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SUB-REPORT 1998

EGYPT

EVALUATION OF THE NETHERLANDS SUPPORT TO WATER MANAGEMENT AND DRAINAGE 1975-1996

Netherlands development assistance

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Preface

The evaluation of Netherlands support to water management and drainage in Egypt was part of a study of the Policy and Operations and Evaluation Department (IOB) on the Netherlands bilateral aid for Egypt during the period 1975–1996. The assistance to water management and drainage has been the largest element of this bilateral aid which amounted to Dfl. 160 million or 20% of total disbursements.

Water management and drainage is a crucial sector for Egypt's economy, food production and the living conditions of its population. The focus on drainage addressed a crucial problem of the country and complied with Egypt's priorities to restore the deteriorating water and salt balance and to improve the management of scarce water resources. The period 1975–1996 has seen great technological change in Egypt's water management and drainage, including the mechanisation of field drainage construction involving the use of high capacity trenching machines and plastic pipe technology, the development of new weed control technologies, and the large-scale introduction of computerised data processing and modelling techniques.

The study concentrated on the main components of the co-operation in water management and drainage: support to the Advisory Panel on Land Drainage and the research institutes under the National Water Resource Centre, assistance to the implementation of the national drainage system, and aid to water management at sub-national level in Fayoum Governorate. It includes a detailed background of water management in Egypt, main problems and government policies. Moreover, Netherlands aid is placed in the wider framework of donor support for the sector.

The study is based on a consultant report produced by Matrix Consultants/Utrecht and Chemonics-Egypt/Cairo. The study was co-ordinated by Roland Rodts (Rocks BV) and Jan Sterkenburg (IOB), whilst advisory groups of external and internal experts in Egypt and the Netherlands advised on methodology and commented on draft reports. The comment of the Egyptian Ministry of Public Works and Water Resources is

attached to the report (Annex 1). Although many individuals contributed to the evaluation study, IOB bears sole responsibility for the report.

Director, Policy and Operations Evaluation Department,
Netherlands Ministry of Foreign Affairs

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Abbreviations

ADB/ADF – African Development Bank/African Development Fund
APLDP – Advisory Panel on Land Drainage Project
ARC – Agricultural Research Centre
AWCP – Aquatic Weed Control Project

BAD – Bilateraal Assistent Deskundige—Associate Expert

CIDA – Canadian International Development Agency
CMRI – Channel Maintenance Research Institute
CWSP – Control of Waterlogging and Salinization Project

DBSP – Delta Breeding Station Project
DEMP – Drainage Executive Management Project
DFL – Directie Flevoland—Netherlands Ministry of Public Works—Rijkswaterstaat
DGIS – Directorate General of International Co-operation
DMGRP – Development and Management of Groundwater Resources Project
DRI – Drainage Research Institute
DRP – Drainage Research Programme
DTC – Drainage Training Center (EPADP)
DTPAP – Drainage Technology and Pilot Areas Project

EBSP – East-Bahr Saft Project
EC – European Commission
EAP – Environmental Action Plan
EEAA – Egyptian Environmental Affairs Agency
EMGRP – Environmental Management of Groundwater Resources Project
EPADP – Egyptian Public Authority for Drainage Projects
EWUP – Egypt Water Use and Management Project

FAO – Food and Agricultural Organisation
FID – Fayoum Irrigation Department
FWCP – Fayoum Weed Control Project
FWMP – Fayoum Water Management Project
FWMDIP – Fayoum Water Management and Drainage Improvement Project
FWSBP – Fayoum Water and Salt Balance Project

GARPAD – General Authority for Rehabilitation Projects and Agricultural Development
GCP – Grass Carp Project
GDID – Groundwater Development for Irrigation and Drainage Project

GIS	–	Geographical Information System
GOE	–	Government of Egypt
GOFI	–	General Organisation for Industry
GON	–	Government of The Netherlands
HAD	–	High Aswan Dam
HED	–	Horizontal Expansion Department
HRD	–	Human Resources Department
HRDU	–	Human Resource Development Unit
HRI	–	Hydraulics Research Institute
HTP	–	Hydrological Training Programme
IAC	–	International Agricultural Center—Wageningen
IAS	–	Irrigation Advisory Services
ICW	–	Instituut voor Cultuurtechniek en Waterhuishouding
ID	–	Irrigation Department
IFAD	–	International Fund for Agricultural Development
IID	–	Irrigation Improvement Department
IIMI	–	International Irrigation Management Institute
IIP	–	Irrigation Improvement Project
ILRI	–	Institute for Land Reclamation and Improvement
IMF	–	International Monetary Fund
IMS	–	Irrigation Management Systems
IOV/IOB	–	Operational Review Unit
ISAWIP	–	Integrated Soil and Water Improvement Project
KfW	–	Kreditanstalt fur Wiederaufbau
LE	–	Livre Egyptien (Egyptian Pound)
MADWQP	–	Monitoring and Analysis of Drainage Water Quality Project
MALR	–	Ministry of Agriculture and Land Reclamation
MED	–	Mechanical and Electrical Department (EPADP)
MIC	–	Egyptian Ministry of International Cooperation
MIS	–	Management Information System
MPWWR	–	Ministry of Public Works and Water Resources
NDP	–	National Drainage Programme
NOPWASD	–	National Organisation for Potable Water and Sewerage Drainage
NRI	–	Nile Research Institute
NWRC	–	National Water Research Centre
PADTP	–	Pilot Area and Drainage Technology Project
PEC	–	Public Excavation Company
PFD	–	Planning and Follow-up Department (EPADP)
PS	–	Planning Sector—MPWWR
PVC	–	Polivinyl Chloride
RDWP	–	Re-use of Drainage Water Project
RIGW	–	Research Institute for Groundwater
RNDP	–	River Nile Protection and Development Project

RNE	–	Royal Netherlands Embassy
SRI	–	Surveying Research Institute
SWRI	–	Soil and Water Research Institute
TA	–	Technical Assistance
TPDP	–	Training Programme for Drainage Projects
UNDP	–	United Nations Development Programme
USAID	–	United States Agency for International Development
USoS	–	Under Secretary of State
WB	–	World Bank
WDIMI	–	Water Distribution and Irrigation Methods Research Institute
WRRI	–	Water Resources Research Institute
WUA	–	Water User Association

Currency equivalents and measures

CURRENCY EQUIVALENTS

Year	1 US$ = LE	1 LE = US$	1 Dfl = LE
1975	0.39	2.56	0.15
1976	0.45	2.21	0.17
1977	0.48	2.07	0.20
1978	0.54	1.85	0.25
1979	0.70	1.43	0.35
1980/81	0.74	1.35	0.37
1981/82	0.81	1.23	0.32
1982/83	0.86	1.16	0.32
1983/84	0.93	1.08	0.33
1984/85	0.84	1.19	0.26
1985/86	0.84	0.84	0.25
1986/87	1.37	0.73	0.56
1987/88	1.54	0.65	0.76
1988/89	2.23	0.45	1.13
1989/90	2.56	0.39	1.21
1990/91	2.57	0.39	1.41
1991/92	3.30	0.30	1.76
1992/93	3.33	0.30	1.89
1993/94	3.35	0.30	1.90
1994/95	3.40	0.29	1.95
1995/96	3.40	0.29	1.95
1996/97	3.40	0.29	1.95

MEASURES

1 feddan = 0.42 hectare (ha) = 1.037 acres
1 hectare (ha) = 2.38 feddan = 2.47 acres

Main findings

Principal characteristics

Bilateral assistance to the water management and drainage sector has been the largest element in the Netherlands development co-operation with Egypt, stretching over the full period of the programme, i.e. 1975–96. It represented some 20% of total Netherlands bilateral aid to Egypt over that period and amounted to nearly Dfl. 160 million, or approximately LE 320 million at the current rate of exchange.

Assistance was provided on a project-by-project basis, with some 25 projects being implemented. The assistance was not embedded in a comprehensive diagnosis of sector constraints and there were no clearly formulated medium and long-term strategies. While there was a rationale for such an approach during the initial period of co-operation in the sector, there was little justification for it in later stages.

Technical assistance was the main instrument of the aid programme, provided through specialised consultants from the Netherlands. Consulting firms often initiated the projects and also had a direct interest in the execution. The support was technical with a predominantly engineering focus. Until the early 1990s, consultant teams invariably consisted of technical experts such as civil engineers and hydrologists. Since then, some socio-economic and organisational expertise has been added. Roughly 60% of total disbursements went to consulting services.

Research institutes and government agencies under the Egyptian Ministry of Public Works and Water Resources were the main recipients, the intention being to realise the overall strengthening of government organisations by improving the technical capabilities of staff. The strong focus on applied research, to which almost half of total expenditure in the sector was devoted, was based on the assumption that more detailed insight into the technical parameters of water management and drainage would lead to the improved execution of drainage works and better water management.

The Netherlands support for the water sector was innovative in several respects: the introduction of computerised models for water management purposes, the use of movable bed and computer models for hydraulics research, the introduction of biological weed control by means of grass carp, the introduction of re-usage of drainage water for irrigation, and the experiments with water users associations in Fayoum as an instrument of farmer participation in organisation and maintenance and improved water management. The list of innovations corresponds with the technical focus of the projects.

Dynamics of the programme

The co-operation programme between Egypt and the Netherlands in the drainage and water management sector shows a number of changes in objectives, disbursement pattern and type of activities over the twenty-year period. These changes were not due to an a priori strategy, but were rather the effect of individual decisions on separate projects.

Objectives broadened and increased in complexity during the period, mainly reflecting the specification of activities on the basis of experience gained during implementation. Since the early 1990s attempts have been made to incorporate current policy themes, such as environmental conservation and women and development.

Expenditure increased in absolute terms from Dfl. 4–5 million per annum in the 1970s to Dfl. 10–11 million per annum in the 1990s. As a percentage of total Netherlands aid it grew from 15% in 1980/84 to 29% in 1985/91 and to 38% in 1991/96. The composition of the aid to the sector also changed over the two decades. The share of research decreased from over 60% of total disbursements in the early years of the programme to slightly less than 40% after the mid-1980s. Expenditure for activities at governorate level rose gradually to the present 30% of the total. This also reflects a shift to integrated water management and to a more direct orientation towards agriculture and the farming community.

There were also changes within the three main components of the support programme. In research the emphasis shifted from drainage technology to re-use of drainage water for irrigation and subsequently to integrated water management and data collection for environmental problem identification. In drainage implementation technical training remained prominent throughout the period, but increasingly it took place in Egypt, gradually coming under full control of the recipient organisation, the Egyptian Public Authority for Drainage Projects (EPADP).

In both research and implementation, the initial emphasis on improvement of technical capabilities was recently broadened to general institutional strengthening. Recent activities focused on the inventorisation of training needs and the design of human resources

development plans, but these have not yet resulted in concrete measures with which to tackle the principal institutional constraints. Some of the main causes for this limited progress are outside the control of the recipient organisations, difficult to influence by donors, and can only be addressed effectively in the wider context of civil service reform.

In Fayoum, emphasis shifted from technical research and model building to broader water management issues integrating irrigation, weed control and drainage aspects, including the re-use of drainage water. Recently, experiments have started with setting-up of water users organisations and participation of farmers.

Another recent development has been support to the planning sector of the Ministry of Public Works and Water Resources (MPWWR). Although it is still too early to identify concrete results, the request for such assistance together with the shift to institutional strengthening activities indicate the good relations that exist between Egypt and the Netherlands and the confidence that has grown between the two parties during twenty years of co-operation.

