



## Egypt

### GEOGRAPHY, CLIMATE AND POPULATION

Egypt lies in the northeastern corner of the African continent and has a total area of about 1 million km<sup>2</sup>. It is bordered in the north by the Mediterranean Sea, in the east by the Gaza Strip, Israel and the Red Sea, in the south by Sudan and in the west by the Libyan Arab Jamahiriya. Its north-south extent is about 1 080 km, and its maximum east-west extent about 1 100 km. The Egyptian terrain consists of a vast desert plateau interrupted by the Nile Valley and Delta which occupy about 4 percent of the total country area. The land surface rises on both sides of the valley reaching about 1 000 m above sea level in the east and about 800 m above sea level in the west. The highest point of the country, at Mount Catherine in Sinai, is 2 629 m above sea level and the lowest point, at the Qattara Depression in the northwest, is 133 m below mean sea level.

The majority of the country area is desert land. Most of the cultivated land is located close to the banks of the Nile River, its main branches and canals, and in the Nile Delta. Rangeland is restricted to a narrow strip, only a few kilometers wide, along the Mediterranean coast and its bearing capacity is quite low. There is no forest land. The total cultivated area (arable land plus permanent crops) is 3.4 million ha (2002), or about 3 percent of the total area of the country. Arable land is about 2.9 million ha, or 85 percent of the total cultivated area, and permanent crops occupy the remaining 0.5 million ha (Table 1).

Hot dry summers and mild winters characterize Egypt's climate. Rainfall is very low, irregular and unpredictable. Annual rainfall ranges between a maximum of about 200 mm in the northern coastal region to a minimum of nearly zero in the south, with an annual average of 51 mm. Summer temperatures are extremely high, reaching 38 °C to 43 °C with extremes of 49 °C in the southern and western deserts. The northern areas on the Mediterranean coast are much cooler, with 32 °C as a maximum.

Population is estimated at 73.4 million (2004) with an average annual growth rate of 1.8 percent. The rural population is 58 percent of the total population. Overall population density is 73 inhabitants/km<sup>2</sup>; however, with about 97 percent of all people living in the Nile Valley and Delta, population density reaches more than 1 165 inhabitants/km<sup>2</sup> in these areas, while in the desert it drops to only 1.2 inhabitants/km<sup>2</sup>.

In 1997 it was estimated that 26.5 percent of the Egyptian population was living in poverty. The percentage was higher in rural than in urban areas and the incidence of poverty and "ultra poverty" was highest in Upper Egypt, while a larger absolute number of poor households was found in Lower Egypt because of the concentration of population there. In rural areas, about 29 percent of the population was living in poverty, compared to 23 percent of the urban inhabitants. Inadequate social services, landlessness, small farm size and inadequate off-farm income opportunities are the main causes of rural poverty.

TABLE 1  
Basic statistics and population

Physical areas			
Area of the country	2002	100 145 000	ha
Cultivated area (arable land and area under permanent crops)	2002	3 422 178	ha
• as % of the total area of the country	2002	3	%
• arable land (annual crops + temp. fallow + temp. meadows)	2002	2 778 872	ha
• area under permanent crops	2002	643 306	ha
Population			
Total population	2004	73 390 000	inhabitants
• of which rural	2004	58	%
Population density	2004	73	inhabitants/km <sup>2</sup>
Economically active population	2004	27 902 000	inhabitants
• as % of total population	2004	38	%
• female	2004	33	%
• male	2004	67	%
Population economically active in agriculture	2004	8 594 000	inhabitants
• as % of total economically active population	2004	31	%
• female	2004	49	%
• male	2004	51	%
Economy and development			
Gross Domestic Product (GDP)	2003	82 400	million US\$/yr
• value added in agriculture (% of GDP)	2003	16.1	%
• GDP per capita	2003	1 146	US\$/yr
Human Development Index (highest = 1)	2002	0.653	
Access to improved drinking water sources			
Total population	2002	98	%
Urban population	2002	100	%
Rural population	2002	97	%

In 2000, about 96 percent of the rural population and 99 percent of the urban population had access to improved drinking water sources, with an average of 97 percent of the total population. Almost 100 percent of the urban population and 96 percent of the rural population had access to improved sanitation, with an average of 98 percent of the total population.

### ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2003, Egypt's GDP was estimated at US\$82.4 billion with an annual growth rate of 3.2 percent. The agricultural sector accounted for 16.81 percent of GDP and employed about 31 percent of the labour force, of which 49 percent were female (Table 1).

Egypt is self-sufficient in almost all agricultural commodities with the exception of cereals, oils and sugar; however, these exceptions make Egypt one of the world's largest food importers. Agricultural imports in 2001 included 4.4 million tonnes of wheat and wheat flour, 4.7 million tonnes of yellow maize, 0.6 million tonnes of vegetable oils and 0.4 million tonnes of sugar. On the other hand, the main export crops were, amongst others, 53 000 tonnes of cotton, 444 000 tonnes of rice, 176 000 tonnes of potatoes and 37 000 tonnes of citrus.

In Egypt, 99.8 percent of cropland was irrigated in 1997. Even the small, more humid area along the Mediterranean coast requires supplementary irrigation to produce reasonable yields. Smallholdings characterize Egyptian agriculture; about 50 percent of holdings have an area less than 0.4 ha (1 feddan). Farmland urbanization represents a serious threat to agriculture in Egypt. It is prohibited by law to construct any buildings on farmland without a licence from the Ministry of Agriculture and Land Reclamation, and violators are prosecuted and face serious penalties.

## WATER RESOURCES AND USE

### Water resources

The Egyptian territory comprises the following river basins:

- The Northern Interior Basin, covering 520 881 km<sup>2</sup> or 52 percent of the total area of the country in the east and southeast of the country. A sub-basin of the Northern Interior Basin is the Qattara Depression.
- The Nile Basin, covering 326 751 km<sup>2</sup> (33 percent) in the central part of the country in the form of a broad north-south strip.
- The Mediterranean Coast Basin, covering 65 568 km<sup>2</sup> (6 percent).
- The Northeast Coast Basin, a narrow strip of 88 250 km<sup>2</sup> along the coast of the Red Sea (8 percent).

The River Nile is the main source of water for Egypt, with an annual allocated flow of 55.5 km<sup>3</sup>/yr under the Nile Waters Agreement of 1959. Internal renewable surface water resources are estimated at 0.5 km<sup>3</sup>/yr. This brings total actual renewable surface water resources to 56 km<sup>3</sup>/year. Internal renewable groundwater resources are estimated at 1.3 km<sup>3</sup>/yr. The overlap between surface water and groundwater being considered negligible, the total actual renewable water resources of the country are thus 57.3 km<sup>3</sup>/yr. (Table 2). The Nubian Sandstone aquifer located under the Western Desert is considered an important groundwater source, but this is fossil groundwater. The main source of internal recharge is percolation from irrigation water in the Valley and the Delta.

All drainage water in Upper Egypt, south of Cairo, flows back into the Nile and the irrigation canals; this amount is estimated at 4 km<sup>3</sup>/yr. Drainage water in the Nile Delta is estimated at 14 km<sup>3</sup>/yr. Treated domestic wastewater in 2001/02 was estimated at 2.97 km<sup>3</sup>/yr. There are several desalination plants on the coasts of the Red Sea and the Mediterranean to provide water for seaside resorts and hotels; total production in 2002 was estimated at 100 million m<sup>3</sup>. Estimates of the potential of non-renewable groundwater in the eastern and western deserts, mainly from the Nubian Sandstone aquifer, vary from 3.8 km<sup>3</sup>/yr to 0.6 km<sup>3</sup>/yr; the latter estimate is defined as an indicator of exploitability over a period of time, where the time is not given.

