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LAND AND WATER MANAGEMENT FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN EGYPT: OPPORTUNITIES AND CONSTRAINTS

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TABLE OF CONTENTS

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NOTES AND ABBREVIATIONS

Data used in this report are mostly from appropriate ministries, some of which were published and the rest from files. Where two or more official figures are available for the same parameter, the “most probable” figure is used. While what is “most probable” is based on personal analysis and judgment, the final decision was made only after extensive discussions and consultations with the appropriate officials.

Following abbreviation and acronyms have been used in this report.

CAPMAS: Central Agency for Public Mobilization and Statistics
EIA: Environmental Impact Assessment
FAO: Food and Agricultural organization
GARPAD: General Authority for Rehabilitation Projects and Agricultural Development.
GOE: Government of Egypt
GOSD: General organization for Sewerage Development
HAD: High Aswan Dam
LMP: Land Master Plan
MALR: Ministry of Agriculture and Land Reclamation
MOH: Ministry of Health
MPWWR: Ministry of Public Works and Water Resources

I. INTRODUCTION

Egypt, said the Herodotus, is the gift of the Nile. More than two millennia after the Greek historian's visit, and inspite of extensive technological developments, it still is not an over-statement since life in Egypt would be impossible without the water of the Nile. Napoleon Bonaparte reconfirmed Herodotus' observation during the French Occupation of Egypt He said: "If I was to rule a country like Egypt, not even a single drop of water would be allowed to flow to the Mediterranean Sea" While, not surprisingly, Napoleon was not aware of the importance of allowing some discharge of the Nile waters to the Sea for salt balance and other environmental reasons, the general thrust of his thinking was correct. In Egypt, the major constraint to development, especially agricultural production, is water and not land. Even after the construction of the High Aswan Dam, which radically altered the water use patterns in Egypt, only about 7.2 million feddans, which is less than 4% of the country's land area, is cultivated at present.

II. BACKGROUND AND STRUCTURE OF THE REPORT

The present report is one of the three background papers prepared by senior international consultants as a contribution for discussion at a National/FAO workshop on the impact of agricultural policy on agricultural development, with particular emphasis on options and perspectives for the 1990s and beyond. The workshop would be held in Cairo, would be attended by senior government officials and decision-makers from the appropriate ministries. The report is based on a 6-week effort, most of which was spent in Egypt. The main thrust of the report is on land and water development for sustainable agricultural development in Egypt. Basically, it is structured into four major parts. The first part deals with major concepts and issues for sustainable agricultural development. Second and third parts deal with land resources, including land reclamation and water resources. The final part considers the major cross-sectoral policy issues: water pricing, environmental quality, risks and uncertainties and data availability, reliability and accessibility.

Policy issues and recommendations are made throughout the report in appropriate sections. For ready reference, only the important policy issues and recommendations are underlined. The major policy issues are then discussed in greater detail towards the end of this report.

III. SUSTAINABLE DEVELOPMENT: CONCEPT AND ISSUES

Contrary to many statements, the concept of sustainable development is not new. The general philosophy behind it has been recognized for many centuries. While the term "sustainable development" became fashionable around 1980, there is in reality very little difference between this and the concept of "ecodevelopment" that was prevalent during the early 1970s.

There is no agreed definition of sustainable development. There are numerous definitions, and they sometimes differ in significant ways. For example, the World Commission on Environment and Development (1987) defined it as "a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations". It further stated that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs". Clearly such definitions are somewhat simplistic and vague for actual use in policy formulation for planning and implementation of specific projects, except in a very general sense. Equally, any development process that does not consider the achievement of a reasonable and equitably distributed level of economic well-being that can be perpetuated continually for many generations cannot be sustainable. This is a fact that is not reflected properly in the cited definition.

In spite of the rhetoric at present, it has to be admitted that operationally it has not yet been possible to identify a development process which can be planned and then implemented and which would be inherently sustainable, however it may be defined It would be true to say that we have had more success in identifying certain aspects of development which are unsustainable, and then take appropriate remedial steps to reduce or even eliminate those undesirable effects than to devise a holistic process that intrinsically sustainable right from the very beginning.

For example, if sustainable agricultural development is considered, it is known that irrigation without drainage would contribute to waterlogging, which in turn would reduce the yields of the irrigated area over a period of time. Since the main purpose of any irrigation project is to increase the total agricultural production, clearly any system that does not fulfill this objective over a long-term period cannot be considered to be sustainable. Similarly, if extensive use of fertilizers by the farmers increases the nitrate content of groundwater so that its use for drinking purposes is impaired, then this practice has to be considered unsustainable (Abu- Zeid and Biswas, 1990).

While there are many issues that are important for sustainable agricultural development, from a policy point of view following three factors are worth noting:

i) **Short-term versus long-term considerations** – The concept of sustainable development automatically assumes that the process selected would be viable over the long-term, even though the issue of what constitutes "long-term" has neither been clarified nor featured much in the current discussions. The time factor either inadvertently or because of its complexity has been basically left fuzzy: no attempt has been made to define or even discuss what is meant by long-term. For example, does sustainability covers 50 years or 100, 500, 1000 or even more years? Some have spoken vaguely of "several" generations.

Even if one considers the lower figure of 50 years, there is a fundamental dichotomy as to its use in the real world. For example, generally the economic planning horizon of farmers in Egypt, or in any other country for that matter, extends to one cropping season or slightly longer. In the newly reclaimed areas, the time horizon could extend to 2 to 3 years, but certainly no more than 5 years. The overriding philosophy of nearly all farmers has been to maximize economic returns from their agricultural activities within this time horizon. Thus, the mindset is inherently based on maximizing profits over a continual series of short-term periods. If the short-term benefits could have long-term costs, even to themselves (e.g., in terms of soil erosion, salinity development, etc.), generally short-term considerations would win over the long-term implications. While in some cases this outlook of "short-termism" could be due to the lack of knowledge or understanding of the potential long-term impacts of their activities, it has to be admitted that for financial reasons, small farmers, who are invariably poor, are mostly forced to consider only the short- term economic implications for their own survival. Accordingly, even if the societal and/or governmental goal is to achieve long-term sustainable development, in reality the main objective of a vast majority of farmers extend normally to short-term survival. Thus, any plan for sustainable agricultural development, which does not specifically consider this fundamental conflict and then attempts to identify realistic alternatives to overcome the problem, is doomed to fail. Such plans are most likely to gather dust on the Ministry shelves.

ii) **Externalities** – Externalities occur when private costs or benefits do not equal social costs or benefits. Farmers and large agricultural estates operate primarily on the basis of their own private costs and benefits. If they perceive opportunities which could reduce their costs and/or increase potential benefits, they often take actions which could be beneficial to them but are unlikely to serve the common good. Commonplace examples include use of excessive irrigation water by the farmers in the headreaches of canals which means tailenders have insufficient and/or unreliable water supply. This, in turn, could decrease the agricultural yields and thus incomes of the tailenders substantially. Similarly, wastes from agro-processing industry could be discharged to canals and rivers, which could impair existing water uses downstream. Such costs could be internalized, at least conceptually, through taxes subsidies and regulations. But in reality, even in developed countries, it has not been easy to internalize the externalities for four important reasons. First, methodologically, calculation of precise value of externalities has been a very difficult task. Second, frequently there are politically powerful individuals and organizations who vociferously defend their own considerable private advantages against a large number of unorganized and disadvantaged individuals who may be experiencing additional costs somewhat indirectly. Third, externalities could develop steadily over time, and thus there could be a time gap before those affected realize the costs. Finally, regulations to control such externalities in nearly all developing countries have proved to be both ineffective and expensive.

iii) **Risks and Uncertainties** – A major issue confronting sustainable agricultural development is risks and uncertainties that are inherently associated with such complex systems. For example, with the increasing population base in Egypt, most of whom are striving to improve their quality of life, there is no question that the country's resources like land and water have to be intensively used in order to maximize agricultural production. The fundamental question for which there is no real clear-cut answer at the present state of knowledge is up to what level can Egypt's agricultural production system be intensified, without sacrificing sustainability? What early warnings could indicate the beginning of a transition process from sustainable to an unsustainable one? What are the parameters that need to be monitored to indicate that such a transition is about to occur or even occurring Clearly, our present knowledge is inadequate even to identify the parameters that could indicate the transition from one stage currently we really cannot much less predict, the to the other. Thus, accurately detect, even transition of such a sustainable system to an unsustainable one. In addition, agricultural systems are variable by nature. Their fluctuations could be so great that statistically significant data could be very expensive or even impossible to obtain in order to state categorically that such variations are natural or signs of unsustainability. If on such already complex issues, additional factors like potential climatic changes are superimposed, the degree of uncertainties in terms of detecting or predicting the transition process increases manifold. One is then confronted with the difficult issue of even identifying the direction of any change, let alone the degree of change. This is illustrated later in the report with only one example, the prediction of the Nile flow, on which almost the entire Egyptian agriculture depends. These types of fundamental issues need to be successfully resolved, before the concepts of sustainable agricultural development can be holistically conceived and then implemented. Unfortunately, while much lip service is given to sustainable agricultural development at present, most of the published works on this subject are either somewhat general or continuation of earlier "business or usual" work that have only been given the latest trendy label of "sustainable development". If sustainable agricultural development is become a reality, national and international organizations like FAO would have to address the crux of the questions, which they have not done so far in any measurable and meaningful fashion. If not, and unless the rhetoric can be effectively translated into reality, sustainable development will remain a trendy catchword for a few years, and then gradually fade away like the earlier concept of ecodevelopment.

IV. LAND RESOURCES

For a very arid country like Egypt, the prime factor which makes land productive is water. Thus, an analysis of arable land can be best divided as pre- and post- High Aswan Dam (HAD) periods. Fortified by increased and more reliable water availability that was made possible by the construction of this Dam and assisted by technological developments, it has been possible both to intensify cultivation in the old lands and to expand agricultural activities in the new areas. Construction of the HAD basically confirmed the fact that the supply of arable land in Egypt is not necessarily inelastic as was often assumed for centuries in the past. Thus, nearly 650,000 feddans out of a total of 805,000 feddans of land reclaimed between the decade 1960–1970 was made possible directly due to the waters released from the HAD (Ikram,1980).

Table 1 shows changes in arable areas in Egypt during the period 1897–1990. It should be noted that between 1907 and 1980, the total arable area increased by only about 700,000 feddans, while population increased nearly 4-fold, from 11.2 million to 42.1 million (Abdel Aal & Rady, 1991). This meant that the area of arable land available per person declined by 71 percent during this 73-year period. The changing patterns of population, total arable land and per capita arable land available are shown in Figure 1. It should be noted that the rate of increase of total arable land during the past decade is highly unlikely to be maintained in the future.

The most detailed analyses of land resources of Egypt were completed in 1986 (Euroconsult & Pacer, 1986). On the basis of analyses carried cut, this Land Master Plan (LMP) concluded that 2.88 million feddans of land could be reclaimed, by using the Nile waters. In addition, another 570,000 feddans could be reclaimed by using groundwater in Sinai and New Valley. Thus, the total land that could be reclaimed, subject to water availability, was estimated at 3.45 million feddans (Table 2).

The LMP study considered land only for irrigated agriculture. Other uses of land like fisheries, forestry and wildlife habitat were not considered.

Year	**Population (millions)**	**Arable Land (feddans)**	
		Total (millions)	**Per capita**
1897	9.7	4.9	0.51
1907	11.2	5.4	0.48
1917	12.8	5.3	0.41
1927	14.2	5.5	0.39
1937	15.9	5.3	0.33
1947	19.0	5.8	0.31
1960	26.1	5.9	0.23
1970	33.2	6.0	0.18
1980	42.1	6.1	0.14
1990	55.0	7.2	0.13

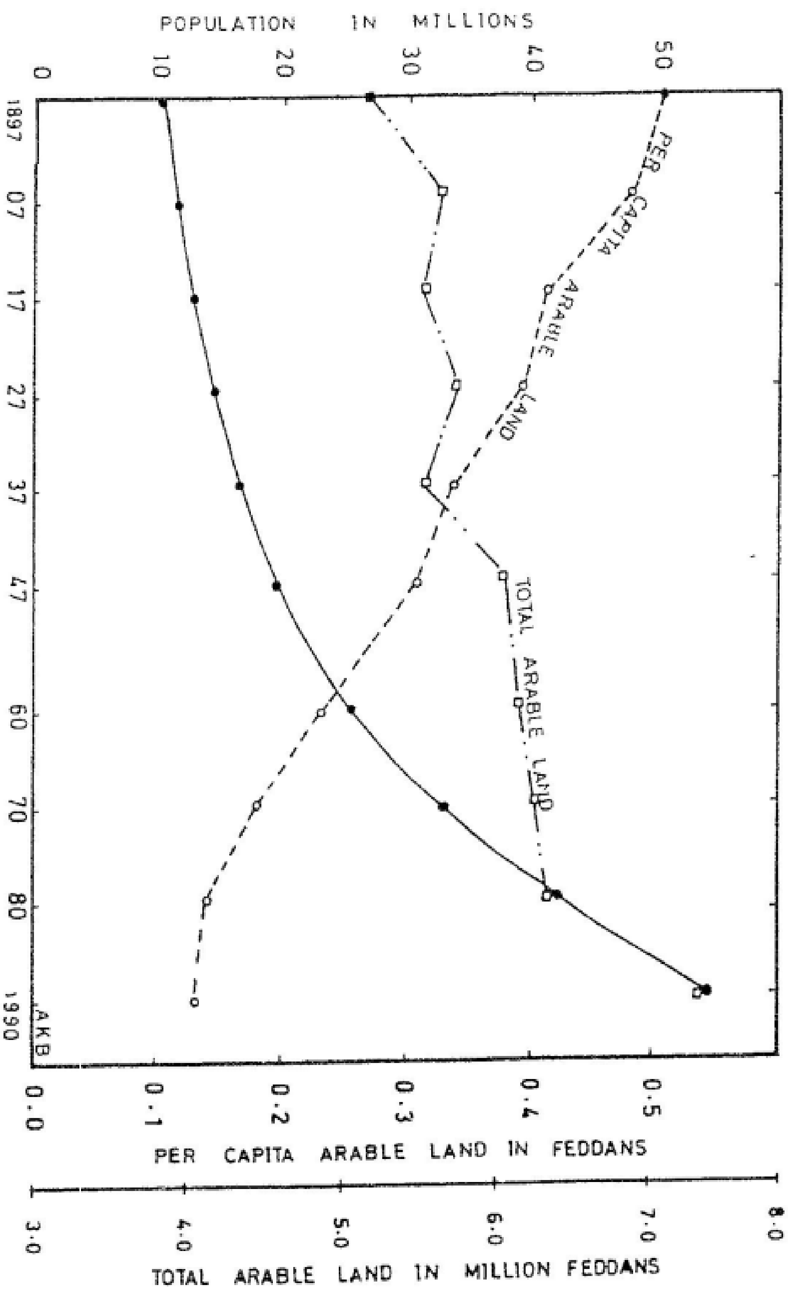
***TABLE 1**. Changing Patterns of Population and Arable Land in Egypt, 1987–1990 (based on data from CAPMAS and MOA)*

