



**Egypt Water Policy Reform  
Contract No. LAG-I-00-99-00017-00  
Task Order 815**

**EVALUATING THE EFFICIENCY AND  
EFFECTIVENESS OF  
SELECTED MARKET-BASED INCENTIVES FOR  
WATER QUALITY IMPROVEMENT**

**Report No. 68**

June 2003

**REPORT NO. 68**

**EVALUATING THE EFFICIENCY AND EFFECTIVENESS OF  
SELECTED MARKET-BASED INCENTIVES FOR WATER  
QUALITY IMPROVEMENT**

Prepared by:

*Dr. David S. McCauley*  
*Dr. Ibrahim Elassiouti*  
*Dr. Robert Anderson*  
*Dr. Abdel Khalek*  
*Dr. Abdel Aziz El-Guindi*  
*Eng. Hisham Shehab*  
*Eng. Aloa Abbas*

June 2003

for

United States Agency for International Development/Egypt

under the

Integrated Water and Coastal Resources Management Indefinite Quantity Contract

Principal: Development Alternatives, Inc.

Subcontractor: International Resources Group

# TABLE OF CONTENTS

<b>List of Acronyms .....</b>	<b>iv</b>
<b>1. Introduction and Background .....</b>	<b>1</b>
1.1 Water Pollution as an Increasing Concern in the Country.....	1
1.2 Emerging Efforts to Address Water Pollution Problems.....	1
1.3 Organization of the Report .....	2
<b>2. Setting Priorities for Water Quality Management .....</b>	<b>3</b>
2.1 Overview: Assessing Water Quality Problems.....	3
2.1.1 Lake Nasser Water Quality.....	3
2.1.2 Nile River Water Quality from Aswan to Cairo .....	3
2.1.3 Water Pollution in the Delta from Cairo to the Sea .....	5
2.1.4 Pollution of Lakes .....	7
2.1.5 Groundwater Contamination.....	8
2.2 Calculating the Costs of Water Pollution.....	8
2.2.1 Methodological Approach and Data Limitations.....	8
2.2.2 Recreation .....	10
2.2.3 Non-user Damages.....	10
2.2.4 Fisheries .....	11
2.2.5 Diversionary Uses.....	11
2.2.6 Health.....	11
2.2.7 Drinking Water Treatment Costs .....	12
2.2.8 Industrial Water Supply .....	12
2.2.9 Agriculture .....	13
2.2.10 Agricultural Output.....	13
2.2.11 Agricultural Exports.....	14
2.2.12 Tourism Impacts .....	15
2.2.13 Summary of Finding Regarding Economic Damages .....	16
2.3 Setting Priorities for Action to Improve Water Quality Management.....	16
<b>3. Institutional and Legislative Framework for Water Quality Management.....</b>	<b>17</b>
3.1 Institutions Responsible for Water Quality Management.....	17
3.1.1 Ministry of Water Resources and Irrigation .....	17
3.1.2 Ministry of State for Environmental Affairs (MOSEA).....	18
3.1.3 Ministry of Health and Population.....	18
3.1.4 Ministry of Industry and Technological Development (MITD).....	18
3.1.5 Ministry of Housing, Utilities and Urban Communities (MHUUC).....	18
3.1.6 Ministry of Interior .....	19
3.1.7 Ministry of Scientific Research .....	19
3.1.8 Ministry of Agriculture and Land Reclamation (MALR).....	19
3.2 Legislative Authority and Potential for Market-based Incentives .....	19
3.2.1 Water Quality Management Authority of MWRI.....	19
3.2.2 Water Quality Management and MOSEA .....	21
3.2.3 Water Quality Management and MHUUC .....	21
3.2.4 Water Quality Management and MITD .....	22

3.2.5 Inter-sectoral Coordination and Integration.....	22
<b>4. Options for Use of Market-based Incentives to Improve Water Quality Management .....</b>	<b>24</b>
4.1 Results of Previous Analysis on MBIs for Water Quality Management .....	24
4.1.1 Increased User Fees for Wastewater Treatment .....	24
4.1.2 Increased Subsidies to Finance Wastewater Treatment Facilities .....	24
4.1.3 Subsidized Rural Sanitation.....	25
4.1.4 Pollution Control Equipment Pricing.....	25
4.1.5 Voluntary Agreements for Environmental Improvements .....	25
4.1.6 Public Environmental Information Disclosure .....	26
4.2 Additional Market-based Incentive Options for Water Quality Management.....	26
4.2.1 Fines or Charges for Damages.....	26
4.2.2 Effluent Discharge Fees.....	27
4.2.3 Removal of Environmentally-Harmful Subsidies.....	27
4.2.4 Tradable Discharge Permits.....	28
4.3 Conclusion .....	29
<b>References.....</b>	<b>30</b>
<b>Annex 1. Ministerial Decree 194/1985: Executive Regulation for the Water Pollution Fund Pursuant to Law 48/1982 for Protection of the Nile River and Its Waterways Against Pollution .....</b>	<b>32</b>
<b>Annex 2. Ministerial Decree No. 124/1986: For Regulation of a Fund Established According to Article 103 of the Irrigation and Drainage Law No. 12/1984.....</b>	<b>36</b>
<b>Acknowledgments .....</b>	<b>40</b>

## List of Abbreviations and Acronyms

BCM	Billion Cubic Meters
DAI	Development Alternatives International
DRI	Drainage Research Institute
EPIQ	Environmental Policies & Institutional Strengthening Indefinite Quantity Contract
GOE	Government of Egypt
IAS	Irrigation Advisory Service
HAD	High Aswan Dam
IIP	Irrigation Improvement Project
IMT	Irrigation Management Transfer
IRG	International Resources Group
IWRM	Integrated Water Resources Management
MALR	Ministry of Agriculture and Land Reclamation
MBI	Market-based Incentives
MCM	Million Cubic Meters
MHUUC	Ministry of Housing, Utilities and Urban Communities
M&E	Monitoring and Evaluation
MWRI	Ministry of Water Resources and Irrigation
NAWQAM	National Water Quality and Availability Management Project
O&M	Operation and Maintenance
RIGW	Research Institute for Ground Water
USAID	United States Agency for International Development
WPAU	Water Policy Advisory Unit
WPRP	Water Policy Reform Program
C&C	Command and Control
EEAA	Egyptian Environmental Affairs Agency
EEPP	Egyptian Environmental Policy Program
EHD	Environmental Health Department
EOMC	Environmental and Occupation Health Center
GDP	Gross Domestic Production
GOFI	General Organization for Industrialization
MHP	Ministry of Health and Population
MHNC	Ministry of Housing, New Communication and Public Utilities
MOSEA	Ministry of State for Environmental Affairs
NRI	Nile Research Institute
NWRC	National Water Research Center
NWUC	National Water Quality Conservation Unit
NVDA	New Valley Development Authority
PSU	Policy Support Unit (of EEPP)
SWRI	Soil and Water Research Institute
WAU	Water User Association
WTP	Willingness to Pay

## CONVERSION FACTORS

- 1 feddan = x hectares (ha)
- 1 billion m<sup>3</sup> (BCM) = 1000 million m<sup>3</sup> (MCM)
- 1 Egyptian Pound (LE) = 5.1 US Dollars (\$)

# 1. Introduction and Background

## 1.1 Water Pollution as an Increasing Concern in the Country

The Government and population of Egypt are paying increasing concern to growing water quality problems in the country. These have arisen as a result of competition over the nation's scarce water resources—especially in the densely populated Nile Delta.

Water pollution originates primarily from municipal wastewater and industrial discharges as well as from agricultural drainage water. At present, only about one-third of Egypt's population is served by a wastewater treatment facility, and many of these are not operating very effectively. The bulk of treated and untreated domestic wastewater is discharged into agricultural drains. Industrial effluents are also a growing concern. Most heavy industry is located in Greater Cairo and Alexandria, however a number of large agricultural processing enterprises discharge to the Nile between the High Aswan Dam and Cairo. The major pollutants in agricultural drains include salts, nutrients, pesticide residues, pathogens and toxic organic and inorganic substances. Though water quality problems in Egypt vary by location, there is an emerging consensus that they demand immediate policy and program attention.

The Ministry of Water Resources and Irrigation (MWRI) has, however, traditionally been primarily oriented to water quantity versus water quality management. Priorities are shifting, and an understanding is taking hold at MWRI that a far greater degree of inter-agency and inter-sectoral cooperation and coordination will be required to adequately tackle water quality issues than was necessary for irrigation management.

## 1.2 Emerging Efforts to Address Water Pollution Problems

The emerging paradigm of integrated water resources management (IWRM) is shaping the direction of policy thinking at MWRI, and integrating water quality with water quantity concerns is an important element of IWRM. In this context, several new initiatives are helping MWRI get itself better geared to dealing with water quality management. These include the establishment of a Water Quality Unit directly under the Minister's office (with Dutch funding) to help reshape staff assignments to favor attention to water quality issues and otherwise to improve coordination on this subject. Major water quality research and monitoring efforts also have been underway for several years, the most notable of which being the National Water Quality and Availability Management (NAWQAM) and the National Water Quality Monitoring efforts, both of which are principally funded by the Canadian International Development Agency (CIDA).

Though the study team was not yet able to obtain a copy, there is apparently a new National Plan for Water Pollution Mitigation that proposed to spend some LE 13 billion over a 10-year period to reduce pollution and otherwise to clean up the nation's waterways. Since water economics is an essential element of the IWRM approach, hopefully this new national plan will take careful account of the benefits versus costs of alternative mitigation measures as well as considering the potential application of market-based incentives (MBIs) for water quality improvement.