TABLE 2

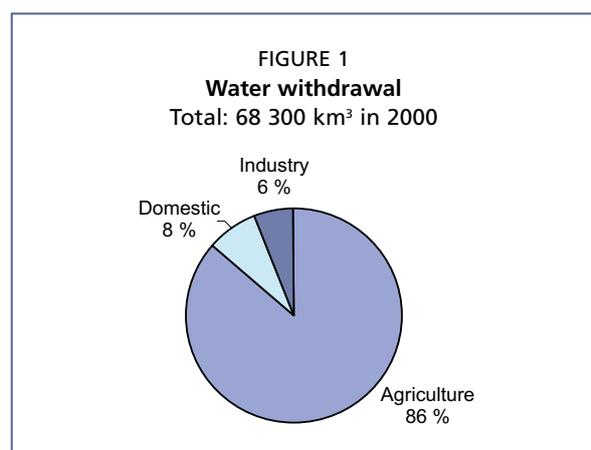
#### Water: sources and use

<b>Renewable water resources</b>			
Average precipitation		51	mm/yr
		51.07	10 <sup>9</sup> m <sup>3</sup> /yr
Internal renewable water resources		1.8	10 <sup>9</sup> m <sup>3</sup> /yr
Total actual renewable water resources		57.3	10 <sup>9</sup> m <sup>3</sup> /yr
Dependency ratio		97	%
Total actual renewable water resources per inhabitant	2004	794.4	m <sup>3</sup> /yr
Total dam capacity	2002	169 000	10 <sup>6</sup> m <sup>3</sup>
<b>Water withdrawal</b>			
Total water withdrawal	2000	68 300	10 <sup>6</sup> m <sup>3</sup> /yr
- irrigation + livestock	2000	59 000	10 <sup>6</sup> m <sup>3</sup> /yr
- domestic	2000	5 300	10 <sup>6</sup> m <sup>3</sup> /yr
- industry	2000	4 000	10 <sup>6</sup> m <sup>3</sup> /yr
• per inhabitant	2000	1 008	m <sup>3</sup> /yr
• as % of total actual renewable water resources	2000	117	%
Water use for navigation and hydropower	2000	4 000	10 <sup>6</sup> m <sup>3</sup> /yr
<b>Non-conventional sources of water</b>			
Produced wastewater	2001	3 760	10 <sup>6</sup> m <sup>3</sup> /yr
Treated wastewater	2001	2 971	10 <sup>6</sup> m <sup>3</sup> /yr
Reused treated wastewater	2000	2 971	10 <sup>6</sup> m <sup>3</sup> /yr
Desalinated water produced	2002	100	10 <sup>6</sup> m <sup>3</sup> /yr
Reused agricultural drainage water (including seepage to gw)	2001	10 967	10 <sup>6</sup> m <sup>3</sup> /yr
Use of fossil water	2000	825	10 <sup>6</sup> m <sup>3</sup> /yr

TABLE 3  
Water availability and water use in Egypt (2000)

Water input	million m <sup>3</sup> /yr	Water use	million m <sup>3</sup> /yr
Renewable surface water resources	56 000	Agriculture	59 000
Renewable groundwater resources	2 300	Domestic	5 300
Reuse of agricultural drainage water (return flow to rivers)*	4 840	Industry	4 000
Reuse of groundwater (seepage from agriculture)*	6 127		
Reused treated wastewater	2 971		
Desalinated water	100		
Use of fossil groundwater (non-renewable water)	825		
<b>Total</b>	<b>73 163</b>	<b>Total</b>	<b>68 300</b>
		Navigation and hydropower	4 000

Note \*: Total water returning from agriculture was about 18 km<sup>3</sup>, of which about 12 km<sup>3</sup> was return flow to rivers and 6 km<sup>3</sup> seepage to groundwater



### Water use

Total water withdrawal in 2000 was estimated at 68.3 km<sup>3</sup>. This included 59 km<sup>3</sup> for agriculture (86 percent), 5.3 km<sup>3</sup> for domestic use (8 percent) and 4.0 km<sup>3</sup> for industry (6 percent) (Table 2 and Figure 1). Apart from that, 4.0 km<sup>3</sup> were used for navigation and hydropower (Table 3).

Groundwater extraction in 2000 was 7.043 km<sup>3</sup> comprising:

- 6.127 km<sup>3</sup> from the Nile Basin (seepage waters)
- 0.825 km<sup>3</sup> from the eastern and western deserts, i.e. mainly the Nubian Sandstone aquifer

- 0.091 km<sup>3</sup> from shallow wells in Sinai and on the northwestern coast

Reuse of agricultural drainage water, returned to the rivers, in irrigation amounted to 4.84 km<sup>3</sup>/yr in 2001/02. Of the 2.97 km<sup>3</sup>/yr of treated wastewater, 1.5 km<sup>3</sup>/yr is reused for irrigation, while the rest is pumped into main drains where it mixes with drainage water and is then used for irrigation. Treated wastewater is usually used for landscape irrigation of trees in urban areas and along roads.

