample Survey Conducted by Chemonics Int. for MALR: "The costs of Production Surveys:" APCP Deliverable: WP-VII/7.3.A.

[23] Ibrahim Soliman, Maisa Megahed, (1998). " Factors Affecting Fuel Consumption Efficiency of Agricultural Tractor in Egypt". The Egyptian Journal of Agricultural Economics, Vol. 8, No. 1, and Page: 73-82.

The ratio of the return to one cubic meter of water to the shadow price of water is estimated in Table (10), under the assumption of the free price of fuel used for operating the agricultural machinery systems for each crop rotation.

The major concluded findings show that if the subsidy of fuel price was removed the economic efficiency of using water for irrigating the sugar cane rotation would be 0.6, Table 10, i.e. the inefficiency of water use would be worsen than the results of table 6. The return to one cubic meter of irrigation water was hardly covering the shadow price of water under the subsidized price of fuel for wheat-maize and berseem (S)-cotton rotations, table 6. Without such subsidy the return to irrigation water would cover only 60% to 50% of the irrigation water shadow price, Table (10). Also berseem-maize rotation would not be economically feasible in using irrigation water without fuel price subsidy. The only two rotations that showed a feasible allocation of irrigation water were Berseem-Rice and Wheat-Rice without the subsidy of fuel price, where the water economic efficiency would be 1.3 and 1, respectively, Table (10). Obviously, The removal of the incentives *subsidy) that are provided to wheat farm price (20% above the imported wheat price) would make the wheat- rice rotation also inefficient in using irrigation water by economic principals.

Table (8) Estimation of Fuel Consumption and Costs At Its Subsidized and Free Price for Major Crops

Crop	Machinery operating hours			Consumed Fuel in Liters	Fuel Costs (L.E)	
	Irrigation	Others	Total		At Subsidized Price of Fuel	At free price of Fuel
Cotton	34	58	92	707	283	565
Wheat	18	69	87	783	313	627
Maize	28	40	68	497	199	398
Rice	15	82	97	915	366	732
Sugar Cane	83	14	97	365	146	292
Berseem L.	29	51	80	627	251	501
Berseem S.	8	25	34	295	118	236

Table (9) Percent of Shrinkage in Net Income Per Feddan of Major Crops: (Due to Phasing out the Fuel Subsidy)

Crop	Total Costs per Feddan (L.E.)	Net Income/ Fed. (L.E.)		% of shrinkage in net income due to phasing out fuel subsidy
		At Subsidized Price of Fuel	At Free Price of Fuel	
Cotton	632	1210	927	23%
Wheat	485	756	443	41%
Maize	465	410	211	49%
Rice	645	625	258	59%
Sugar Cane	2046	1040	894	14%
Berseem L.	388	633	382	40%
Berseem S.	237	195	77	60%

Table (10) Impacts of Phasing out Fuel Subsidy On Economic Efficiency of Irrigation Water

Crop	Real Net Income per Feddan (at subsidized fuel price L.E.	shrinkage in net income due to fuel subsidy (L.E.)	Real net income per feddan At fuel free price L.E.	Consumptive Use of Water/feddan (m3)	Real net income/m^3 in Egyptian piasters (EP)	Economic Efficiency of Irrigation Water
Berseem-rice	774	347	427	5598	7.6	1.3
Wheat-rice	620	331	289	5274	5.5	1.0
Berseem(L)-maize	401	175	226	5385	4.2	0.7
Wheat- maize	300	159	141	4929	2.9	0.5
Berseem(S)-cotton	320	132	188	5338	3.5	0.6
Sugar cane-maize-berseem	304	77	227	6312	3.6	0.6

ANNEX 1
Irrigation Water Demand and Supply: An Overview
The Economic efficiency of Irrigation water

It is the ratio of (Marginal return to irrigation water in activity "crop" I) to (the marginal cost of irrigation water using system J). If such ratio equals one for all activities there will be an optimum efficiency in water allocation among agricultural activities. It is also can be used to estimate water allocation efficiency between agricultural and non-agricultural sectors. In this case the comparison would be between the marginal return to irrigation water versus that to the non-agricultural activities.

Concerning irrigation water for agriculture, the crop that shows a ratio greater than one means that more irrigation water can be allocated for its production. If this ratio is less than one there is access irrigation water and a proportion of it should be reallocated among other activities (crops) that showed a ratio greater than one.
The marginal return to water in agriculture: The Demand Side

It is the additional value of output (crop production) generated by an additional one cubic meter of water. It determines the demand for irrigation water. For a certain agricultural activity (crop), the demand for water as an agricultural production factor is derived from the demand for this crop. Where the value of marginal product of this crop is the demand price of water at different density (quantity) of water applied per feddan. However, under existing water policies in Egypt, such derived price of irrigation water, if estimated, would represent the shadow price of water, rather than a market price, because the farmers do not pay for irrigation water as a scarce natural resource.