Policy orientation

Policy orientation refers to the degree to which the support focused on crucial development problems, its compliance with Egyptian priorities and its relevance for Netherlands development co-operation policy objectives.

Support to water management and drainage concurred with Egyptian priorities. The drainage and water management sector is crucial for the Egyptian economy, food production and food security, and for the living conditions of a large proportion of its population. The focus on drainage addressed a crucial problem, complying with Egyptian priority given to restoring the country's deteriorating water and salt balance and to improving the management of scarce water resources.

The Netherands contribution was complementary to the assistance given by two main donors, USAID and the World Bank. The former provided funds for improving the irrigation system, while the latter focused on supplying equipment for the implementation of the national drainage programme. Netherlands aid equalled 10–15% of the assistance provided by these two main donors. As such, it was a vital element in overall donor support to the sector.

As the Netherlands did not explicitly formulate its policy objectives for aid to this sector until 1996, it is not possible to establish any sector-specific policy compliance. The focus

on water management and drainage, however, is in agreement with the general objective of environmental conservation.

Support was geared primarily towards increasing Egypt's economic self-reliance. Only marginal attention was given to direct poverty alleviation.

There were two main instruments by which the results of Netherlands support are fed back to Egyptian government policy: the regular bilateral consultations and the Advisory Panel of Experts. The former provided a forum in which to review past experiences and set the agenda for future co-operation. The latter focused on technical aspects of co-operation in the sector. The evaluation mission found no evidence of Panel interventions or of bilateral consultations with respect to sector policy issues such as programming of research activities, cost recovery, water pricing and privatisation of institutions in the sector. Discussions in the Advisory Panel may have influenced policy decisions through informal channels.

The actual policy framework in the irrigation, drainage and water management sector was established under USAID and World Bank covenants, which contributed almost two-thirds of donor support to the sector.

Effectiveness

Effectiveness refers to the results of donor assistance in relation to short and medium-term goals.

The assistance has been instrumental in strengthening the technical capabilities of recipient organisations, and helped in setting-up of three of Egypt's leading research institutions in the field of land drainage and water management. Over the years and through the extended support period, these institutes and the Hydraulics Research Institute have gained stature in, and established valuable contacts with the international scientific community.

The overall effectiveness of research support in the sector has been mixed. It has been good in the case of contract research, which was demand-driven and responded to explicitly formulated assistance requests from end-users. Some 70% of supported research programmes were not contracted, however; effectiveness was then low mainly because of deficient communication between the research institutions and (potential) clients.

The drainage execution and Fayoum water management assistance programmes helped to strengthen the recipient organisations by training large numbers of staff and through

operational investment support. The goal of speeding-up the implementation rate of the field drainage programme has been partially achieved: the area brought under drainage from 1992 onwards shows a gradually upward trend, largely due to the massive investment in equipment. In general, technical assistance is mentioned to have had a positive impact on performance but the evaluation found little concrete evidence of such an effect.

Over the years, all supported organisations produced a massive number of technical papers and documents which provided further insight into the country's water and salt balance and drainage problems, groundwater development potential and the scope for increasing water management efficiency.

While the support has helped to improve technical capabilities, its effectiveness has been hindered by institutional and managerial problems in the executing organisations and agencies. In general, the assistance was insufficiently embedded in institutional development plans that would enable the recipient organisations to gain optimal benefit and to raise standards of performance.

Factors affecting institutional performance include the low salary levels compared to the private sector, the government's seniority-based staffing and career development policies, and highly centralised decision-making patterns. Organisational-strengthening programmes have only recently been introduced and, at the time of the evaluation, a definite impact on organisational performance could not be established.

Measuring the assistance programme's overall impact in terms of increased agricultural production or farm income, i.e. its ultimate goal, is complicated by deficiencies in basic data collection and analysis. The information on yields is partial and based on estimates rather than on duly elaborated benchmark surveys. Nevertheless, sometimes substantial improvements in yield levels and favourable rates of return are indicated by farmers' explicit desire to have drainage installed in their fields.

In Fayoum, the assistance programme helped to raise agricultural production in water-deprived tail-end areas of the irrigation system. Overall irrigation efficiency improvement was realised mainly through increased re-use of low-quality drainage water, however, creating substantial risks for soil salinisation and sustainable agriculture in the longer run.

Efficiency

Efficiency deals with the assessment of outcomes in relation to inputs, looking at costs, implementation times and the performance of organisations concerned in the various phases of the project cycle.

In general, the efficiency of project implementation was low. Most projects were not completed within the originally established time frame and frequent project extensions and additional funding were needed to complete planned activities. Implementation problems were particularly severe in the three main investment projects (East Bahr Saft, Drainage V and the Batts Pumping Station).

The reasons for low efficiency were manifold. In most cases, implementation problems were attributable to flawed project identification and formulation. Projects were identified on an ad-hoc basis, largely in response to individual assistance requests from the Ministry of Public Works and Water Resources, the Advisory Panel or initiatives by Netherlands consultants. Proposals for technical assistance were invariably based on a perceived 'severe shortage' of technical expertise and limited Governmental financial capabilities. Such proposals were not underpinned with a thorough analysis of the organisation, financial situation and staffing position of the applicant institutions.

In addition, project formulation took a substantial amount of time and manpower with little visible impact on the quality of project execution documents. Objectives were generally formulated in very broad terms with little attention being given to the wider socio-political environment for institutional development and the role of project-supporting Governmental agencies. An approach that linked project activities with proposed inputs and expected outputs, as outlined in the instruction manual introduced in the mid-1980s, was rarely used.

The implementation of projects was beset by recurring problems in the mobilisation of consultants, contract approval, recruitment and training of local staff, procurement of goods and civil works and co-operation with other Governmental and/or donor agencies. Over the years, there emerged a need to address structural problems more systematically, rather than to persist with labour-intensive, repetitive, case-by-case and issue-by-issue resolutions. In absence of a regular reassessment of issues and progress towards longer-term objectives, however, implementation problems persisted.

Sustainability

The period 1975–95 has seen great technological change in Egypt's drainage and water management sector. The most relevant developments have been: (i) the mechanisation of field drainage construction involving the use of high capacity trenching machines and plastic pipe technology, (ii) the development of new weed control technologies replacing traditional silt removal and chemical weed control, and (iii) the large-scale introduction of computerised data processing and modelling techniques, enhancing the management capabilities of all organisations in the sector.

During the early stages external aid, including that of the Netherlands, played an important role in the introduction of these new technologies. They had to be imported and there was an acute shortage of foreign exchange, Government revenues were inadequate to finance these technologies, and staff was insufficiently trained to make optimum use of them. In the meantime, Egypt's foreign exchange position has improved substantially and there is now a considerable number of well-trained Egyptian engineers. In terms of technology, therefore, the results of the co-operation in this sector are sustainable.

With respect to the research sector, the maintenance of a high quality research capability hinges on the Egyptian Government's ability to introduce institutional and managerial reforms to improve the motivation as well as salaries of productive staff, to enhance the role of end-users throughout the entire research cycle, and to reduce dependency on Government funding through contract research. The outlook is best for those institutes which started to develop structural links with society and the economy and secured a more solid financial basis on which to retain and/or recruit motivated staff.

At the level of the Fayoum water management authorities, organisational and financial sustainability of the results of the assistance effort is also a point of concern. In Fayoum, neither the water management nor the weed control assistance effort has as yet been sufficiently integrated into the regular organisational pattern to sustain benefits in the longer term. Uncertainty also prevails about the financial sustainability of project operational support in Fayoum. The complete transfer of financial ownership involves a substantial increase of the Irrigation Department's current operational and investment budget (by as much as 100–200%) which has yet to be sanctioned by the Egyptian Government or otherwise secured (through direct cost recovery).

Organisational and financial sustainability is fairly secure in the case of EPADP, the drainage executing agency. The technical assistance programme made a valuable contribution to institutionalising in-service training efforts through establishing a self-sustaining

Drainage Training Centre and Human Resources Development Department. In view of the high priority given by the Egyptian Government to the field drainage programme, operational and investment support for EPADP is assured.

Netherlands policy priorities

The chief objectives of Netherlands development co-operation over the past two decades have been to contribute to economic self-reliance and poverty alleviation. During the late 1970s two additional priority themes in aid policy were introduced, namely, environment and women and development. Together with poverty alleviation, these two policy themes became the principal criteria in the appraisal of project proposals from the mid-1980s onwards.

Support to the water and drainage sector in Egypt has concentrated on contributing to economic self-reliance. This refers to the effects of aid on macro-economic performance, primarily in terms of GDP growth and improvement of the balance of payments position.There are indications that the assistance helped Egypt's economic self-reliance because of the higher crop yields that followed improved drainage and the consequent reduction of food imports. This has contributed to GDP growth and to balance of payments improvements.

Due to the technical/engineering orientation of the support, the lack of reliable baseline data and weaknesses in monitoring, it is difficult to assess the effects of the aid programme in socio-economic terms and, consequently, its contribution to poverty alleviation. Available information indicates little specific effect for poor farmers, apart from the estimated overall increases in yields. Moreover, as little is known about the socio-economic consequences of improved drainage in Egypt, it is not possible to establish with any certainty which groups in society profited from this type of assistance.

In supporting the drainage and water management sector, the co-operation programme addressed one of Egypt's most fundamental problems: that of preventing the land from becoming waterlogged and salinised, thereby reducing and ultimately losing its productive capacity. The support given to the executing agency for drainage works contributed to the recent increase in annual output and to the improved quality of drainage, and has had a positive effect on sustainable land use. The support given to the re-use of drainage water for irrigation is a two-edged sword. While raising output in the short term, the continued use of present low quality drainage water may seriously endanger the agricultural production base in the longer term.

Specific environmental components related to water quality were recently incorporated into the programme. These refer to water quality monitoring and are still in the design stage, so that results cannot be assessed yet.

In the 1990s attempts have been made to operationalise the women-and-development theme both at the project and sector level. Chances to integrate this theme into the sector programme are rather limited because of the latter's technical/engineering nature and to the primary concern given to improving key governmental agencies. In sum, support given to drainage and water management has not contributed directly to strengthening the position of women.

In sum, the Netherlands assistance to the drainage, water research and water management sector has helped considerably in the solution of serious problems in a crucial sector for Egypt's development. The assistance was in line with Egyptian priorities, supplementary to that of other donors, and instrumental in strengthening the technical capabilities of relevant Government organisations. Support to research institutions was insufficiently demand-driven, thus seriously reducing its effectiveness. The effectiveness of assistance to executing agencies has improved over time. Efficiency of project implementation was rather low, however, and a re-appraisal of further support is required to enhance longer term sustainability, especially with regard to institutional support.

Summary

1 Organisation of the study

Objective and key questions

This evaluation report on the Egypt–Netherlands co-operation programme in water management and drainage is part of the overall country programme evaluation. The sector was chosen for evaluation because of its importance for the Egyptian economy and future development and the substantial part of the aid flow from the Netherlands it absorbed (i.e. 20%) during a period of more than twenty years.

The objective of the evaluation is to assess the policy relevance, effectiveness, efficiency and sustainability of Netherlands assistance against the background of the sector's principal characteristics and problems. The following key questions structured the evaluation study:

1. What are the main characteristics of the water management and drainage sector in Egypt and which changes have occurred in the sector over the past twenty years?
2 What are the main features of government policy for the sector?
3 What was the Netherlands development co-operation policy for the sector and how did this relate to the sector's main problems, to Egyptian government policy and to the activities of other donors?
4 Which projects and programmes were supported by the Netherlands and what were the results of that support?
5 How efficiently was the support organised and carried out?
6 How sustainable are the results of Netherlands support and which factors influence sustainability?