### International water issues

Under the 1959 Nile Waters Agreement between Egypt and Sudan, Egypt's share of the Nile flow is 55.5 km<sup>3</sup>/yr. The agreement was based on the average flow of the Nile during the 1900-1959 period, which was 84 km<sup>3</sup>/yr at Aswan. Average annual evaporation and other losses from the Aswan High Dam and reservoir (Lake Nasser) were estimated at 10 km<sup>3</sup>/yr, leaving a net usable flow of 74 km<sup>3</sup>/yr, of which 18.5 km<sup>3</sup>/yr was allocated to Sudan and 55.5 km<sup>3</sup>/yr to Egypt.

In 1998, recognizing that cooperative development was the best way to bring mutual benefits to the region, all riparian countries (except Eritrea which had observer status only) joined in a dialogue to create a regional partnership to facilitate the common pursuit of sustainable development and management of Nile waters. The transitional mechanism, the Nile Basin Initiative (NBI), was officially launched in February 1999 in Dar es Salaam, the United Republic of Tanzania, by the Council of Ministers of Water Affairs of the Nile Basin States. The shared vision of the NBI is "to achieve sustainable socio-economic development through the equitable utilization of and benefit from the common Nile Basin water resources".

The first meeting of the International Consortium for Cooperation on the Nile (ICCON) took place in 2001 in Geneva, Switzerland to celebrate cooperation between

the ten countries of the Nile Basin and to establish partnerships leading to sustainable development and management of the Nile River for the benefit of all. The ICCON's first meeting was a major milestone for the NBI as it brought together, for the first time, ministers and senior officials from Nile Basin countries with a broad range of bilateral and multilateral donors and other interested parties from civil society, professional organizations, the media and NGOs.

If conditions permit the completion of the development projects on the Upper Nile, Egypt's share in the Nile water will increase by 9 km<sup>3</sup>. This amount includes 1.9 km<sup>3</sup> and 1.6 km<sup>3</sup> respectively from the first and second phases of the Jonglei canal project in southern Sudan. Two other projects in the upstream swamps are expected to provide 5.5 km<sup>3</sup>.

The vast Nubian Sandstone aquifer is shared with the Libyan Arab Jamahiriya, Sudan and Chad.

## IRRIGATION AND DRAINAGE DEVELOPMENT

### Evolution of irrigation development

Irrigation potential is estimated at 4 420 000 ha. The total area equipped for irrigation was 3 422 178 ha in 2002; 85 percent of this area is in the Nile Valley and Delta. Rainwater harvesting is practised in about 133 500 ha in Matruh and North Sinai. All irrigation is full or partial control irrigation (Table 4). Surface irrigation was practised on 3 028 853 ha in 2000, while 171 910 ha were under sprinkler irrigation and 221 415 ha under localized irrigation (Figure 2). Surface water was the source for 83 percent of the irrigated area in 2000, while 11 percent (361 176 ha) of the area was irrigated with groundwater in the provinces of Matruh, Sinai and New Valley. The remaining 6 percent (217 527 ha) was irrigated with mixed sources (Figure 3). The power irrigated area in 2000 was estimated at 2 937 939 ha.

The irrigation system in the old land of the Nile Valley is a combined gravity and water lifting system. Downstream of the High Aswan Dam, there are seven barrages to facilitate abstraction. The main canal system (first level) comprises 31 200 km of canals and takes its water from head regulators, located upstream of the Nile barrages. Water is distributed along branches (second level) where the flow is continuous. At the third level, distributaries receive water according to a rotation schedule. Water is pumped from the distributaries to irrigate fields (lift: about 0.5-1.5 m). The irrigation system in the new lands (reclaimed areas) is based on a cascade of pumping stations from the main canals to the fields, with a total lift of up to 50 m. Surface irrigation is banned by law in the new reclaimed areas, which are located at the end of the systems, and are more at risk of water shortage. Farmers have to use sprinkler or drip irrigation, which are more suitable for the mostly sandy soil of those areas. If used efficiently, sprinkler and drip irrigation need less water than surface irrigation.