Hence, the marginal return to irrigation water (as a shadow demand price of water for agriculture) is the incremental crop yield generated by the last added cubic meter of irrigation water multiplied by the crop price. On the other hand, the marginal return to irrigation water is affected by other exogenous factors. These factors are the *type of crop*, the *productivity* of the crop and its *price level*, which determine the marginal return to irrigation water. Therefore, the irrigation water demand price is not determined, only by the quantity of available water, but it is mainly an outcome of the agricultural economy performance and policies. Any intervention to reform the water use policy should concern such factors.

Type of Crop:

The type of crop is determined by the cropping pattern. Under free market system the crop rotation and pattern are the farmers' decisions. The type of soil and climate as well as the crop profitability are the factors affecting the farmer's decision. The Government of Egypt has liberalized its controls on agricultural sector that constrain the farmer's choice.

The Crop productivity:

The farming system reflects the response of the input output relations, farm size and level of technology. The technological package, in turn, is a resultant

of the type and density of physical technology (mechanization), chemical technology (fertilization), and biological technology (crop variety).

Crop Price Policy:
The crop price is a determinant variable of profitability. Under free market the price policy should not violate the price mechanism, which in turn, makes the profitability of each crop a real reflection of its comparative advantage. Accordingly, the price policy affects, significantly, the role of comparative advantage in the crop choice decisions among alternative competitive crops. Any governmental intervention in the price mechanism that ignores comparative advantage leads to some sort of price distortion. Finally, such price distortions, if any, would violate the optimum allocation of the water use, according to the economic efficiency definition showed above.

The Marginal cost of irrigation water: The Supply Side

Irrigation System Network:

The major components of the irrigation system from the source till the destination (the field) compose of "Water Transportation and Conveyance System", "Water Distribution System", and "Water Operational System on Farm". The design, technology and maintenance of these systems affect at different proportion the costs of water supply up to the plant. Furthermore, the farmers are responsible for maintaining the tertiary irrigation system (Mesqas) that deliver water to their field. Thus the farmer's contributing a small proportion of the total cost of entire system of irrigation water delivery to the field.

Generally, such cost is derived from the fixed and operational expenditure of water supply. They include the investment cost of establishing the national irrigation system network, and the costs of operating the system as well as the cost of maintaining such system. The *irrigation system network*, rate of *water losses* and the *irrigation efficiency,* consequently, affect these expenditure items.

Water Losses:
The Water losses occur all the way along the network of irrigation, i.e. from the source till the destination (the farm field). The irrigation water losses are mainly due to evaporation and leakage. All types of losses limit the net water volume that reaches the crop roots in the field. Consequently, they affect the irrigation efficiency.
The irrigation efficiency:

The aggregate irrigation efficiency is the ratio of actual quantity of water reached the plant to the quantity of water discharged to the irrigation network. Whereas it is commonly estimated at the farm level, it is measurable at any distribution or conveyance stage from the source till the field. If the major objective is to reform the irrigation water policy, then one of its main targets will be to increase the irrigation efficiency. This, in turn, will lead the system towards minimization of water supply cost. Consequently, will lead to maximize the economic efficiency of water use.