Policy relevance focused on whether the goals of the set of activities were consistent with country and sectoral assistance strategies and on whether the choice was appropriate in view of the principal objectives of Netherlands development aid.

Effectiveness concerned the review of the programme's effects in relation to the short and medium term goals, whether physical, financial, institutional or policy-related. Efficiency was assessed in terms of outcomes in relation to inputs, including costs, implementation times, and organisational performance in the various phases of the project cycle.

Sustainability involved assessment of the potential to maintain the achievements of development aid in terms of financial viability, appropriate technology and institutional capability.

Evaluation methodology

The evaluation covered a period of roughly twenty years (1975–96) and dealt with all support to projects executed under the authority of the Egyptian Ministry of Public Works and Water Resources. All projects supported in the sector during the period have been examined. The study is founded upon a variety of sources: desk reviews of project correspondence, internal memoranda and financial records, analysis of project identification, formulation and monitoring reports, appraisal documents and project evaluations; and reviews of available literature and documents produced by other donors. On the basis of the desk study and complementary interviews a series of position papers was prepared, identifying the need for further study. These position papers served as a basis on which the field study programme in Egypt was formulated. That field study was contracted-out to an independent team of Egyptian and Netherlands consultants.

Consultants' and draft IOB reports were discussed by Advisory Groups in Egypt and the Netherlands, and relevant sections were presented for comment to institutions and consultants concerned.

2 The water sector in Egypt

Water resources

Egypt is an arid country with an average rainfall of less than 200 mm along the northern coast to almost nil south of Cairo. The river Nile is the only source of surface water and has provided the basis of agricultural development in Egypt for more than 5000 years. Under the terms of the International Agreement for the Full Utilisation of Nile Water, Egypt receives 55.5 billion m^3 of water per annum. The actual supply is greater, as some 5 billion m^3 of the annual quantity is re-used after having been discharged into the drainage system. In addition, some 2.6 million m^3 of groundwater is extracted for drinking water purposes and for supplementary irrigation along the fringes of the Nile Delta and Valley.

Egypt's water demand is known with less certainty than its supply. It is estimated that some three-quarters is for crop consumption or evaporates, one-fifth drains to the sea, while the remaining part is divided almost equally between industrial/domestic use and river transport. Per capita availability dropped from 2100 m^3 per annum in 1960 to less than 1000 m^3 per year in 1995. The present figure is generally considered to characterise a 'water stress' situation. Under the circumstances, pressure on available water resources has increased substantially. While demand by the non-agricultural sectors has grown, the total quantity available for agricultural use has remained almost constant throughout the last twenty years. Increased agricultural demand has been met by increasing irrigation efficiency, re-use of drainage water, and complementary groundwater extraction.

Agriculture

Historically, the agricultural sector has always been a major contributor to the Egyptian economy, providing the bulk of employment and output, and crucial to government revenue and foreign exchange earnings. In the early 1970s, however, the pace of agricultural growth declined due to the limited water and land resource base and to pervasive government intervention in agricultural pricing, production and marketing. Investments in agriculture, irrigation and drainage infrastructure fell from 25% of total investments in the mid-1960s to less than 6% in the mid-1980s. Significant reforms of agricultural policies began to be introduced in the 1980s. The cropping area allocation system was abandoned, delivery quotas and price and exchange rate subsidies were abolished, and cost sharing by beneficiaries was introduced in irrigation and drainage in newly-reclaimed agricultural lands. Since the beginning of the liberalisation process important gains have been made in food production and crop levels are now comparable to standards in developed countries. Production increases have enabled the country to reduce or stabilise imports of basic foodstuffs for a number of years, in spite of population increases.

Because of improvements in other sectors of the economy, the agricultural sector's share in GDP dropped from 30% in the early 1970s to less than 20% in the 1990s. That low percentage underrates the socio-economic importance of the sector, which continues to employ 35% of the labour force and contributes about 25% of the value of merchandise exports.

Farms in Egypt are generally small: one-third are of less than 0.5 feddan (0.2 ha) and 40% is smaller than 2 feddan (0.8 ha). About 60% are owner-operated. The balance of farming households rent or sharecrop land to provide employment and income to their members. Households with small farms have to supplement their income through off-farm employment.

Irrigation and drainage

Egyptian agriculture has depended on the annual flooding of the Nile since around 3000 BC when irrigation was first started, including deliberate flooding and drainage by sluice gates and dikes. The system underwent only marginal changes until the first half of the 20th century, when tremendous improvements were introduced. The first Aswan Dam and a series of barrages were built on the Nile to hold up low summer water levels and to allow for the introduction of perennial irrigation. In the 1960s the High Aswan Dam (HAD) was completed, protecting the land from devastating floods and further increasing the irrigated area. Since the early 1950s some 1.6 million feddan (650,000 ha) have been reclaimed. Yet the net total cultivated area did not increase substantially because roughly 1.2 million feddan (500,000 ha) of old lands were lost to urban encroachment. As a result, the cultivated area served by the irrigation network increased marginally to some 5.7 million feddan (2.4 million ha).

The Egyptian irrigation system is one of the oldest in the world and is characterised by its dependency on a single source, i.e. the river Nile. The system has always been centrally controlled and technological innovations caused the expansion and increasing complexity of the institutions involved. The irrigation system is formed by a series of command areas or sub-systems, each served by a main canal. These supply water to secondary canals which in turn feed clusters of farms through off-takes to a tertiary delivery system or 'mesqa' serving 50 to 500 feddan (20 to 200 ha). In principle, water supply is allocated on the basis of estimated cropping patterns and then adjusted in response to requests and complaints. Except in Fayoum and some small areas elsewhere in Egypt, water is supplied below groundwater level, obliging farmers to lift water onto their land. The cost of doing so discourages excessive use of irrigation water by individual farmers.

Drainage became urgently necessary after the introduction of perennial irrigation. Historically, Nile water contained a very low concentration of salt and the annual floodings of the valley also flushed salt from the soils. As a result of several decades of perennial irrigation, however, the water table gradually rose with a consequent increase in soil salinity. At the beginning of this century a system of open drains was constructed. It was not effective because water was not sufficiently drained from the fields and maintenance was inadequate. Research was initiated in the late 1930s to appraise the advantages of covered field drainage and experiments were fairly successful. The covered field drainage system consists of a network of lateral and collector drains. Lateral drains are of corrugated and perforated pvc pipes, which discharge water into collectors and subsequently into open drains. Collectors drains are generally constructed of plain concrete pipes The drainage operation requires pump stations at various locations: at present there are 76 main and 23 minor pump stations.

In 1973, a specialised agency, the Egyptian Public Authority for Drainage Projects (EPADP), was set up with overall responsibility for implementing drainage works. By the end of 1994, the total area with installed field drains slightly exceeded 4 million feddan, roughly 60% of the total cultivated area. The figure is increasing annually by 170,000–190,000 feddan. The programme is the largest of its kind in the world.

Institutional framework

The Ministry of Public Works and Water Resources (MPWWR) has overall responsibility for appropriating and distributing water and for managing drainage and groundwater. It is also responsible for controlling the inflow of pollutants into public waterways. At present, the Ministry employs some 88,000 people including an engineering staff of some 2400. It is organised in Authorities and Departments, most of which have regional Directorates. The Irrigation Department is by far the largest unit, currently employing some 39,000 staff or about 45% of all employees of the Ministry. The Authority for drainage projects EPADP is responsible for implementing all drainage projects and for maintaining the open and sub-surface drainage system. The National Water Research Centre (NWRC) is a separate unit in MPWWR, responsible for all research activities carried out through eleven affiliated research institutes.

Water sector policies

The government's decision to reclaim large amounts of new agricultural lands made it necessary for the MPWWR to elaborate a comprehensive strategy for the effective use of water resources. During the early 1980s long-term planning tools were developed and alternative scenarios worked-out for future water supply, based on various rates of agricultural development and water use increases. The planning effort culminated in the national Water Master Plan of 1986, for which the World Bank was the executing agency. This Plan made recommendations for future activities and developed a set of mathematical models for water resources planning. The exercise revealed that local capacity for policy formulation required further improvement. In particular, co-ordination among policy-making bodies appeared to be problematic. The water resource management strategy also placed greater weight on economic and environmental aspects.

In policy implementation the improvement of existing irrigation and drainage systems remained the most important priority. This included measures to increase irrigation efficiency and to expand the drainage system. Recently the Egyptian Government has come to recognise the benefits of privatisation and user participation in managing and maintaining

water facilities and operations. In the period 1993–95, Water User Association and the Irrigation Advisory Service legislation was introduced and applied on a pilot scale to enhance participation and effectiveness in water management at the tertiary level. Reforms have not yet been initiated in the area of pricing but the cost recovery of improvement measures (such as drainage) has received more attention. Water supply expansion was given political priority; pricing and demand management received less attention.

Main problems

The main problems were partly technical, partly institutional in nature. The most pressing technical problem confronting Egypt's irrigation system is the limited control over water supplies: many structures are only partially functional, and deficiencies are apparent in system management. Improved management of the irrigation system would reduce the need for drainage. Options for improvements are limited, however, because: (i) most irrigation canals are below ground level and irrigation water is pumped privately by farmers; (ii) the age-old irrigation rotation system would need to be altered; and (iii) investments in irrigation structures and improvement of their operation would need to be throughout the entire system, probably resulting in higher costs than the construction of localised pipe drain systems.

With respect to drainage, the government has progressively developed design criteria that are adapted to the country's specific conditions. Further improvements are still needed in technical design, construction management and quality control, techniques for the rehabilitation of old systems, monitoring and the evaluation of maintenance and operations.

Several institutional constraints affect efficient water management. The expansion of the Ministry of Public Works' elaborate organisational structure resulted in sectors and departments being created according to need. In the process, it also led to duplication of tasks and infrastructural facilities. The substantial investment needed to build and strengthen research capacity now awaits the formulation of policies, which will facilitate the communication of needs to researchers. Furthermore, the centralisation of decision-making makes the process of co-ordination and exchange of information within and between ministries unnecessarily bureaucratic. Committees have been formed to improve co-ordination among agencies. Finally, the dominance of civil engineers in MPWWR's professional staff has led to top positions being reserved for them. The lack of non-engineering skills has considerably increased the need for training in such specialisations as economic and financial analysis and management.

Donor support

Since the early 1950s, the Egyptian economy has benefited from extensive external donor support, a substantial part of which has been spent on activities in the water management and drainage sector. USAID and the World Bank have been the principal donors in that sector. USAID support focused on irrigation improvement, contributing to an integrated research project to test farm level improvements in water delivery. It also supported a massive investment programme for physical improvement of the irrigation and drainage infrastructure, including a contribution to the construction of 37 pumping stations, the supply of three pvc pipe factories, and dredging and earth moving equipment. In addition, USAID recently sponsored a comprehensive institutional analysis of the MPWWR in an attempt to contribute to an Action Plan for Strengthening Water Resource Management.

The World Bank has been heavily involved in the formulation and execution of Egypt's national field drainage programme. Since 1970, it has supported implementation of six drainage projects. Moreover, it served as executing agency for two UNDP-funded projects, i.e. the Water Master Plan and the Irrigation Rehabilitation project, and co-ordinated the drafting of the Egyptian Environmental Action Plan. Apart from USAID and the World Bank, the Netherlands, Canada, Germany, Japan, Italy and the EU all supported activities in the water sector although to a far lesser degree. The Netherlands was responsible for 10–15% of assistance of the two main donors to the sector.