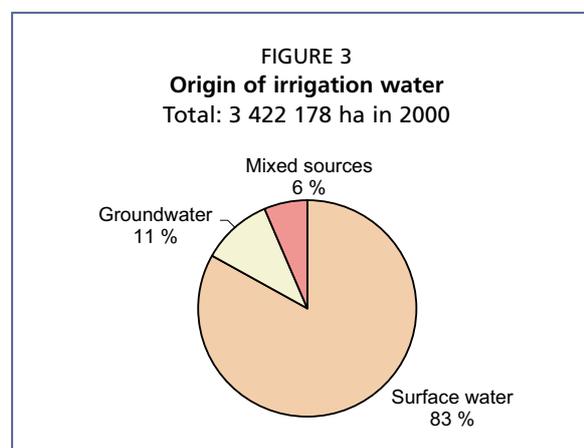
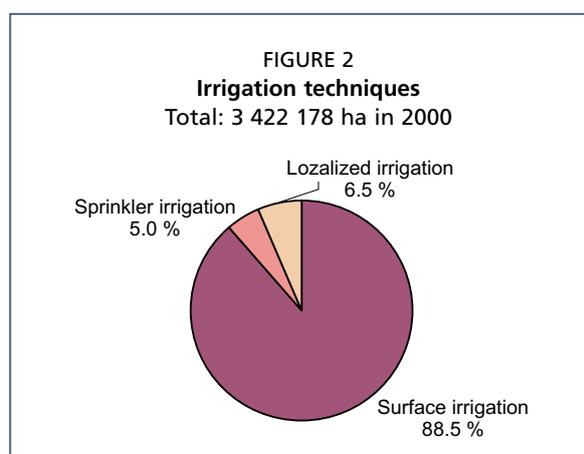


TABLE 4  
Irrigation and drainage

Irrigation potential		4 420 000	ha
<b>Water management</b>			
1. Full or partial control irrigation: equipped area	2002	3 422 178	ha
- surface irrigation	2000	3 028 853	ha
- sprinkler irrigation	2000	171 910	ha
- localized irrigation	2000	221 415	ha
• % of area irrigated from groundwater	2000	11	%
• % of area irrigated from surface water	2000	83	%
• % of area irrigated from mixed sources	2000	6	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		-	ha
3. Spate irrigation		-	ha
<b>Total area equipped for irrigation (1+2+3)</b>	<b>2002</b>	<b>3 422 178</b>	<b>ha</b>
• as % of cultivated area	2002	100	%
• average increase per year over last 9 years	1993-2002	0.6	%
• power irrigated area as % of total area equipped	2002	86	%
• % of total area equipped actually irrigated	2002	100	%
4. Non-equipped cultivated wetlands and inland valley bottoms		-	ha
5. Non-equipped flood recession cropping area		-	ha
<b>Total water-managed area (1+2+3+4+5)</b>	<b>2002</b>	<b>3 422 178</b>	<b>ha</b>
• as % of cultivated area	2002	100	%
<b>Full or partial control irrigation schemes Criteria</b>			
Small-scale schemes	< ha	-	ha
Medium-scale schemes		-	ha
Large-scale schemes	> ha	-	ha
Total number of households in irrigation		-	
<b>Irrigated crops in full or partial control irrigation schemes</b>			
Total irrigated grain production	2003	19 230 797	tonnes
• as % of total grain production	2003	100	%
Total harvested irrigated cropped area	2002	6 027 115	ha
• Annual crops: total	2002	3 773 462	ha
- wheat	2002	1 029 180	ha
- rice	2002	650 026	ha
- barley	2002	96 201	ha
- maize	2002	827 949	ha
- sorghum	2002	156 155	ha
- potatoes	2002	82 588	ha
- sweet potatoes	2002	8 388	ha
- other roots and tubers (taro, yams, etc.)	2002	3 001	ha
- sugar beets	2002	64 596	ha
- pulses	2002	164 013	ha
- vegetables	2002	472 062	ha
- other annual crops	2002	219 303	ha
• Permanent crops: total	2002	2 253 653	ha
- sugar cane	2002	135 815	ha
- bananas	2002	24 165	ha
- citrus	2002	145 421	ha
- cotton	2002	296 693	ha
- fodder	2002	1 195 903	ha
- soyabeans	2002	5 914	ha
- groundnuts	2002	59 241	ha
- sunflower	2002	15 493	ha
- sesame	2002	30 284	ha
- flowers	2002	26 055	ha
- Other permanent crops	2002	318 669	ha
Irrigated cropping intensity	2002	176	%
<b>Drainage - Environment</b>			
Total drained area	2003	3 024 000	ha
- part of the area equipped for irrigation drained	2003	3 024 000	ha
- other drained area (non-irrigated)		-	ha
• drained area as % of cultivated area	2002	88	%
Flood-protected areas		-	ha
Area salinized by irrigation	2005	250 000	ha
Population affected by water-related diseases		-	inhabitants