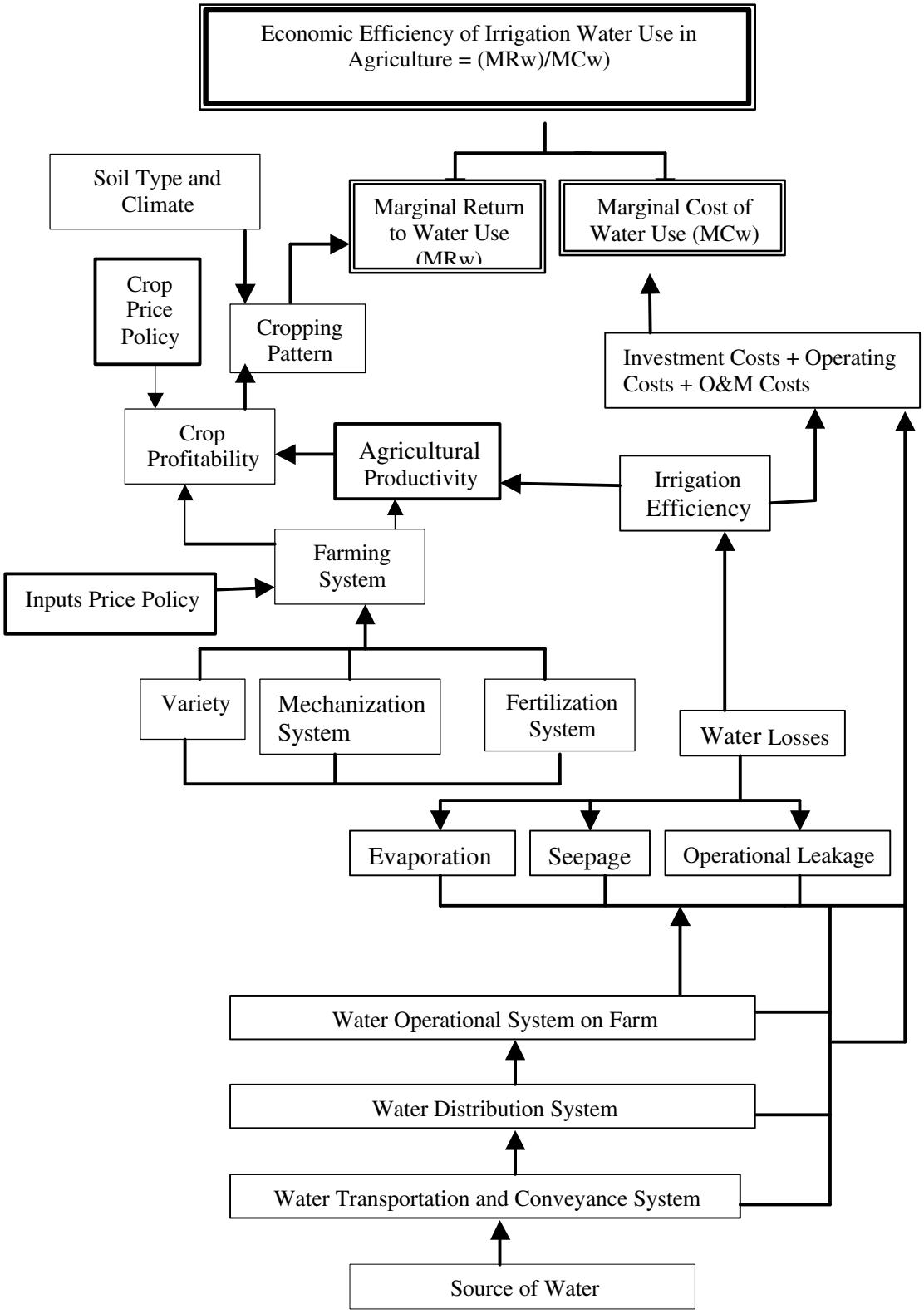
The Water Supply and the Market Price Mechanism
Economically, the marginal cost of water supply supposes to be the value of an additional cubic meter of irrigation water. However, the government authorities

(MOWRPW and MOALR) in Egypt determines the aggregate volume of water supply for agriculture. It is a controlled spatial allocation regime, which provides a constant water supply by agricultural region and even by basin[24]. Currently, the Government tries to allot the regions of the crops of highly demand for water, particularly, sugarcane and rice. However, the violation of such area allotment by the farmers is frequent. Therefore, the supply of irrigation water is not determined via market price mechanism If there were a market price mechanism for water, the beneficiaries of water use (the farmers) would have considered the full cost price of irrigation water in their expected crop profitability and crop choice. Currently, they consider only the cost of the water pump that lifts water from the canal to their field.

It seems that the Irrigation water allocation faces market failure conditions. Therefore it is necessarily to investigate the causes of such issue within a techno-economic context. The market failure stems from that the farmers make benefits from using a scarce economic resource and they do not pay its social price or economic cost. In other words, the demand for irrigation water is a derived demand. It is derived from the demand for agricultural output (the primary demand). The agricultural output provides benefits to farmers (agricultural profitability), and consumers (consumer welfare). When the demand for irrigation water meets the constant supply of water allocated for agriculture, a market price of irrigation water would be determined. Accordingly, the beneficiaries (the farmers) suppose to pay the market price of water. However, the economy does not receive from the beneficiaries (the farmers) the shadow price of the irrigation water as a natural resource or a public good. They do not, even, bare a significant portion of the irrigation network system up to the field.

[24]The agricultural areas in Egypt, at each district, are divided into large blocs. Each one has homogeneous soil type, fertility and physical characteristics.

Figure 1. The Irrigation Water Demand and Supply Model



Annex 2
Agricultural Land Use and Profitability of Major Crops
In 1986 and 1994

Comparative Item	**1986**		**1994**		**% Annual Change in** Nominal Net Income Per Feddan L.E.
	(000) Feddan	Nominal Net income per feddan (L.E)	(000) Feddan	Nominal Net income per feddan (L.E)	
WINTER: Berseem (S)	870	129	737	305	17%
Berseem (L)	1866	194	1785	737	35%
Wheat	1206	279	2111	559	13%
Broad Beans	307	320	373	159	-6%
Sugar Beets	37	N/A.	42	236	N/A
Others	742	N/A.	808	**N/A**	N/A
Winter Total	**5028**	N/A.	**5856**	**N/A**	**N/A**
Summer & Nilli: Maize	1231	134	2058	473	32%
Rice	1008	410	1379	1277	26%
Others	2023	N/A.	1637	NA	N/A
Summer Total	**4262**	N/A.	**5115**	**NA**	**N/A**
Cotton	1055	73	721	661	101%
Sugar Cane	262	508	301	1222	18%
Perennial Total	**1317**	**N/A**	**1022**	**N/A**	**N/A**
ORCHARDS&PALM-DATES	**529**	N/A.	**1002**	**N/A**	**N/A**
Cropped Area	**11136**	N/A.	**12995**	**N/A**	**N/A**
Cultivated Area	**6003**	N/A.	**7165**	**N/A**	**N/A**
Cropping Intensity	**1.86**	N/A.	**1.81**	**N/A**	**N/A**