Potential Land Reclamation by Regions	***Land Categories (1000 feddans)***					***Total***	***Priority Areas (1000 fd)***
	I	**II**	**III**	**IV**	**V**		
1. <u>With Nile Water</u>							
East Delta	268.5	-	135.1	43.5	351.6	798.7	612.0
West Delta	41.5	171.2	49.1	65.0	358.1	684.9	264.0
Central Delta	59.0	-	-	-	-	59.0	59.0
Middle Egypt	-	-	31.5	6.2	186.2	223.9	184.0
Upper Egypt	-	3.6	160.1	342.5	275.4	781.6	195.0
Aswan High Dam Lake Shores	-	9.0	-	-	41.0	50.0	0.0
Sinai	102.5	-	-	111.6	29.5	283.6	212.0
Total	471.5	183.8	375.8	568.8	1281.8	2881.7	1526.0
2. <u>With Groundwater</u>							
New Valley	1.5	62.5	14.2	-	484.5	562.7	
Sinai	-	-	2.0	5.2	-	7.2	
Total	1.5	62.5	16.2	5.2	484.5	569.9	82.0
TOTAL	473.0	246.0	392.0	574.0	1766.0	3451.6	1608.0

TABLE 2*. Land that can be reclaimed in Egypt by regions, (based on data from Euroconsult and Pacer, 1986)*

The LMP study divided potentially reclaimable land into 5 categories, depending on one more land use and management options. These options considered cropping patterns, irrigation and drainage systems and farm types. This classification was based on a modified US Bureau of Reclamation system. A succinct summary of the five land management categories is given in Table 3, and the extent of land available in different regions of Egypt under various categories is shown in Table 2 and Figure 2. From this analysis, it can be seen that coarse to gravely sands in the desert area (Category V) account for more than half the land that can be reclaimed. Categories III, IV and V, which contain coarse sandy soils and sandy loams, account for nearly 80% of the potentially reclaimable area. All these three categories land basically constitute desert reclamation.

On the basis of economic criteria, and considering potential budgetary allocations for land reclamation and for agricultural and water resources development, it was considered that 1.61 million feddans should receive priority in terms of implementation. Of this amount, 1.52 million feddans could be developed by the Nile Water and 82,000 feddans by groundwater. The priority areas by regions are shown in Table 2.



POPULATION AND ARABLE LAND (TOTAL AND PER CAPITA) IN EGYPT, 1897 - 1990

FIGURE 1

Not surprisingly it can be seen that 61% of the priority reclaimable land through the Nile waters is located in the Delta region. In parts of these areas, where soil is loamy in nature, wheat can be cultivated relatively successfully.

Land Categories	Soil Types	Terrain	Main Locations	Most Suitable farming System		
				Crops	**Irrigation & Drainage**	**Farm Type (1)**
I	Clays, low permeability saline	Flat	Coastal areas Western Desert Depressions	Rice Fodder	Basin Drainage difficult	Smallholders Family farms
II	Clays to sandy loams, permeable calareous	Flat	Nubaria New Valley	Cereals Legumes Fodder Vegetables Grapes	Gated pipe sprinkler Drainage easy	Smallholders Family farms
III	Sandy loams to sands, low available moisture	Flat to gently undulating	Desert	Legumes Oil crops Fodder Vegetables Fruit trees	Sprinkler and drip Drainage easy	Family, Commercial and Estate farms
IV	Sandy loams to sands, low available moisture	undulating	Desert	As in III	As in III Drainage easy Requires, good water management	Commercial and Estate farms
V	Coarse sands, very low moisture retention	Flat to rolling	Desert	As in HI but limited number	Sprinkler- and drip Drainage easy	Estate farms

(1) Farm types - smallholders: about 5 fd; family farms: 15–20 fd;
Commercial farms: 200–500 fd; estates: 1000–5000 fd

***TABLE 3**. Definition of land management categories (based on data from Euroconsult and Pacer, 1986)*

Parts of the priority areas identified by LMP are already now in a more or less advanced stage of development.

Loss of Productive Land – Not much has been written on the loss of productive land in Egypt, except in a general and anecdotal fashion. Estimates of land loss available at present range from a low of 20,000 feddans (Parker & James, 1981) to a high of more than 100,000 feddans (World Bank, 1990c) per year. In reality, most of these estimates are based on anecdotal observations and some like more than 100,000 feddans are clearly wild guesses.

The problem of calculating land loss is compounded by four complex factors. First, net area of cultivated land can only be estimated at present since the last agricultural census was carried out in 1961. Second, as mentioned later in this report, land reclamation statistics refer only to gross areas: reliable data are unavailable on areas that are not fully reclaimed, unproductive, and abandoned. Third, no information is available on land losses due to the urbanization process, even for very specific years. Fourth, current estimates of land loss due to waterlogging and salinity development are so vague that they are literally meaningless.

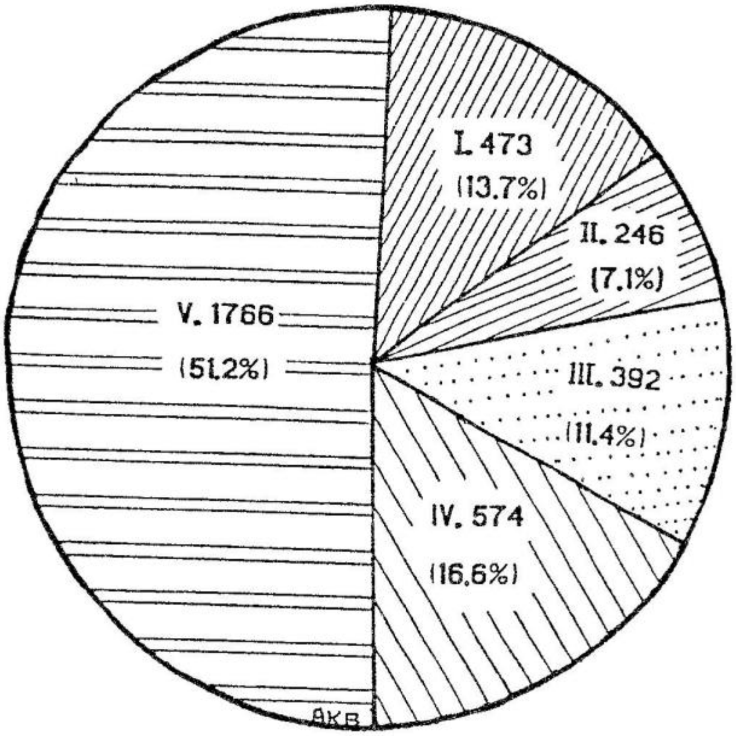


FIGURE 2. CATEGORIES AND EXTENT OF LAND THAT CAN BE RECLAIMED DEPENDING UPON AVAILAB1LITY OF SURFACE AND GROUNDWATER

The literature on environmental aspects of Egypt is full of anecdotal or superficial estimates on land loss which have been masquerading as realistic data. For example, one World Bank report (1990c) quotes annual loss of "agricultural land to topsoil skimming and urban encroachment" to 100,000 feddans in 1983, which is clearly absurd. Haas (1990) claims that by 1972, "One-third of Egyptian irrigated land was estimated to be salinized or was threatened by salinization," which is really a meaningless statement. Similarly, Kishk's (1986) statement that at least 50% of the land was salinized is equally meaningless. Neither Haas nor Kishk even indicate what is meant by salinized land: for example does it mean decline in agricultural productivity due to salinity by 1%, 5%, 10%, 50% or 80%, or land completely withdrawn from agricultural activities?

Considering the present estimate of cultivated land area in Egypt of 7.2 million feddans, and then assuming net irrigated agricultural area of the order of 6.65 million feddans, the best "guestimate" that can be made at present of the annual loss of agricultural land due to urbanization would be of the order 30,000 feddans. This is consistent with certain other estimates (Ghabbour, 1990; World Bank, 1990b). Assuming this estimate of land loss reasonably accurate, it means that the land reclamation efforts have modestly managed to increase the agricultural land base, but very modestly.

It should be pointed that there is some discrepancy between the accepted figure of 7.2 million feddans of cultivated land, which is generally being used at present, and the study carried out by the Egyptian Public Authority for survey (1989). The latter study indicated that the total cultivated area in Egypt is 7.49 million feddans, of which 7. 21 million feddans is in the Nile Valley. The cultivated land areas by different governorates for 1963 and 1989, as given by the Public Authority for survey is given in Table 4. It is essential that this discrepancy be promptly resolved.

From a policy viewpoint, it is essential that GOE needs to give urgent attention to reduce the loss of arable land due to urbanization for the following three important reasons. First, with continually increasing population, existing agricultural land areas should not be allowed to be lost. Second, land reclamation is an expensive process, and hence it would be desirable not to lose any additional land areas that are already productive, and then try to compensate that loss by reclamation. Third, often land lost due to urbanization is more productive than the reclaimed land.

Currently laws exist which are expected to prevent the loss of arable land due to urbanization, but such laws have been basically ineffective since they were not initially properly formulated, and hence their implementation has left much to be desired. However, it should be noted that the prevention of the loss of agricultural land due to urbanization has not been possible in nearly all developing countries as well as in many developed countries.

Governorates	**Cultivated Areas (feddans)**			**Percentage Increase (+) or Decrease (-)**
	1963	**1989**	**Difference**	
1. Lower Egypt				
Alexandria	24,448	141,278	+116,830	+447.9%
El-Beheira	745,156	1,244,810	+499,654	+ 67.1%
Kafr El-Sheikh	447,714	575,089	+127,375	+ 28.5%
El-Gharbia	425,724	397,714	- 28,010	- 6.6%
El-Menoufia	330,133	312,987	- 17,146	- 5.2%
El-Kalioubia	202,190	213,278	+ 11,068	+ 5.5%
Damietta	101,568	132,791	+ 31,223	+ 30.7%
Dakahlia	659,125	687,614	+ 28,489	+ 4.3%
El-Sharkia	606,595	790,105	+181,510	+ 29.8%
Port Said	132	6,995	+ 6,863	+5,200%
Ismailia	51,045	155,954	+104,909	+205.5%
Suez	9,325	8,828	- 497	- 5.3%
Total	3,605,155	4,667,443	1,062,288	+ 29.5%
2. Upper Egypt				
Cairo	19,257	11,252	-	- 41.5%
Gira	181,235	232,807	8,005	+ 28.5%
Fayyoum	328,067	351,901	+51,572	+ 7.3%
Beni Suef	273,529	275,300	+23,834	+ 0.7%
El-Menia	465,045	507,589		+ 9.15%
Assiut	330,135	325,807	+1,771	- 1.3%

Sohag	333,245	317,967	+42,544	- 4.6%
Kena	369,993	374,783	-	+ 1.3%
Aswan	114,745	153,758	4,329	+34.0%
			-15,278	
			+4,790	
			+49,013	
Total	2,415,251	2,551,163	135,912	+ 5.6%
Total, Nile Valley	6,020,406	7,218,606	1,198,200	+ 19.9%
3. Desert Governorates				
Matrouh	-	34,346	-	-
New Valley	-	29,930	-	-
N. Sinai	-	166,882	-	-
S. Sinai	-	1,419	-	-
Red Sea	-	383	-	-
Total	-	272,960	-	-
Grand Total, Egypt	-	7,491,566	-	-

TABLE 4. *Cultivated areas in Egypt, 1963 and 1989 (based on data from MPWWR)*

Land Reclamation

In an arid country like Egypt, land reclamation has been practiced over several thousand years. For most of this period, reclamation was practiced primarily in the Nile Valley and the Delta, since land in these areas could be reclaimed with low levels of technology and investment.

Tremendous progress was made in land reclamation in the 19th century, at the beginning of which areas cultivated were estimated at 2 million feddans, of which only 250,000 feddans could be cultivated in the summer. By 1848, the area cultivated, had increased to 2.6 million feddans, by 1880 to 4.7 million feddans and by 1900 to 5.0 million feddans. Thus, during the last century, the arable land area increased by 150% or some 3.0 million feddans.