In addition to the older developments in the oasis of the New Valley, which pump water from the Nubian Sandstone aquifer, new large irrigation schemes are under development in the southwestern part of the country at Al Oweinat; in 2003 about 4 200 ha were under cultivation and there are plans to extend the project to several times that area.

In the Fayoum Province, irrigation was practised with gravity until recently, without any water lifting system. By the year 2000, however, gravity irrigation was practised on only 1 900 ha, or less than 1.2 percent of the cultivated area in Fayoum. Drainage water in the province is directed by gravity into Wadi Rayan and the Qaroon Lake.

Water harvesting (Matruh and Northern Sinai) is possible thanks to the construction of cisterns and diversion dikes. The average rainfall in the areas is between 220 and 250 mm.

### Role of irrigation in agricultural production, the economy and society

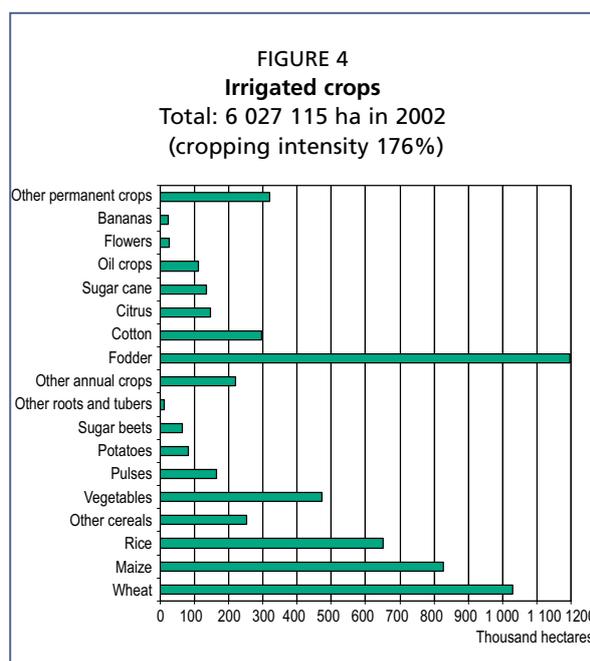
The cropped area was slightly more than 6 million ha in 2002, with an average cropping intensity of 176 percent. There are three growing seasons in Egypt: winter - from November to May; summer - from April/May to October; and "Nili" - from July/August to October.

Most crops are grown both in the Delta and the Valley, with the exception of rice (Delta mainly) and sugarcane (Valley). The main winter crops are wheat and clover or berseem (*Trifolium alexandrinum*). Berseem is grown either over 3 months with 2 cuts as a soil improver (short berseem), usually preceding cotton, or over 6-7 months, either with 4-5 cuts as a fodder crop or grazed by tethered cattle (long berseem). Minor winter crops are, amongst others, pulses, barley and sugar beet. The main summer crops are maize, rice and cotton, the latter being the most important Egyptian export crop (Table 4 and Figure 4). In 2002, yields were 6.4 tonnes/ha for wheat, 8.1 tonnes/ha for maize, 9.4 tonnes/ha for rice and 2.6 tonnes/ha for cotton.