3 Netherlands assistance

Egypt has been eligible for bilateral aid from the Netherlands since 1975. Discussions between individual Egyptian ministries and various technical missions have yielded a series of projects, mostly in the field of land drainage and irrigation. Activities were planned and implemented on a project-by-project basis, some 25 in total during the period 1975–96. Many projects initiated during the first ten years ran into implementation problems, and the timely disbursement of aid was a serious concern.

The introduction of the four-year country programming system in Netherlands development co-operation in the mid-1980s did not bring a more detailed formulation of policy. The relevant sections of country programme documents are characterised by rather general statements, justifying the support on the basis of the importance of the Egyptian irrigation sector for food production, the crucial role of government institutions in the sector, the need to strengthen research and managerial capacity, and the complementarity of Netherlands expertise.

In essence, the development co-operation programme in the Egyptian water sector has been one of technical assistance, seeking to improve the performance of key research institutions and governmental agencies indirectly or directly involved in water resources management. During the early stages of the programme, when the sector portfolio was restricted to three projects, the annual assistance volume varied between Dfl. 4 and 5 million. By 1986 the portfolio had grown to ten projects and the annual disbursement rate had roughly doubled to Dfl. 10–11 million. It stayed basically at that level during the last 10-year period.

Financial contributions by the Netherlands to the water sector over the period 1975–95 totalled some Dfl. 160 million. The composition and evolution of the sector project portfolio is summarised in Table 1.

Table 1 Netherlands contribution to the Egyptian drainage water research and water management sector 1975–96 (in Dfl. 1,000)

	1975–80	1981–85	1986–90	1991–96	TOTAL	%
ADVISORY PANEL ON LAND DRAINAGE						
Phases IV–VI (1983–96)	0	1,659	3,610	1,593	6,862	
Subtotal		1,659	3,610	1,593	6,862	4.3
DRAINAGE RESEARCH INSTITUTE						
Advisory Panel on Land Drainage Phases I–III	2,657	2,793	0	0	5,450	
Associate experts	729	1,148	0	0	1,877	
Drainage Technology and Pilot Areas	0	854	2,322	1,793	4,969	
Re-use of Drainage Water	0	2,831	2,075	3,124	8,030	
Drainage Research Programme	0	0	0	2,515	2,515	
Re-use Monitoring Programme	0	0	615	276	891	
Monit. and Analysis of Drainage Water Quality	0	0	0	1,155	1,155	
Associate experts	0	0	1,809	448	2,257	
Subtotal	3,386	7,626	6,821	9,311	27,144	17.1
RESEARCH INSTITUTE GROUNDWATER						
Hydrological Training Programme	0	2,700	1,400	0	4,100	
Development and Management of Groundwater Res.	0	0	5,421	2,007	7,428	
Environmental Management of Groundwater Res.	0	0	0	3,055	3,055	
Vertical Drainage Study	0	0	450	0	450	
Feasibility of Groundwater Development.	0	0	858	114	972	
Pump sets	0	0	205	1,068	1,273	
Control of Waterlogging and Salinization	0	0	0	2,481	2,481	
Associate experts	0	0	0	312	312	
Subtotal	0	2,700	8,334	9,037	20,071	12.7
CHANNEL MAINTENANCE RESEARCH INST.						
Aquatic Weed Control	6,720	700	0	0	7,420	
Gras Carp	2,171	2,572	0	0	4,743	
Delta Breeding Station	0	3,560	170	513	4,243	
Subtotal	8,891	6,832	170	513	16,406	10.3
HYDRAULICS RESEARCH INSTITUTE						
Hydraulic Studies	0	0	3,275	5,857	9,132	5.8
SUB-TOTAL RESEARCH INSTITUTES	12,277	17,158	18,600	24,718	72,753	45.9

(Table 1 continued)

	1975–80	1981–85	1986–90	1991–96	TOTAL	%
EPADP DRAINAGE EXECUTION						
East Bahr Saft drainage	7,427	2,417	23	0	9,867	
Drainage V	0	0	6,125	3,752	9,877	
PVC raw material	0	1,855	1,125	0	2,980	
Drainage Executive Management	0	640	5,003	13,267	18,910	
Associate experts	0	0	0	260	260	
Subtotal	7,427	4,912	12,276	17,279	41,894	26.4
FAYOUM WATER MANAGEMENT						
Fayoum Water and Salt Balance Study	0	1,013	642	0	1,655	
Batts Pumping Station	0	0	5,374	1,474	6,848	
Fayoum Water Management and Drainage Impr.	0	0	2,030	3,645	5,675	
Fayoum Weed Control	0	0	3,605	3,849	7,454	
Fayoum Water Management	0	0	0	10,496	10,496	
Associate experts	0	345	232	518	1,095	
Subtotal	0	1,358	11,883	19,982	33,223	20.9
OTHER						
Strengthening MPWWR Planning Sector	0	0	0	3,034	3,034	
National Water Quality Monitoring Network	0	0	0	682	682	
Other	0	28	211	6	245	
Subtotal	0	28	211	3,722	3,961	2.5
GRAND TOTAL	19,704	25,115	46,576	67,298	158,693	100.0

Slightly less than half of total funding was spent on support to four research institutes operating under authority of the National Water Research Centre, i.e. the Drainage Research Institute (DRI), the Research Institute for Groundwater (RIGW), the Channel Maintenance Research Institute (CMRI) and the Hydraulics Research Institute (HRI). The remainder was devoted to general and direct advisory support to the water management and drainage sector. With the exception of three capital investment contributions (Dfl. 23 million), disbursements covered the cost of institutional support to the Egyptian Public Authority for Drainage Projects (Dfl. 19 million), the Fayoum Governorate/ Irrigation Department (Dfl. 33 million),) and the Ministry of Public Works and Water Resources in general (Dfl. 11 million). Since the late 1980s, emphasis in disbursements has shifted more towards implementation and governorate level activities.

Technical assistance packages have invariably consisted of a relatively large manpower or consultancy component which included on-the-job training (65%), infrastructural investment such as cars, computers and measurement equipment (some 20%), local operational cost financing including salary supplements in the form of so-called incentives (10%), and general manpower training support (5%). The majority of the packages were contracted-out to Dutch consulting firms under the technical assistance procedure. In most cases, tender requirements were waived and contracts were awarded directly to the Netherlands in-house or partner consultant. Through the regular 3–5 year project formulation process,

long-term co-operation relationships developed with the target organisations. In the case of DRI and EPADP the co-operation dates back to 1976, in other cases assistance has been provided for periods of 10–13 years.

Background information and evaluation findings of assistance to the drainage and water management sector are grouped under four main categories of activities: the Advisory Panel on Land Drainage, research support, drainage execution support and the Fayoum water management programme.

4 The Advisory Panel on Land Drainage

The Advisory Panel on Land Drainage Project (APLDP) was initiated in 1975, shortly after the Egyptian–Netherlands bilateral co-operation programme was formally launched. The original objective was to assist the executing agency EPADP in planning the field drainage programme, in introducing new technologies, in designing and monitoring/evaluating the programme, and in training Egyptian nationals in the various fields of expertise.

Between 1976 and 1982 the project had two components: research on drainage supported by a team of resident engineers, and advice on the implementation of drainage works by a panel of high level experts. The research project focused its attention on building up a drainage research capability. That objective was achieved in the sense that the Drainage Research Institute became the country's leading research institution in the field of land drainage. The project encouraged the setting-up of a drainage water measurement network, which formed a valuable contribution to the government's policy of making optimum use of scarce water resources.

The impact of the six years research effort on the execution of drainage works was limited. Firstly, the technical and economic feasibility of a modified field drainage design for rice-growing areas was rejected by EPADP. Secondly, the outcome of the pilot areas research (to assess the impact of field drainage) was delayed for six years. Thirdly, the economic evaluation programme was discontinued prematurely after early withdrawal of Netherlands financial support.

During this period, the Panel advised EPADP on a wide variety of issues affecting execution of the drainage programme supported by the World Bank. Its impact on the execution of drainage works focused on technical matters such as abandoning the use of gravel envelopes on drainage pipes in heavy clay soils and promoting the general application of pvc pipes for lateral drains. The rather technical advice did not focus on the main problems in the execution of drainage works, which were primarily organisational

and financial. The drainage programme was affected by substantial administrative delays in procuring and commissioning equipment, shortage of complementary national funding, inadequately trained staff and deficient contractor performance.

Between 1983 and 1996, the Panel functioned mainly as a project co-ordinating, monitoring and evaluating entity in the water sector, providing technical and managerial support and guidance to the drainage research programme. In general, it proved a useful conduit between the hierarchical and centralised structures that dominate Egyptian bureaucracy. Its potential was not fully utilised owing to the dual function held by a number of Panel members who had a direct interest in execution of the programme, its limited expertise in certain areas (Fayoum water management and computer modelling) and the restriction in the scope of work to activities funded by the Netherlands.

In the period 1983–96, the Panel project continued to provide a framework for the monitoring, guiding and co-ordination of water sector projects financed by the Netherlands. Its effectiveness and impact was subject of considerable debate. Apart from creating an environment for better project execution, at the level of the Panel (and both evaluation missions), the project was thought to have substantial material but unquantifiable benefits through a higher return on investments in research, training and field projects. At the level of the field projects and outside the Panel's immediate sphere of influence, however, there was generally little appreciation of its work and impact. On the whole, it is felt that its potential was not fully used because: (i) many of the members were direct stakeholders in the execution of the programme; (ii) it had limited expertise in modelling and specialised fields of work other than drainage.

The restriction of its scope of work to Netherlands-financed activities and problems related to these activities, reduced the Panel's potential role in policy design and formulation. While a number of policy issues were discussed indeed, the actual policy and legislative framework in the drainage and water management sector was basically conceived under USAID and World Bank covenants without explicit involvement of the Panel.

5 Water research

Background

During the twenty years of development co-operation between Egypt and the Netherlands in the water management and drainage sector, about 45% of total disbursements were channelled to four of the eleven research institutes under the National Water Research Centre, namely the Drainage Research Institute, the Channel Maintenance Institute, the

Research Institute for Groundwater and the Hydraulics Research Institute. The support varied in intensity, type and duration for the various institutes. The Drainage Research Institute was the main recipient with Dfl. 27 million over the two decades; the Hydraulics Research Institute was the smallest recipient of the four with some Dfl. 9 million.

The approach has basically been project-based. In the absence of a clearly-formulated research strategy for the sector, a series of individual technical assistance projects was identified. Co-operation with the four research institutes was based on initiatives of the expert panel and consultants in the Netherlands rather than on a comprehensive inventory of the tasks and responsibilities of the various institutes under the National Water Research Centre. The relevance of those tasks to the main constraints in the sector and the objectives of Netherlands development co-operation policy were not clarified prior to the beginning of support to individual research institutes.

For three institutes, research was not client-driven and research agendas were basically set by the institutes themselves, by the Advisory Panel, consultant or donor through regular project cycle procedures. In contrast, the research agenda of HRI was demand-driven, and fulfilled the need for expert advice in the field of hydraulics engineering.

For all institutes donor support emphasised the transfer of technical know-how, with little attention given to a broader type of institutional strengthening. During recent years this situation has changed and for both the DRI and RIGW the support now gives more attention to manpower development and management issues.

Effectiveness

The support provided to the four research institutes contributed to their establishment and technical strengthening and to the development of valuable research capacities in the water sector. In terms of technical know-how, the four became the leading national research organisations in their respective fields. Researchers also gained stature in the international scientific community and developed a valuable network of international contacts.