Since the independence of Egypt in 1952, rapid increases in population (Table 1, Figure 1) have contributed to shortages of arable land areas which could be economically cultivated. During the 1950s, however, the social objective of setting landless people was considered to be more important than the economic objective of increasing the ·national agricultural production. Even with this high priority, the actual progress in the area of resettlement was somewhat slow since only 80,000 feddans could be reclaimed, out of a target of one million feddans. Of this reclaimed area, about 30,000 feddans was given to small farmers.

Construction of the High Aswan Dam, significantly increased both the supply and reliability of irrigation water availability. This, in turn, allowed considerable expansion of the land reclamation process. Thus, between 1960–1971, a total of 912,000 feddans were reclaimed much of which was in the Western Delta (Table 5). The area reclaimed during this period is now called old-new lands. It should be noted that the figures quoted are for gross areas. Even though the net agricultural area is generally assumed to be about 85% of the gross area, realistically only about 75% can be considered to be productive (about 685,000 feddans) because some of these reclaimed areas have since gone out of cultivation due to serious waterlogging and salinity problems. Another 90,000 feddans are under rehabilitation (Nagmoush, 1988).

Year	**Delta**			**Middle Egypt**	**Upper Egypt**	**Other**	**Total**
	East	**Middle**	**West**				
1960	23.6	2.5	42.9	6.7	-	3.1	78.8
1960-61	1.5	2.0	5.7	-	-	19.0	28.2
61-61	10.7	17.7	25.2	3.1	9.6	23.1	89.4
62-63	13.2	23.6	42.9	4.9	13.6	24.2	122.4
63-64	8.0	33.7	53.9	5.5	23.8	34.5	159.4
64-65	8.5	27.0	58.9	12.0	16.7	12.9	137.0
65-66	-	4.0	65.5	22.0	11.1	17.0	119.6
66-67	-	4.0	27.5	21.5	2.1	2.0	56.1
67-68	-	2.0	32.0	-	-	-	34.0
68-69	7.0	19.0	19.1	-	-	-	45.1
69-70	5.0	7.0	6.0	-	3.0	-	21.0
70-71	13.0	8.0	-	-	-	-	21.0
78-79	1.0	-	14.9	0.8	0.5	4.7	21.9
79-80	8.3	8.1	4.6	-	0.8	2.5	24.3
80-81	3.7	7.0	2.5	-	1.0	2.1	16.3
81-82	57.3	1.0	32.5	0.3	4.6	4.2	99.9
82-83	-	3.4	27.9	1.5		10.9	43.1
83-84	13.0	4.4	18.9	5.1		5.2	45.6
84-85	14.7	2.5	22.4	6.6		4.4	50.6
85-86	11.5	2.3	26.4	15.7		0.5	56.5
86-87	3.5	11.5	36.2	13.0		1.7	65.9
87-88	20.0	2.3	96.2	18.2		16.9	153.6
88-89	-	-	-	-	-	-	170.0
5 – Yr. Plan 87-88/91-92	175.0	5.0	214.0	41.5	94.5	219.6	750.0

TABLE 5. *Land Reclaimed in 1000 feddans, 1960–61 to 91–92 Reclamation between 1971–72 and 1977–78 was negligible. (Adopted from World Bank data)*

Much of the land reclaimed during the 1960s was kept as state farms, since the then prevailing wisdom was that only such large farms would allow extensive mechanization and could benefit from economies of scale. This indicated a shift in official policy of emphasizing the social objectives of the previous decade to increasing agricultural production and generation of marketable agricultural surpluses.

The World Bank missions which visited Egypt between 1976 and 1979, made scathing comments on the overall impact of land reclamation carried out (Ikram, 1980) during this period:

> "So far, however, the program has done little to solve the problems of the small farmers or to add to food production and foreign exchange earnings. Huge cost overruns, long gestation periods, poor physical performance, and management problems have made the program a burden to the sector and added to the difficulty of maintaining productivity in the delta and the Nile Valley."

During most of the 1970s GOE priorities were focused primarily on defense-related issues, and accordingly land reclamation was virtually neglected. It was restarted in 1978, and during the decade of 1978–79 to 1988–1989, a total of 74,700 feddans were reclaimed. However, figures available from GARPAD are often confusing and contradictory, because of clarity of definition of land reclamation (target, initiated, completed, cultivated, etc.). Like the 1960s, maximum reclamation carried out was in the Western Delta, nearly 50%. These reclaimed areas are now called **new-new lands**. The land areas reclaimed in Egypt during 1960 to 1988 by different regions are shown in Table 5.

There was another major policy shift during the 1980s. GOE became disillusioned with the overall performance of the state farms because of their inherent inefficiency, inability to adopt new farming practices quickly, and general lack of development of new farming systems that are more applicable to desert-like conditions. Accordingly, a policy decision was taken to allocate **new-new lands** in varying ratio of 60–40% to investors with adequate capital to develop their own farms and the balance 40–60%, to economically disadvantaged groups like landless farm workers, unemployed graduates, and a small number of retired government and army personnel. The actual ratio of land distributed between investors and economically disadvantaged groups varied from project to project. Currently, any reliable aggregated data on how **new-new lands** have been actually distributed to the various groups is simply not available (World Bank, l990a).

The total investment cost for lands reclamation has so far been significant. For example, since the 1952 revolution, over L.E. 3 billion (nominal) have been spent on land reclamation. By 1975, L.E. 485 million had been spent to reclaim 912,000 feddans of **old-new lands**. It was estimated that an additional L.E. 285 million would be needed to complete this task properly (World Bank 1990a). It should be noted that the cost figures mentioned above are difficult to interpret since they are in nominal and not in constant terms, and relate to areas at different stages of reclamation. There is, however, no question that in terms of the GOE policy, land reclamation has been consistently considered to be a priority area in Five-Year Investment Plans starting from 1978. If the budgets allocated to the land reclamation sector through the Ministries of Land Reclamation, Agriculture and Irrigation and MPWWR, for the 1978–82, 1982/83 - 1986–87 and 1987/88 - 1991/92 Investment Plans are analyzed, they accounted for 41%, 41% and 40% respectively of the total proposed investment for the entire agricultural sector. However, actual expenditures have generally been significantly lower than the targets due to financial constraints. For example, the actual expenditure during the 1982/83 - 1986/87 Investment Plan was only about 50% of the target.

Analysis of land reclamation expenditures by its major components for the 1960 to 1975 period (World Bank 1990a) indicates that about 57% of total expenditure was for agriculture and another 24% was for irrigation and drainage. Thus, the present GOE policy which leaves agricultural development costs to the farmers means that government investment costs could be reduced by half, when compared to the earlier practice. For investor farmers, for whom social infrastructure costs could be excluded, the costs could be reduced by another 20%. This was confirmed by the actual expenditure during 1982/83 - 1986/87 Plan, where agricultural development constituted only 5% of the land reclamation costs. The 1987/88 - 1990/91 Plan also uses similar cost estimates.

The Land Master Plan study (Euroconsult & Pacer, 1986) estimated that the investment costs for land reclamation varied from L.E. 3,000 to L.E. 7,000 per feddan, depending upon the complexities encountered. In some remote areas, high cost of infrastructure increased the cost to L.E. 8,000 or even higher per feddan. The average investment cost was about L.E. 5,000 per feddan. Annual running cost, excluding on-farm cost, varied from a low of L.E. 200 per feddan for some low- lying deltaic areas to over L.E. 400 per feddan for certain sandy desert areas at a level of more than l0Om from the adjacent Nile water level.

Reclaimed land is being sold at little more than cost, around L.E. 2,500–5,000 per feddan. In addition, farmers are expected to bear the cost of agricultural development in these new farms. GOE has already pledged not to dictate cropping patterns in these areas. Thus, it is highly likely that many farmers will plant high value crops, probably perennial fruit crops, on significant parts of their new lands in order to generate sufficiently attractive returns on their initial investments.

It should be noted that the farm models developed by FAO and MALR indicate that field crops (including and excluding tree crops), vegetables and small animal livestock could achieve positive marginal productivity by the second year. However, low-value field crops like cereals, grain, legumes and oil seeds, may not be perceived by the farmers to be economically attractive. Consequently, it is possible that the total production of fruits in Egypt may increase significantly in the near future. The potential impacts of such increases on market prices of fruits and thus return to the farmers, need to be investigated. Equally, where it is economically possible to develop a more diversified crooning pattern, MOA should encourage farmers to do so through better extension and credit facilities, creation of pilot farms, and/or other appropriate measures.

In terms of resource management policy issues for the land reclamation sectors, the following need additional attention:

i) Life of Land Reclamation Projects – With the increasing population base in Egypt, land reclaimed at considerable cost must not only retain their productivity but also the production system must be sustainable over the long term. With a continually declining man-arable land ratio, land reclaimed must be kept productive for Egypt’s long-term future. Land can only be productive, if water is available for irrigation. With increasing population, larger number of people achieving a better standard of living, and higher levels of industrialization, water demands for the municipal and industrial sectors would undoubtedly continue to increase in the future. Since these two sectors are most likely to have higher priority than the agricultural sector in terms of water use, reliable water availability in the future for the reclaimed areas should receive more serious attention. Since the current estimates of water use for the year 2000 can be considered tenuous at best, (discussed later in the report), very little confidence can be placed on any estimate beyond the year 2000. What can, however be said with considerable confidence is that the relative share of water available for the agricultural sector in Egypt will decline steadily with time in the future. The decline is likely to be significant in the post-2000 period.

Accordingly, even if an economic life of around 30 years or so is considered for the present generation of land reclamation projects, efficiency of water use in Egypt has to be steadily increased over time in order to ensure that all the reclaimed land will continue to receive their share of water in the future on a reliable basis. Technological developments could reduce crop-water requirements, but it would be prudent not to depend on this factor alone, since what these developments could be, and the time when they would be available, are both uncertain factors.

What is thus urgently needed for formulation of realistic future land use policies is more rigorous estimates of water availability and demand for the next 20–25 years, especially during the post-2000 period. Once better estimates of water availability for the agricultural sector, and hence for reclaimed land, are available, more realistic plans could be made to ensure their sustainability.

ii) Environmental issues – Like any other development project, land reclamation projects have both positive and negative environmental impacts. For example, desert reclamation often requires development of shelter belts, which reduce wind erosion and thus particulate concentration in the air and enhance bird and small animal habitat. Equally, land reclamation could provide better habitats for disease vectors, and could contribute to consequent increases in diseases like schistosomiasis. Overuse of water, and/or improper drainage system could contribute to the development of salinity and waterlogging problems. Irrigation of land at higher levels could contribute to waterlogging at lower levels.

In **old-new lands**, drainage systems were generally not provided where groundwater levels were low. With continuing water conveyance through unlined canals and overuse of water by the farmers, groundwater tables rose in many areas after a period 6f years. As much of the initial aquifer contained heavily saline water, build-up of groundwater, increased soil salinity, which reduced yields. For example, in Tahrir, wheat yields declined from 4.10 ardebs per feddan to 2.42 within the 4-year period of 1972–73 to 1975–76, a 41% reduction.

An issue that needs greater emphasis is drainage in newer sandy areas. Even if lined canals are used and drip/sprinkler irrigation systems are practiced, it should be noted that the onset of waterlogging problems would only be delayed but not completely eliminated. Also, in areas like Sinai, additional attention has to be given to irrigation return flow, especially in terms of their long-term adverse environmental impacts. So far environmental impact assessment of land reclamation projects have not been carried out. There is no question that <u>in future environmental impact assessment (EIA) has to be considered to be an integral part of all land reclamation projects</u> for two important reasons. First, proper environmental impact assessment can only be of long-term benefit to the country. Second, in the present era of environmental consciousness, all multilateral and bilateral donors are likely to make EIA mandatory before providing any future loan or grant.

iii) Design Changes – Night irrigation is generally not practiced in Egypt, and yet pumping stations are designed for 24-hours operation. Practicing only daylight hour's irrigation means water demands during this period could be high, which could mean unreliable water supply for the tailenders. Equally additional water is available during night times when it is not used. This means that the system not only has lower irrigation efficiency (actual efficiency is likely to be lower than the designed by about 20%) but also has higher energy costs due to pumping. This is a problem not only in the reclaimed areas but also in other agricultural areas as well. <u>Some consideration has to be given to developing night storage of irrigation of water, either in terms of in-channel or on-farm storage</u>.

<u>Forestry Land Use</u> – Egypt virtually has no forestry, even though 2.2 million m^3 of forest products were imported in 1988. Only one small commercial forest exists in the-country: a 100-150 feddans eucalyptus and casuarina plantation near Alexandria. Some plans currently exist for afforestation. Probably the major one is a rainfed afforestation project for the Mediterranean coastal strip between Alexandria and· the Libyan border. It should, however, be noted that this forms part of the Transnational Green Belt Project, which was proposed during the United Nations Conference on Desertification held in Nairobi in 1977. The original proposal was to establish a green belt along the Mediterranean coastal fringes of Morocco, Algeria, Tunisia, Libya and Egypt to combat desertification. The project was also expected to incorporate range management and dryland farming in areas receiving 150–250 mm of annual rainfall. However, the progress made to develop the green belt in all the countries mentioned has been minimal so far.

<u>From a policy paint of view, land use for forestry in Egypt should receive increasing attention both from GOE and appropriate external funding organizations. The private sector could be encouraged to play a more prominent role in forestry development</u>.

<u>V. WATER RESOURCES</u>

Egypt is a very arid country, where ·the average annual rainfall seldom exceeds 200 mm along the northern coast. The rainfall declines very rapidly from these coastal to inland areas, and becomes almost nil south of Cairo. This meagre rainfall occurs in the winter in the form of scattered showers, and cannot be depended upon for extensive agricultural production. Thus, reliable availability of irrigation water is a mandatory condition for agricultural development.