### **1.3 Organization of the Report**

This report deals with the subject of MBIs and their possible use as policy measures to help improve water quality management. The report is a direct follow-on to a previous phase of analysis carried out under the auspices of the EPIQ Water Policy Reform Program. The prior study examined the potential application of MBIs to both water quantity and quality management efforts in Egypt, and the findings of that work are reported in: McCauley, et al., 2002. *Economic Instruments for Improved Water Resources Management in Egypt*, EPIQ/WPRP: Cairo.

The report is organized into three sections. The first examines costs associated with water quality problems in the country as a means for better directing priorities for action. The second briefly reviews the current policies and legislation governing water quality management and existing authority for the use of MBIs in pollution control. The final section suggests some promising ways forward using both existing authorities and by adjusting the legislative and regulatory framework.

## **2. Setting Priorities for Water Quality Management Interventions**

### **2.1 Overview: Assessing Water Quality Problems**

One of the parallel studies being conducted under the Water Policy Bridging Activity (Study 1: Nile River Pollution Study) is meant to provide an updated assessment of water pollution problems in the country. As the findings of that analysis were not yet available at the time of this report's preparation, the summary of key water quality problems presented below relies on earlier information. This brief survey of water quality patterns found in the main waters of Egypt begins upstream with Lake Nasser and concludes with the situation in the Nile Delta and along the Mediterranean coast.<sup>1</sup>

#### **2.1.1 Lake Nasser Water Quality**

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 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.

#### **2.1.2 Nile River Water Quality from Aswan to Cairo**

Between Aswan and the Delta Barrage below Cairo, the Nile River receives discharge from 124 point sources, of which 67 are agricultural drains and 57 are industrial sources. Of the 43 major drains, only 10 are in compliance with the standards set by Law 48/1982 that regulates the quality of drainage water that can be mixed with freshwater (Article 65) and establishes the legal minimum water quality levels for discharges in Egypt (Article 61). 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. Most of the industrial outlets are not in compliance with the standards set in Law 48/1982.

---

<sup>1</sup> This section draws from information presented in: McCauley, et al., 2002. *Economic Instruments for Improved Water Resources Management in Egypt*. EPIQ/WPRP: Cairo. It will be updated when additional information from the parallel Water Policy Bridging Activity study on water pollution is available.

**Table 1. Discharges of Nile River Industries Out of Compliance with Law 48**

Source of Pollution	Law 48 Limits & Recorded Discharge Levels (exceeded standards in bold)								
	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	<b>55</b>	<b>1920</b>	15	<b>6.4</b>	<b>450</b>	0.20	0.11
Kom Imbou Sugar Factory	5.7	<b>83</b>	<b>657</b>	410	<b>67</b>	<b>9.3</b>	2.1	0.06	0.85
Idfou-1 Sugar Factory	<b>9.3</b>	<b>410</b>	<b>1440</b>	365	<b>65</b>	<b>5.6</b>	2.2	0.04	0.23
Idfou-2 Sugar Factory	5.2	<b>81</b>	<b>600</b>	225	<b>42</b>	<b>5.6</b>	1.3	0.04	0.74
Qous Sugar Factory	7.5	<b>77</b>	<b>189</b>	240	22	--	1.0	0.15	0.40
Sohag Oil Factory	7.6	8.5	33	<b>1374</b>	<b>145</b>	<b>7.3</b>	3.5	0.04	0.39
Coca Cola Bottling Factory	<b>11.3</b>	<b>83</b>	<b>256</b>	737	<b>39</b>	<b>5.9</b>	3.5	0.14	0.27
Elhwamdia Sugar Factory	1.1	<b>440</b>	<b>3850</b>	<b>8192</b>	<b>60</b>	<b>17.6</b>	10	<b>7.50</b>	--
Salt and Soda Factory	--	<b>130</b>	<b>155</b>	--	<b>387</b>	<b>9.4</b>	--	--	--
Talkha Fertilizer Factory	<b>10.2</b>	<b>98</b>	<b>204</b>	<b>1350</b>	<b>67</b>	<b>7.6</b>	<b>128</b>	--	--

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).

A comparison of ambient water quality data collected for this part of the Nile under different monitoring programs in 1977, 1986 and 1991 suggests that water quality has 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 Biological Oxygen Demand (BOD) load, but water quality remains within the standards of Decree 8/1983, which is 6 mg of O<sub>2</sub>/l. High loads of Chemical Oxygen Demand (COD) originate at the Coca Cola bottling plant, onion drying factories, and sugar mills, but water quality remains within the standard for this parameter (10 mg O<sub>2</sub>/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. Law 48 does not have a standard for fecal coliform bacteria (FC) but the catchment areas of

several drains below the Aswan High Dam have FC levels well in excess of the World Health Organization (WHO) guidelines for use of water for unrestricted irrigation (1000/MPNml). This indicates the presence of untreated human waste, a situation requiring special attention.

### **2.1.3 Water Pollution in the Delta from Cairo to the Sea**

Irrigation canals 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 the existing laws. Water quality sampling undertaken in 12 canals and rayahs in 2001 revealed that 10 canals and rayahs had FC content in excess of WHO standards for irrigation water, while a different 10 canals and rayahs exceeded Egyptian standards for BOD. As explained below, irrigation canals are receiving increasing volumes of drainage canal water under official drainage water “reuse” programs meant to supplement irrigation supplies.

At present, only about 50% of the population of Egypt is connected to a wastewater treatment facility. While the government is making substantial investments in this sector, the percentage with sewerage connections is not expected to change significantly through 2017. Most sewage treatment facilities are located in urban areas while there is almost no sewerage coverage in rural areas. Many villages discharge raw or partly treated sewage into irrigation and drainage canals. In rural areas, wastewater is usually collected in septic tanks that frequently overflow due to poor construction and maintenance. On occasions when the tanks are emptied, the pump wagon usually will discharge wastes to the closest drainage or irrigation canal.

Water quality monitoring during 2001 revealed that in the Damietta Branch, dissolved oxygen, nitrogen and phosphorus, BOD and total dissolved solids all were within the permissible limits of Law 48. COD values exceeded the standard set by Law 48 but were similar to those observed between Aswan and the Delta Barrage. FC counts exceeded WHO guidelines at most sampling sites. Similar results were found in the Rosetta Branch, however FC counts were somewhat better.

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.

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 the Rosetta Branch Canal for eventual discharge to the Mediterranean Sea.

Since the 1980s, efforts have been underway to extend available water supplies by mixing drainage water in the Delta with fresh water and supplied for reuse in agriculture. 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

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 irrigation 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.

Supported by CIDA through the NAWQAM, the Drainage Research Institute (DRI) 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. At every monitoring station levels of COD and BOD exceed national ambient water quality standards, 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 1). Several others are threatened with closure (MWRI, 2001).

Presently a total of over 7 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 9 BCM by 2017. In addition to water supply threats, unauthorized use of drainage water to irrigate fields also is a health concern. Of the 7 BCM of drainage water reuse, farmers illegally remove approximately 3 BCM of drainage water annually and apply it directly to their fields. Where contaminated with human waste and/or toxic substances (especially heavy metals), this poses a troublesome health issue. Drainage water reuse contributes to rising salinity and pollution levels in the Delta and presents one of the most important water management challenges facing the country.

The government is now attempting to implement a new policy on “intermediate reuse” that emphasizes the recycling of water at points upstream of significant pollution discharge points to reduce problems of cross-contamination and the accumulation of pollutants in drainage canal water used to supplement irrigation water.

**Table 2. Status of Mixing Stations for Drainage Water Reuse in the Nile Delta and Fayoum**

Pumping Station	Drain	Mixing Location	Annual Discharge (MCM)	Status
<b>East Delta:</b>				
Wadi	Qaliobia	East Wadi	200	<i>Shut down</i>
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	<i>Shut down</i>
Upper Elserw	Serw	Damietta Branch	275	Operating
Elsalam 1	Lower Serw	Elsalam	650	Operating
Elsalam 3	Hadous	Elsalam	1350	Operating
<b>Middle Delta:</b>				
Upper (1)	Number 1	Damietta Branch	60	<i>Shut down</i>
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	<i>Shut down</i>
<b>West Delta:</b>				
Elemoum	Elemoum	Nobaria	1000	<i>Shut down</i>
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
<b>Fayoum:</b>				
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.*

#### 2.1.4 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. 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 it located on the Mediterranean coast in the central portion of the delta where it receives industrial effluent principally through the Nashart Drain.

### **2.1.5 Groundwater Contamination**

Groundwater in the Delta, largely a shallow underground aquifer fed by seepage from 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, where 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.

## **2.2 Calculating the Costs of Water Pollution**

### **2.2.1 Methodological Approach and Data Limitations**

Water pollution such as that currently experienced in Egypt can cause a number of adverse effects on natural systems and the human economy—often termed environmental externalities. In order to have adequate information for the well-informed setting of intervention priorities to improve water quality, it is important to move beyond simply

identifying the types and locations of major water pollution sources to also assess their environmental costs.

This section provides some preliminary analysis of these costs by placing values on the damages incurred from poor water quality in the country. The basic method used is termed a “damage function” approach, and it follows that employed in a recent World Bank study<sup>2</sup> which estimated the costs of Egypt’s degrading air and water quality, deteriorating coastal zones and cultural heritage and associated losses to the global environment.