Annex 3
Agricultural Land Use and Profitability of Major Crops
In 1994 and 2000

Comparative Item	**1994**		**2000**	
	(000) Feddan	Nominal Net income per feddan (L.E)	(000) Feddan	Nominal Net income per feddan (L.E)
WINTER: Berseem (S)	737	305	525	1082
Berseem (L)	1785	737	1864	2296
Wheat	2111	559	2463	907
Broad Beans	373	159	307	445
Sugar Beets	42	236	136	731
Others	808	**N/A**	1159	**N/A**
Winter Total	**5856**	**N/A**	**6454**	**NA**
Summer & Nilli: Maize	2058	473	1928	763
Rice	1379	1277	1569	1276
Others	1637	NA	2883	NA
Summer Total	**5115**	**NA**	**6380**	**NA**
Cotton	721	661	518	1156
Sugar Cane	301	1222	319	2404
Perennial Total	**1022**	**N/A**	**837**	**NA**
ORCHARDS&PALM-DATES	**1002**	**N/A**	**1087**	**NA**
Cropped Area	**12995**	**N/A**	**13921**	**NA**
Cultivated Area	**7165**	**N/A**	**7542**	**NA**
Cropping Intensity	**1.81**	**N/A**	**1.85**	**NA**

REFERENCES

1) Agricultural Production and Credit Project: Conducted by Chemonics Int. for MALR: "The costs of Production Surveys:" APCP Deliverable: WP-VII/7.3.A.

Hazzell, Peter, N. Perez, G. Siam and Ibrahim Soliman. (1995). "Impact of The Structural Adjustment Program on Agricultural Production and Resource Use in Egypt". EPTD Paper No. 10. Environment and Production Division, International Food Policy Research Institute. Wash. D.C. USA.

2) Hussein, Z., Seckler, D. and El-Kady, M. (1994). " Crop Substitution for More Efficient Water Use in Egypt". Working Paper Series No. 1-14. Cairo Strategic Research Program.

3) Ibrahim Soliman Osman Gad and Mohamed Gabber, (1997). "Wheat Marketing Performance under Free Market System". Egyptian Journal of Agricultural economics, Vol.7, No.2.

4) Ibrahim Soliman, Maisa Megahed, (1998). " Factors Affecting Fuel Consumption Efficiency of Agricultural Tractor in Egypt". The Egyptian Journal of Agricultural Economics, Vol. 8, No. 1, and Page: 73-82

5) Ibrahim Soliman, Mohamed Gaber and Ali Ibrahim, (1994). "Socio-Economic Impacts of Application of Non-Conventional Mechanization for Wheat Crop: A case Study in Kafr Al Shaikh". Minia J. Agric. Res. & Vol. 16, No. 3, P: 958-980.

6) Ibrahim Soliman, Mohamed Gaber and Ali Ibrahim, (1994). "Socio-Economic Impacts of " The Bio-mechanical Technological Package Applied for Sugar Cane Development: A case Study in Minia Governorate". 5th Conf. Agric. Dev. Res., Fac. Agric., Ain Shams Univ., Cairo, Egypt. Page: 1-22.

7) Johansson, R. "Pricing Irrigation Water: A Literature Survey". The World Bank, Wash. D.C. USA.

8) Mahdy El Sayed, Michael Rock and Mona El Kady. (1996). " The Impact of Economic Liberalization in Egyptian Agriculture on Consumptive Use of Water". WRSR Publication Series No. 19. Water Resources Strategic Research Activity. Ministry of Public Works and Water Resources, National Water Research Center, Winrock International Institute for Agricultural Development and USAID, Cairo, Egypt.

9) Mann, Arthur, M. Sharaf and T. Khaled. (1999). "Egypt: The Taxation of Agricultural Sector". APRP-RDI Unit. Report No. 55

10) Mohieddin, M. (1995). "The Land Tax System in Egypt: A descriptive Report of Its Historical, Legal and Organizational Aspects". The International Irrigation Management Institute. Cooperative agreement No. 263-0132-A-00-5036-00, MPWWR & USAID.

11) National Center For Environmental Economics. (2001). "The United States Experience With Economic Incentives for Protecting the Environment". EPA-240-R-01-001. Office of Policy, Economics and Innovation. U.S. Environmental Protection Agency. Wash. D.C. USA.