Surface Water – The main and almost exclusive source of surface water is the River Nile. The Nile Waters Agreement of 1959 clearly defines the division of the water of the River between Egypt and the Sudan. Ethiopia is not a signatory to this Treaty, even though nearly 85% of the water of the Nile in Egypt originates from the Ethiopian Highlands (Figure 3).

The 1959 Agreement was based on the average flow of the Nile during the 1900–1959 period. The average flow at Aswan during this period was 84 billion m^3. The average annual evaporation and other losses in the High Dam Lake was estimated at 10 billion m^3, leaving a net usable annual flow of 74 billion m^3. Under the 1959 Treaty, this amount of water was allocated in proportion to the population of the two countries: 55.5 billion m^3 for Egypt and 18.5 billion m^3 for the Sudan.

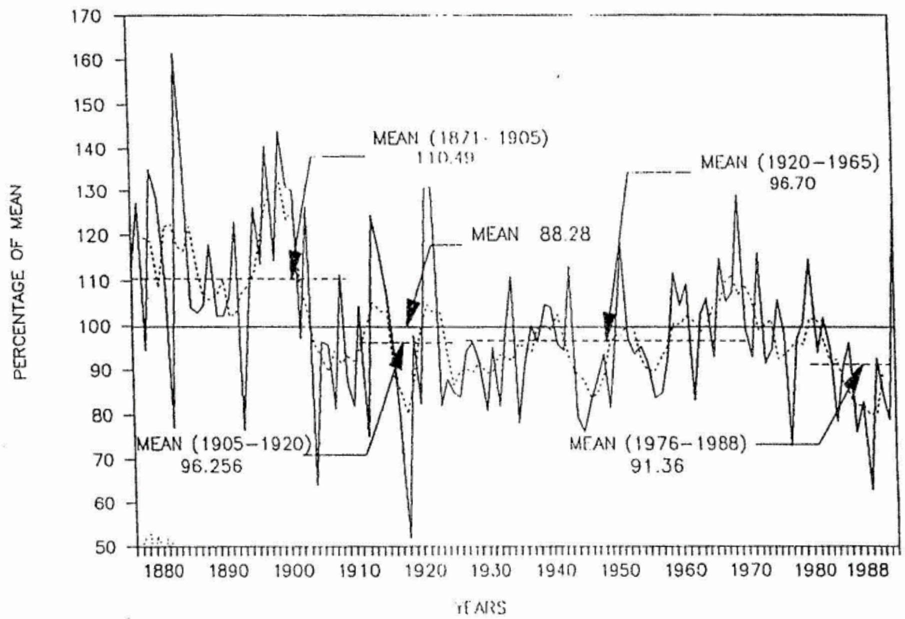
The High Dam Lake has a live storage capacity of around 130 billion m^3, and thus can provide over-year storage. If the average flow of the Nile at Aswan persists at the earlier observed flow of 84 billion m^3, the HAD Lake can provide a regulated flow of 55.5 billion m^3 to Egypt. Figure 4 shows the annualized Nile flow at Aswan for the past 110 years. It indicates the average flows during the 1970s and 198Os have not been similar to the 1900–1959 period.

The average annual release from the HAD Lake during the period 1990–91 has been 55.942 billion m^3, which is slightly higher than 55.5 billion m^3 Egypt is entitled to under the 1959 Agreement. This higher release has not created any problem since the Sudan was unable to use its full allocation of 18. 5 billion m^3. The annual discharges from the High Dam Lake during the period 1968 to 1990 are shown in Figure 5.

There is a potential for increasing the Nile flow at Aswan if the Jonglei Canal can be constructed. The project was expected to canalize the river channel in the Sudd region of the Sudan and thus reduce the substantial evapotranspiration losses. The construction of the Phase I of the Canal was started in 1976, but had to be abandoned in 1983 due to political unrest and the resulting security problems in the southern Sudan. Initially this phase was expected to be completed around the mid-1980s, which would have provided an additional 4 billion m^3 of water at Aswan. A total of 7 billion m^3 was expected after the completion of Phase II. The extra water was to be shared equally between Egypt and the Sudan.

Even under an optimistic scenario, it is highly unlikely that the Phase I of the Jonglei Canal could be completed before the year 2000. Political unrest and the general instability in the Sudan, deteriorating economic situations required at present by all bilateral and multilateral aid organizations mean the Jonglei Canal is unlikely to be completed well into the 21st century at the earliest.


THE
NILE BASIN
SCALE 1/15,000,000
1 100 200 300 400
FIGURE 3
MEDITERRANEAN SEA
Edfina Barrage
Zifta Barrage
Delta Barrages
CAIRO
EGYPT
LIBYA
Asyut Barrage
Naga Hammadi Barrage
Esna Barrage
Aswan Dam
High Dam
Main Nile
Wadi Halfa
CHAD
SUDAN
KHARTOUM
Jebel Aulia Dam
Girba Dam
Sennar Dam
White Nile
Roseires Dam
Tana
Bahr el Arab
L. No
ETHIOPIA
CENTRAL AFRICA
Bahr el Jebel
Bahr el Zaraf
L. Albert
L. Kioga
KENYA
Owen Dam
L. Edward
ZAIRE
L. Tanganyika
TANZANIA
INDIAN OCEAN



ANNUALIZED NILE FLOW AT ASWAN

FIGURE 4

Groundwater – Less reliable information is available on groundwater than on surface water. The total available groundwater storage in the Nile Valley aquifer is about 200 billion m^3, with an average salinity of 800 ppm (Water Research Center, 1990). Another 300 billion m^3 is available in the Delta region. Thus, the total groundwater storage in the Nile Valley and Delta is 500 billion m^3 (Figure 6). The current annual rate of abstraction of groundwater for domestic, industrial and agricultural uses is 2.6 billion m^3. This can be increased to 4.9 billion m^3, which is estimated to be equivalent to the annual recharge rate.

Groundwater exists in the Western Desert, generally at great depths. This is not a renewable resource. Preliminary estimates indicate that the total groundwater storage in this area is of the order of 40,000 billion m^3, with salinity varying between 220 and 700 ppm. Use of this fossil water depends on the cost of pumping and potential economic return over a fixed time period. Investigations at New Valley indicate that annually about 1,042 billion m^3 of groundwater can be used at an economic return rate. This will allow Irrigation of 150,000 feddans, of which 43,000 feddans is already being cultivated. Groundwater is available in Sinai in numerous aquifers of varying sizes. The depths vary and so does the water quality. More studies are necessary before a better picture emerges of groundwater storage and availability in Sinai.

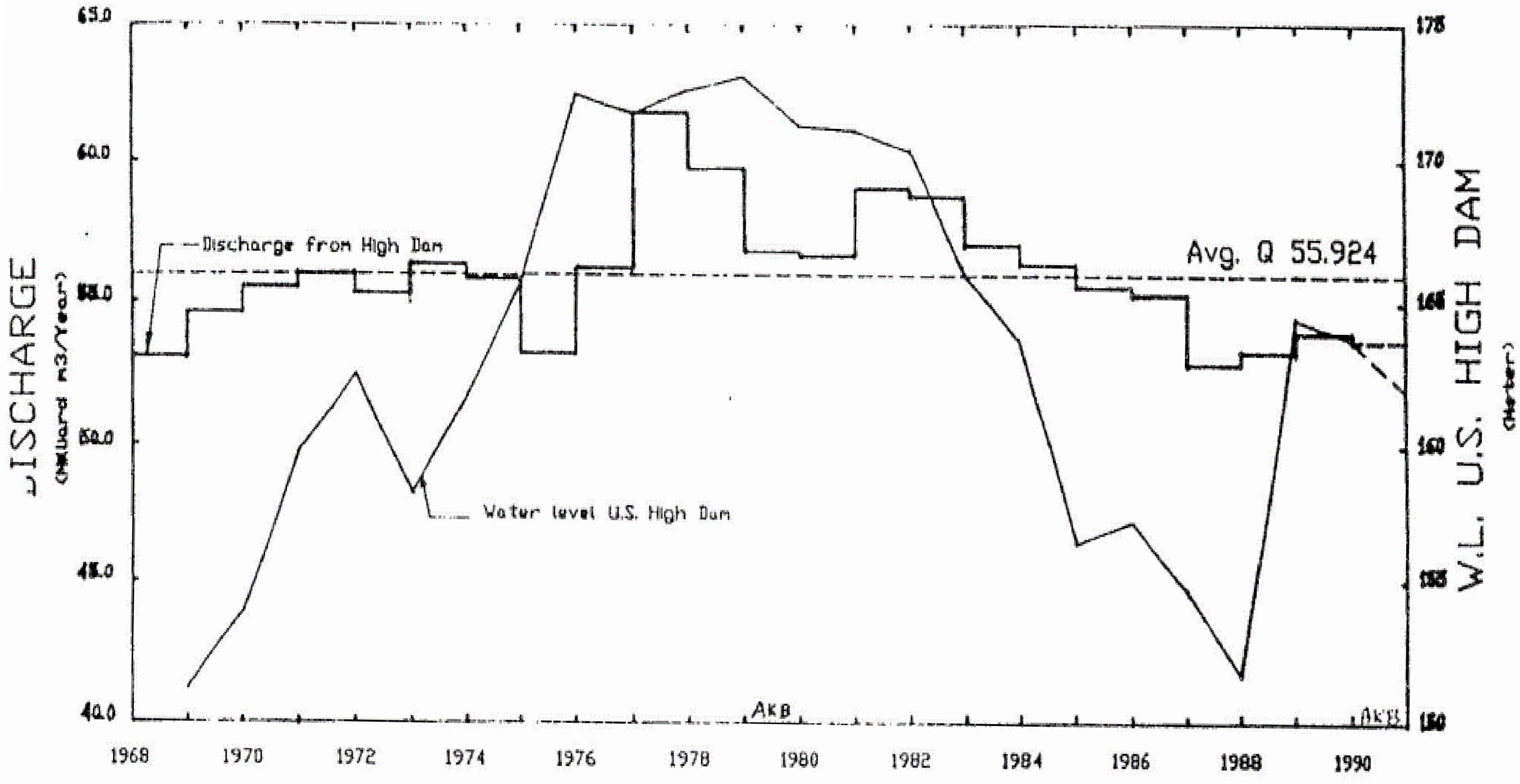


FIGURE 5 WATER LEVELS IN HIGH DAM LAKE AND DISCHARGES FROM THE DAM, 1968-1991

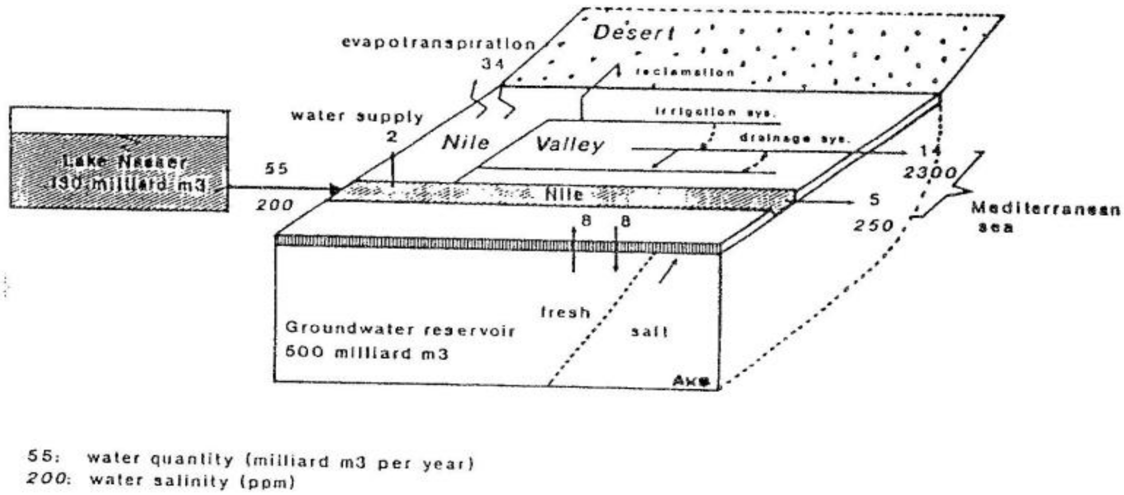


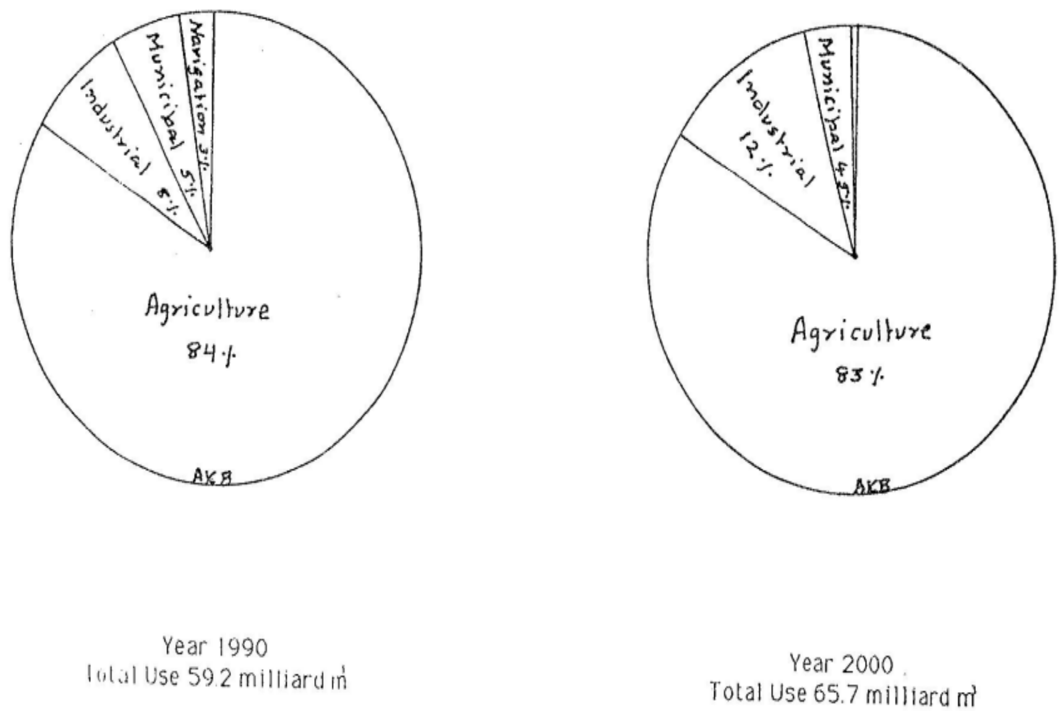
FIGURE 6 WATER AND SALT BALANCE OF THE NILE, 1980 - 88

Other Sources of Water – In addition to available sources of surface and groundwater, the only other sources of new water could be desalination, and reuse of wastewater and drainage water. From economic considerations, desalination cannot be considered to be viable source of water for agricultural uses. However, additional sources of agricultural water could be reuse of domestic and industrial wastewater after appropriate treatment and reuse of drainage water. Already formal and informal reuse is taking place, but clear environmental and health safeguards have to be ensured if such reuse is to take place on a long-term sustainable basis.