Four steps are employed in calculating the economic consequences of water pollution: (1) identify sources of pollution and their magnitude of discharge; (2) assess the impacts on ambient water quality; (3) estimate the impacts of changes in water quality on human health, recreation, fisheries and other economically-important water uses; and (4) value these effects in monetary terms. The World Bank study omits many of the steps, choosing to focus on economic estimates of damage, but the supporting research employed the full damage function approach to the extent possible.

At the outset it is important to note that a great deal of work and good data are necessary to make truly credible estimates of this sort. The resources available to the World Bank study—let alone this effort—were severely limited. Moreover, there are important data gaps in Egypt, several of which are the subject of supporting studies to this report (under the Water Policy Bridging Activity). Sources of water pollution may be identified reasonably well in published reports, but the actual quantity and strength of discharges over time remain largely unknown—especially for many of the large state-owned enterprises along the Nile Valley and in the Delta region. In contrast, discharge data for privately-owned enterprises in the new industrial cities is quite good. The World Bank study notes that its estimates do not include all environmental costs because of lack of data and the difficulty of quantifying impacts. The study observes this is particularly true for water resources, solid waste and coastal zone impacts.

To improve on the water resources portion of the World Bank study, a useful starting point is to compare the categories of damage identified in the study with the categories of economic benefit from improved water quality in a more comprehensive effort in the US (Freeman, 1982). This provides a quick check for omissions of economically important water quality impacts (see Table 3). To this list of economically important effects, potential damages from the reuse of agricultural drainage water also should be considered, since this is significant in Egypt (but not in the US upon which the Freeman report was based). Likewise, tourism impacts also should be noted.

---

<sup>2</sup> This section builds upon the World Bank study: World Bank, 2002. *Arab Republic of Egypt: Cost Assessment of Environmental Degradation—Sector Note*, Rural Development, Water and Environment Department, The World Bank: Washington.

**Table 3. Types of Damage from Impaired Water Quality**

Category of Loss	Estimated by World Bank for Egypt (% of GDP)	Noted by Freeman (1982)
Recreation	0.07%	X
Non-user benefits		
Aesthetics		X
Ecosystems		X
Property values		X
Fisheries	0.07 - 0.10%	X
Diversionary uses		
Health morbidity	0.50 - 1.10%	X
Health mortality		X
Municipal treatment costs		X
Households (non-health)		X
Industrial supplies		X
Agriculture		
Impact on quantity		
Impact on quality		
Tourism		

### 2.2.2 Recreation

Categories of recreational benefits include fishing, boating, swimming, and waterfowl hunting. Freeman estimated that recreational benefits from water pollution control efforts ranged from 0.15 to 0.70% of US GDP in 1982. Water-based recreational activities are important in Egypt in three regions: the immediate Cairo area, the Mediterranean coast near Alexandria, and the Red Sea. The first two areas have been affected by water pollution while the Red Sea remains largely unaffected.

The World Bank estimated the damage cost to recreation at 0.07% of GDP per year based on international evidence of willingness to pay by individuals for recreational use of water. This is lower than the bottom of the range Freeman estimated for the US, but may be an accurate reflection of fewer opportunities, a lower intensity of use, and lower willingness to pay for water-based recreation in Egypt.

### 2.2.3 Non-user Damages

Water resources provide several non-user benefits including support of ecosystems, aesthetics, and property values. In addition, there could be “existence values” stemming from the knowledge and assurance that clean water resources are available even if they are not used. For example, much of the Nubian aquifer may never be used, however people in Egypt may value it for its existence. The World Bank study omits the non-user category of damage. Freeman estimated these to be about 0.1% of GDP. It seems

reasonable to include a comparable modest estimate for Egypt since non-user effects are unlikely to be zero.

#### **2.2.4 Fisheries**

The main lakes along the northern coast of Egypt have been in a state of decline for several decades—shrinking in size due to agricultural reclamation and deteriorating with respect to several environmental parameters. Paradoxically, fish catch in the northern lakes increased by 28% and by 23% in inland lakes from 1989 to 1998. This is attributed to more intensive fishing and increased use of fish pens. The World Bank put fisheries losses at 10-15% of potential catch or nearly 0.1% of GDP, an amount quite similar to Freeman's estimate of 0.06% of GDP for the US.

#### **2.2.5 Diversionary Uses**

The use of water for human consumption, industrial activities and agriculture results in additional costs when water is polluted. When water is made cleaner, these costs are reduced. There is a useful symmetry in the manner by which such avoided costs are calculated: a benefit foregone is considered a cost, and a cost avoided is counted as a benefit. For example, such calculations in the US led Freeman to estimate the benefits from avoided water treatment costs in the US at around \$1.3 billion annually (by 1982) due to water pollution control efforts carried out over the previous 20 years. This equated to about 0.06% of US GDP at that time. Likewise, the avoiding of such costs in Egypt would generate large benefit streams. So-called “diversionary uses” are examined with respect to water quality impacts on human health, drinking water, and industrial water supply.

#### **2.2.6 Health**

***Morbidity and mortality impacts from exposure to contaminated water.*** The World Bank estimates that more than 17,000 children die every year in Egypt from diarrheal diseases. This is mainly caused by poor drinking water quality and inadequate water quantity and quantity for personal and domestic hygiene, coupled with inadequate sanitation and inadequate personal, food and domestic hygiene. This loss represents approximately 20% of all childhood deaths. It was estimated that 35 years of future productive life were lost for each child death, and this is expressed as 35 Disability Adjusted Life Years (DALY). One child DALY was “valued” as a range of LE 1,620 to LE 3,240 (based on 50 and 100% of GDP per capita). The lower end reflects lower incomes in rural Egypt where water quality problems are more severe, and the higher end approximates lost future income for the average person in Egypt. The World Bank also estimated that there are 60,000 additional DALYs lost due to non-fatal diarrheal episodes among children. Combined, the total loss to Egypt from childhood deaths and illnesses is from 0.5 to 1.1% of GDP per year.

There are at least two reasons why these estimates probably represent a lower bound on the associated costs. First, some effects have not been quantified, including most effects that result from wastewater pollution (World Bank, page 5). Second, alternative valuation methods would yield far higher results. A great many health damage studies in the US and Europe are based on the willingness to pay (WTP) by individuals to reduce the risk of death. Valuation using WTP generally yields results that are about six times as high.

The World Bank also provided no estimates for infectious or environmentally caused disease morbidity and mortality among adults, even though such effects almost certainly exist. For example, the environmental assessment for the Bahr Bagar Drain (APRP) noted an increase of 5-40% for various cancers and heart disease in areas that irrigate with drainage water. The mechanism for causing adverse health effects was not investigated. Such effects are potentially quite important given that agriculture accounts for 30% of employment, and 50% of Egypt's population lives in a rural setting. If 30% of the land is irrigated with mixed drainage water, then the health of some 10 to 15% of the population may be at risk from drainage water reuse. If the rates of fatal and other serious diseases are 20% higher for these individuals due to their exposure to reused drainage water, then this would represent about 10,000 excess deaths and serious illnesses each year. Valuing these effects at 35 DALY each would produce an estimated additional loss of approximately 0.5% of GDP. Moreover, if these adult health effects were valued using WTP rather than DALY methods, the impact would be about 8% of GDP.<sup>3</sup> Similarly, if the 17,000 estimated childhood deaths due to water pollution were valued at one-half of the adult WTP, the result would be 6.8% of GDP (or six times the World Bank estimate). The revised range for health effects from exposure to contaminated water would increase from the World Bank study's (DALY-based) estimates of 0.1 to 0.5% of GDP to the far higher 1.4 to 15% of GDP!

***Health risks from contaminated agricultural output.*** The potential health risks from consuming foodstuffs irrigated with polluted water have received considerable concern in environmental circles but scant attention in Egyptian research. It is of great potential interest due to the extensive reuse of drainage water and contamination of freshwater canals. Most at risk would appear to be the farmers themselves, since they are likely to consume some of what they produce fresh from the fields. Those effects would be captured in the calculation above of health effects in rural areas, but some contaminated agricultural output will find its way to markets, potentially exposing consumers to a variety of health risks (and uncalculated costs).

### **2.2.7 Drinking Water Treatment Costs**

In the Delta, and especially in Alexandria, salinity in municipal water supplies is a growing concern. At some date in the future, Alexandria and some other cities will face the prospect of having to install desalination infrastructure to reduce salinity (through expensive processes such as reverse osmosis) in order to meet drinking water standards. At present, however, salinity levels are manageable, and no extra costs are being incurred.

To estimate the range of potential future economic cost, we will assume that 20% of water supplies will eventually require additional treatment that will double the cost of delivered water. Water accounts for approximately 0.5% of household expenditures in developed nations. If the same relationship holds in Egypt, a doubling of delivered water cost for 20% of Egyptian households would increase annual household costs by around 0.1% of GDP.

### **2.2.8 Industrial Water Supplies**

---

<sup>3</sup> WTP to avoid loss of one statistical life typically is estimated to be \$3-\$4 million in the US; adjusting this to reflect the ten-fold difference in GDP per capita produces an estimate of the value of a statistical life in Egypt of roughly LE 2 million. 10,000 excess adult deaths would have a value of LE 20 billion, or 8% of GDP).

Several experts interviewed during the course of preparing this study noted a rise in industrial sector complaints about their ability to obtain water at the quality levels desired for their processing needs. However, no quantitative information was available to provide an assessment of the additional expenditures or other potential effects experienced by industrial water users.

