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Land Resources for Sustainable Agricultural Development in Egypt

Egypt now has the lowest arable land per capita of any country in Africa. With steadily increasing population and high import of food crops, it will be necessary for Egypt to manage its arable land sustainably. This paper analyzes the present status of the agricultural land base, including loss of productive land to urbanization and effectiveness of past land reclamation measures.

INTRODUCTION

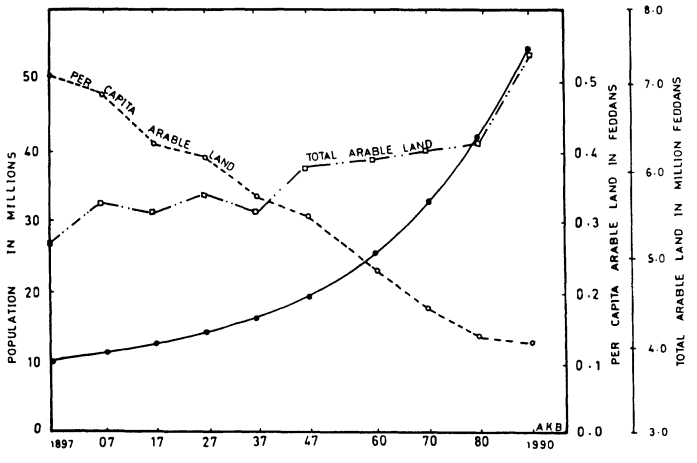
Egypt, said Herodotus, is the gift of the Nile. More than two millennia after the Greek historian's visit, and in spite of extensive technological developments during the intervening period, it still is not an overstatement since life in Egypt would be impossible without the water of the Nile. Less than 4% of the country's land area is cultivated at present and over 96% of Egypt's agricultural land is in the Nile Valley. Thus, the main constraint to expanding the country's land base is water and not land.

LAND RESOURCES

For a very arid country like Egypt, the prime factor which makes land productive is water. Thus, an analysis of arable land is 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 development, it has been possible both to intensify cultivation in the old lands and to expand agricultural activities in the new areas by reclaiming deserts. Construction of the HAD basically confirmed the fact that the supply of arable land in Egypt is not necessarily inelastic, as was often assumed (1). Thus, nearly 80% of land reclaimed between the decade 1960–1970 was made possible directly due to the waters released from the HAD (2).

Figure 1 shows changes in arable areas, per capita arable land and population in Egypt (3) during the period 1897–1990. It should be noted that between 1907 and 1980, the total arable area increased only by about 700 000 feddans (1 feddan is approximately 1 acre or 0.4 ha), while population increased nearly 4-fold, from 11.2 million to 42.1 million (4). This meant that the area of arable land available per person declined by 71% during this 73-year period. 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.

Figure 1. Population and arable land in Egypt, 1897–1990.



The most detailed analyses of land resources of Egypt were completed in 1986. On the basis of analyses carried out, 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 1).

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

The LMP study divided potentially reclaimable land into five categories, depending on one or 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 2 and the extent of land available in different regions of Egypt under various categories is shown in Table 1 and Figure 2. From this analysis, it can be seen that coarse to gravelly 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 of 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 1.

Not surprisingly, it can be seen that 61% of the priority reclaimable land through the Nile waters is located on the fringes of the Delta region. In parts of these areas, where soil is loamy in nature, wheat can be cultivated relatively successfully. 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 many reliable data are available on the loss of productive land in Egypt, due to urbanization and various forms of land degradation, except in a general and anecdotal fashion. Estimates of land loss available at present range from a low of 20 000 feddans (5) to a high of more than 100 000 feddans per year (6). In reality, most of these estimates are based on anecdotal observations and some, e.g. more than 100 000 feddans, are clearly wild guesses. (7)

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, land reclamation statistics refer only to gross areas; reliable data are unavailable on areas that are not fully reclaimed, unproductive, and abandoned. Third, no reliable 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 in terms of both intensity and extent of problems are so vague that they are literally meaningless.

The literature on environmental aspects of Egypt is full of anecdotal or superficial estimates of land loss, which are now being quoted and requoted without serious

Aswan High Dam which significantly contributed to the expansion of Egyptian agriculture. Photo: A. K. Biswas.

Figure 2. Categories and extent of land in 1000 feddan that can be reclaimed, depending on availability of surface and groundwater (3).