The average cost of irrigation development is about US\$800/ha for localized irrigation of orchards and about US\$1 200/ha for localized irrigation of vegetable or field crops. Mobile sprinkler irrigation costs about US\$800/ha and stationary sprinkler irrigation costs about US\$1 800/ha.

### Status and evolution of drainage systems

An extensive National Drainage Programme has been carried out over the last four decades to control waterlogging and salinity. The drainage system consists of open drains, sub-surface drains and pumping stations. In 2003, slightly over 3 million ha of the total irrigated area were drained, of which about 2.2 million ha with sub-surface drainage. The sub-surface drained area represents more than 65 percent of the total cultivated area. There are 99 pump stations devoted to the pumping of drainage effluent. The power-drained area was estimated at about 1.65 million ha in 2000. Drainage water from agricultural areas on both sides of the Nile Valley is returned to the River Nile or main irrigation canals in Upper Egypt and in the southern Delta. Drainage water in the Delta is either pumped back into irrigation canals for reuse or pumped into the northern lakes or the Mediterranean Sea.



## WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

### Institutions

The Ministry of Water Resources and Irrigation (MWRI) is in charge of water resources research, development and distribution, and undertakes the construction, operation and maintenance of the irrigation and drainage networks. Specifications and permits for groundwater well drilling are also the responsibility of MWRI. Within MWRI, the following sectors and departments are of importance:

- The Planning Sector is responsible at central level for data collection, processing and analysis for planning and monitoring investment projects.
- The Sector of Public Works and Water Resources coordinates water resources development works.
- The Nile Water Sector is in charge of cooperation with Sudan and other nilotic countries.
- The Irrigation Department provides technical guidance and monitoring of irrigation development, including dams.
- The Mechanical and Electrical Department is in charge of the construction and maintenance of pumping stations for irrigation and drainage.

Further to the above institutions, other public authorities are directly related to MWRI:

- The High Dam Authority is responsible for dam operation.
- The Drainage Authority is responsible for the construction and maintenance of tile and open drains.
- The National Water Research Center comprises 12 institutes and is the scientific body of MWRI for all aspects related to water resources management.

MWRI also represents Egypt in the meetings of the Nile basin countries on Nile water issues. There are several joint projects between those countries for the development of Nile water. These projects, if completed, would increase the water shares of member countries significantly. Egypt would gain an additional 9 km<sup>3</sup> of Nile water.

The Ministry of Agriculture and Land Reclamation (MALR) is in charge of agricultural research and extension, land reclamation and agricultural, fisheries and animal wealth development. The Agricultural Research Center comprises 16 institutes and 11 central laboratories and is the scientific body of MALR for all aspects related to agricultural development. The Land Development Authority is in charge of contracting and monitoring land development projects and manages land allocation to investors and individuals. The Agricultural Development and Credit Bank provides credit to farmers to finance various production requirements.

### Water management

The Government has indicated its intent to shift emphasis from its role as the central (or sole) actor in developing and managing water supply systems, towards promoting participatory approaches in which water users will play an active role in the management of irrigation systems and cost sharing. Important institutional and legislative measures have been taken recently to promote the establishment of sustainable participatory irrigation management (PIM) associations. However, despite these measures, the development of water users' associations (WUAs) as effective partners in irrigation management remains at an early stage. In the new lands, the concept of PIM is not yet effectively operational for a variety of economic, financial and institutional reasons.

While most settlers recognize the importance of WUAs in the equitable distribution of available water, uneven water availability, either due to design shortcomings or to lax enforcement of rules against excess abstraction by front-end water users, has acted as a disincentive to the successful operation of WUAs in many instances.

### Finances

The government invests considerable resources in the land-reclamation programme. Investment is primarily in irrigation and drainage infrastructure, settlement construction, and provision of potable water, electricity and roads. Very little is invested in social services (education and health), and no investment is made in the provision of agricultural services (technology, water management and rural finance). Consequently, poor settlers face difficulties in settling and farming, and a considerable percentage move back to the old lands and abandon their new land farms.

Both MWRI and MALR activities are considered public services and their water and land development projects are budgeted in the national economic and social development plan.