### **2.2.9 Agriculture**

The World Bank study notes that damages from poor water quality likely extend to the agricultural sector productivity (page 8), but it was unable to quantify such effects. Potential effects of impaired water quality on the agricultural sector may be decomposed into three categories: (1) decreases in the quantity of agricultural output; (2) decreases in the quality of agricultural output; and (3) further reductions in the value of agricultural products due to limits on exports.<sup>4</sup>

### **2.2.10 Agricultural Output**

Reuse of drainage water in the Nile Delta began in the 1920s and expanded significantly thereafter. Currently, some 50 BCM of water are used in agriculture, of which 7-8 BCM come from reuse of agricultural drainage water in the Delta region. Agricultural drainage canals receive not only field run-off but also untreated and partially treated municipal wastewater and industrial discharges. In the past, the primary focus of research on drainage water reuse was on salinity and its impacts on yields. In recent years, however, attention has turned to the potential impacts on agricultural production of farm chemicals, municipal wastewater and industrial pollution in drainage canal water reused for irrigation. The reuse of polluted water potentially could affect land use, cropping patterns, labor inputs, water consumption, fertilizer application, seed requirements, crop yields, and human health, among others.

Current evidence suggests that net negative impacts (correcting for the increased production resulting from the expanded irrigation supplies due to reused water) have been small thus far, although some of the potential effects such as food safety have not been evaluated systematically.<sup>5</sup> For example, the Drainage Water Irrigation Project (1997) sampled 275 farms and concluded that—with the exception of beans, which show net production increases from reused irrigation water—there is a decline in net returns when comparing farms using fresh and drainage water (see Table 4). Mixed water use yields fall between those of fresh and drainage water use. Compared to fresh water, drainage water use reduced yields by an average of 23.5%, while the application of mixed water use reduced yields by an average of 15.3% compared to fresh irrigation water.

---

<sup>4</sup> Possible health effects to farmers and health effects from consuming contaminated agricultural products were discussed above.

<sup>5</sup> See the review paper by Dr. Mohamed Lofty Youssef.

**Table 4. Effects of Water Quality on Crop Productivity (per feddan in LE)**

<b>Crop Mix</b>	<b>Fresh Water</b>	<b>Mixed Water</b>	<b>Drainage Water</b>
Wheat & rice	1487	1278	1121
Wheat & maize	624	458	135
Berseem & cotton	2300	1655	1373
Beans & rice	1522	1543	2029
Beans & maize	659	723	1043
Berseem & rice	1590	1350	1049
Berseem & maize	727	530	63
<b>Average</b>	<b>1272</b>	<b>1077</b>	<b>973</b>

Care must be taken in interpreting these findings. As noted, it is not appropriate to consider these yield reductions as losses due to use of polluted water, because total production with reused irrigation water must be compared to the level without reuse of drainage water. If only the available fresh water irrigation supply was used, crops would be water stressed and overall yields would be lower than those achieved through the reuse of drainage water.

However, assuming full implementation of the intermediate reuse policy for augmenting irrigation supplies (which focuses on the pumping of agricultural drainage water back into irrigation canals near to its source), some calculation can be made of the costs of pollution in drains (or benefits from reduced pollution) in terms of crop production. If all drainage water could be made as pure as freshwater (given the impacts shown in Table 4 above), the impact on agricultural output would be equal to 0.8% of GDP.<sup>6</sup> The extent to which the contamination of drainage water might be reduced is largely unknown, but this analysis allows for a very rough range of the current negative impact of drainage water pollution on agricultural output that translates into between 0.1 and 0.5% of GDP.

### **2.2.11 Agricultural Exports**

Agricultural exports may have higher value than agricultural commodities grown for the domestic market and are of interest for their beneficial effects on the balance of payments. If water of low quality is used on fields, some contamination by heavy metals, fecal coliform bacteria or pesticides could render some crops unacceptable for export (especially to markets in the European Union or the US).

Egypt's agricultural exports were LE 1.9 billion in 1998 or almost 2% of GDP. The two most important agricultural exports are rice and cotton (representing 30% and 45%, respectively, of export value). Other agricultural exports include potatoes, oranges, flowers, strawberries, guava, grapes, mango, grapefruit, lemons, asparagus, melons, peanuts and dried vegetables. In 1998 the Ministry of Agriculture indicated that agricultural exports were expected to increase to LE 5 billion by 2004. This would still represent about 2% of GDP. The European Union is Egypt's largest trading partner for agricultural products, followed by the Gulf states (principally Saudi Arabia). Already 30% of vegetable produce and 20% of fruit shipped to Europe is lost because it is no longer fit for sale by the time it arrives at its destination. There is no information

<sup>6</sup> Assuming 30% of irrigated agricultural output comes from use of mixed water, and these yields could be increased by an average of 15%, and an 18% total agricultural share of GDP.

regarding impacts on agricultural exports due to contamination by heavy metals, fecal coliform or other substances transmitted to crops by poor water quality. Any effects are likely to be small, however, because growers who focus on export markets know they must meet high standards. Export markets are limited not by the quality of Egyptian agricultural output but also by quotas and other trade barriers imposed by Egypt's principal trading partners. For these reasons, this category of costs associated with water pollution is currently considered to be negligible.

**Table 5. Estimates of Economic Damage from Impaired Water Quality**

Category of Loss	World Bank Estimate (% of GDP)	Revised Estimate (% of GDP)
Recreation	0.07	0.07
Non-user benefits		0 - 0.10
Fisheries	0.07 - 0.10	0.10
Diversionsary uses		
Health	0.5 - 1.10	1.40 - 15.00
Municipal treatment costs	0	0 - 0.10
Industrial supplies		0.10
Agriculture		
Impact on quantity		0.10 - 0.50
Impact on quality		0
Tourism		0.05 - 0.25
<b>Total Impact</b>	<b>0.67 - 1.27</b>	<b>1.82 - 16.22</b>

### 2.2.12 Tourism Impacts

The World Bank study estimated that air pollution in Cairo causes tourism losses on the order of 0.2 to 0.3% of GDP. Tourists also have health concerns regarding the quality of drinking water and sanitation as well as potential contact with polluted water, such as might occur while riding in a felucca or taking a Nile River cruise. Tourism also may be affected by visual and olfactory dimensions of water pollution. While the World Bank study did not include any estimate of water quality impacts on tourism, it should not be ignored.

How many foreign tourists have avoided Egypt because of polluted water? No study on that topic is known. Based on the estimates of the World Bank study, it seems reasonable to suggest that tourism may be reduced by between 1 and 5% from low water quality, and by another 1 to 5% each due to air pollution and solid waste. With tourist visits of approximately 5 million foreign visitors annually, this translates to a loss of between 50,000 and 250,000 visits due to each of the three forms of pollution. Assuming expenditures of roughly LE 5,000 for each tourist visit (based on the World Bank study's data), water pollution may cause an annual loss in expenditures of between 0.05 and 0.25% of GDP.

### **2.2.13 Summary of Findings Regarding Economic Damages**

Table 5 summarizes the discussion and analysis of this section. The revised range of losses due to impaired water quality is roughly 1.8 to 16% of GDP. The lower figure is based on the use of DALY methods to value health effects and the higher estimate on WTP.

### **2.3 Setting Priorities for Action to Improve Water Quality Management**

This report is meant to explore the application of market-based incentives to improving the management of water quality in the country. Before suggesting promising avenues for the potential use of MBIs as water quality policy measures, it is important first to understand the priorities for water quality improvement. Policy and program attention should be directed to those areas where: (1) economic damage is high or suspected to be high; (2) reasonable policy interventions potentially exist; and (3) the costs of interventions are acceptable and do not appear to be in excess of the damage(s) they seek to avert. The analysis and estimates given above provide some insights into the first of these three considerations: economic damage from water pollution. The second and third elements will be examined in subsequent sections of the report.

With respect to economic damages from poor water quality, at least one clear conclusion can be drawn from this analysis: health impacts from water pollution appear to far outweigh all other damages or losses. This suggests that the most important areas for water quality improvement lie in actions to: (1) improve management of agricultural drains and irrigation canals in the Nile Delta, especially to reduce the introduction of municipal and industrial wastes into these waterways; and (2) mitigate against “hot spots” caused by industrial or municipal wastewater discharge in the Nile River and its drainage canals above the Delta, especially when these threaten drinking water supplies.

The high costs of water pollution on human health indicate that special attention must be given to the improved management of household wastewater—especially in Cairo and the Delta. Despite considerable expenditure to improve wastewater collection and treatment services in urban areas, deficiencies remain. And rural areas continue to be largely without effective and environmentally sound systems for the disposal of their liquid wastes. Improper management and removal of sewage lowers the quality of life and leads to the premature deaths of thousands of people every year—with high costs to the society and economy.

### 3. Institutional and Legislative Framework for Water Quality Management<sup>7</sup>

#### 3.1 Institutions Responsible for Water Quality Management

Responsibility for water quality management is spread among several government bodies. While MWRI is clearly the lead agency for overall water management in the country, it shares a significant degree of its authority with several other bodies when it comes to water quality. Agencies involved include those given below.

##### 3.1.1 Ministry of Water Resources and Irrigation

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 issues licenses to commercial, industrial, and tourist establishments for the discharge of liquid waste into inland waterways. According to Law 48/1982 (see below), industrial waste must receive treatment to the level of prescribed pollution standards before being discharged into inland water bodies, though there are widespread violations of this provision.

MWRI also handles monitoring of surface waters and groundwater 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).** 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 more broadly 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.