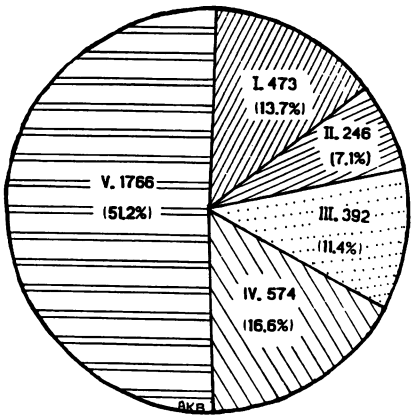


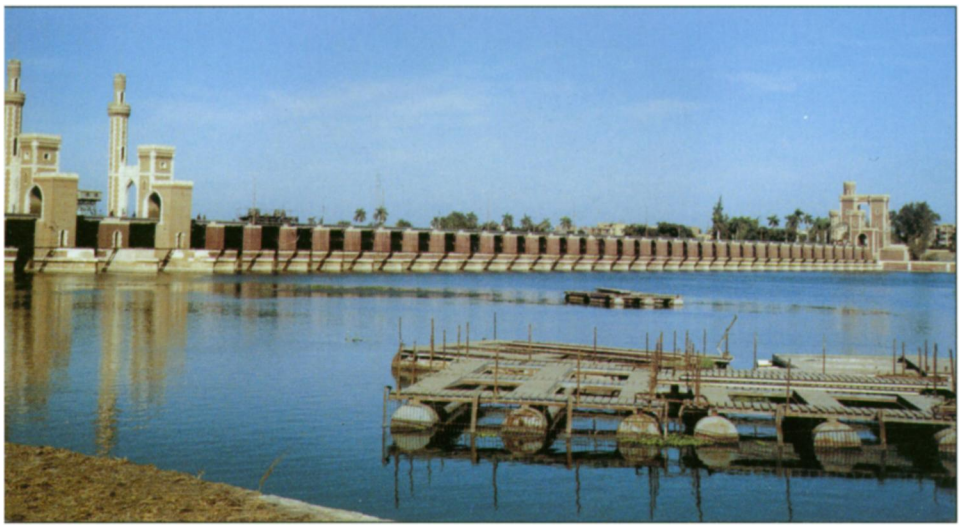
Table 1. Land that can be reclaimed in Egypt by regions (5).

Potential land reclamation by regions	Land categories (1000 feddans) I	II	III	IV	V	Total	Priority areas (1000 fd)
1. With Nile water							
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
UpperEgypt	–	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. With Groundwater							
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. Definition of land-management categories (5).

Land categories	Soil types	Terrain	Main location	Most suitable farming system: Crops	Irrigation and drainage	Farm type
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 calcareous	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 III 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: 100–5000 fd.



One of the magnificent barrages on the Nile. Photo: A. K. Biswas.

scrutiny. For example, one World Bank report (6) quotes annual loss of "agricultural land to topsoil skimming and urban encroachment" to 100 000 feddans in 1983, which is clearly erroneous. Haas (8) claims that by 1972, "one-third of Egyptian irrigated land was estimated to be salinized or was threatened by salinization", which is not a meaningful statement. Similarly, Kishk's (9) statement that at least 50% of the land was salinized is equally meaningless. Neither Haas nor Kishk indicate what is meant by salinized land, for example, does it mean decline in agricultural productivity due to salinity by 1%, 5%, 10% or 80%, or is it land completely withdrawn from agricultural activities? Without information on the intensity of the problem, aggregated data on area concerned—even if it was correct—is of very limited value for planning and decision-making purposes.

Considering the present estimate of cultivated land area in Egypt of 7.21 million feddans in the Nile Valley, 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 of 30 000 feddans. This is consistent with certain other estimates (10, 11). Assuming this estimate of land loss is reasonably accurate, it means that the land reclamation efforts have increased the total agricultural land base, but very modestly.

The study carried out by the Egyptian Public Authority for Survey (12) indicates that the total cultivated area in Egypt is 7.49 million feddans, of which 7.21 million feddans is irrigated by the Nile waters. The cultivated land areas by different governorates for 1963 and 1989, as given by the Public Authority for Survey, are presented in Table 3.

From a policy viewpoint, it is essential that the Government of Egypt needs to give urgent attention to reducing the loss of arable land due to urbanization for three important reasons. First, with a continually increasing population, existing agricultural land areas need to be maintained. Second, land reclamation is an expensive process, hence it is desirable not to lose 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. However, this statement is not very meaningful unless some information can be provided on the extent of productivity of this 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, initially, not properly formulated and 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 either developing countries or in developed countries.