### Policies and legislation

The main water and irrigation strategy is concerned with the development and conservation of water resources. This is done through adopting water rotation for irrigation canals, limiting the rice growing area, lining irrigation canals in sandy areas and prohibiting surface irrigation in the new developed areas outside the Nile basin.

Recent water resources policies include different structural and several non-structural measures. Structural measures include: irrigation structures rehabilitation; improvement of the irrigation system; installation of water level monitoring devices linked to the telemetry system; and expansion of the tile drainage system. Non-structural measures include: expansion of water user associations (WUAs) for irrigation ditches; establishment of water boards on branch canals; promotion of public awareness programmes; and involvement of stakeholders.

The legal basis for irrigation and drainage is set in Law No. 12/1984 and its supplementary Law No. 213/1994 which define the use and management of public and private sector irrigation and drainage systems including main canals, feeders and drains. The laws also provide legal directions for the operation and maintenance of public and private waterways and specify arrangements for cost recovery in irrigation and drainage networks.

The most recent water policy was drafted in 1993. It included several strategies to ensure satisfying the demands of all water users and expanding the existing agricultural area at that time of 7.8 million feddan (about 3.12 million ha) by an additional 1.4 million feddan (about 560 000 ha).

### ENVIRONMENT AND HEALTH

Salinity and waterlogging are now under control in about 80 percent of the affected areas following the installation of drainage systems. This has led to a reduction in saline areas from about 1.2 million ha in 1972 to 250 000 ha at present. Seawater intrusion is a problem in the northern part of the Delta, where groundwater becomes brackish to saline. About half of the Delta contains brackish to saline groundwater, and no water is pumped in the northern Delta. Average salinity of groundwater in the Delta was between 680 and 1 170 mg/liter in 2000/01. It is said that the rice belt is a major defence factor to keep salinity under control in the northern areas of the Nile Delta, as well as to stop the invasion of sea water further inland in the Delta aquifer.

The salinity of agricultural drainage water is higher in winter, especially downstream because less water is used for irrigation. In the new Al Salam Canal, drainage water is mixed with Nile water at a ratio of 1:1, and the salinity of the mixed water is within safe levels.

The main challenge for the sustainability of water resources is the control of water pollution. The Ministry of the Environment is observing the enforcement of the new legislation regarding the treatment of industrial and domestic wastewater. MALR is also

advocating organic farming and limiting the use of chemical fertilizers and pesticides to reduce crop, soil and water pollution. In addition, present policy is to minimize the use of herbicides and to depend mainly on the mechanized control of submerged weeds and water hyacinths.

Bilharzia, or Schistosomiasis, is still a common disease in rural areas in Egypt but its occurrence has greatly decreased with the provision of improved drinking water to most rural areas, periodic examination of school children, free medical treatment and extension programmes to educate people on ways of protecting against the disease. The Ministry of Health and Population announced that Bilharzia cases in the examined samples of rural population in 2001 were only about 4 percent. Malaria is rare in Egypt.

### PERSPECTIVES FOR AGRICULTURAL WATER MANAGEMENT

In 1984 it was estimated that there were another 0.5 million ha with development potential, in addition to the approximately 2.5 million ha already equipped for irrigation.

The Al Salam irrigation canal has recently been inaugurated, delivering mixed water from the Nile and two main drains to the northeastern delta and northern Sinai. The area to be irrigated with canal water is about 268 800 ha. In the present five-year development plan ending in 2007, 463 000 ha are to be developed, all outside the Nile Basin. This area includes:

- 150 000 ha east of the Delta and in Sinai, as part of the Al Salam project.
- 228 000 ha in Upper Egypt and New Valley at Toshky and Al Oweinat, to be inaugurated in the next few years.
- 64 000 ha on the northwestern coast.
- 11 000 ha in the western Delta.
- 10 000 ha in middle Egypt.

All new development areas have to use sprinkler or localized irrigation. Surface irrigation is not permitted outside the Nile Basin. The Al Salam project and the project at Toshky have been financed locally and with aid from Arab countries and international agencies. The long-term plan in Sinai is to develop 630 000 ha; the present five-year plan includes 107 520 ha in the region.

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