---

<sup>7</sup> This section was meant to draw heavily from: El-Guindy, Abdel Aziz. 2003. *Economic Instruments in Environmental Policies*. EEPP/PSU: Cairo, however at the time of this draft's preparation, the subject report was available only informally and in Arabic. The analysis will be expanded in the next version of the paper when further information is available.

### **3.1.2 Ministry of State for Environmental Affairs (MOSEA)**

After MWRI, MOSEA is the most important governmental 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.

### **3.1.3 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:

- **Environmental Health Department (EHD)**—responsible for sampling intakes to drinking water treatment plants as well as discharges from wastewater treatment plants and industry; and
- **Environmental and Occupational Health Center (EOHC)**—responsible for environmental monitoring (air, water and soil), which has monitored Nile River and main canal waters since 1998 in cooperation with EEAA.

### **3.1.4 Ministry of Industry and Technological Development (MITD)**

The Ministry is responsible for overseeing the licensing and operation of firms in Egypt. Within MITD, the General Organization for Industrialization (GOFI) has responsibility for supervising 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. An Environmental Management Department within the Ministry has been charged with 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. Also, according to Law 93/1962 and its Amending Decree 9/1989, industrial wastewater must receive pretreatment before discharge to public sewer systems. GOFI functions may now be superceded by a new Industrial Management Institute and the Environmental Management Department's role coordinated under a new Environmental Management Group (see below).

### **3.1.5 Ministry of Housing, Utilities and Urban Communities (MHUUC)**

MHUUC is responsible for planning and developing water supplies and wastewater treatment facilities. MHUUC and its affiliate agencies oversee construction of sewers and wastewater treatment facilities throughout Egypt. The regional wastewater authorities and other bodies affiliated with MHUUC 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 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.

### **3.1.6 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. The so-called Water Police are under the Ministry's jurisdiction and work very closely with MWRI in protecting the integrity of irrigation and drainage canals as well as dealing with polluters under existing regulations.

### **3.1.7 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.

### **3.1.8 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. Through its Soils and Water Research Institute (SWRI), the MALR also is responsible for performing research on the sustainable development in the agricultural sector. In this capacity, SWRI 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. SWRI has a modern laboratory for physical, chemical and biological analysis of soil and water. MALR also handles policies relating to input subsidies for fertilizers and pesticides, though these have largely been removed in recent years.

## **3.2 Legislative Authority and Potential for Market-based Incentives**

### **3.2.1 Water Quality Management Authority of MWRI**

The Ministry of Water Resources and Irrigation derives its legal mandate as the lead governmental body for the water sector from two pieces of legislation: Law 12/1984 on Water Management (primarily dealing with irrigation and drainage); and Law 48/1982 on Protection of the Nile River and its Waterways from Pollution.

Law 12/1984 and its supplementary Law 213/1994 provide the basic legal structure for the management of water flows.<sup>8</sup> The Law defines the use and management of the public

---

<sup>8</sup> Significant amendments to Law 12 are currently under Committee review at the People's Assembly.

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.

With respect to the regulation of drainage water, Article 103 of Law 12 provides for the assessment of fines on those who: misuse Nile water, illegally withdraw from or deposit to irrigation or drainage canals; or obstruct and/or change the course of these canals. Revenues raised from such fines are to be deposited in a “Restitution Fund” maintained by MWRI and used, among other purposes, to correct any damage from the offence. This existing mechanism holds some potential for the development of market-based incentives, though further analysis is needed of how the system of fines and other means can be used to ensure that damages are repaired. The Ministerial Decree governing this Fund is given as Annex 1.

Law 48/1982 regulates the discharge of waste and wastewater into the Nile and its waterways and sets standards for the quality of effluents.<sup>9</sup> The law establishes the responsibilities of the MWRI and the Ministry of Health and Population (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 and municipal wastewater treatment facilities are required to obtain licenses for wastewater discharges to any part of the Nile River water system. A bond is required with the license application, and a fee of LE 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 monitor compliance by carrying out periodic sampling and analysis of wastewater and waste discharge from establishments that are licensed to discharge to waterways.

Law 48 also provides for fines to be assessed on those who pollute the Nile and its waterways, and it establishes a “Water Pollution Fund” into which all such revenues are deposited. In practice, this applies primarily to illegal liquid and solid waste disposal into irrigation and drainage canals, and preliminary investigations into how it is being implemented in practices indicated some confusion and inconsistencies. Like the Restitution Fines and Fund, it could potentially be developed as a market-based mechanism by adjustment of the basis on which fines are levied. The Ministerial Decree governing the Water Pollution Fund is given as Annex 2.

In fact, these two Funds under MWRI jurisdiction are managed by the same Board of Directors. The annual revenues generated are relatively small (LE 810,000 for the Water Pollution Fund and LE 2,630,000 for the Restitution Fund in fiscal year 2001/2002). They do, however, hold potential as existing legal mechanisms for the assessment of fines and other penalties on those violating water pollution codes.

---

<sup>9</sup> A number of revisions and amendments to Law 48 have been proposed, and these are currently under review within the Ministry of Water Resources and Irrigation.

While the limited field investigation (in Ibrahimya Irrigation Directorate) yielded little concrete understanding of the workings of these funds at the field level, it did indicate that the two most important canal pollution issues encountered are solid waste deposition and the dumping of sewage water into canals by trucks collecting wastewater from latrines and septic tanks. Moreover, it became clear from discussions with Irrigation District staff that the solid waste management problems they face cannot be solved without much stronger cooperation and coordination with municipal authorities charged with providing solid waste collection and disposal services.

### **3.2.2 Water Quality Management and MOSEA**

The Ministry of State for Environmental Affairs and its subsidiary body, the Egyptian Environmental Affairs Agency (EEAA), also exert considerable influence over water quality management through authorities vested under Law 4/1994 on Environmental Protection. Law 4/1994 delineates the roles and responsibilities of EEAA, including its financing through the Environmental Protection Fund. The law covers protection of water quality from the discharge of treated wastewater, protection of the marine environment from liquid wastes at the coast and a list of substances that industries may not discharge into the marine environment. The Law authorizes use of certain incentives for managing the environment and supports the provisions of Law 48 regarding the management of water resources.

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—who are charged with the oversight of compliance with all environmental and workplace standards. If inspectors find a problem, their options under Law 4 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. 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 considered to be major polluters. In 2000, approximately 235 of these were inspected, but thousands of small to medium-scaled establishments are inspected rarely, if at all. 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, EEAA has had an outreach program for point source polluters to help them make and implement plans for water treatment and/or waste minimization. As a result, almost all industries now at least have effluent treatment facilities capable of meeting existing discharge standards (when in operation).

### **3.2.3 Water Quality Management and MHUUC**

Law 93/1962 provides MHUUC with the authority to govern the discharge of liquid wastes and to set standards for wastewater discharge into sewers. As the Ministry responsible for planning and developing water supplies and wastewater treatment

facilities, MHUUC is a leading agency applying MBIs in the water sector through its existing system of user charges billed to customers for potable water supply and wastewater collection. As noted, the current charges are insufficient to fully cover operations costs and provide only weak incentives for water conservation (see below). The Ministry is an essential partner in the effort to improve policies and programs for water quality management.

### **3.2.4 Water Quality and MITD**

Ministerial Degree 380/1982 requires that all firms must establish pollution control measures as a condition for the issuance of industrial licenses. 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.

The Ministry of Industry and Technological Development (MITD) is currently restructuring itself to better deal with environmental management in its sector—including water pollution. A new Industrial Management Institute will encourage greater efficiency in the sector, which should lead to reduced waste and discharges. An Environmental Management Group has been formed directly under the Minister to build internal capacity in environmental management and otherwise to coordinate efforts to improve industrial environmental performance. Environment management improvements also recently were added to the “quality” component of the EU-funded Industrial Modernization Program.

### **3.2.5 Inter-sectoral Coordination and Integration**

There is a significant need for improved coordination of effort across sectors at both the policy and regulatory levels. For example, 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.

Such cooperative efforts will be needed if structural barriers to progress are to be overcome. 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—allowing them an inexpensive “dilution solution” to meeting volume-based discharge standards if they are so inclined. The gradual privatization of some enterprises has improved the situation modestly.

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 MHP and/or MWRI. Finding financing to complete these plants is a high priority as is the permitting of those ready to operate. Apparently it has been agreed by an inter-ministerial committee, chaired by MWRI, that those already constructed should be given discharge permits even if they do not meet current standards. But the permits will not be issued to these treatment plants until Law 48 is itself changed to allow for relaxed effluent discharge standards for canals (despite the obvious irony that the alternative often is discharge of raw sewage).

In general, better coordination and communication is needed among the current range of Government 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, MHUUC 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.
- MITD is encouraging the use of “cleaner production” methods in the industrial sector and otherwise stepping up its efforts to improve industrial environmental management performance.
- A Water Quality Unit has been established under the Minister’s Office in MWRI partly to address some of these coordination issues.

## **4. Options for Use of Market-based Incentives to Improve Water Quality Management**

### **4.1 Results of Previous Analysis on MBIs for Water Quality Management**

The cost estimates from the damage assessment given in Section 2 point clearly to the negative impacts of water pollution on human health as the highest priority for policy intervention. This translates especially into the need for reducing the introduction of household and industrial wastes into agricultural drains and irrigation canals in the Nile Delta and also into protecting the Nile River and its drainage canals above the Delta from similar sources of pollution, especially where they threaten drinking water supplies.