LAND RECLAMATION

In an arid country like Egypt, land reclamation has been practiced for thousands of 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.

At the beginning of the 19th century, areas cultivated were estimated at 2 million feddans, of which only 250 000 feddans (13) could be cultivated in the summer. By 1900, the area cultivated had increased to some 5 million feddans (4). Other estimates of the land reclaimed during the past two centuries abound; a situation that is fairly common in Egypt. Without extensive research it is not possible to make definitive estimates of past development.

Since Egypt's independence in 1952, rapid increases in population (Fig. 1) have contributed to a shortage of arable-land areas, i.e. land which can be economically cultivated. During the 1950s, however, the social objective of settling landless people was considered to be more important than the economic objective of increasing national agricultural production. Even with this high priority, the actual progress in the area of resettlement during this period 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 (Table 4).

Table 3. Cultivated areas in Egypt, 1963 and 1989.

Governorates	Cultivated areas (feddans) 1963	1989	Difference	Percentage Increase (+) or Decrease (–)
1. Lower Egypt				
Alexandria	24 448	141 278	+116 830	–477.9
El-Beheira	745 156	1244 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	+11 088	+5.5
Damietta	101 568	132 791	+31 223	+30.7
Dakahlia	659 125	687 614	+28 489	+4.3
El-Sharkia	608 595	790 105	+181 510	+29.8
Port Said	132	6995	+6863	+5200
Ismailia	51 045	155 954	+104 909	+205.5
Suez	9325	8828	–497	–5.3
Total	3 605 155	4 667 443	1 062 288	+29.5
2. Upper Egypt				
Cairo	19 257	11252	–8005	–41.5
Giza	181 235	232 807	+51 572	+28.5
Fayyoum	328 067	351901	+23 834	+7.3
Beni Suef	273 529	275 300	+1771	+0.7
El-Menia	465 045	507 589	+42 544	+9.15
Assiut	330 135	325 807	–4329	–1.3
Sohag	333 245	317 967	-15 278	–4.6
Kena	369 993	374 783	+4790	+1.3
Aswan	114 745	153 758	+49 013	34.0
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	–	1419	–	–
Red Sea	–	383	–	–
Total	–	272 960	–	–
Grand Total, Egypt	–	7 491 566	–	–

Between 1960–1971, a total of 912 000 feddans were reclaimed, much of this land area was in the Western Delta (Table 4). 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, only about 75% can be considered to be productive (about 685 000 feddans) because some of these reclaimed areas are no longer cultivated, for various reasons, among which are serious waterlogging and salinity problems and lack of irrigation water. Another 90 000 feddans are under rehabilitation (13).

Much of the land reclaimed during the 1960s was kept as state farms, since the then prevailing view was that only such large farms would allow extensive mechanization and could benefit from economies of scale. This indicated a shift in the 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 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." (2)

During most of the 1970s, the Egyptian Government priorities were focused primarily on defence-related issues, and accordingly land reclamation was virtually neglected. It was restarted in 1978, and during the decade of 1978/79 to 1988/89, a total of 747 700 feddans were reclaimed. However, figures available from official sources are often confusing and contradictory, because they lack clarity of definition of land reclamation (target, initiated, completed, cultivated, etc.). Like the 1960s, maximum reclamation (nearly 50%) carried out was on the fringes of the Western Delta. 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 4.

There was another major policy shift during the 1980s. The Egyptian Government 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 the desertlike conditions. Accordingly, a policy decision was taken to allocate new-new lands in a varying ratio of 60:40% to investors with adequate capital to develop their own farms and the balance 40:60%, at low prices, to economically disadvantaged groups like landless farm workers, unemployed graduates, and to government officers, army personnel and university professors. 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. The distribution of land was important since it had a major impact on the use and productivity of the new land. However, many of those who received land were speculators or absentee farmers.