12) O'mera, Gerald, Ibrahim Soliman, Emad El Hawary and Samir Mostafa, (1994). " The Cotton Supply Response: Agronomic and Economic Factors Affecting Cotton Production in Egypt". APCP/USAID PROJECT NO. 263-0202, PBDAC and Chemonics Int.

13) O'mera, Ibrahim Soliman, E., and. (1992). "The response of Egyptian Farmers to Cotton Policy Interventions. Chemonics. Final Report of the Project No.

14) Soliman, Ibrahim, El Sayed Mahdy and M. Gaber. (1992). " Major Constraints of Water Management in El Fayoum Governorate". Egyptian Journal of Agricultural Economics. Vol. 2, No.2. Agricultural Club. Dokki, Cairo.
15) Stavins, R.N. (2000). "Experience With Market-Based Environmental Policy Instruments". Paper No. 00-09, Resources for the Future, Wash. D.C.
16) Tiwari, Digha and Dinar Ariel. "Role and Use of Economic Incentives in Irrigated Agriculture". Rural Development Department, World Bank, Wash. D.C. USA.

ANNEX C

STAKEHOLDER WORKSHOP RESULTS

BACKGROUND

The MBI Study Team investigated the water management challenges facing Egypt in the future. Two problem areas were defined: managing water supplies (quantity) and water quality degradation. These were disaggregated and then the team identified a long list of potential economic instruments that might be employed to mitigate one or more of the disaggregated problem areas. This list was reviewed as to applicability and practicality to arrive at twenty instruments judged to be deserving of further study. The team developed and applied a screening process to the twenty instruments that were considered deserving of further study. A stakeholder workshop was conducted on 24 March 2002 to obtain input from stakeholders regarding the potential efficiency and acceptability of the twenty short-listed instruments.

WORKSHOP FORMAT

The stakeholder workshop was organized as follows:

- Presentations by study team
- Working Group Sessions to discuss and evaluate MBIs
- Completion of questionnaires by individuals subsequent to participation in the Working Groups.

WORKSHOP RESULTS

The results of the workshop are presented in the following attachments:

Attachment 1: Workshop Questionnaire

Attachment 2: Summary Table of Questionnaire Results

Attachment 3: Stakeholder Comments (arranged by instrument)

ATTACHMENT 1

Workshop on Economic Incentives for Water Resources Management
March 24, 2002; USAID-MWRI EPIQ Water Policy Reform Program

Questionnaire on Evaluating Potential Market-based Incentives for Improved Water Management in Egypt

Instructions: Please answer the questions (v - check the appropriate box) for each proposed water management MBIs based on your professional experience and judgment.

A. Water Quantity MBIs

1. Introduce area-based charges for smallholder agriculture
Warrants study & action Deserves further study Not presently applicable
Comments:_____

2. Create a market for participation in irrigation improvement programs
Warrants study & action Deserves further study Not presently applicable
Comments:_____

3. Allow Contracts for priority water delivery
Warrants study & action Deserves further study Not presently applicable
Comments:_____

4. Increase water tariffs to large industries
Warrants study & action Deserves further study Not presently applicable
Comments:_____

5. Increase urban water tariffs
Warrants study & action Deserves further study Not presently applicable
Comments:_____

6. Introduce volumetric irrigation water charges in areas in addition to Toshqa
Warrants study & action Deserves further study Not presently applicable
Comments:_____

7. Introduce a tradable groundwater rights scheme for the Western Desert
Warrants study & action Deserves further study Not presently applicable
Comments:_____

8. Introduce groundwater extraction charges
Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

9. Provide a subsidy for the purchase of urban water meters

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

10. Provide a subsidy for the purchase of water-conserving equipment

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

11. Reduce the subsidy on fuels used for water pumping

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

B. Water Quality MBIs

1. Increase wastewater user charges

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

2. Provide Government subsidies to wastewater plant construction

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

3. Reduce tariffs on pollution control equipment

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

4. Increase discharge fees to industry

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

5. Increase sewerage fees for households

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

6. Improve self monitoring of discharges by industry

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

7. Encourage small-scale environmentally acceptable ways of disposing of household sewage

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

8. Formalize liability for harm to water and ground water

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

9. Introduce new applications of performance bonds

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

10. Widen public disclosure of EIA and environmental quality data

Warrants study & action Deserves further study Not presently applicable

Comments:_____

_____

Any other Comments:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

ATTACHMENT 2

Workshop On Economic Incentives For Water Resources Management, March 24, 2002

Summary of Questionnaire Results

A. Water Quantity MBIs	**Warrants study & action**	**Deserves further study**	**Not presently applicable**	**Total**
Introduce area-based charges for small holder agriculture	7	14	12	33
Create a market for participation in irrigation improvement programs	11	16	5	32
Allow contracts for priority water delivery	3	10	20	33
Increase water tariffs to large industries	21	12	1	34
Increase urban water tariffs	16	11	6	33
Introduce volumetric irrigation water charges other than in Toshqa	7	14	11	32
Introduce a tradable groundwater rights scheme for the Western Desert	7	17	10	34
Introduce groundwater extraction charges	9	20	3	32
Provide a subsidy for purchase of urban water meters	18	10	4	32
Provide subsidy for purchase of water-conserving equipment	18	11	1	30
Reduce the subsidy on fuels used for water pumping	6	13	12	31