Many research activities were of an innovative nature, such as the development of mathematical models to assess the impact of water management scenarios and the new hydrographic survey and data processing techniques. The modified drainage design research, the introduction of new mechanical and biological weed control methods, and grass carp technology, were also innovative in the Egyptian context and may have hampered contacts with implementing agencies and the application of results. Over the years, the focus

of research has evolved from drainage technology to the re-use of drainage water and, subsequently, to integrated water management and environmental aspects.

The research effort brought a wealth of data on groundwater potential, hydrogeological maps and groundwater development plans. The setting-up and maintaining of a monitoring network on drainage water quantity and salinity was also an important achievement. Results of the research have been published in an impressive number of publications and contributions to international conferences. At the policy level, the research has raised the government's awareness of groundwater resources and of the potential for re-using drainage water.

The ultimate yardstick for assessing effectiveness is the impact of the research on the concrete policies and activities of executing organisations. The establishing of a drainage water monitoring network and the production of hydrogeological maps have been the most fruitful activities. The former contributed to government policy in optimising the use of available water resources through the construction of re-use pumping stations. The groundwater maps, produced at the explicit request of the Ministry of Public Works and Water Resources, play an important role in licensing groundwater extraction and the planning of land reclamation schemes in desert areas. Furthermore, the impact of hydraulics research is indicated by its practical use for clients of the Hydraulics Research Institute. Most of that research has been commissioned to support investment projects in the field of power generation and infrastructure. River sediment and hydraulics studies have played an important role in maintaining navigability on the river Nile.

In contrast to these positive effects, drainage research had little impact on the progress and quality of the field drainage programme. The mathematical re-use model exercise has not yet been used in water resources planning. Hardly any use has been made of the groundwater development plans while the vertical drainage and grass carp research programmes were terminated after ten years without practical application.

The principal reasons for this rather disappointing effectiveness of research activities were the following:

- The outcome of the research often confirmed current practices in Egypt or the findings of similar types of research elsewhere in the world (pilot areas research).
- The long period needed to undertake the research and the late availability of research findings (drainage criteria and synthetic envelope research).
- The scientific and innovative nature of the research and the rather complicated presentation of research findings, insufficiently adapted to the practical needs of executing agencies (data books without analysis, complex mathematical models, too detailed and specific envelope material specifications).

– Insufficient co-ordination with executing agencies in designing the research and in carrying-out practical experiments (construction of pilot research areas, grass carp stocking experiments).

Efficiency

The efficiency of the support to research institutes is assessed with regard to the main phases of the project cycle: preparation, implementation, and monitoring and evaluation. In general, efficiency was fairly low.

Project identification and formulation took a substantial amount of time and manpower. Documents did not clarify the role of organisations involved in the sector which had to provide complementary support, such as executing agencies under the Ministry of Public Works and Water Resources and the Ministry of Agriculture. Usually, documents did not include a review of available manpower resources, needs for training and other forms of manpower development for the institutions involved, or of the activities of other donors. The programming of project activities and output was often over-optimistic and paid little attention to institutional constraints.

The project concept was adequate in terms of composition of the package of activities and, in general, responded to the needs of the institutes. For all institutes, it combined long-term on-the-job technical training, complemented with short-term advisory missions and investment support in office equipment, laboratory and field instruments, and transport facilities. The relative weight of the various components differed per institute: for the Drainage Research Institute and the Research Institute for Groundwater there was a heavy component of resident consultants over a long period of time, for the Hydraulics Research Institute the emphasis was on short-term specialised missions. The latter form appeared to be much more cost-effective. Project design did not usually contain phasing-out arrangements and a gradual increase in the sharing of recurrent costs by the recipient organisation. Finally, project design did not include any strategy for the mobilisation of various crucial executing agencies in field experiments and in the application of research results.

With the exception of the Hydraulics Research Institute, implementation was characterised by serious delays and the consequent sub-optimal use of available manpower and financial resources. The main reasons for such delays were over-optimistic planning, shortcomings in project formulation, and inadequate implementation arrangements with supporting government agencies. The rigid organisational structures and the often detailed bureaucratic regulations in Egypt's public sector also played a role. By and large, working relations between the staff of the institutes and expatriate consultants were good and consultant teams included competent and highly motivated local and expatriate experts.

Monitoring was rather weak. The Netherlands Embassy relied primarily on the judgement of the Advisory Panel, which was not officially assigned with a monitoring task until 1983. Later, it was hampered in executing that task as it consisted largely of persons who, in one way or another, were involved in the implementation of activities. In several cases the setting-up of a special Steering Committee improved the quality of monitoring. Monitoring improved after a Sector Specialist was stationed at the Netherlands Embassy.

Evaluations did little to adjust the research programmes or to increase effectiveness. During the first decade of Netherlands support, activities were not evaluated. Thereafter, evaluations were directed largely towards project extension rather than assessing achievement of objectives. Since the early 1990s, evaluations have improved considerably, but in several cases they were insufficiently followed-up (pilot areas/vertical drainage research programme evaluations).

Sustainability

Sustainability has been defined as the potential to maintain the achievements of development aid in terms of financial viability, appropriateness of technology and institutional capability.

By and large, sustainability of research support is uncertain. The support programme focused mainly on the transfer of technical know-how with little attention being given to the long-term issues of overall institutional strengthening and financial viability. Among the most important conditions for maintaining high quality research capability are the design of good research policies, the obtaining of funding and commissioned research, and the developing of structural relationships with clients. The National Water Research Centre recently produced a long-term and comprehensive research plan for its affiliated institutes, which forms the basis of government funding. In addition, most institutes have expanded their volume of contract research in recent years. The Hydraulics Research Institute has been able to build up a structural relationship with its clients and to reduce its dependency on government budget allocations and donor support. For the research institutes, sustainability will primarily be contingent on developing and consolidating a market niche in applied research inside the country and then extending it abroad.

The focus on the transfer of technical know-how explains the limited attention given to long-term sustainability such that the continuity, learning effects and the constituency of

research are guaranteed. Recently, the Egyptian and Netherlands governments decided to address this problem. By integrating an Organisational Strengthening Programme and specialised generic skills with regard to organisation and management in the on-going co-operation programme with the drainage and groundwater institutes, efforts are being made to consolidate research capability. Some factors that influence sustainability are partly outside the control of research institutes. These include central decision-making procedures, rigid staff and career development policies and inadequate staff compensation. Although improved management practices may bring temporary and partial solutions, these problems can only be addressed in the wider context of civil service reform.

6 Drainage execution

Background

The Egyptian Public Authority for Drainage Projects (EPADP) is charged with constructing and maintaining the country's drainage infrastructure. Some functions are centralised at its headquarters in Cairo, but most of the implementation is delegated to regional Directorates. At present, EPADP employs about 6600 permanent staff, compared to 3600 in the early 1970s when the field drainage programme was launched. In principle, EPADP provides public and private sector contractors with self-produced pvc and cement pipes and self-imported drainage construction equipment for the execution of drainage works. EPADP recovers equipment costs through pay certificates issued to contractors, according to progress of the works.

Over the years, a division of activities in donor support has developed. The massive investment component of the national drainage programme was covered under World Bank and Egyptian Government financing. The Netherlands provided funds for technical assistance to improve EPADP's construction planning and management practices and to raise its drainage system design and supervising capabilities. During the initial 1976–82 period, indirect support was provided through short-term consultant missions, planned and organised under the umbrella of the Advisory Panel. In 1983, the Training Programme for Drainage project heralded the beginning of a long-term training-cum-manpower development effort—the Drainage Executive Management project—which started in 1986 and is currently in its fourth phase (which ends in 1998).

Technical assistance has been complemented with direct investment support for EPADP's field drainage programme. In the East Bahr Saft Project and the Drainage V co-financing arrangement with the World Bank, the Netherlands contribution covered the cost of procuring drainage construction machinery, a pvc pipe production unit and spare parts.

By the end of 1996, the Netherlands financial contribution totalled almost Dfl. 42 million, of which Df 23 million was for direct investment and some Dfl. 19 million for technical assistance.

Effectiveness

Since its establishment in 1973, EPADP has evolved into a technically capable and relatively well-managed authority for constructing and maintaining the national drainage network. The support provided between 1976 and 1982 under the panel project was too scattered to have any lasting impact on performance. After 1983 the technical assistance programme financed by the Netherlands was instrumental in training substantial numbers of junior and senior engineers and contractors' personnel. Until recently the focus was on the transfer of technical know-how and little attention was given to the broader range of institutional constraints that affect EPADP's performance. Since the early 1990s the agency has addressed certain institutional constraints and made a beginning with formulating a long-term manpower development plan.

In general, EPADP and contractors staff appreciated the training, which was also seen as a means to boost working morale and motivation. By far the most important achievement was the establishment of a sustainable in-house technical training facility.

Investment support (East Bahr Saft, Drainage V) made a small contribution to implementation of the national drainage programme, enabling the ultimate objective of installing field drainage in the planned area to be achieved. After completion of the works there was no follow-up by DGIS. In the absence of an effective monitoring system, no information is available on construction quality and the functioning of the system since that time. The drainage machinery was reported to have been transferred to public and private contractors. The pvc pipe factory was a good investment; almost 13 years old, it is now near the end of its technical and economic life and on the point of being decommissioned.

World Bank appraisal documents see a positive impact of technical assistance on performance, but the actual evidence of such an impact is rather thin. The goal of speeding-up the implementation of the field drainage programme through new technology and improved management has recently been achieved. Since 1993, the average annual rate of implementation slightly increased from the pre-programme level of 170,000 feddan (71,000 ha) to 190,000 feddan (80,000 ha) but remained far below the original planning target of 300,000 feddan (120,000 ha).

It may be expected that construction standards have also improved, due to training and experience gained. Firm conclusions with respect to quality are hindered by the lack

of uniform standards of quality control. Nor is there statistical evidence that drainage equipment has been better maintained or utilised by contractors over the years.

The ultimate objective of sub-surface drainage is to increase yields through improving crop production conditions by lowering groundwater tables and decreasing or eliminating salinity problems. Farmers' demand for drainage and various studies including World Bank appraisal documents, indicate increased yields and better farm income in areas with field drainage. Attempts to assess economic benefits more accurately have failed, however, and the question of the financial and economic viability of the national drainage programme cannot be answered accurately.

Efficiency

The efficiency of support to the drainage and water management sector was rather low. In general, project preparations were superficial and insufficiently based on systematic assessment and analysis of the EPADP organisation and of its sectoral and national policy framework. The identification and formulation of the two investment projects was particularly scanty. The East Bahr Saft was not supported by cost–benefit analysis or by a comprehensive review of equipment availability and needs. The Drainage V co-financing contribution was covered formally under the World Bank appraisal. During implementation the composition of the equipment package was frequently revised. In addition, the rationale for the co-financing contribution was rather obscure given that funding of the project was already secured and the loan agreement signed, before Netherlands support was agreed upon.

The concept of technical assistance was satisfactory insofar as it provided not only for the transfer of technical know-how but also for building up a self-sustaining, in-house training and human resources development capability. The programme was characterised by excellent working relations between EPADP staff and the consultants. The projects focused principally on the development of technical skills, however, and were ill-designed to deal with the broader range of institutional issues constraining EPADP's performance. Throughout the period, training programme implementation was affected by problems in recruiting consulting staff and by delays in obtaining administrative approval of project documents. Implementation of the two sector investment projects was erratic and inefficient. In both the East Bahr Saft and Drainage V cases, the procurement of machinery and equipment was delayed by cumbersome practices, partly due to donor intervention while the quality of project execution was disappointing.