Reuse of wastewater and drainage water is discussed in more detail later in this report.

Water Use in Egypt – The total annual water use in Egypt in 1990 was estimated at 59.2 billion m^3, of which agricultural use accounted for 84%. Industrial, municipal and navigational use accounted for additional 8%, 5% and 3% respectively (Figure 7). Current estimates indicate that the total water use will increase to 65.7 billion m^3 by the year 2000. Percentage of water used by agricultural and municipal sectors will remain almost similar to 1990, but the share of industry will increase by 50%, and navigational use will decline very substantially.

Current estimates of water use by the year 2000 should be considered indicative at best, and substantial modifications may have to be made during the next few years. Current figures available for water use beyond 2000 are likely to be unreliable.

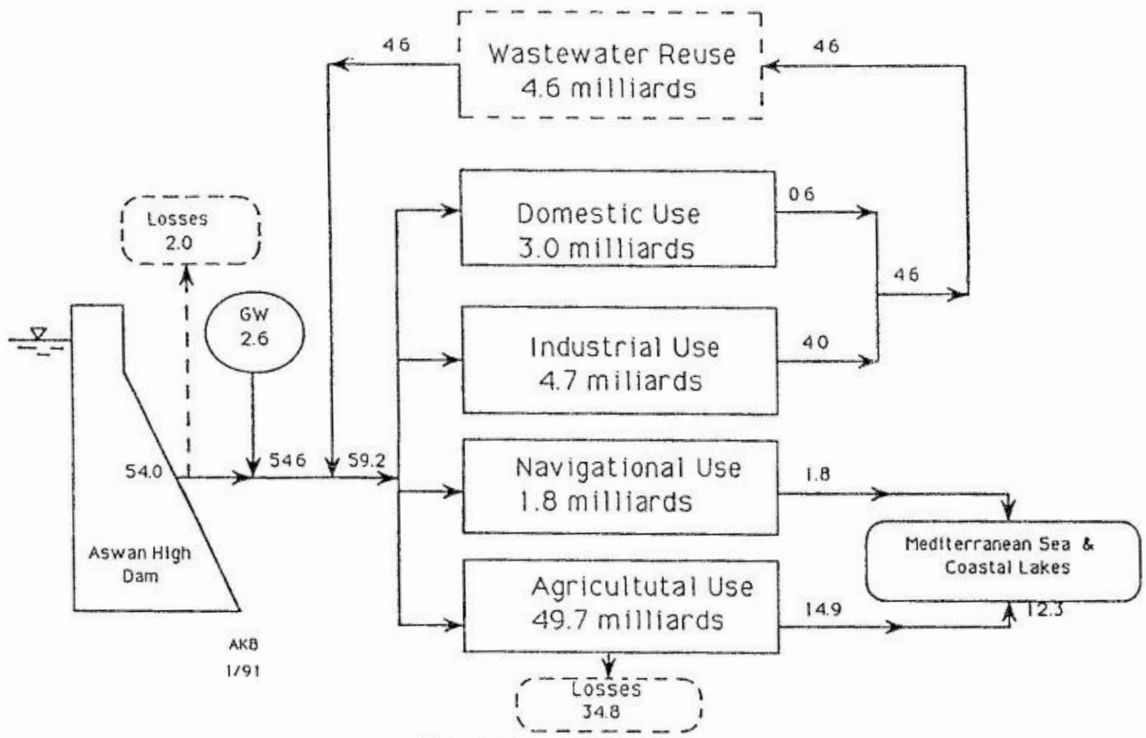


Water Use in Egypt

FIGURE 7

Agricultural water use – While in percentage terms, amount of water used for agriculture has declined slowly during the past decade, currently (1990) agriculture accounts for the lion's share of water use at 84% or 49.7 billion m^3 per year. This amount does not include an annual estimated loss of 2 billion m3 from main, lateral and sublateral canals mainly due to evaporation. Annual evapotranspiration losses are estimated.at 34.8 billion m^3, accounting for the bulk of the agricultural water use. It should be noted that this figure really is the difference between releases at Aswan and other outflows and usages. It thus includes not only crop consumptive use but also any "unaccounted" for water. Water availability and use for various sectors for 1990 and 2000 are shown in Figures 8 and 9.

Domestic Water Use – The annual domestic water use for 1990 was estimated at 3.0 billion m^3. It is assumed that the present level of distribution losses is 50%. While this is a neat round figure, it should be noted that no realistic loss figures are available it could be equally 40% or 60%. However, it is somewhat unlikely that the actual losses are less than 50%, probably quite a bit higher.



Water Availability and Use in Egypt, 1990

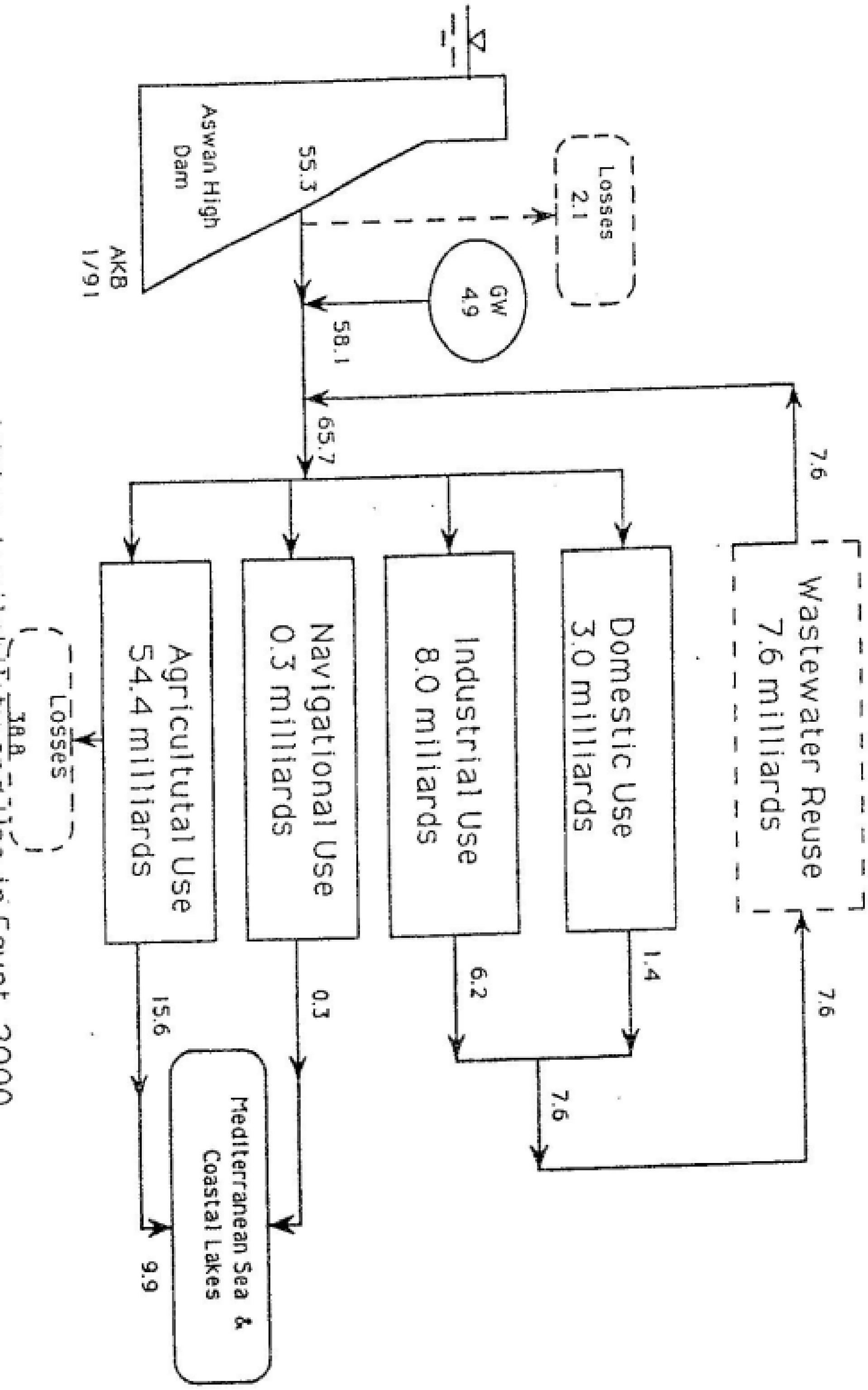
FIGURE 8

It is assumed that the domestic water use could be held at 3 billion m^3 by the year 2000 by reducing distribution losses from 50% to 20%.

Industrial Water Use – The 1990 estimate is based on the extrapolation of the 1980 field survey carried out for the Master Water Plan. It is estimated at 4.7 billion m^3 for 1990 and 7.6 billion m^3 for 2000. These figures may have to be readjusted upwards or downwards in the future.

Navigational water Use – From February to September, water releases for irrigation is sufficient to maintain water levels in the Nile for navigation, especially between Aswan and Luxor. Irrigation demands, however, are not enough during October to January to maintain appropriate navigational level in the River. This period also is the peak tourist season, when numerous tourist boats make regular sailings between Aswan and Luxor. At present, some 1.8 billion m^3 of water has to be released during this period to maintain navigational level in the river.

Currently the Esna Barrage is being extensively modified, which would provide better control of the Nile water level. It is expected that by the year 2000, annual navigational water requirements could be reduced to only 0.3 billion m^3 by better control of the Nile water level and implementation of storage in the northern lakes.



Water Availability and Use in Egypt, 2000

FIGURE 9

Reuse of Treated wastewater

Wastewater has been reused indirectly in Egypt for centuries, but the first formal use of wastewater was initiated in 1915 in the eastern desert area of Jabal Al Asfar, 25 km north-east of Cairo (Eid, 1988). After primary treatment, wastewater was used for desert agriculture, which has allowed an area of 2,500 feddans to be fully cultivated. Unfortunately, after the first 20 years of operation, sewage effluents reaching this treatment plant had increased to twice its design capacity. Since then, only raw sewage has been used for agriculture as the plant could not cope with the heavy load.

The productivity of the reclaimed land increased initially. However, with the initiation of the practice of sewage irrigation, soil quality started to deteriorate due to retention and accumulation of oil and grease in the topsoil. Eventually, clogging of soil took place, and small sewage ponds developed on the surface, with attendant environment and health problems. Groundwater in the reclaimed area is now extensively contaminated with pathogens.

Clearly the experience of wastewater reuse in Jabal Al Asfar has not been auspicious, but this should not mean that treated wastewater should not be reused in Egypt, as long as such practices are carried out properly with appropriate scientific and monitoring safeguards. In fact, since water is the major constraint to the further expansion of agricultural area, treated wastewater must be considered to be a new source of additional irrigation water. As new wastewater treatment plants come on stream in Cairo and other major urban centers, amount of treated wastewater that would be available for agricultural activities would steadily during the next three decades.

While detailed analysis of treated wastewater that is likely to be available in the future for the country as a whole is not available at present, the plans for the Greater Cairo area could be considered to be indicative (AMBRIC, 1989). Assuming an average unit wastewater production factor of 340 liters per capita per day (l.p.c.d.) in 2000 (in late 1970s it was calculated to be 220 l.p.c.d. based on the flow records), it has been estimated that the total amount of wastewater that would be available from the Greater Cairo area, would increase from 2.49 cmd in 1990, to 4.6 cmd in 2000 and to 5.3 cmd (1.93 billion m^3 annually) by 2010. Treated wastewater would thus become an important new source of irrigation water by the year 2000 and beyond.

Treated wastewater contains fertilizers like nitrogen, phosphorous and potassium, as well as some micro-nutrients like metals. Hence, in terms of agricultural productivity, treated wastewater is generally more beneficial than normal irrigation water. However, they do not contain the required major nutrients in optimal proportions for crop growths, nor in large amounts. On the basis of limited analyses carried out, it appears that wastewater contains less N, P, and K in Egypt than in developed countries. While the reasons for this are not known, P-content could be less due to comparatively low use of synthetic detergents in Egypt.

Considerable experience has now been gained on the use of treated wastewater in various parts of the world, including some of the Mediterranean countries. On the basis of extensive case studies carried out it can be authoritatively said that as long as the treatment plants are functioning properly, and appropriate monitoring safeguards are ensured, use of treated wastewater would not present any health or environmental problems in Egypt (Biswas and Arar, 1988a, 1988b).