B. Water Quality MBIs				
Increase wastewater user charges	15	13	2	30
Provide Government subsidies for wastewater plant construction	12	16		28
Reduce tariffs on pollution control equipment	22	9		31
Increase discharge fees to industry	23	10		33
Increase sewerage connection fees for households	8	16	6	30
Improve self monitoring of discharges by industry	20	10	1	31
Encourage small-scale environmentally acceptable ways of disposing of household sewage	16	12	2	30
Formalize liability for harm to surface water and groundwater	19	10	2	31
Introduce new applications of performance bonds	5	23	1	29
Widen public disclosure of EIA and environmental quality data	20	7	3	30

ATTACHMENT 3
STAKEHOLDER COMMENTS ON INSTRUMENTS

Instrument	Comment (Numbers Represent Different Stakeholder)
A1	1. WUAs issue 2. Positive if linked to crop evapotranspiration, to motivate switch to more valuable crops (best if goes back to system for improvements). 3. Land tax is already applied, the holders less than 3 feddans are exempted, and new lands has a grace period 10 years. 4. Services to be improved as to convince farmers to share cost. 5. They pay land tax which is considered including in it part for irrigation waters. 6. OK for funding if can solve the head-tail equity issue. Will have no effect on efficiency or reduction in area. 7. High priority to improve local infrastructure link to WUA + land tax + local development fund accounts legal structure. 8. Should include technology as criterion for change. Trip less than gated pipes less than furrow. 9. Farmer's ability to pay. 10. It might be very difficult to apply political and /or socially or economically. 11. Based on regions, associations, WB, ect. 12. To be left to WUAs to apply or water boards and not applicable as it is presented. 13. Leave this to the WUA. 14. To be combined with other instruments that promotes efficient practices (ex. tax reduction, ….etc) 15. Service before charges. 16. Left to the WUAs/Water Boards to decide on the appropriate instrument for charging for irrigation water.
A2	1. Difficult to sell, program has some geographic priorities of its own. 2. It will take sometimes for people to touch the benefits and afterwards they will ask for it for their lands. 3. Information to make it clear to the water users of the benefits. 4. The irrigation improvement is needed in the old lands, 90% are smallholders own less than 3 feddans (very poor far more). 5. Not clear what the econ. instruments / incentive being proposed is. 6. Need to be careful poor associations are not left out, potential for resource capture in a reuse. 7. Link with # 1 but includes new lands and crops. 8. Method of payment, grace period, repayment period. 9. It is presently applied. 10. Difficult to apply in IIP areas at the moment.

11. It needs first to convince users by the benefits of irrigation improvement.

A3

1. Equity averse.
2. It could be applicable for mega project as done in Toshka.
3. Should be within the Government responsibility for the time being.
4. Unfair – negative social & economic Impact.
5. Some cost recover, but little impact on volumes used.
6. Could be applicable on mega projects, further studies for small farms.
7. Raises issues of *resource capture* by wealthier persons / WUAs equity can be a concern. Need much study if going to use.
8. Examine what rates should be charged to fully compensate losers (what risk fee should Toshka farms pay to Delta?).
9. No classes for water delivery.
10. Negative equity results.
11. Equity issue.
12. Applied in mega projects and also study for impacts another users.
13. They for Toshka…. old lands?
14. Not practical now.
15. This has had impact from the social point of view.
16. Applicable for mega projects but requires for the study on the impacts on the other users.

A4

1. Keep in mind that firms in industrial cities already pay high water tariffs. Problems are with collection and with translating the revenues to actual improved mgt.
2. Will be a problem for public sector industry.
3. Applicable for large industries with incentives for recycling, better quality discharge.
4. A recycling and utility low quality water.
5. Yes very important but should be combined with incentives for clean tech.
6. Considering the policy of GOE towards giving incentives for investors.
7. Impact on industry competitiveness.
8. Include as charge for discharge monitoring and treatment.
9. MBI for quality (link to B4)
10. You have to increase tariffs for both supply water & wastewater.
11. (But relatively small impact due to low % of water demand) Probably better than # 5 though, esp. of metered # 9.
12. How it will affect the costs of the final product and prices.
13. It is possible now.
14. Within overall package of financial & non-financial “incentives”.
15. But the quality of wastewater must be controlled and recycling is a must.
16. To economically evaluate the reflection on the product cost and the marketing process.