Sustainability

Sustainability of the drainage programme is related to cost recovery and to institutional capabilities There have been intensive discussions between the World Bank insisting on full recovery of drainage costs, and the Egyptian Government which was unwilling to put any additional financial burden on the farming community. In time, the government introduced legislation under which the investment costs of field drainage would be recovered without interest over a 20-year period, starting one year after implementation. The amounts collected in this way increased significantly over time. In 1994 roughly 86% of the total amount due was recovered through the regular tax collecting system. Plans to recover also operation and maintenance costs by raising the land tax were cancelled because they were politically not feasible. Moreover, EPADP has no control over the recovered funds and remains entirely dependent on central government budget allocations.

At the organisational level, the long-term effectiveness of technical training is a point of concern. The assistance effort has focused primarily on the transfer of technical know-how and EPADP's capability has structurally improved in that respect. Until recently, little attention was given to overall institutional strengthening or to changes in the management environment in which EPADP continues to operate. The main institutional issues that constrain EPADP's performance are rigid staffing and career development policies, complex internal management systems, and problems of co-operation and co-ordination with other government agencies. These are issues that affect the functioning of all MPWWR-related institutions.

7 Fayoum water management

Background

The Fayoum is a depression in the Egyptian Western Desert, 90 km south-west of Cairo with sharp topographical and hydrological boundaries. The land slopes from 25 m above sea level in the south-east to 43 m below sea level at Lake Qaroun. The water for Fayoum is diverted from the Nile at Assiout and enters the Fayoum through two main intakes, the Bahr Youssef and the Bahr Hassan Wasef. Irrigation is mainly by gravity, with a continuous supply of water to rotational units that vary between 8 and 200 ha.

Fayoum is inhabited by almost two million people who are largely dependent upon agriculture, the backbone of its economy. The cultivated area is now in the order of 150,000 to 160,000 ha. Roughly 90% of the land is owned by some 125,000 farming families. Land distribution is rather skewed: 10% of the holders own 45% of the land.

The remaining 90% have no more than 0.6 ha on average. Moreover, over one-third of rural households is landless and share cropping and off-farm employment are common for small farmers. Agricultural practice is very intensive and highly dependent on an effective supply of irrigation water. By the early 1990s almost half of all households were estimated to fall below the poverty line of LE 3160 per annum.

Until 1950, Fayoum's water balance was largely in equilibrium. The supply of irrigation water corresponded more or less with cropping and leaching requirements, and the saline drainage water flowing into Lake Qaroun via two natural streams was roughly equal to the annual quantity that evaporated from the lake. In time, the water and salt balance started to deteriorate as the annual intake of irrigation water was increased to meet the demand of additional reclaimed land and to stimulate cropping intensification. Irrigation efficiency remained low, much of the additional water ultimately drained into Lake Qaroun whose level rose at an alarming rate. To restore the balance, a new drainage outlet was built to the Wadi Ryan depression which now takes 30% of the total discharge. At present, about two-thirds of the Fayoum has a relatively well-functioning open drainage system; one-third must be complemented with subsurface drainage, the installation of which is on-going. In the meantime, soil salinity and soil alkalinity problems are on the rise and affect agricultural productivity, especially in the lower parts of the depression.

The complex and not always transparent water allocation system results in an uneven geographic distribution of irrigation water. The main reasons for this are: the problematic nature of advance planning of water supply in accordance with crop needs, the universal problems of tail-end irrigation, the poor condition of canals and other structures, and the system management which tolerates excess supply draining to the Wadi Ryan depression in order to avoid any extra rise in the Lake Qaroun level. Even more serious distribution problems are manifest at the secondary level, mainly due to neglected structural maintenance and to successful but illegal attempts by farmers to change hydraulic conditions in their favour. At the tertiary or mesqa level there is also room for improvement of water use: in certain areas tertiary canals are insufficient in capacity, in other parts there is excessive spillage of irrigation water into drains. There is also scope for improved maintenance of irrigation and drainage canals.

Netherlands support

Netherlands support to the Fayoum water management sector was intended to assist the Fayoum Irrigation Department in improving the operational aspects of irrigation and drainage management, with a view to increasing water use efficiency and, consequently, agricultural production and farm income. The Netherlands' involvement in the Fayoum

dates back to the late 1970s when support was given to the Batts Pumping Station project and the Water and Salt Balance Study. The former provided technical assistance and direct financial support for the design and construction of the biggest re-use pumping station in the area. The second was instrumental in setting-up a water monitoring network and in developing a set of computer models to assess the impact of different water management scenarios on the area's delicate water and salt balance. In the second half of the 1980s another two projects were launched: the Water Management and Drainage Improvement Project, a sequel to the Water and Salt Balance study, and the Weed Control project. The former addressed the basic water distribution problems and irrigation efficiency of the Fayoum irrigation system. The latter was meant to assist the Fayoum authorities in testing and setting-up a comprehensive irrigation channel maintenance organisation. In 1993, the two projects were extended and merged into the ongoing Fayoum Water Management Project.

The total financial contribution to the Fayoum water management and drainage sector for the period 1975–96 amounted to some Dfl. 33 million. Somewhat less than one-quarter of this was for investment in the Batts Pumping Station; the bulk of the support was for a series of technical assistance projects. Of the latter, approximately 60% went to consultancies, 27% to investments; and the balance was more or less equally divided over transport, operational costs and formal training.

Effectiveness

It is too early to assess accurately the effectiveness of the support to the Batts Pumping Station. Since its completion in 1993 it has been kept in good operational condition and is functioning to satisfaction. It has been operating at some 50–65% of its capacity during the summer period and at some 30% during the rest of the year when water demand is low. Pending the completion of a 10,000 feddan reclamation scheme, the recycled water is used by an unknown number of farmers in the reclaimed area and by some 400 to 500 on the old lands No quantitative information is available on benefits derived from the extra water supply, but the much higher than expected salt content of the drainage water is a major constraint for the choice of crops and the increase of yields. Contrary to the plan, the area has so far not been provided with a field drainage system and is seriously threatened by increasing salinisation.

The technical assistance projects addressed the more technical issues of inequity and effectiveness of water distribution in the main system by: (i) establishing a well-functioning monitoring network, and building a mathematical water management model, (ii) rectifying major bottlenecks in the distribution network, (iii) introducing improved methods of

mechanical and manual weed control, and (iv) carrying out on-farm studies and testing of integrated water management techniques in selected pilot areas.

The monitoring system has been extended and refined to such a level that it allows for timely adjustment of the water flow to crop demand in the main distributaries of the system. Unfortunately, water demand for the various command areas cannot yet be established precisely, due to incomplete and inaccurate data on cropping patterns and to co-ordination problems between the Fayoum Irrigation Department and the Ministry of Agriculture.

The Fayoum Operational Water Management model, which simulates and evaluates the water and salt management of the irrigation system, is a valuable instrument for better water management. Whether it will continue to be used is doubtful; neither the office of the Under-Secretary of State nor the Fayoum Irrigation Department has developed a planning tradition in which use of the model is firmly embedded.

The assistance has familiarised the technical staff of the Irrigation Department with the preparation of new designs and re-construction of main irrigation structures. Applied research has exposed the area's basic water distribution problems and major bottlenecks. Through rehabilitation of works, the assistance programme has been instrumental in creating conditions for greater equity in internal water distribution. There are indications that primary distribution imbalances still persist, however, and improvements in the supply of water to tail end areas and in overall irrigation efficiency have been achieved mainly by increasing drainage water re-use.

Intervention towards improved weed control was partially successful. The programme assisted in the development of modern maintenance planning techniques and in the introduction of technically and financially viable technologies on a pilot scale. As the maintenance of irrigation channels has become mainly a weed control problem since completion of the High Aswan Dam, the support has contributed to irrigation improvements. At the institutional level there was continuing uncertainty regarding the organisation responsible for the weed control operations.

Finally, Netherlands assistance has also contributed to farmer participation. It opted for an approach which started by solving primary and secondary level distribution problems, followed by raising farmers' awareness of participation benefits and introducing the Water User Board concept at the secondary level. The strategy to focus first on primary and secondary distribution problems was justified. Water user groups can be expected to co-operate in the equitable distribution of water, maintenance of the on-farm system and payment for irrigation services only when water delivery meets their needs and they have some control over the water delivery schedule.

An overall judgement on the ultimate impact of the programme is hampered by the non-availability of basic social and financial/economic data. Until recently, no systematic baseline or any other form of field survey of farm production or income in Fayoum had been made. Statements by the Advisory Panel, evaluation missions and other parties, confirming the positive impact on farm income, were of a qualitative nature and not backed-up with figures.

Efficiency

The efficiency of the support to Fayoum governorate is evaluated on the basis of organisation and management performance for the main phases of the project cycle: preparation, implementation and monitoring and evaluation. In general, efficiency was rather low in all phases.

Preparations for the Batts station lasted more than three years, of which more than a year was needed for discussions between the Ministry of Public Works and Water Resources and the Netherlands about the need for, and the scope of, a further technical and economic evaluation of alternative proposals. The detailed design and tendering process was delayed for almost a year because of late payment for consulting services. Reformulation of the consultant's scope of work took another year; the Ministry of Public Works and Water Resources instructed the contractor to make a complete re-design of the pumping station, and the construction period itself was characterised by regular disputes among the various parties over design changes and execution modalities. Eventually, the pumping station was commissioned three years behind schedule and ten years after initiation of the feasibility study.

In general, technical assistance needs of the Fayoum Irrigation Department and other Governorate organisations have been inadequately identified and formulated. Project documents did not contain a comprehensive review of available manpower resources, their level of education, experience and training needs. Technical assistance needs were only globally assessed and not on the basis of analyses of sectoral and national policy frameworks and the responsibilities of the organisations involved. Project objectives were formulated in very general terms. The project design was satisfactory in the sense that the programme responded to the general need of the recipient organisation. The relative size of the various project components was determined arbitrarily. There is some doubt about the effectiveness and efficiency of the heavy input of as many as seven full-time expatriates during the last phase of the programme.

Implementation of the programme was characterised by excellent working relationships between the expatriate and local consultants and the staffs of the recipient organisations.

Training activities addressed a wide range of relevant subjects. Evaluations revealed good attendance rates of the courses and high motivation to learn. Also, the acquisition of modern computer, communication and measuring equipment enhanced the quality and efficiency of the assistance effort.

Sustainability

The longer-term sustainability of the 10-year aid effort is a major point of concern. On several occasions progress reports and evaluation missions pointed out that project activities in water management and weed control were insufficiently integrated into the Irrigation Department's regular schedule of activities. Both components continued to function as separate operational units. The transfer of financial responsibility was not incorporated into the project design or otherwise secured. Up to now, all assistance budgets have covered recurrent costs of project establishment and have not contained phasing-out arrangements.

The programme focused on the technical aspects of irrigation improvement with only limited attention for institutional and financial/economic aspects. Despite the availability of full information on manpower and management problems of the Fayoum Irrigation Department, no objectives related to institutional development were stated in the project documents.

In the long run, high salinity of drainage water may create serious environmental problems. While benefiting the farming community in the short term, there are two basic reasons why increased use of drainage water is a less than desirable long-term option to improve overall irrigation efficiency and farm income. Re-use involves the pumping of water and additional costs, and calls for sophisticated water management skills to deal adequately with salinisation and environmental pollution. The latter applies to Fayoum in particular, for which recent findings indicate that continued use of present quality irrigation water without proper leaching practices may seriously endanger the agricultural production base. Another major environmental concern is the rapidly deteriorating salt balance of Lake Qaroun which is expected to destroy its fishing potential within the next decade.