Currently, in Egypt, detailed experience on wastewater reuse has been somewhat limited. Sometime ago an interdepartmental committee was established under the Academy of Scientific Research and Technology on this subject, but thus far it has been basically inactive. From a policy viewpoint <u>urgent step should be taken to establish some major pilot projects on the use of treated wastewater for agricultural production</u>. Such pilot projects would also convince the general population that such practices, as long as they are properly carried out, impose no risk to human and animal health.

Proper sewage treatment, in addition to providing treated wastewater, could make another major contribution to agriculture. Dried sludge can be effectively used as a soil conditioner for agricultural land. Many European counties now apply sludge to agricultural areas. Currently, nearly 40% of all sewage sludge produced in the U.K. is applied to agricultural land. Corresponding figures for the Netherlands, Germany, France and the United States are 53%, 39%, 30% and 18% respectively.

Sludge is already used for agriculture in Egypt. For example, during 1988–89, some 46,000 m^3 of dried sludge was produced and sold to the farmers and other organizations at Jabal Al-Asfar and Abu Rawash by GOSD at L.E. 3.00 per m^3 (AMBRIC, 1989). Corresponding price in 1982–83 was L.E. 1.00 per m^3, which clearly indicates that there is a demand for sludge. While no regulation currently exists in Egypt on sludge utilization, GOSD has restricted the sale of dried sludge to 5m^3/feddan (3 tons/feddan) in any one year and only for fruit cultivation.

The AMBRIC study (1989) estimated that at full development of the Greater Cairo Wastewater Project in the year 2010, 3,410 t/d of dry solids would be produced in Cairo (2,165 t/d from primary treatment and 1,245 t/d from secondary treatment), and another 135 t/d at Helwan (85 t/d from primary and 50 t/d from secondary treatment). The study further provided a conservative estimate of total annual market demand of 779,000 m^3 of sludge for the following purposes: 525,000 m^3 for cropping on existing agricultural land, 220,000 m^3 for land reclamation and 34,000 m^3 for afforestation and urban landscape planning. The estimate for the high demand scenario was a total use of 2.53 million m^3 of sludge per year.

It is clear that for environmental health purposes, GOE must provide treatment for sewage. The two major by-products of such treatments are wastewater and sludge, both of which could be considered essential requirements for agriculture. Thus, from an optimal resource use viewpoint, <u>GOE must urgently develop clear policy guidelines on the use of waste-water and sludge for agriculture. This will require more intensive collaboration between MALR, MPWWR, MOH, GOSD, Environmental Affairs Agency and other appropriate authorities, which is clearly lacking at present. Unless such coordination takes place instead of using wastewater and sludge optimally to enhance agricultural production, GOE will have to spend additional funds for their disposal in an environmentally-sound</u>

fashion. Thus, the country will lose in two ways: first not use the resources available optimally, and second use additional investment for their safe disposal. While the recommended policy option would contribute to a win-win situation, its non-implementation will ensure a lose-lose condition.

Reuse of Drainage water – Drainage water in Upper Egypt is returned to the River Nile. This increases the salinity of the river water from 200 ppm at Aswan to 350 ppm at Cairo. The Drainage water in the Nile Delta is of lower quality, and accordingly they are collected through an extensive drainage network for disposal to the Mediterranean Sea.

The total amount of drainage water discharged to the Sea depends on many factors: amount of water released at Aswan, cropping patterns and irrigation efficiency. The total amount of drainage water discharged annually has varied from 14 billion m^3 in 1984 to 12 billion m^3 in 1988 (Abdel Gawad et al., 1990). The salinity of this water ranges between 1,000 and 7,000 ppm, but about 75% (1984) to 70% (1988) of this water has salinity of less than 3,000 ppm. Some 3 billion m^3 (1984) to 2.4 billion m^3 (1988) of drainage water is used annually in the southern part of the Nile Delta by mixing in most cases with fresh Nile water in the larger irrigation canals.

Currently, annual average reuse of drainage water in Egypt is about 4.7 billion m^3, of which 2.6 billion m^3 is in the Nile Delta, 0.95 billion m^3 in Fayoum, and 1.15 billion m^3 returned to the Nile in Upper Egypt. The present plans are to gradually increase the annual use of drainage waters to 7 billion m^3 by the year 2000. This will reduce the amount discharged to the Sea to around 9.9 billion m^3 annually. It should be noted that the potential savings from improved water management (e.g., more efficient operation of the system to reduce outflows to the Sea as practiced in 1987–88 and 1988–89) and increasing drainage water reuse are not mutually exclusive. There is a real danger that the salinity could increase steadily over the years. Thus, a cautious approach to increasing the use of drainage of water, especially in terms water quality, is likely to be in the long-term interest of the country.

VI. FISHERIES PRODUCTION AND POTENTIAL

The total fish catch in Egypt more than tripled in Egypt during the period 1970 to 1988, from 80,900 to 250,000 t (FAO, n.d). This is shown in Table 6.

The coastal lagoons and the brackish waters of the Lake Quarun are very productive. Unfortunately, however, the quest for agricultural land has meant that parts of those water bodies have been filled. Since such reclamation practices are likely to continue in the future, it will have an adverse impact on the total fish capture. The problem is likely to be compounded by the implementation of a more efficient water control system which would reduce further the inflow of fresh water to the Delta area, increasing water pollution from domestic and industrial wastes and increasing water salinity. On the positive side, the full potential of the High Dam Lake is relatively high and has yet to be reached, and aquaculture in coastal lagoons could be successfully increased.

Year	Nominal Fish Production (1)			
	Inland capture	Aqua culture (1)	Marine capture	Total
1970	53,700	-	27,200	80,900
1971	53,200	-	34,400	87,600
1972	55,000	-	38,800	93,800
1973	65,700	-	27,800	93,500
1974	68,700	-	27,465	96,165
1975	80,664	-	25,910	106,574
1976	72,276	-	30,488	102,764
1977	74,959	-	29,582	104,541
1978	79,005	-	20,910	99,915
1979	100,000	-	37,480	137,480
1980	108,148	-	32,249	140,397
1981	108,146	-	33,564	141,710
1982	112,614	18,520	24,594	155,728
1983	106,856	24,000	26,446	157,302
1984	116,130	25,000	22,708	163,838
1985	130,757	47,346	37,817	215,920
1986	140,036	50,000	39,042	229,078
1987	141,700	60,000	48,300	250,000

(1) Included in inland capture if not indicated.

TABLE 6. *Fish Production in Egypt, 1970–1987 (based on data from FAG)*

VII. WATER PRICING AND COST RECOVERY

In Egypt, as well as many other arid developing countries where water is a limited resource, there have been periodic discussions on economic aspects of water allocation in general, and water pricing and cost recovery in particular.

Considering the high investments made by the country over the years in the irrigation and land reclamation sectors, and Egypt’s current economic situation issues of irrigation water pricing (World Bank, 1990a), the and cost recovery have started receiving to increase attention. Conceptually at least water pricing could affect:

- allocation of water resources between competing uses;
- water conservation;
- generation of additional revenue which could be used to operate and maintain irrigation systems, and even repay some or all of investment costs;
- income distribution;
- cropping patterns;
- efficiency of water management; and
- overall environmental impacts.

During the eighties, many papers were written all over the world on water pricing. The general thesis was that if right water prices could be charged to the users, farmers would then become rational optimizers. Use of excessive water by farmers, especially in the head reaches of the canals, could be significantly reduced, if the farmers had to pay an econo1nic price for this resource, and this would make water distribution more reliable and equitable. Irrigation Departments would receive the revenues thus generated through water pricing, and this additional resource would enable them to operate and maintain their irrigation and drainage systems more efficiently. Thus, overall, water pricing would contribute to a win-win situation. Unfortunately, these hopes have not been realized so far in any developing country of South Asia or Egypt, where extensive irrigation projects have been constructed during the past three decades.

The effectiveness of water pricing to achieve its expected objectives is dependent on many factors, among which are the following three main ones. First, historically and traditionally, nearly all governments in developing countries have totally financed irrigation development and water delivery. For example, in Egypt, Ministry of Public Works and Water Resources (MPWWR) is responsible for operating and maintaining the irrigation networks. The farmers are not charged directly for irrigation water. Since farmers in developing economies like Egypt or India form an important and powerful group, the political implications of introducing water pricing should not be underestimated. It should also be noted that attempts at cost recovery from beneficiaries (USAID, 1990) have not been easy not only for irrigation but also for most other sectors. Second, in South Asia, where certain types of water charges have been levied in many areas for some time, water charges paid by farmers is generally <u>not</u> dependent on the volume of irrigation water received, but on the cultivated area which receives the water. Thus, in reality it is a land tax on area irrigated, and not a water tax. Accordingly, not surprisingly, such taxes have not improved either water allocative efficiency or its efficiency of use by the individual farmers. Furthermore, it has to be admitted that at present we do not have a cost-effective system which enables us to measure water consumption of individual farmers volumetrically, and then set up an administrative process to levy and collect water rates based on such consumption patterns. It has not been easy to develop such a cost-effective system, especially in developing countries where there are large numbers of small farmers. Third, as some have noted (Khedr, 1989), “pricing water is not in line with the Islamic rules and spirits since water is free resource.”

In addition, two other fundamental issues need to be addressed before water pricing and cost recovery can be rationally introduced in a country with a socioeconomic and political situation like Egypt. First, water has been generally subsidized to achieve very specific socio-political goals of food security, increasing the income of the rural poor and reducing migration from rural to urban areas. If economic water pricing is to be introduced, other policy options need to be considered to achieve the stated objectives. These policy options may not necessarily enhance the efficiency of water use. For example, crop subsidies could encourage excessive use of water. Thus, not only are social, agricultural and water policies closely interlinked in a country like Egypt, where agriculture is a very important sector, but also the farmers reactions to these changes in policies are not easy to predict in advance of the implementation of such policies.

Second, on what criteria should water charge be based? Is it logical to charge the beneficiaries only the cost of storage and delivery of water? Or should it include external costs like damages to the environment, which may have been inflicted by Egypt's extensive irrigation and drainage networks? If the latter is to be included in water pricing, what methodologies can be used to determine realistically the economic costs of environmental damages, which are often intangible? Can this be done properly at the present state of our knowledge? These are all difficult issues, which need to be successfully addressed to before any national policy on water pricing and cost recovery can be finalized.

In Egypt, at present MPWWR is responsible for the operation, maintenance and rehabilitation of the country's entire irrigation and drainage systems. The farmers are required only to maintain their mesgas. Because of the financial constraints faced by MPWWR, maintenance of irrigat1on and drainage systems have not been as good as they could have been. In 1982, the then Ministry of Irrigation started a long-term program for replacement of inefficient hydraulic structures, preventive maintenance and other forms of irrigation and drainage improvement, with the financial assistance of various multilateral and bilateral donors. However, for both medium and long-term considerations, the sustainability of the efficiency of operation of the irrigation and drainage systems will depend on the availability of adequate level of financial support. GOE can of course continue the present practice of financing MPWWR through general taxes and other financial support from the donors, but this is unlikely to provide a long-term viable solution. One attractive possible policy could be the consideration of establishing a revolving fund, where funds could be generated through an implementable cost-recovery system from the beneficiaries. This revolving fund should then be specifically earmarked for use in operation and maintenance of the irrigation and drainage systems.

It will not be an easy task to establish a functional water pricing and cost recovery system in Egypt, which has a tradition of practicing irrigation over a few thousand years. Even the methodological problem of how best to devise an equitable and efficient system, which could be administratively cost-effective, would undoubtedly be a very difficult and complex task under the best of circumstances. In addition, there are some fundamental issues which need to be considered specifically for the Egyptian conditions. Among these issues are the following:

- Identification of the beneficiaries of the system, and how to allocate costs fairly between them. This would include in the first stage allocation of costs between major users of water: agriculture, hydropower generation, domestic and industrial users and navigation. At the second stage, especially for the irrigation sector, consideration has to be given to what type of pricing system could be instituted that would be equitable, generate revenue and simultaneously promote more water efficient water use than is the case at present.

- Considering the dominance of small farmers in the Egyptian agriculture, any water pricing system that may be implemented must be within the farmers' abilities to pay. Over 95% of family farms in Egypt is smaller than 5 feddans as shown Table 7.
- Any water pricing system should not reduce the incomes of farmers, especially small farmers, significantly so that they are discouraged to continue their farming activities and are then forced to migrate to urban areas seeking alternative forms of livelihood.
- Different types of water pricing system have been tried in several developed and developing countries, with very mixed results. Which type or types are likely to be most appropriate for Egypt?
- The general policy finally adopted on water pricing and cost recovery should be consistent, and applied uniformly over the entire country.
- The price of water cannot exceed its cost of delivery since it could be country to Islamic religious norms.
- The policy should not only promote efficient water use and generate revenue but also should be compatible with the overall social and economic development objectives of the country.