A5

1. Very difficult.
2. Sensitive issues but if there were real improvement in service delivery it would be double-econ. Stratification.
3. Include categories to vary charges.
4. Yes the urban demand is low compared with Agr. But the losses are big.
5. To enable evaluate its reflection on the poor.
6. Without affecting the low-income groups categories.
7. Need meters first.
8. This will rationalize water usage in additional to treatment costs.
9. Meter based or not? Small impact due to low % of water demand, potential/equity problems.
10. How we control the losses in the water system and assure the right consumption.
11. Could be increased based on categorized it.
12. How does it? It is necessary, but concerns of poor must be addressed. Look at block rate tariffs.
13. Study cross-subsidy for rich + poor by geographic areas.
14. Make sure you ask for real cost and according to actual consumption.
15. If the water meters are provided.
16. Based on metering which is not easy.
17. Without affecting the low-income groups.
18. Could be increased on bases of slices without affecting low-income groups.
19. Very difficult will require decades of concerted effort.
20. Politically difficult. Poor metering system another USAID project already investigating this. No need to reinvent the wheel.

A6

1. It is possible to study introducing such system in other mega projects like El Salam.
2. To survey other mega projects similar to Toshka that have rich land ownerships.
3. Not technically feasible.
4. Capacity building is needed.
5. For mega projects/large holder agriculture.
6. Volumetric charges for individuals are impossible may be it is applicable with IMT system and allocation.
7. Look at charging on a bigger unit than farms by WUA for example.
8. So difficult to be applied.
9. Very important “but cost recovery” after improving the system to enable vol. meas.
10. There are other locations such as El Salam Canal, etc.
11. Some areas need further studies.
12. The old valley shall be subjected only for big holder (say 5 feddans or more).
13. It is very critical and it nictitates careful legalization.
14. Very hard and costly to implement.

15. Also El Salam Canal Project and other new land projects (Nuberia, etc)

A7

1. Meanwhile the establish of holding companies is an issue.
2. Individually owned wells, group owned wells and governmental well.
3. The cost of using G.W. in western desert is costly-such use must be cost effective.
4. Deserve further study to show whether it is presently valid or not.
5. Exists in some areas depends on existence of pumps (not free flow) and allocability of rights by owner/controller.
6. Have to be very careful to introducing new property rights. How tradable? Can create new barriers to efficiency and new class of wealth with no action.
7. Socio-economic studies are needed.
8. That have limits on withdrawals, use must be tied to right. Sell right to private company, regulated by government.
9. Yes.
10. It is not very clear to me.
11. Impacts need to be assessed and analyzed, establishment of Holder companies for water supply in the Western Desert.
12. Can be used but it has serious impacts. Holding companies established is a good example.

A8

1.Above lower limit of extraction.
2. But we have to consider that there are some areas suffering from water shortage in some months.
3. For municipal industries.
4. Can be studied for industry & urban uses.
5. Municipal and Industrial water use.
6. No!!! Users pay fees for licensing. However the fees' should be reused.
7. User should pay for benefit gained from a national adaptable asset. Industry & urban need study.
8. Most of groundwater systems in need for rehabilitation including deep and shallow wells.
9. Yes for industry much better than property # 7.
10. Provided that the charges not to be the only element, but the life time of the project should be considered.

A9

1. To evaluate its economic viability.
2. Users pay for meters.
3. Best.
4. Applicable.
5. It is important to be done.
6. The further study may focus on the size of urban water meters installed and size needed to be installed.
7. Study where meters should be household reuses neighborhood.
8. Why subsidy? What would that accomplish?
9. Purchase is one thing; maintenance is a big constraint.
10. Subsidy in reuse of tariff reduction.
11. What about the rural areas?
12. Important precursor to # 5, though costs may significantly reduce benefits.

A10

1. In terms of industry link to modernization & reduction of pollutants discharged. # 3 next section.
2. Yes.
3. The instrument is good.
4. Yes by all means.
5. Can be applied.
6. Or exemption from another tax.
7. Revolving funds.
8. Same as in 9.
9. It is better to exempt the user of these equipment from the proposed irrigation charges-this will be more effective and will reduce the burden on the government.
10. Check the society awareness about the potential of this issue.
11. Could we look at tariff differentiation on imports as well?

A11

1. Politically difficult, not specific to water sector but relevant to economy at large.
2. For whole economy.
3. How to avoid impact on small farmers.
4. Not too much effective.
5. It will not help.
6. To economically and socially evaluate its reflection.
7. Part of the much larger issue of the diesel subsidy.
8. It's difficult though to charge for informal pumping.
9. What is the percent of fuel used for water pumping?
10. Too complex & tightly linked to other sectors of economy.
11. Fuel is not the only input for water pumping (animal power, electricity and manual)
12. A key idea if economy wide but major political issue needs to be resolved

B1

1. Don't know.
2. Should be based in a mental costing to encourage reuse recycling should differential teletypes of pollutant in water encourage clean each.
3. Link to efficiency.
4. Make sure they are connected & payoff first.
5. Real readings (estimates) according to household size.
6. To some extent.
7. Focus on large and/or strong industrial discharges.
8. Equity.
9. The wastewater treatment plants are still beyond any action (40% in urban and 5%in rural).