1 Organisation of the study

1.1 Objective and scope

The present evaluation report on the Egypt–Netherlands bilateral assistance programme in the drainage, water research and water management sector is part of the overall Country Programme Evaluation exercise carried out by the Operations Review Unit of the Netherlands Ministry of Foreign Affairs. It was chosen as a priority sector because of its crucial importance for the Egyptian economy and the country's future development. Apart from this, it absorbed a substantial part of the Netherlands aid programme. In current prices, the financial contribution to the sector amounted to some Dfl. 159 million, representing about 20% of the total bilateral assistance flow.

The objective of the evaluation is to assess the policy relevance, effectiveness, efficiency and sustainability of the Netherlands assistance, taking account of the sector's main problems.

The following set of key questions are addressed:

1. What are the main characteristics of the drainage, water research and water management sector in Egypt and which changes occurred in the sector over the past decades?
2. What are the main features of Egyptian Government policy for the sector?
3. What was the Netherlands development co-operation policy for the sector and how did this policy relate to the sector's main problems, the Egyptian Government's policy and the activities of other donors?
4. Which projects and programmes were supported by the Netherlands and what were the results of this support?
5. How efficient was the support organised and carried out?
6. How sustainable are the results of the Netherlands' assistance and which factors influence sustainability?

The evaluation covers a period of roughly 20 years, starting in 1975 when the programme was initiated and ending in 1996 when the desk and field research activities were completed.

For analytical and practical reasons, the coverage was restricted to projects executed under the authority of the Egyptian Ministry of Public Works and Water Resources. Projects in the drinking water and sanitation sector, carried out under the authority of the Ministry of Housing, New Communities Construction and Public Utilities, are not included.

1.2 Methodology

In view of the objective of the study, the sector assistance programme has been analysed from four perspectives:

Policy relevance. To determine whether the goals of the assistance programme were consistent with country and sector assistance strategies and whether the design was appropriate in terms of the Netherlands assistance goals of increasing economic self-reliance, alleviating poverty, conserving the environment and improving the position of women.

Effectiveness. To review what have been the programme's effects and compare them with its goals, whether physical, financial, institutional or policy related. To the extent possible, longer-term effects on people, policies and domestic capacities are assessed to determine what lasting contributions Netherlands assistance has made to the country's development.

Efficiency. To assess the outcomes in relation to inputs in terms of costs, implementation times and performance of organisations involved in the various phases of the project cycle: i.e. preparation (identification, formulation and design, and appraisal), implementation, monitoring and evaluation.

Sustainability. To assess the potential to maintain assistance achievements generated or expected to be generated in the respective operational plans (f.i. in terms of financial viability, appropriateness of technology and institutional capability).

The study was launched with an extensive desk review of DGIS archives containing project correspondence, internal memoranda, financial records, project identification and formulation reports, appraisal documents, progress reports of executing agencies and consultants, and monitoring and evaluation reports, providing first insight into the performance record of individual projects and systemic project implementation issues. The desk

review further included an analysis of available literature on Egypt's drainage, irrigation and water management sector and relevant documents produced by other donors. A list of most relevant documents and references is attached in Annex 2.

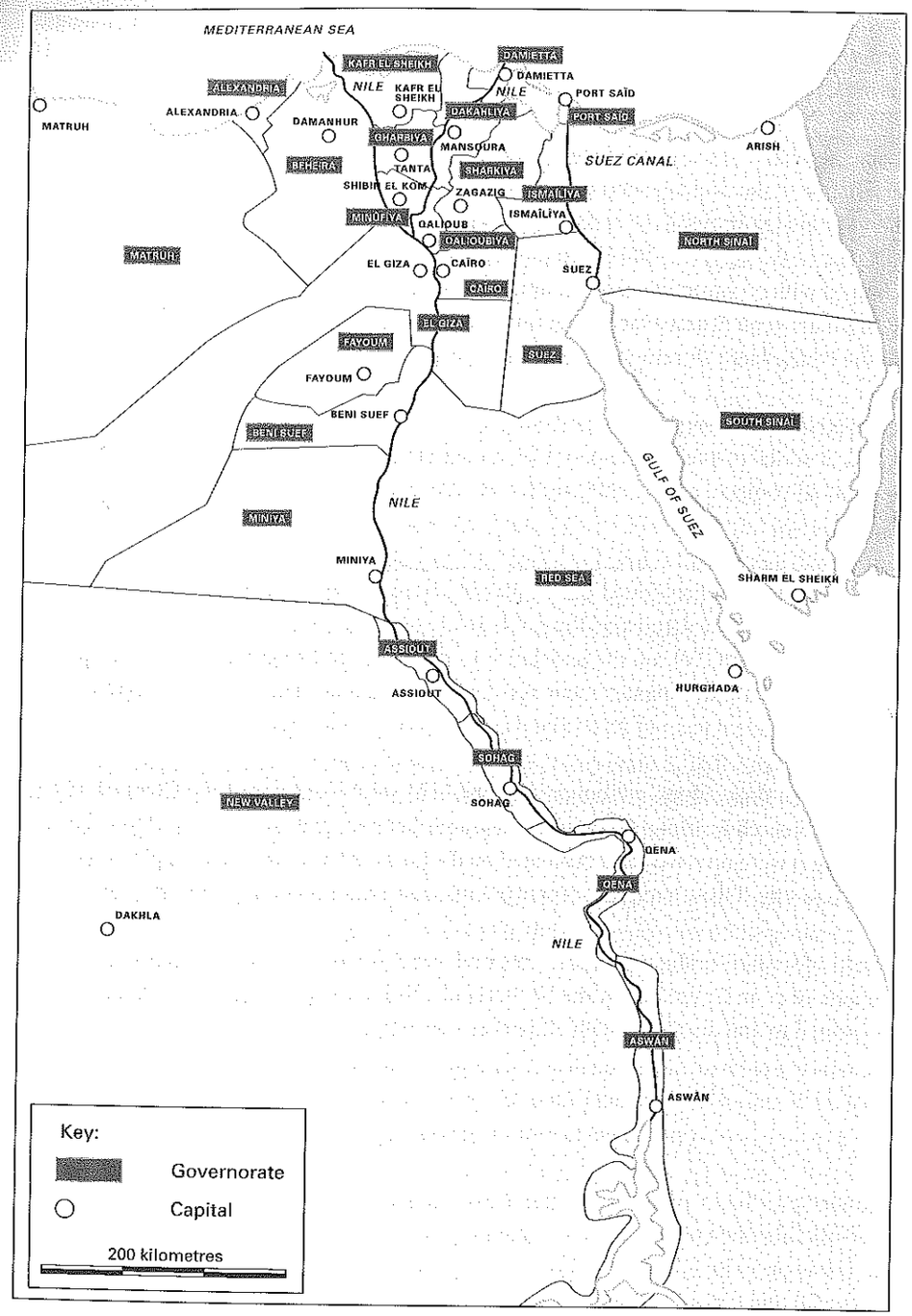
For analytical purposes, activities were grouped under four major headings, i.e.: (i) general assistance to the drainage and water management sector through the Advisory Panel for Land Drainage Project; (ii) assistance to the drainage and water research sector; (iii) assistance to the Egyptian Public Authority for Drainage Projects (EPADP), the authority charged with construction and maintenance of the national drainage network; and (iv) the water management assistance programme in Fayoum Governorate, the concentration area of the Netherlands development co-operation programme.

On the basis of the desk study and complementary interviews with parties in the Netherlands, a series of position papers was prepared retracing the implementation record of individual projects and identifying the need for a further, more detailed field study in Egypt.

The field study concentrated on the two main research institutes supported under the programme i.e. the Drainage Research Institute (DRI) and the Research Institute for Groundwater (RIGW), on the assistance to the drainage executing agency EPADP, and on the Fayoum water management assistance programme. The study was contracted out to an independent team of Netherlands and Egyptian consultants.

Parts of the programme not covered by the field study (support of the Channel Maintenance Research Institute, Hydraulics Research Institute and the Advisory Panel on Land Drainage) were reviewed and evaluated on the basis of the desk study supplemented with interviews by IOB of recipient organisations, consultants and other donor agencies.

Drafts of the IOB evaluation report were reviewed by two Advisory Groups of independent experts resp. in Egypt and in the Netherlands. Relevant sections of the report were also presented to and discussed with all parties concerned.



Map 1 Egypt—Administrative map

2 Water management in Egypt

2.1 Economic context

Egypt has a total land area of about 1 million km^2 of which only 35,000 km^2 is populated and to a high extent cultivated. The remainder is largely uninhabited desert. In the 1950s, Egypt's population was growing by more than 3% a year—a rate that threatened to double its population every 20 years. Much of that growth was, and still is, concentrated along the narrow strip of fertile land on both banks of the Nile. Today, the demographic situation is marked by declining fertility and mortality and continued urbanisation of the population. Yet despite reductions in fertility levels, the population continues to grow at an average 2–2.2%. Population pressure on land is severe and getting worse: in 1996 density, related to the inhabited area of the country, was 1,700 persons per km^2. The 1996 population of roughly 60 million is projected to increase to 100 million by the year 2025.

Administratively, the country is divided into 26 Governorates with largest concentrations of population in the five urban Governorates of Cairo, Alexandria, Ismailiya, Port Said and Suez (see Map 1).

During the 1960s Egypt, under President Nasser, pursued a centrally planned, public-sector dominated and inward-looking development strategy stressing social welfare objectives. The wars with Israel in 1967 and 1973, and Nasser's death in 1970, heralded a major period of change in Egypt's economic relations with its Arab neighbours and with the superpowers. President Sadat's Law No. 43 of 1974 led to the replacement of Nasser's socialist planning by an 'open-door policy' and brought about a partial liberalisation of the economy. The underlying development strategy remained, however, one of import substitution financed mainly by large inflows of foreign exchange from external assistance and borrowing, oil-related exports, workers' remittances, tourism and Suez canal revenue. Egypt's economy grew at very high rates during 1974–85, averaging about 8.5% per year. Resulting from substantial per capita income increase and investments in physical and social infrastructure, significant social progress was achieved. A food

subsidy and ration system served as the last safety net for the poor and as an additional income transfer source for the better-off.

When oil-related foreign exchange revenues began to decline in the 1980s, the Egyptian economy started to suffer from low rates of growth (averaging 2.5%), stagnating or declining per capita incomes and a rise in inflation and unemployment rates. This contributed to a gradual erosion of the gains in the standard of living that had been made over the previous decade. Public sector expenditures increased faster than revenues. The resulting massive fiscal and balance of payment current account deficits were in turn financed through large inflows of external assistance and foreign as well as domestic borrowing which caught the country in an external debt crisis. After having accumulated US$ 11 billion of non-paid arrears, a debt rescheduling operation was carried out and the implementation of an IMF/World Bank sponsored Structural Adjustment Programme (SAP) was started in May 1987. The rate of acceptance was low, however, and by the end of 1988 the SAP partially collapsed.

Thereafter, the cost of the Gulf war made the economic situation and foreign debt crisis unmanageable. In 1991, facing large external debt service arrears, stagnating economic growth, a worsening balance of payment and an inflation rate of more than 20%, the Government re-launched its economic reform programme aiming at fundamental changes in policies and economic structures. The first phase of the new Economic Reform and Structural Adjustment Programme (ERSAP) was successfully implemented from 1991 to 1993. Substantial progress was made in reducing the fiscal deficit and in initiating financial and trade liberalisation reform; agricultural input and output prices were decontrolled; agricultural trade was liberalised and a unified foreign exchange market was created. To alleviate the impact of economic reforms on low income groups, donors in 1991 pledged a total of US$ 617 million to a newly established Social Fund for Development (SFD).