The previous phase of analysis concerning options for the application of MBIs to water management in Egypt reviewed a wide range of potential MBI mechanisms covering water quantity as well as water quality management.<sup>10</sup> An assessment method was used to screen these options with respect to their economic and institutional attractiveness in the Egyptian context. On this basis, six immediately promising MBI policy measures were identified—all of which could potentially assist in averting the highest costs associated with water pollution.

#### **4.1.1 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.

Expanded wastewater treatment plant construction, operation and maintenance is of high priority because of the high levels of untreated organic sewage currently finding its way into 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.

#### **4.1.2 Increased Subsidies to Finance Wastewater Treatment Facilities**

More sewage treatment plants and also better disposal methods for sewage pumped from latrines or septic tanks are urgent needs based on the damage assessment's findings. 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 was deemed to merit careful further analysis.

---

<sup>10</sup> See: McCauley, et al., 2002. *Economic Instruments for Improved Water Resources Management in Egypt*. EPIQ/WPRP: Cairo.

Throughout the world, governments have subsidized the construction of wastewater treatment plants. The reason is that both users (those receiving wastewater treatment service) and nonusers (those not connected to the system) benefit from reducing pathogens in rivers and lakes. In Egypt most wastewater treatment plants have been constructed with donor assistance. Operating and maintenance expenditures are an ongoing issue. Current user fees are only 20% to 40% of O&M costs, so wastewater treatment plants require continuous subsidies from the government or they cannot treat wastes properly. Typically, these plants are achieving less than 50% of their designed waste treatment. Vast quantities of untreated and partially treated wastewater are sent out of the plants every day. With better funding many of the wastewater treatment plants in Egypt could operate more effectively.

#### **4.1.3 Subsidized Rural Sanitation**

It also 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.

This would help to reduce both the pollution of surface waters as well as groundwater. There appears to be an information and possibly capital supply gap preventing the wider dissemination of known systems for rural sanitation that are otherwise affordable and efficient. The collection of wastewater from collection facilities (latrines and septic tanks) is largely unregulated, and pump trucks routinely and illegally dump these wastes into the nearest unsupervised irrigation or drainage canal (though they are subject to water pollution fines under the provisions of Law 48). In most cases they have little economically viable alternative, and simple provisions for legal discharge of such wastes at water treatment facilities would seem to offer promise as a partial solution to this problem.

#### **4.1.4 Pollution Control Equipment Pricing**

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. There is no data available yet to indicate whether this measure would have a noticeable impact on the adoption of improved wastewater treatment practices by industries or municipalities, but it warrants further investigation.

#### **4.1.5 Voluntary Agreements for Environmental Improvements**

Various voluntary agreement options—such as enhanced self-monitoring of effluent discharges by industry—were deemed to 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. The basis for using such an approach already exists through the efforts of EEAA in its outreach to the heaviest “hot spot” polluters along the upper Nile. Industries were offered time to comply with existing standards and assistance in finding capital for investments in wastewater treatment. Some flexibility was offered in the measures taken to meet standards as well as in the timing. Further applications of this direct outreach—to industry associations or geographically determined clusters of pollution sources—could offer opportunities for greater flexibility in achieving reductions in water pollution.

There would appear to be considerable additional scope for such approaches by all government agencies with authority over water quality management.

#### **4.1.6 Public Environmental Information Disclosure**

Finally, it was suggested that 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—could be used to hold those damaging the environment more accountable to the public and their financiers. This would seem to hold the greatest promise as a deterrent for large point sources of pollution where there are clear and adverse impacts on communities. The role of non-governmental organizations in such an approach would need much further investigation in the Egyptian context, but information disclosure has proven to be an effective tool in many countries—including in the developing world.

#### **4.2 Additional MBI Options for Water Quality Management**

Huge capital investments and considerable ongoing operating costs will be required if Egypt is to meet its water quality goals and protect public health. The capital costs for constructing municipal sewage treatment plants through 2017 are projected to exceed LE 55 billion just to keep up with population growth and maintain the present percentage of population served by sewers. Making improvements in water quality will require even larger capital investments. Existing sewage treatment plants operate far below design performance because they do not have adequate funds for operating and maintenance needs. Industry faces large but unknown costs to comply with effluent discharge requirements. Egypt faces a serious capital shortage to finance these investments. Making significant progress in improving water quality, indeed even holding quality at present unsatisfactory levels, will require that Egypt finds ways to lower the cost of treating effluent discharge. Several additional MBI approaches hold just such a promise.

In addition to the six measures previously identified as of immediate interest, several other MBI options are worthy of mention in this regard. Several could possibly be introduced through the reinterpretation of existing legislative authority and they would, in most cases, reinforce those policy measures suggested above and help to lower the overall cost of effluent reduction and treatment.

##### **4.2.1 Fines or Charges for Damages**

As noted in the previous section, MWRI has the authority under Law 12 and Law 48 to impose fines and restitution charges on those who pollute or otherwise disturb irrigation and drainage canals. 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. A thorough review of the implementing regulations associated with these charges could potentially yield a system of fines that would better reflect the damages caused and assign liability to those who cause such damages. Irrigation Districts and Drainage Districts are currently responsible for implementing the policy (in cooperation with the Water Police of the Ministry of Interior), but it is of low priority among their many duties. Revenues generated through such a system might be directed toward awareness raising or other pollution prevention measures.

Another related option would involve expanding damage assessments authorized under Law 102/1983 (for protected areas) to include harm to surface water bodies or groundwater resources. This Law would appear to offer adequate authority for the wider application of damage assessments as water quality management policy tools.

#### **4.2.2 Effluent Discharge Fees**

Effluent fees are a common MBI form used to discourage water polluting behavior. 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, though even low levels of charges can raise significant amounts of revenue.

Egypt already has a system of effluent charges, however the fee level is too low to provide an economic incentive to reduce volume or toxicity. Law 48 of 1982 regulates the discharge of waste and wastewater into the Nile and its waterways and sets standards for the quality of effluents as well as ambient water quality standards for the river. The law establishes the responsibilities of the MPWWR and the MOH 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 must obtain licenses to discharge their wastes. A bond is required with the license application and a fee of one piastre per cubic meter of effluent is levied according to article 82 of the implementing regulations. Proposed revisions to Law 48 would increase the fee to 15 piastres (approximately \$0.027) per cubic meter of effluent discharge. Under this law, the MOH has the obligation of carrying out periodic sampling and analysis of wastewater and waste discharge from establishments that are licensed to discharge to waterways.

The proposed increase in discharge fees is a step in the right direction. However, the new fee level generally remains far below treatment costs. In the absence of significant increases, effluent charges in Egypt will continue to function largely as a revenue-raising device rather than as a market-based tool to improve water quality. To be effective as a deterrent, the fee should be based on the total pollutants discharged and *not* merely on the volume of wastewater discharge (per the current system). Such fees, if high enough, can be 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. Many provisions of Law 48 are currently under review, and this approach would appear to deserve careful attention in this regard.

#### **4.2.3 Removal of Environmentally-harmful Subsidies**

Fuel and water subsidies affect water use and, indirectly, water quality. Diesel and mazut (#6 fuel oil) are priced in Egypt at approximately one-half of the world price. Water is supplied free to agricultural users and large industrial users located on the Nile pay modest prices for the water they use. In the past, fertilizers and pesticides also were heavily subsidized, leading to high use and water quality impairment. With water very cheap to some of the largest industries, effluent discharge concentration limits are met in part through dilution rather than actual pollution reductions. Increasing water charges (and collecting unpaid charges) will increase incentives for industry to treat effluent discharges. This shows a clear connection between water quantity and quality policies, and the reduction or removal of such subsidies deserve careful attention in the context of efforts to improve water quality management.

#### 4.2.4 Tradable Discharge Permits

Relative to command-and-control regulatory alternatives, tradable discharge permits (also known as water quality trading) can reduce the costs of achieving a given level of pollution control. Under such a scheme, sources of water pollution are required to meet limits on the quantity of effluent they may discharge based on a total pollution load deemed acceptable for a given water body or stretch of river/canal. A pollution control authority would distribute (through auction, allocation to permitted sources, or other means) tradable permits to discharge a fixed total quantity of pollution into this water body. 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.

Water quality trading allows one source to meet its effluent discharge obligations by using effluent discharge credits created by another source that has lower effluent treatment costs. Through the purchase of effluent discharge credits, sources with high pollution control costs save money. Sources with low pollution control costs gain by selling credits for more than what it costs to reduce discharges. Modeling exercises predict the cost savings to achieve a water quality goal could be anywhere from one-third to approximately two-thirds of the cost of traditional regulatory approaches. Tradable permits thus can reduce compliance costs because pollution sources with low costs abate more than is required and sell the excess permits to sources with high control costs, who find this cheaper than reducing their pollution discharges. Trading requires a knowledge of the total mass/load of effluents that a water body can tolerate and still meet applicable water quality standards or ambient water quality targets. 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 cover both concentrations and volumes of discharge if an effluent trading program were to be implemented, but this option should be reviewed for possible authorization (perhaps at a future date) under any revised version of Law 48.