B2

1. Government already constructs.
2. The GOE. are already financing wastewater treatment plants – private sector is hardly participating.
3. Yes.
4. Very initial.
5. Don't know economics what do we know about BOTs + user charges….
6. Egypt is short of wastewater plants & the GOE budget needs reinforcement.
7. Already in practice?
8. With supervision to insure meeting standards.
9. No private sector participation should be the trend.
10. Look at all options to increase construction of new plants. Needs to keep up with need.

B3

1. To know how much could be the Government burden.
2. In conjunction with low tariff on clean production equipment instead of control "scrubbers".
3. To encourage end of pipe control but as important is the reduction differentiation of tariffs between clean tech. Polluting tech.
4. May send wrong signal with whom trying to reduce tariffs in general? Could we differentiate between imported polluting & non-polluting equipment that entails Egypt adopting its own technical guidelines under TBT agreement?
5. Should also consider a fund to provide clear tech. Loans.
6. See # 10 above.

B4

1. Must be couple with access to wastewater plants otherwise fees would encourage industry to illegally dump into the Nile.
2. 4.B Incentives for recycling (link to A4)
3. It is very important but needs a mechanism with enforcement.
4. Needs mass-based-monitoring to fractions?
5. Enforcement?

6. According to the composition of its wastes.
7. Link to modernization programs to reduce pollutant discharges & water needs.

B5
1. Will not encourage consolation, only a revenue generation tool for GOE.
2. Consideration for the low-income group.
3. What's the difference from # B1?
4. Not existing now?
5. Not a flat fee. It should be based on real consumption/discharge.
6. How many are now connected? Need to assess none water based waste disposal setlines.
7. Based on what? Consumption?
8. As in the case on increasing water tariffs, will take a long time.
9. Another USAID project already made headways in investigating this. No need to reinvent the wheel.
10. To know whether it is within the poor capabilities.

B6
1. Accuracy? Disclosure?
2. Industry is a responsible "citizen"
3. How to monitor and assure improvement in quality of discharges.
4. Awareness first.
5. Should be taken seriously right away.
6. High priority, use other donor industry support projects for implementation.
7. Must link to improvement. Not clear what this is?
8. Concepts of clear production need to be highlighted & self-monitoring is important to track savings in resources.

B7
1..Specifically applicable to poorer rural districts. Highly desirable because households are paying informally but, in an unsustainable way.
2. Not practical.
3. The only solution especially in the rural areas.
4. For rural areas, encouragement.
5. Difficult to apply & can create confusion.
6. In areas that cannot be served by centralized treatment.
7. Should be started because the problem is growing up.
8. Yes, especially in rural areas.
9. See #5 above.

B8
1. Weak enforcement limits usefulness.
2. Of vital importance.
3. Need to determine implementation mechanism.
4. Enforcement?
5. Legal analysis for existing liability rules would be useful.

6. But should be coupled with alternative ways disposal methods + a lot of awareness.
7. WUA's & Boards Juditual system.

B9 1. No significant/viable options were proposed through.
2.??? For water??
3. Update existing laws to make them score significant & streamline GOE Admin. Process.
4. Not easy to be introduced ever for irrigation.
5. Attitudes.

B10 1. Involve NGO community + Ministry of Health need legitimate political pressure.
2. It will help awareness of public of the problem.
3. Well designed database.
4. Critical.
5. Law 4/1994 specifies the implementation of EIA for any project in the planning stage.
6. Part of a much broader awareness program on water.
7. Definitely.
8. Though I would not consider it an MBI and it seems to be politically unacceptable in Egypt.
9. The public needs to understand its rights and obligations in terms of environmental conservation.

Any Other Comments

1. They need to understand the importance of scarce resources.
   We need to raise awareness and to raise the interest of the people in the country.
   The "need to know" should be developed so that the data disseminated can be ultimately used.
2. Discussion of water quality instruments was too academic – did not get enough into pros (screening criteria) on <u>specific</u> instruments.
3. Information is a powerful tool. Government is gradually getting used to providing different types of useful information.
4. Incentive for recycling water. Look at combinations of C-C & MBIs.
5. Thanks.
6. MBI for encouraging introducing new technology in irrigation system may tax exemption on modern equipment.
7. It is important to link the use of new technologies with tax or subsidy to allow more water use efficiency.
8. Distinguish between fees for O & M on investment and charges or other incentives (disincentives to change behaviors. The presentation was lumping a bench of distinctive tools into one basket.
9. People (users) shall pay for water use or consumption. But small holders (less than 2 feddans) might be exempted for the time being.

10. Make sure that the report use agreed upon text.