Farm Size (Feddans)	**Number of Landowners (1,000)**	**Area Owned (1,000 feddans)**	**Percentage of All**	
			Landowners	**Area Owned**
Less than 5 fd		2,904	95,3	53,5
5-10 fd	3,271	576	2.5	10.6
10-20 fd	87	589	1.3	10.8
20-50 fd	46	621	0.6	11.4
50-100 fd	6	407	0.2	7.5
More than 100 fd	2	334	0.1	6.1
Total	**3,433**	**5,431**	**100.00**	**100.00**

TABLE 7. *Distribution of land ownership in Egypt, 1985 (based on data from MOA)*

Very limited amount of serious work has been carried out thus far on irrigation water pricing and cost recovery in Egypt. Among these are some preliminary studies, which do provide some indicative but widely varying estimates. The Master Plan for Water Resources Development and Use in Egypt (Ministry of Irrigation, 1982) estimated that the average cost of irrigation water at L.E. 1.92 per 1000m^3. Elassiuti's (1985) work on the cost of delivery of irrigation water at different locations in Upper and Middle Egypt varied from L.E. 9. 46 to 18.8 per 1000m^3 in 1984. He further estimated the economic value of irrigation water by using the crop-budget method. It varied from a loss of L.E. 33 per 1000 m^3 of water for maize to a net return of L.E. 39 per 1000 m^3 for sugar beet. However, changing government intervention policies through quotas, various agricultural subsidies and price distortions are likely to have changed these estimates significantly during the past six years. Hence, new analyses are urgently needed.

Allam's work (1987a, 1987b), also based on early 1980s data from the MPWWR, indicated annual irrigation water cost within the range L.E. 10–20 per 1000m^3, which translated into about L.E. 80–160 per feddan. This cost, however, did not include cost of various hydraulic structures and pumping. Allam noted that the cost estimates would have been even higher, if more adequate maintenance budgets were considered in his model. Other published work on water pricing and cost recovery in Egypt include Abdel Aal (1987), Abdel Aaland Rady (1991), and Allam and Marks (1984). The analyses carried out for the Land Master Plan study (Euroconsult and Pacer, 1986) considered that water will be continued to be available free for land reclamation. However, if a true long-run marginal cost of water is introduced in this analysis, efficiency of land reclamation projects will undoubtedly become sensitive to the price of water.

Analyses carried out by Abdel Aal and Rady (1991) indicate that existing situation gives a somewhat skewed results in term of agricultural return since irrigation water is free. They considered five types of cropping patterns sugarcane, broadbeans and maize, broadbeans and sorghum, broadbeans and soyabeans, and wheat and maize. For each cropping pattern and using average yields, they computed the price of the total production per feddan. Sugarcane gave the best return and broadbeans and sorghum produced the worst result. When return per 1,000m^3 of water was computed, sugarcane gave the worst return, but broadbeans and sorghum produced the second-best results. The best was broadbeans and maize. Since water is free, extent of its use does not enter into the decision-making processes of the farmers, except in an indirect way in terms of its availability only. If water pricing is introduced, it may encourage farmers to grow more water sensitive crops: say sugar beet instead of sugar cane.

While complexities of implementing a functional water pricing and cost recovery system in Egypt should not be underestimated, in the longer term the country really has no other feasible alternative but to go along this route.

There are five compelling reasons as to why urgent consideration should be given in Egypt for the farmers to pay for the water they receive, which is managed by the public irrigation and drainage authorities.

i. If farmers have to pay for water, total water consumption in the agricultural sector is likely to be reduced by appreciable amount. In addition to achieving water conservation, such a policy would reduce or even eliminate over-irrigation which is harmful in terms of imposing extra costs on farmers as well as the Egyptian society as a whole. This is because of lost productivity due to waterlogging and salinization, and their potential long-term impacts on antiquities and thus tourism, and also because of increased health hazards from the higher incidence of water-borne diseases.
ii. Irrigation subsidies in the form of free water have been a significant drain on the Egyptian public treasury. Such subsidies may have transferred in the past

public revenues from necessary expenditures in other essential sectors. Subsidies have also resulted in chronic shortages of funds for the operation and maintenance of irrigation and drainage projects at reasonably high levels.

iii. From equity consideration, it is reasonable that the farmers who gain most from irrigation water (since both their incomes and value of. land holdings are likely to increase), should also contribute the most for delivery of that water.

iv. Since financial resources available to the country is limited, beneficiaries should contribute towards the costs over the life periods of the projects. This principle could be valid not only for irrigation but also for other sectors as well.

v. Appropriate level of pricing could be expected to induce farmers to produce higher value crops.

There has been considerable general interest in water pricing in Egypt in recent years, but work in this area needs to be accelerated significantly before feasible alternative policy options could be seriously identified and discussed. Additional work in this area is urgently needed by the appropriate Ministries concerned as well as in the academia.

One policy alternative worth considering is to introduce initially water pricing in the newly reclaimed lands, where significant government investments have to be made to provide irrigation water. Once this idea is accepted by the farmers, it could then be gradually extended to other older areas where irrigation systems need extensive renovation. Whatever water pricing system is finally adopted, it must be carefully planned, regularly reviewed and sensitively executed.

In the final analysis, water pricing and cost recovery in Egypt, like in any other major irrigating country, will have to be a political decision. Considerable resistance to implementing such policies can be anticipated from the farmers, unless appropriate groundwork is carried out in advance to smoothen the transition process. Consultation with the farmers is essential. Why cost recovery is essential and in their own long-term interest, should be carefully and objectively explained to them. During the early stages of implementing an appropriate water pricing system, there must be continued strong political support. Otherwise, based on experiences in certain South Asian countries, total benefits that may accrue from water pricing are likely to be minimal, and may not prove to be worth the trouble of developing and administering the necessary cost recovery system.

VIII. ENVIRONMENTAL CONSIDERATIONS

Environmental issues in Egypt, like in most other developing countries, have received only limited attention. However, with increasing human activities, and water resources of the country should protection of land become a priority consideration. There is no question that if Egypt is to progress towards the path of increasing self-sufficiency in agricultural production, environmental issues must receive much higher priority than they are given at present.

A reasonably clear and detailed picture of environmental issues confronting the land and water sectors simply does not exist at present. Nor is any estimate available on the cost of land and water degradation to the national economy. Quite clearly the cost is already significant at present, and on the basis of existing trends and realistic assessment of potential actions that might be taken in the near term, it is likely to become even higher during the 1990s.

Water pollution already is a serious problem in certain parts of Egypt. While a reasonably clear picture exists in terms of salinity of water, availability of usable information on other water quality parameters is an exception rather than the rule. Time series data on various water quality parameters are basically non-existent. Some data are available on a few parameters, but their potential use for water quality management is extremely limited since they are collected at long intervals (sometimes 1–3 times a year), often in a random time sequence, and only at a few select places. The reliability of some of the analyses carried out can further be seriously questioned. There is no question that a rational water quality data collection and management programme has yet been prepared, let alone implemented. This issue must receive priority attention.

In the absence of reliable water quality data, the present status of water pollution in terms of agricultural activities can only be discussed in a general and somewhat anecdotal fashion.

Some have claimed that about 90% of wastewater is untreated (World Bank, 1990c), and this is discharged into the Nile, irrigation canals and drainage ditches. While one can question the actual percentage figure, there is no question that a very high proportion of domestic and industrial effluents are untreated at present. One study estimates that 66 agricultural drains that are monitored carried an annual discharge of 3.2 billion m^3, which included raw sewage from 5,000 rural agglomerations, and semi-treated or untreated wastewaters from Cairo and other urban centers, and mostly raw sewage from the rapidly growing unserviced peri-urban areas (world Bank, 1990c).

In addition, significant proportions of fertilizers and pesticides used must leach into the water system. Potential groundwater contamination from fertilizers could be a concern, since groundwater is used extensively for drinking purposes, and it is more vulnerable than surface water in terms of fertilizer contamination. Table 8 shows that the application of nitrogen, phosphate and potash fertilizers in the Egyptian agriculture increased nearly 4-fold during the 1960–1988 period. Nitrate contamination of groundwater from agricultural activities has been a major environmental concern in many developed countries. It is now increasingly becoming a subject of some concern in a few developing countries, especially in those areas where extensive irrigated agriculture is practiced.

Use of pesticides, which are mostly imported, has increased as well (table 9) but not at the same rate as fertilizers. Depending on specific years, 48 to 88% of imported pesticide was used for cotton.

Crop Years	Nitrogen		Phosphate		Potash	
	Actual (1000 tons)	**Index** (1960–61=100)	**Actual** (1000 tons)	**Index** (1960-61=100)	**Actual** (1000 tons)	**Index** (1960–61=100)
1960–61	192	100	48	100	2.0	100
1965–66	314	164	43	90	0.7	35
1970–71	325	169	46	96	1.6	80
1975–76	428	223	66	138	2.8	140
1980–81	568	296	104	218	2.9	145
1981–82	626	326	134	279	3.6	180
1982–83	660	343	143	296	3.0	150
1983–84	746	389	160	333	5.5	275
1984–85	639	333	164	342	7.5	375
1985–86	775	404	183	382	7.6	380
1986–87	777	405	185	386	n.a	n.a
1987–88	791	412	190	396	n.a	n.a

TABLE 8. *Use of different types of fertilizer in Egypt, 1960–61 to 1987–88 (based on d.3.UJ. from MOA)*

Crop Years	*Pesticides (1000 tons)*	*Imported Value (L.E million)*
71/72	18.20	10.90
80/81	22.50	51.60
81/82	31.40	56.70
82/83	32.30	37.90
83/84	34.30	53.10
84/85	32.60	54.10
85/86	24.50	53.50
86/87	14.80	54.90
87/88	9.30	55.00
88/89	9.60	55.00

TABLE 9. *Import of Pesticides in Egypt, 1971–72 to 1988–89 (based on data. from MOA)*

In early 1991, use of herbicides to control aquatic weeds became an important media and political concern. In 1990, 200 tons of acrolein was used in canals to control submerged weeds, 120 tons of ametryn to control water hyacinths in drains, and another 8–10 tons for controlling water hyacinths in an area of about 4,000 feddans in the Rosetta and Damietta branches of the Nile. Aquatic weeds is a major concern for efficient water management. In 1990, 13,000 km of canals and drains were estimated to have been infested by submerged aquatic weeds, and another 1,900 km were covered by water hyacinths. The rate of ametryn application was 2 litres per feddan. Because of the political and public concern, use of ametryn has now been cancelled for 1991. Also, acrolein will be used only for another 2–3 years, after which only manual, mechanical and biological means will be used for weed control.

Realistically, it is difficult to see how the limited use of herbicides to control aquatic weeds could have caused the health problems claimed by certain people. The decision to reduce and then swiftly eliminate the use of herbicides appears to be one of political expediency, which is difficult to justify on economic and environmental grounds. In addition, extensive use of manual control would most likely increase the incidence of bilharzia among the labourers used for weed removal. Expansion of mechanical control would require additional investments in terms of imported equipment and spare parts, as well as for constructing roads on the canal and drain banks. Clearly, analyses of trade-offs between the various control methods should have been carefully considered before a final decision was taken. <u>For economic, environmental and water use efficiency considerations, the best solution would probably be to use integrated means for controlling aquatic weeds, including rational use if herbicides</u>.

Increasing water pollution from industrial and domestic sources, if allowed to grow unchecked, is likely to reduce the amount of water available for various uses in the future. This clearly ·isnot in the long-term interest of the country. In addition, the total economic and health costs to the country due to unchecked water pollution would be substantial. For example, the Second Pumping Station Rehabilitation Loan of the World Bank concluded that excessive pollution of drainage waters around Alexandria reduced the lifespan of irrigation pumps from 20 years only 4, and required more sophisticated pumps and piping at higher costs. The irrigations system is currently kept functional by some 675 pumping stations, which clearly cannot be allowed to deteriorate due to water pollution.

Legal basis of controlling water pollution already exists through Law 48 of 1982 on the “Protection of the River Nile and Waterways from Pollution (Water Act)”. The law establishes stringent effluent standards for various organic and inorganic pollutants. Unfortunately, the water quality standards stipulated were too strict and rigid with no flexibility, exceptions or possible recourse. An analysis by the author indicated that the drafters of the law basically considered western water quality standards prevailing at that time, and in some cases even tightened them. No appreciable consideration was given to adopting these regulations to the country’s economic, social, and technological conditions or in terms of implementation-institutional arrangements, availability of adequate funds, trained manpower and sophisticated laboratories for analyses, monitoring, inspection and enforcement requirements. Thus, not surprisingly, <u>the law has been ineffectual</u>. Shortly after the law was promulgated GOE was forced to grant dispensations to polluters, many of whom were public-sector companies, since it was not possible for them to comply with the regulations. Clearly, <u>this law has to be amended urgently, if water pollution is to be controlled</u>. This is a good example of best being the enemy of good.

Salinity and waterlogging from irrigation practices has been a problem. However, Egypt has embarked on the construction of an extensive drainage system, a significant part of which is already operational. <u>For the long-term sustainability of agriculture, drainage· should continue to receive priority</u>.

In term of environmental health, much has been written on the adverse impact of the expansion of irrigated area due to the construction of the High Aswan Dam because of increasing incidence of schistosomiasis. Unfortunately, nearly all of these reports were based on spurious data, which justified the biases of the writers.

On the basis of data collected over the past two decades, it can now be said that the situation was overtly dramatized by some people. A detailed and independent evaluation carried out in 1985 (Kessler et al., 1987) indicated that in many parts of Middle and Upper Egypt, schistosomiasis is no longer a serious public health problem. Between 1977 and 1984, prevalence rates had been reduced from 30 to 8%, and serious disease indicated by high worm burden had become rare. Table 10 shows decline in prevalence rates of S. haematobium in Beni Suef, Minya and Assiut (North) Governorates during the period 1977 to 1984.