The feasibility of using tradeable permits as a tool to achieve water quality objectives in the Egyptian context requires considerable further analysis. In the United States, the Environmental Protection Agency only published its review on the subject in January 2003.<sup>11</sup> And several pilot projects will be carried out to test the feasibility of this approach before a permitting system is adopted on a broad scale. Water quality trading is taking much more time to implement than did air emissions trading for a number of reasons. First, effluents generally contain more pollutants of concern than is the case with emissions to the air. Second, measurement of the constituents in effluent discharge is difficult to do on a continuous basis and sampling is often left to the source. This leads to uncertainty regarding the exact magnitude of discharge of various substances. Third, an airshed may be approximated as a basin where emissions mix, whereas a watershed generally has an important spatial orientation (rivers flow in one direction, making upstream and downstream distinctions very important for trading). Fourth, unlike air emissions that mainly come from easily identified sources, only about one-half of all

---

<sup>11</sup> <http://www.epa.gov/owow/watershed/trading/finalpolicy2003.html>

effluent discharge originates with point sources while the remainder come from hard to regulate non-point sources such as farms and paved surfaces.

Despite the aforementioned difficulties inherent in trading water quality, the potential cost savings are compelling. As USEPA has proposed, water quality trading is best implemented first in the form of pilot tests in water basins or along stream segments. In Egypt, pilot testing of water quality trading could be considered within the confines of specific drainage or irrigation canals.

### **4.3 Conclusion**

This report has provided a further review of the potential application of market-based incentives to improving the management of water quality in Egypt. It began with a review of economic damages associated with water pollution as one important step in understanding priorities for water quality improvement. It also has assessed existing institutional and legislative provisions from the standpoint of their potential amenability to the further introduction of MBIs in the area of water quality management. Finally, it has suggested some promising avenues for the potential use of MBIs as policy measures, especially to address the most costly forms of water pollution and to build on the recommendations of the previous MBI assessment.

It is hoped that this analysis will further contribute to an understanding of MBI measures as potential water quality policy tools in Egypt. As indicated in the report, there are many promising opportunities, and it is important to maintain the current momentum towards the wider application of economic incentives in the country's water policies.

## References

- EPIQ/WPRP. 2002. *Survey of Nile System Pollution Sources*. Report No. 64, USAID: Cairo.
- EPIQ/WPRP. 2000. *Policies and Procedures for Improved Urban Wastewater Discharge and Reuse*.
- EPIQ/WPRP. 1999. *Intermediate Drainage Reuse in Bahr Bagar Drain Basin: Socioeconomic assessment, economic assessment, environmental assessment*.
- El-Din, Gamal Essam. 2000. "A Future for Fruits." *Al-Ahram Weekly*, January 13-19, Issue No. 464.
- El-Guindy, Abdel Aziz. 2003. *Economic Instruments in Environmental Policies*. EEPP/PSU: Cairo (Draft, in Arabic).
- Egyptian Environmental Affairs Agency, 2000. *The Environmental Protection Fund: Operating Manual – General Principles*. EEAA: Cairo.
- EPIQ, 1998. *Options for Strengthening Egypt's Support for Environmental Financing*. USAID: Cairo.
- ERM Economics, 1996. *Study of Market-Based Instruments for Water Pollution Control at 6th October City*. Overseas Development Association: London.
- Freeman, A. Myrick III, 1982. *Air and Water Pollution Control: A Benefit-Cost Assessment*. New York: Wiley.
- Government of Egypt, Ministry of Economy and Foreign Trade. 2002. *Summary of Trade Balance*.
- Government of Egypt. 2002. *The Environmental Profile of Egypt*.
- Hagler Bailly, 1997. *Environmental Management Guidelines for 10th of Ramadan City*. USAID: Cairo.
- Khouzam, Raouf, 1996. *Economic Incentives to Promote the Abatement of Nile Pollution*. Egyptian Center for Economic Studies: Cairo.
- McCauley, et al., 2002. *Economic Instruments for Improved Water Resources Management in Egypt*, EPIQ/WPRP: Cairo.
- Pillet, Gonzague. 2001. *Cost Assessment of Environmental Degradation in Egypt*. World Bank: Cairo.
- World Bank. 2002. *Arab Republic of Egypt: Cost Assessment of Environmental Degradation*. Sector Note, June 29.

Yousef, Mohamed Lofty. 1998. *Socio-Economic Factors in Drainage Water Irrigation Decisions*. Paper delivered at the International Workshop, Drainage Water Reuse in Irrigation, Sharm El-Sheikh, May 3-5, 1998.

**Ministerial Decree 194/1985**  
**Dated 2/8/85**  
**Executive Regulation for the Water Pollution Fund**  
**Pursuant to Law 48/1982**  
**for Protection of the Nile River and Its Waterways Against Pollution**

**Minister of Irrigation:**

- According to Law 48 of Year 1982 and its executive regulation dealing with the protection of Nile River and water ways against pollution.
- And Law 12 of year 1984 dealing with irrigation and drainage.
- And Presidential Decree No. 653 of Year 1980 for restructuring of the Ministry of Irrigation
- And the minutes of the Committee of Undersecretaries on 13/3/1984 authorized on 17/3/1984.

**It is Decided:**

**Article 1**

The Water Pollution Fund is to be managed by a Board of Directors whose structure is as follows:

- Head of Irrigation Sector	Chairman
- Chairman of River Transportation general authority or who represents him	Member
- Chairman of authority for prosecution of the law and its executive regulation	Member
- Undersecretary of the Ministry of Health nominated by the Minister of Health	Member
- Manager of the general administration for Water Police or his representative	Member
- Undersecretary for Financial and Administrative Affairs of the Irrigation Department	Member & Undersecretary

The Board should meet at least once a month or if deemed necessary, according to an invitation from the Board Chairman. Meetings are held in order to draw the Water Pollution Fund's general policy, work progress and procedures and to establish the system and mechanisms ensuring the achievement of its objectives.

**Article 2**

The Undersecretary of the Water Pollution Fund is charged with preparing the Fund's draft budget, including the estimated proceeds, and expenditures, and presenting it to the Board of Directors, sufficiently in advance of the start of the fiscal year, and approved by the Minister of Water Resources and Irrigation.

The Fund's Undersecretary is also responsible for preparing the Fund's final account by the end of each financial year to be approved by the Fund's Board of Directors as a preface towards submittal to the account's control in the Central Auditing Authority.

### **Article 3**

The Fund's proceeds consist of:

- charges for issuing licenses, and deposits regarding the construction of any establishment, from which wastes results and which are to be discharged into water bodies.
- Charges for issuing licenses and deposits regarding the construction and/or renewal of new boats, and river units.
- The amount of levies and fines prescribed in Article (16) of the referenced Law 48/1982.
- State credits and aid designated for supporting the Fund's proceeds (Revenues).
- Donations and/or contributions that are given by the Minister of Water Resources and Irrigation.

### **Article 4**

The Fund Undersecretary is entrusted to make payments from the Fund's revenue on the following items in particular:

- Cost of administrative suppression of contraventions.
- Donations made to parties constructing waste treatment facilities and approved by the Board of Directors.
- Costs of carrying out studies, research and laboratory analysis.
- Reward to guides and persons reporting crimes contravening this law, and as stated in the executive regulation.
- Rewards to persons who made extraordinary efforts in assessing and suppressing violations or contraventions.
- Salaries to workers who are entitled to remove contraventions or violations.

### **Article 5**

The value of rewards shall be estimated as a percentage of the value of the fine as follows:

- 3 % for those who reported the violation.
- 7 % for those who assessed the contravening crime.

### **Article 6**

Rewards stated in the previous article shall be awarded as follows:

- Rewards should be issued directly after the case is issued whether or not the fine has been collected.
- Rewards are for those who reported the crime in person.
- Rewards for those who executed the law according to a list approved by the authority to which they belong.

### **Article 7**

Rewards to suppressors of contraventions or violations should equal 20% of the value of the fine and should be distributed after the approval of the Board of Directors.

### **Article 8**

Rewards should be approved by the irrigation directorates and/or Nile inspectorates where the violation took place, and are to be paid from the Water Pollution Fund's account and based on the necessary procedures for payment and upon the approval of the Board of Directors as stated in this regulation for a maximum of LE 300 for each violation case.

### **Article 9**

If for any reason, a reward did not reach those who deserved it within three months from the date of its approval, it should be reimbursed to the Water Pollution Fund – and can again be paid upon the request from those who deserve it to the Fund's Undersecretary, but no later than 6 months from the date of approval.

### **Article 10**

The Board Undersecretary and the Board of Directors are provided an award of LE 15 for each Board meeting and LE 5 is provided to the Board's session Secretary.

### **Article 11**

Incentives to the Board Undersecretary and the Board of Directors are to be approved by the Minister of Water Resources and Irrigation.

### **Article 12**

If necessary, personnel can be delegated to work on a part or full-time basis in order to accomplish specific work related to the implementation of the Law and its executive regulations. The Fund's Board of Directors is entitled to approve delegations and define the monthly award for delegates as a percentage of their total salary after getting approvals from the unit where they are delegated and according to pertinent laws and regulations.

### **Article 13**

The cost of removing the contravention is to be paid by means of the general irrigation directorates, Nile inspectorates or the general drainage directorates, after getting the approval of the Fund's Chairman. Those expenditures are to be filed on the Fund's debit account and are to be reimbursed to the above mentioned authorities from the fund's account after the approval of the Fund's undersecretary on the request from those authorities and based on previously made approvals.

#### **Article 14**

Revenues to the Water Pollution Fund that are collected by means of the general irrigation directorates, Nile inspectorates, general drainage directorates are to be added to the Fund's credit account at those authorities, and then checks with the same value of the collected revenues are to be sent to the Fund's account.

#### **Article 15**

Authorities are entitled to pay for any related expenses by paying from the so-called "debit account under settlement by the fund", until a special account is opened for the Water Pollution Fund, and collecting its revenues as a step towards payment by means of the Fund's undersecretary.