The total investment cost for land reclamation has so far been significant. For example, since the 1952 Revolution, over LE 3 billion (nominal) have been spent on land reclamation (exchange rate on 15 July 1992 was USD 1.00 = LE 3.33). By 1975, LE 485 million had been spent to reclaim 912 000 feddans of old-new lands. It was estimated that an additional LE 285 million would be needed to complete this task properly (11). 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 doubt that in terms of the Egyptian Government policy, from about 1960, land reclamation has been consistently considered to be a priority area. If the budgets allocated to the land reclamation sector through the Ministry of Agriculture and Land Reclamation (MALR) and the Ministry of Public Works and Water Resources (MPWWR) for the 1978–1982, 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 (14) indicates that about 57% of total expenditures was for agriculture and another 24% was for irrigation and drainage. Thus, the present Government 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 the 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 estimated that the investment costs for land reclamation varied from LE 3000 to LE 7000 per feddan, depending upon the complexities encountered. In some remote areas, high cost of infrastructure increased the cost to LE 8000 or even higher per feddan. Annual running cost, excluding on-farm cost, varied from a low of LE 200 per feddan for some low-lying deltaic areas to over LE 400 per feddan for certain

Table 4. Land Reclaimed in 1000 feddans, 1960–1981 to 1991–1992. Reclamation between 1971–1972 and1977–1978 was negligible (12).

Year	East	Delta Middle	West	Middle Egypt	Upper Egypt	Other	Total
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
1961–61	10.7	17.7	25.2	3.1	9.6	23.1	89.4
1962–63	13.2	23.6	42.9	4.9	13.6	24.2	122.4
1963–64	8.0	33.7	53.9	5.5	23.8	34.5	159.4
1964–65	8.5	27.0	58.9	12.0	16.7	12.9	137.0
1965–66	–	4.0	65.5	22.0	11.1	17.0	119.8
1966–67	–	4.0	27.5	21.5	2.1	2.0	56.1
1967–68	–	2.0	32.0	–	–	–	34.0
1968–69	7.0	19.0	19.1	–	–	–	45.1
1969–70	5.0	7.0	6.0	–	3.0	–	21.0
1970–71	13.0	8.0	–	–	–	–	21.0
1978–79	1.0	–	14.9	0.8	0.5	4.7	21.9
197980	8.3	8.1	4.6	–	0.8	2.5	24.3
1980–81	3.7	7.0	2.5	–	1.0	2.1	16.3
1981–82	57.3	1.0	32.5	0.3	4.6	4.2	99.9
1982–83	–	3.4	27.9	1.5		10.9	43.1
1983–84	13.0	4.4	18.9	5.1		5.2	45.6
1984–85	14.7	2.5	22.4	6.6		4.4	50.6
1985–86	11.5	2.3	26.4	15.7		0.5	56.5
1986–87	3.5	11.5	36.2	13.0		1.7	65.9
1987-88	20.0	2.3	96.2	18.2		16.9	153.6
1988-89	–	–	–	–	–	–	170.0
5-Yr.Plan 87–88/91–92	175.0	5.0	214.4	41.5	94.5	219.6	750.0

sandy desert areas at a level of more than 100 m from the adjacent Nile water level.

Reclaimed land was sold at little more than cost, between LE 2500 and 5000 per feddan during the late 1980s. In addition, farmers are expected to bear the cost of agricultural development for these new farms. The Government 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, during the 1980s, low value field crops like cereals, grain, legumes and oil seeds, were not perceived by the farmers to be economically attractive. If this perception continues, 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. However, with the rapidly changing marketing and price situation in Egypt at present, some farmers have already started to review cropping patterns because of the low prices and marketing problems of fruit crops.

CONCLUSIONS

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

Life of Land Reclamation Projects: With the increasing population base in Egypt, land reclaimed at considerable cost must not only retain its 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 numbers of people achieving a better standard of living, and higher levels of industrialization, water demands for the municipal and industrial sectors are increasing steadily and will undoubtedly continue to increase. Since these two sectors are most likely to have higher priority than the agricultural sector in terms of water use, reliable water availability for the reclaimed areas should receive more serious attention. Since the current estimates of water use for 2000 can be considered tenuous at best, 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 a share of water 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, their costs, and the time when they will become available are all uncertain factors.

What is urgently needed for a 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.

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 habitats. Equally, land reclamation could provide better habitats for disease vectors and, thus, contribute to increases in diseases like schistosomiasis. Overuse of water, and/or improper drainage systems 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. As much of the initial aquifer contained highly 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 sandy areas. Even if lined canals are used and drip/sprinkler irrigation systems are practiced, the onset of waterlogging problems would only be delayed, not completely eliminated. Also, in areas like Sinai, additional attention has to be given to irrigation return flow, especially in terms of long-term adverse environmental impacts.

So far, environmental-impact assessment of land reclamation projects has not been carried out. There is no question that future environmental impact assessment (EIA) has to be considered as an integral part of all land-reclamation projects 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 loans or grants.

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