IX. RISKS AND UNCERTAINTIES

There are two major risks and uncertainties in terms of water availability that have not received adequate attention thus far. These are reliability of the flow regime of the Nile on the Basis of which the High Dam was designed, and the international character of the Nile.

i. **Flow regime of the Nile** – Even though the storage of the High Dam Lake was estimated on the basis of a long period of river flow of 1900–1959 there is no guarantee that the river regime-during the post- construction period would follow similar pattern. Figure 4 shows the annualized Nile flows at Aswan as a percentage of long-term mean covering nearly 120 years (Abu-Zeid and Biswas, 1991). It indicates that the river flow was high during the period 1871–1905, less than the long-term mean than the mean during 1905–1965, and significantly lower during the post-1970 period. The low flows observed in the later period have encouraged certain scientists to reinterpret the recent climatic history. They have suggested that the river flows during the post-1970 period are similar to drier conditions which prevailed in the south of the basin during the earlier part of the19th century and probably long period before that (Allan, 1988/89). In addition, the issue of potential climatic change due to global warming and what its impacts could be on the Egyptian agriculture and the Nile are basically unknown factors at present. What can be said with some degree of confidence is that the range of uncertainties in the 21st century, which the Egyptian agriculture would have to endure, is likely to be significantly higher than what it is at present. Accordingly, water management in Egypt must become an increasingly sophisticated process during the next 2 to 3 decades.

Governorates	***Prevalence rates in percentage***					
	1977 (Baseline)	***1980***	***1981***	***1982***	***1983***	***1984***
Beni Suef	27.7	14.8	15.5	15.2	9.3	6.8
Miniya	33.6	17.3	14.7	14.0	11.6	9.1
Assiut (North)	19.3	9.9	10.4	7.6	8.9	10.4

Total (Weighted)		15.3	14.1	13.2	10.5	9.2

TABLE 10*. Trends in prevalence rate of S. haematobium, 1977–1984 (based on data from MOH)*

ii. **International Character of the Nile** – Nine countries Egypt, Sudan, Ethiopia, Uganda, Kenya, Tanzania, Rwanda, Burundi and Zaire share the Nile Basin. This makes its rational management a most complex process. From a strategic viewpoint, Ethiopia is the most important country to ensure continued flow of water in the Nile, because 85% of its flow reaching Egypt originates from the Ethiopian plateau Ethiopia was not a signatory to the 1959 treaty. During the past decade it has steadfastly declined to participate in any meaningful discussion on the sharing of the Nile water, let alone be a party to any possible agreement.

It has to be admitted that the continued unrests in the Sudan and Ethiopia have been of unexpected benefit to Egypt. The Sudan's development plans have now been delayed indefinitely, and so would its water requirements. At least for the near and medium terms, its water requirements are likely to remain near its present rate. Equally, Ethiopia is unlikely to take much advantage of the Nile water during the near and medium terms even though it has some plans for developing the Blue Nile. On the longer term, however, one could envisage a scenario wherein new political, economic and technological conditions could encourage Ethiopia to develop its water resources for hydropower generation and agricultural development. Accordingly, it would be to Egypt's advantage to negotiate an agreement on the use of the Nile waters between all the nine riparian countries. There have been hesitant international efforts to promote such an agreement, but all such efforts have failed miserably so far mainly because of the lack of a clear strategy.

Unquestionably, the sustainability of the Egyptian agriculture in the 21st century would directly depend on a new Nile agreement which will guarantee Egypt at least the availability of its present share of water.

X. DATA AVAILABILITY, RELIABILITY AND ACCESSIBILITY

A significant problem confronting Egypt in terms of practicing efficient land and water management is the general absence of a proper data management system. The problems are manifold at present, but the main ones are of the following nature:

1. Data have been collected, but are generally not available. This could be due to limited number of published reports available, as well as the absence of centralized library or information system for land and water where such reports could be readily consulted. Equally, often one encounters general reluctance of some officers to provide any data, even when such data would

be used for official purposes like the present case, or for other legitimate reasons like research in the universities and other research institutions.

2. The quality of data available need to be reviewed. Often several different figures are available for the same parameter, and all being published by the same Ministry. Sometimes it could be due to imprecise definitions used as for land reclaimed discussed earlier. Other times it appears to be general carelessness.
3. Some data collection processes need to be reviewed with reference to their possible utilization. If the data collected have no potential use, its collection cannot be justified. For example, collection of certain water quality data once a year, at a random point in time, is really not a very productive or useful process.

Overall, <u>there is an urgent need to review the existing data collection processes as well as data management systems so that they become user-driven. Data collection for the sake of collection, or treating data available as "national secret" is an expensive luxury· that Egypt cannot afford. Equally data collected must be analyzed and processed in a timely fashion. Delays of at 2 to 3 years in processing and disseminating some agricultural data reduces the potential benefits of using that data. When the natural variances inherent in water and agricultural systems are superimposed on possible errors in collection, analysis and interpretation of data, it could significantly magnify the potential for making erroneous management and operational decisions. This aspect needs additional attention</u>.

XI. MAJOR POLICY ISSUES AND RECOMMENDATIONS

Since land and water are the two most critical components for sustainable agricultural development, there are many policy issues at both macro and micro-levels which need to be critically and objectively reviewed and then appropriately readjusted for Egypt's long-term growth. These policy issues have been raised in the relevant sections of this report.

In this section, only the important policy issues are discussed in greater depth, along with specific recommendations on each policy issue.

i) Analyses of Beneficiaries for Implementing Sustainable Agricultural Development Policies

Like any policy in other fields of development, any policy on sustainable agricultural development would have its beneficiaries as well as those who would have to pay some costs. This has been discussed in some detail in Section III.

For new policies aimed at sustainable agricultural development to be adequately implemented, the policy-makers must have a clear idea not only of the total benefits and costs, but also the distribution of these benefits and costs, i.e. who would be the beneficiaries and who may be adversely affected by it. While the total benefits and costs of new policies are normally estimated, past experiences in Egypt indicate that the nature of the beneficiaries (both positive and negative) are seldom analysed, except in a cursory fashion. For politically and socially sensitive areas like food and agriculture, it is essential not only to have clear ideas of benefits and costs but also who might benefit and who may pay the costs. Some methodologies are now available to carry out such analyses. Such information is essential for policy formulation and implementation and forms the heart of any democratic decision-making system. Such analyses should be considered mandatory for major policy changes.

ii) Land Reclamation

A clear idea of land reclaimed, and the present status of its productivity, are not known at present. Figures available are often confusing and contradictory. Considering the cost to the exchequer for land reclamation in the past, it is not a very healthy situation.

While the Euroconsult and Pacer study (1986) is a good beginning, it can no longer be considered to provide a sound basis for formulating land reclamation policies due to inadequate assumptions and/or faulty analyses. For example, the study assumes water will be made available to the farmers at zero cost. Clearly, for financial reasons, Egypt cannot continue to provide water to the farmers free indefinitely. On the contrary, a good case can be made to initiate water pricing in the newly reclaimed lands (see item vi in this section). If water is priced, the entire estimation of land that can be reclaimed economically has to be significantly revised. Similarly, World Bank analyses (1990b) indicate that the height of water lift is not as sensitive a parameter as calculated by the Euroconsult and Pacer study.

A new plan for land reclamation needs to be devised, with more realistic assumptions and more definitive analyses. It must also ask some hard policy questions. For example, if the country has limited funds available, where would such funds provide the best return in terms of agricultural production: in the existing cultivated lands or in the newly reclaimed lands? What would be the social implications of policies based on such findings? Only when such difficult questions are answered, appropriate policies can be formulated for the optimal benefit of the country.

iii) Loss of Arable Land

The estimate made in this report of land loss due to urbanization is of the order of 30,000 feddans annually. Since preliminary evidence indicates that this land lost is generally of a better quality than the reclaimed land, a major policy issue has to be how to effectively reduce such regular losses.

It is clear that the existing laws that were promulgated to reduce such land losses have been ineffective. Urgent measures are necessary as to why such laws are ineffective. Is it because they were not properly formulated? If so, can new and more implementable legal regimes be established? This important issue needs to be carefully analysed on a multi-disciplinary basis, within the legal-social-political-institutional framework of Egypt. Since laws have very little meaning unless they can be implemented, emphasis has to be given to development of new laws that would be socio-politically acceptable and economically feasible. Only then can loss of arable land due to urbanization be significantly reduced.

iv) Water Use

The main constraint to further expansion of agriculture in Egypt is water and not land. While initial estimates of present wat.er use patterns in Egypt can be made, mere accurate estimates are urgently needed. Estimates of water availability and use even to the year 2000, only 10 years from now, are somewhat preliminary, and need to be considered sharpened. Water availability and demand patterns during the post-2000 period simply do not exist.

Since minimum economic life periods of land reclamation projects have to be 25–30 years, their long-term viability could be questioned, as not much information on the water availability for the agricultural sector around 2010 and beyond can be found at present.

What is urgently needed is realistic forecasts of water availability for various sectors, especially during the post-2000 period. What would be the expected share of water for the agricultural sector in 2010 and beyond? If the relative shares of domestic and industrial sectors increase significantly during the post-2000 period, as the current trends indicate, one must have more definitive measures in terms of agricultural water availability so that appropriate policies can be formulated. Considering the importance of agriculture to Egypt's economy, water availability and use study for the post-2000 period needs to be urgently carried out so that national agricultural policies for the future can be formulated.

v) New Sources of Water

For agricultural uses, the new sources of water in the future are likely to be reuse of treated wastewater and drainage water. Estimates are essential about the quantities of treated wastewater and drainage water that may be available during the next 2 to 3 decades so that their use can be incorporated in the future agricultural planning exercises. Both these sources have health and environmental implications. However, current experiences from other countries indicate that as long as there is a functional monitoring system, these sources can be properly and regularly utilized, without any unanticipated side-effects. Thus, effective monitoring systems need to be developed. In order to ensure that appropriate expertise is developed, it is necessary to establish some major pilot projects on wastewater irrigation in different parts of Egypt, as soon as the major wastewater treatment plants in various urban centres come on stream. Long-term potential environmental impacts of reuse of drainage water should also be considered before such reuse practices become extensive.

vi) Water Pricing

Considering the present financial situation, it is clear that Egypt cannot continue providing free water to farmers indefinitely. The Government does not have any option but to consider some form of water pricing in the medium-term which will at least recover operational and maintenance costs.

Politically, it may not be easy to start a water pricing system at one time over the entire country. Considerable thought needs to be given not only to what could be an effective pricing system but also the strategy for its introduction. One possibility could be to initiate the process in the newly reclaimed areas. As people get used to this idea, water pricing can be gradually introduced all over the country.

vii) Environmental considerations

No rough estimate is available at present on the cost of land and water degradation to the national economy. Such estimates are necessary in order to sensitize the policy-makers, and also to make the general public aware of the magnitude of the environmental problem facing the country.

Environmental impact analyses (EIA) of water projects are not carried out at present. This policy has to be changed. EIA must be made mandatory for new projects as well as for modification of existing ones.

An operational water quality data monitoring and management system has to be urgently prepared and implemented. Expertise needed for developing and managing such systems, and the institutional implications of establishing such systems, should be given urgent attention. Probably, the best first initial step would be to select the water quality parameters that need to be monitored, and to identify the sites where they should be monitored. As a general rule, it is advisable to start with those regions where quality of water is already under severe stress.

The legal basis of controlling water pollution through Law 48 should be reviewed, since this law has been basically ineffective. The problems as to why the law is ineffective has been discussed in detail in Section VIII. A new regulatory legal regime has to be developed which should properly consider the country's economic, social and technological conditions so that the law can be actually implemented and the water pollution can be controlled.

viii) International Character of the Nile

The Nile is the main source of water in Egypt. Since it is an international river, it would be to Egypt's advantage to negotiate an agreement on the use of the Nile waters between the nine riparian countries. The sustainability of the Egyptian agriculture in the 21st century will depend on an agreement on the Nile which will guarantee the country's availability of at least its present share of water.

Egypt should strongly encourage the current hesitant international efforts to negotiate a successful treaty on the Nile which would be acceptable to her. Otherwise during the post-2000 period, this could be a major uncertainty which may hinder sustainable development of the agricultural and other sectors of the country.

In addition to ensuring the water availability, the treaty should also consider water quality issues (including sediments), and sustainable development of the Nile Basin as a whole. Current treaty with Sudan does not deal adequately with water-environment related issues. A new overall treaty that is based on basin-wide approach to development is likely to be acceptable to all the 9 co-basin countries.

ix) Forestry

Forestry land use so far has played a very minor role in the Egyptian land and water management policies. Considering the amount of forest products imported annually, and the positive role of forestry to combat desertification, and to ensure land and water conservation, forestry must receive significantly more emphasis than it has received in the past. Since this sector has so far been basically neglected, a viable forest policy for Egypt should be urgently developed.

x) Fisheries

Even though the total fish catch has tripled in Egypt during the past two decades, Egypt still has considerable scope for expanding fish production on a sustainable basis. Maintenance of the coastal lagoons, which are sometimes being filled to expand agricultural land, and prevention of pollution of their waters, could significantly increase fish production. Use of scientific techniques to improve the fisheries potential in the High Dam Lake and for aquaculture in the coastal lagoons would also enhance the country's total fish catch.

Considering the importance of fisheries to improve the nutrition of the rural people, and the extent of fish products imported annually, a national plan to enhance the fisheries potential is likely to produce good results in the long run.

xi) Data Management

A major constraint to policy formulation in Egypt continues to be availability, reliability and accessibility of data. Timely availability of reliable data is an essential requirement for good policy formulation and implementation.

What is needed is development of functional data management systems. For example, it would be most helpful if MOA develops a functional land-related data management system and MPWWR develops a similar water- related system. These two systems need to be compatible, so that the users can benefit from them. Currently both the Ministries have numerous data collection and management systems that use differing hardwares and/or softwares. Since these systems are not often compatible, users encounter many operational problems.

It is strongly recommended that a compatible data management system be developed, which can handle both land- and water-related data. Conceptually at least such an integrated system can be established in Cairo, with direct on-line access from other important centres within the country. Availability of such an operational system would undoubtedly improve the existing policy formulation and implementation processes significantly.

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