#### **Article 16**

This decree is to be implemented starting from its date of issuance by means of all authorities charged herein.

**Ministerial Decree No. 124/1986**  
**Dated 29/5/86**  
**For Regulation of a Fund Established According to**  
**Article 103 of the Irrigation and Drainage Law No. 12/1984**

**Minister of Irrigation:**

- According Law 53 of year 1973 regarding the state general budget and to its executive regulation.
- And according to law 127 of year 1981 for governmental accounting and its executive regulation.
- And according to Law 12 of Year 1984.
- And Law 12 of year 1984 dealing with irrigation and drainage.

**It is Decided:**

**Article 1**

The Irrigation Department is to supervise the Restitution Fund which is established according to Article 103 of the specified Law on Irrigation and Drainage.

**Article 2**

The Restitution Fund is to be managed by a Board of Directors to be structured as follows:

- Head of Irrigation sector	Chairman
- Chairman of River Transportation general authority or who represents him	Member
- Chairman of authority for prosecution of the law and its executive regulation	Member
- Undersecretary of the Ministry of Health nominated by the Minister of Health	Member
- Manager of the General Administration for Water Police or his representative.	Member
- Undersecretary for Financial and Administrative Affairs of the Irrigation Department	Member & Undersecretary

The Board should meet at least once a month or if deemed necessary, according to an invitation from the Board Chairman. Meetings are held in order to draw the Restitution Fund's general policy, work progress and procedures and to establish the system and mechanisms ensuring the achievement of its objectives.

### **Article 3**

The Fund's Board of Directors is the dominant authority for its affairs and the sole authority responsible of making decisions in order to achieve the targets for which it is established. It is specifically entitled to:

1. Establish the Fund policy and direct its activity within the framework of the decided plan.
2. Organize the Fund's work and supervise its affairs.
3. Approving the Fund's annual budget and approve its financial statement.
4. View periodical reports about the Fund's work and its financial status.
5. Approve employees' applications to work at the Fund.

### **Article 4**

The Fund's Board of Directors should meet at least a month and whenever it is necessary.

The invitation for meetings should be sent to the members enough in advance of its scheduled time with the Agenda enclosed, and the meeting will not be official unless a majority of the Board members are present. Furthermore, a decision shall only be taken when a majority of those in attendance voting in favor of that specific decision. If the number of votes against a certain decision is equal to those in favor of that decision, then the winning side will be that of the Board's Chairman.

Decisions of the Board cannot not take effect unless they are approved by the Minister of Water Resources and Irrigation.

### **Article 5**

The Restitution Fund Board minutes and Board's decisions are to be recorded in a special file and are to be signed by the Chief of the session and the person charged with secretarial affairs.

Also the Fund's Undersecretary shall be responsible for notifying concerned entities of the Board's decisions.

### **Article 6**

The Chairman of the Restitution Fund will undertake the following functions:

1. Follow up on execution of the Board of Directors' decisions.
2. Considering urgent subjects and making sure necessary procedures are presented to the Board of Directors at the first meeting to be signed.
3. Issuing decisions seen to enhance the Fund's work proceedings.
4. Following up on the procedures for restitution that are to be adapted by concerned entities. Among the Board of Directors, the most senior head of the Central Irrigation Directorate is to undertake the responsibilities and authorities of the Fund's Chairman on occasions when he is absent.

### **Article 7**

The Fund's Undersecretary shall be in charged with financial and administrative issues and is responsible of its accounts and preparing its budgets.

#### **Article 8**

A special account at the Central Egyptian Bank for the Fund is to be opened after the approval of the Ministry of Finance and payment must be through checks signed: 1) as a first signature by the Fund's Chairman or Undersecretary, and 2) as a second signature by the Ministry of Finance representative, the Manager for the Irrigation Sector's account or his assistant.

#### **Article 9**

The Irrigation Sector accounting unit is entitled to supervise the resources and expenditures of the Fund, and separate files are to be opened and maintained specially for those resources and expenditures, and they are subject to the judgments and regulations of Chapter Four of the Executive Regulations of the Governmental Financial Law.

The Chairman of the Board of Directors approvals should use models and files and other records which suit the nature of the work and specify its form and data and its manner of use and means of supervision.

#### **Article 10**

The fiscal year of the Fund begins with the Country's fiscal year and ends by its end.

#### **Article 11**

The resources of the fund consist of:

1. The collected funds via the regulations of the Law on Irrigation and Drainage stated as follows:
  - Fees of issuing and renewing licenses allowed by law.
  - Fines and levies paid by violators.
  - Restitution fees collected from violators.
2. Grants and contributions which suit the Fund's goals and that are approved by Board of Directors and concerned entities.

#### **Article 12**

The Irrigation Department and responsible entities, each in its respective authority, shall charge violators with fines and the cost of restitution according to the Law on Irrigation and Drainage and shall inform the Fund's management with the amount of funds collected each month during the first ten days of the month following the collection of these charges in order to deposit the amount to the Fund's account.

#### **Article 13**

In the event that the violator does not take actions necessary for restitution, the Irrigation Department and the concerned entities will prepare a cost estimate مقايضة for restitution to

be studied and then presented the Board's Chairman for his approval to send a check in the appropriate amount to the concerned entity (Irrigation or Drainage General Directorates, Nile Inspectorates, etc.), which will in turn record those expenditures on the Fund's debit account at those entities, and charge this account for restitution expenses. Restitution expenses should not exceed the estimated cost, except if previously approved by the Fund's Chairman.

#### **Article 14**

After restitution, concerned entities, as appointed in the previous article, are to provide the Fund with a final accounting of the balance and return the remaining funds, if any. The Fund's employees shall file the actual expenses and debts to the Fund's credit account at those entities, and shall also follow up on the procedures followed by those entities for charging and making the final balancing of the Fund's account. The concerned entities should also file and follow up the collection of debts owed to the Fund.

#### **Article 15**

Some personnel may be delegated to work on a part or full-time basis in order to accomplish specific work for implementation of the Law and its executive regulations, and after getting approvals from the authorities so charged and according to relevant laws and regulations.

#### **Article 16**

The Minister of Water Resources and Irrigation shall issue a decree to define rewards for the Board's Chairman and the Board of Directors and for attendance of Board meetings according to the regulations of Presidential Decree No. 71/1965.

#### **Article 17**

The Undersecretary of the Restitution Fund is charged with preparing the Fund's draft budget, including the estimated proceeds, and expenditures, and with presenting it to the Board of Directors, sufficiently prior to the beginning of the fiscal year, and for obtaining approval by the Minister of Water Resources and Irrigation.

The Fund's Undersecretary also is responsible for preparing the Fund's final account by the end of each financial year to be approved by the Fund's Board of Directors and for reporting to authorities so charged according to the aforementioned Law 53/1973 and its executive regulations.

#### **Article 18**

If anything is not specifically stated in this Decree, then provisions of the following laws and/or regulations are applicable: Law 53/1973 and its executive regulations, Law 127/1981 and its executive regulations, and all active laws and regulations.

#### **Article 19**

This decree is to be published in the formal gazette of the Egyptian Government.

## Acknowledgments

This report was prepared by a team assembled under the auspices of the Water Policy Bridging Activity, a joint activity of the Ministry of Water Resources and Irrigation (MWRI) and the United States Agency for International Development Egypt Mission (USAID/Egypt). Implementation of four studies under the Water Policy Bridging Activity is the joint responsibility of Development Alternatives International (DAI) and International Resources Group (IRG) through the Water Indefinite Quantity Contract (Water IQC).

The study reported upon in this paper follows on to a previous analysis begun in August 2001 under the auspices of the Water Policy Reform Program and implemented through the Environmental Policy and Institutions Strengthening Indefinite Quantity (EPIQ) Contract. The findings of that work are reported in: McCauley, et al., 2002. *Economic Instruments for Improved Water Resources Management in Egypt*, EPIQ/WPRP: Cairo.

This analysis is designated as “Study 2” of four being carried out under the Water Policy Bridging Activity through the Water IQC. The team for the current study included some of the same members as were involved in the previous work and comprised: Dr. David McCauley (Study Manager/Water Resource Economist); Dr. Ibrahim Ellassiouty (Water Policy and Institutions Specialist); Robert Anderson (Environmental Economist); Dr. Abdel Khalek (Water Quality Management Specialist); Dr. Abdel Aziz El-Guindi (Legal and Regulatory Specialist, EEPP/PAU); Eng. Hisham Shehab (Water Management and Engineering Specialist, WPAU); and Eng. Aloa Abbas (Water Management and Engineering Specialist, WPAU).

The Study 2 Team is greatly appreciative of all those who contributed to this report. Numerous officials and specialists were interviewed by the team to gain an understanding of the potential applications of market-based incentives to improving water quality management in the country. Important inputs were received from a large number of MWRI staff, including especially Eng. Gamil Mahmoud, Chairman of the Water Policy Bridging Activity Steering Committee and the MWRI Water Policy Advisory Unit (WPAU) as well as from the active oversight of Eng. Mohamed Nasser Ezzat of the WPAU. The Study 2 Team also gratefully acknowledges the guidance received from the Water Policy Bridging Activity managers at USAID, Dr. Ross Hagan and Dr. Wadie Fahim Mankarious, as well as other USAID technical officers. Finally, the entire effort has been carried out under able advice and assistance of Dr. Ibrahim Ellassiouty, who has served as the overall DAI/IRG Water Policy Bridging Activity Team Coordinator and Study 2 Deputy Manager.

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