Although progress was made in deregulating the economy and establishing a market-based incentive structure, the country continued to witness weak output growth. In 1993 real GDP growth was in the order of 4% (up from 1.9 and 2.9% in 1991 and 1992, respectively, see Table 2.1) but remained below the level deemed necessary to allow a reduction in unemployment. The output stagnation was due in part to the fiscal and monetary contraction implemented in order to stabilise the economy and hesitant progress of structural reforms in the trade, public enterprise and regulatory areas which continued to provide a poor incentive framework and undermine the credibility of the reform effort.

Against the earlier backdrop, and in the context of new challenges and opportunities presented by the Middle East peace process, the structural reform programme gained momentum in 1995. Early 1996, the newly formed Government committed itself to

Table 2.1 Egypt—Key economic indicators 1990 to 1995

		1990	1991	1992	1993	1994	1995
GDP real growth rate (WB)	%	3.6	1.9	2.9	3.9	4.7	5.0
Shares of GDP							
Investment	%	23.3	18.2	16.2	16.6	16.3	16.6
Overall fiscal balance	%	−18.1	−5.4	−3.5	−2.1	−1.2	−1.3
External debt	%	107.7	89.5	69.2	58.0	55.7	49.2
Balance of payments							
Merchandise Exports	US$ billion	4.4	5.7	4.8	6.3	4.6	4.9
Merchandise Imports	US$ billion	11.4	11.4	10.0	10.7	8.5	11.3
Resource Balance	US$ billion	−3.9	−2.6	−2.1	−1.7	−2.9	−2.8
Current account	US$ billion	−1.7	−0.1	2.7	0.2	−0.6	−0.3
International reserves	US$ billion	8.2	15.2	20.4	24.0	26.6	28.1
Rate of inflation	%	14.7	21.1	11.1	9.0	9.4	7.2

Source: World Bank, *Country Economic Memorandum*, 1997.

stepping up the pace of adjustment and economic reform under a new two-year, second phase ERSAP arrangement with the IMF and World Bank to consolidate the gains of the first phase and deepen the structural reforms and induce a strong and sustainable response from the private sector. In the mean time, real GDP growth is reported to have picked up gradually to an estimated 4–5% exceeding, for the first time in six years, the increase in population.

2.2 Agriculture

The Egyptian economy has traditionally relied heavily on the agricultural sector as a source of growth. This dominant role was reinforced by agriculture's strong performance between 1955 and 1969, when production increased at over 3% annually—an exceptional performance, given the relatively high base level. In the 1970s and 1980s, the pace of growth declined to 2–2.5% due to the levelling of crop yields in old lands and a lower output than expected from reclaimed lands.

The policy framework, within which the agriculture sector operated then, was characterised by heavy government interventions in production, pricing and marketing of major crops and inputs. The objective was to attain self-sufficiency in basic food production, provide basic foodstuffs to consumers at low prices and provide a source of employment for the fast expanding labour force. These (ambitious) objectives were not achieved. Food production growth failed to keep pace with the increasing population and consumption. The country became increasingly dependent on imports of grains, edible oils, sugar, meat and milk products.

Significant reforms of these agricultural policies began to be introduced in the mid-1980s under the earlier mentioned Structural Adjustment Programme. Since then, agriculture has been at the forefront of other sectors in initiating reforms. Within the framework of the Programme, the Egyptian Government implemented several deregulatory measures including: (i) removal of crop area allotments and delivery quotas; (ii) removal of price and exchange rate subsidies; (iii) higher interest rates for agricultural lending; (iv) liberalisation of land rents and (v) (partial) recovery of irrigation and drainage investment costs. To support the programme of policy reforms, investment allocations for the agricultural, irrigation and drainage sector were increased. With the introduction of a free foreign exchange market import/export constraints were removed for the private sector to increase its participation in the import, export and domestic marketing of agricultural inputs and outputs.

While the overall average growth rates for the sector remained modest (1–2% on an annual basis), indicators point towards a positive supply response to reforms which allowed the country to contain further deterioration of its annual food import bill (roughly US$ 2 billion, see Table 2.2). Most importantly, however, the reforms sensitised the farmers towards taking market-induced decisions and are signs that competition in agricultural markets is now increasing.

In the final analysis, the sector's share in GDP fell from 30% in the early 1970s to less than 20% at present. This relatively low share somehow understates the socio-economic importance of the sector which continues to employ 35% of the labour force and contributes about 25% of the value of merchandise exports. Moreover, some 50% of the manufacturing labour force is employed in cotton-related industry, while 25% of merchandise exports are manufactured products of agricultural origin (World Bank, 1993).

Socio-economic information on the Egyptian farming community, the ultimate 'beneficiary' of the assistance programme, is incomplete and often unreliable. Until 1996, land tenure was regulated by the agrarian reform legislation which set at 50 feddan the maximum size of the private farm owned by one individual and at 100 feddan for more than one individual in a family. The legislation was liberalised in 1997. About 60% of the farms are owner operated. The balance of the farming households rent or sharecrop other land to provide employment for their family members and increase their income. Farms are generally small; average farm sizes vary from 0.5 feddan for very small farms (35%) to 2 feddan for medium farms (40%) to 6.5 feddan for the large farms category (25%) (ILO,1991). The average farming family comprises seven persons of whom at least four are active on the farm. The other family members are either at school, when they are young, or working outside the farm to help bring additional income to the family.

Table 2.2 Egypt—Key agricultural statistics 1980–93

	1980	1986	1987	1988	1989	1990	1991	1992	1993
AGRICULTURE									
Value (LE million)	–	8,640	8,856	9,033	9,187	9,352	9,485	9,638	9,963
Growth (%/year)	6.7	2.9	2.5	2.0	1.7	1.8	1.4	1.6	3.4
Share (% GDP)	20.0	20.6	20.2	20.2	19.9	19.9	20.1	20.2	20.5
AREA CULTIVATED (main crops—1,000 feddan)									
Beans	238	286	363	329	303	291	390	220	342
Cotton	1,178	988	1,014	1,006	993	851	840	884	721
Maize	1,924	1,810	1,960	2,004	1,976	2,068	1,966	1,973	2,057
Millet (sorghum)	413	317	314	306	319	324	355	348	376
Rice	1,178	983	838	984	1,037	1,101	1,216	1,283	1,378
Wheat	1,400	1,373	1,422	1,533	1,955	2,215	2,091	2,171	2,111
Berseem	2,778	2,525	2,404	2,400	2,457	2,363	2,390	2,472	2,521
PRODUCTION (main crops—1,000 tons)									
Beans	208	323	362	407	375	283	215	243	317
Cotton lint	529	403	381	311	290	320	357	416	255
Maize	3,309	3,619	4,088	4,529	4,799	5,122	5,069	5,039	5,550
Millet (sorghum)	653	552	587	586	630	676	765	779	731
Rice	2,236	2,404	2,131	2,677	3,167	3,448	3,910	4,161	4,583
Wheat	1,938	2,722	2,839	3,183	4,268	4,483	4,618	4,833	4,439
YIELDS (main crops—ton/feddan)									
Beans	1.39	1.13	1.00	1.24	1.24	0.97	0.54	1.10	0.93
Cotton	0.45	0.41	0.38	0.31	0.29	0.38	0.43	0.47	0.36
Maize	1.72	2.00	2.09	2.26	2.43	2.48	2.58	2.55	2.70
Millet (sorghum)	1.58	1.74	1.87	1.97	1.97	2.08	2.15	2.24	1.94
Rice	2.34	2.45	2.55	2.72	3.05	3.13	3.22	3.24	3.32
Wheat	1.39	1.98	2.00	2.08	2.18	2.03	2.21	2.23	2.10
EXPORTS (US$ million)									
Agricultural									
cotton	394	343	354	269	220	83	35	37	45
rice	39	4	7	5	7	4	33	26	45
potatoes		16	22	15	15	28	40	19	21
citrus	47	49	60	31	90	38	58	42	35
other		54	55	51	75	73	92	75	92
cotton yarn	195	241	343	270	446	318	283	204	212
cotton textile	69	57	93	47	59	75	87	65	66
foodstuffs	25	46	52	52	60	86	145	101	88
Other exports		1,775	2,252	1,959	2,173	3,182	2,934	2,569	2,461
TOTAL EXPORTS	5,848	2,585	3,238	2,697	3,145	3,887	3,636	3,417	3,065
IMPORTS (US$ million)									
Food and beverages		1,864	1,618	2,404	2,327	1,802	1,979	1,878	1,940
Other imports		6,088	8,274	7,957	9,114	9,623	8,075	8,851	8,776
TOTAL IMPORTS		7,952	9,892	10,361	11,441	11,425	10,054	10,729	10,716

Source: CAPMAS, Ministry of Agriculture and World Bank. Figures refer to fiscal years.

2.3 Water resources and water use

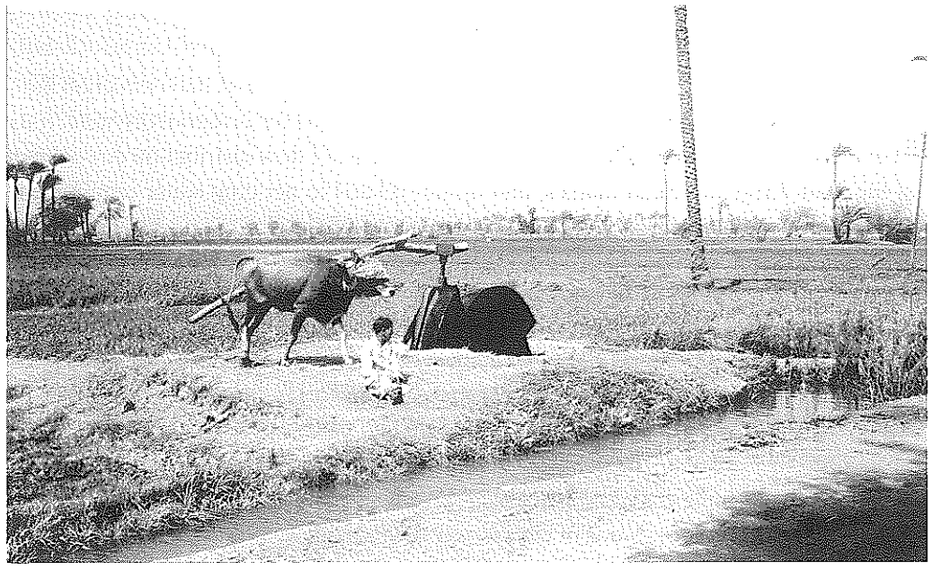
Water resources

Egypt is an arid country whose average annual rainfall seldom exceeds 200 mm along the northern coast. This declines rapidly from coastal to inland areas, becoming almost zero south of Cairo. The meagre rainfall occurs in winter in the form of scattered showers and cannot be depended upon for extensive agricultural production or for any other use.

The Nile is the country's only source of surface water and has provided the basis of agricultural development in Egypt (and Sudan) since agriculture started in the area about 7,000 years ago. While Britain dominated the Nile Basin its presence enabled the unified planning of the Nile Valley; at the same time, Egyptian fears of intervention with the Nile waters were allayed by the British imperial shield. When independence swept through the Nile Basin in the early 1950s, however, Egyptian fears were aroused when another seven independent upstream states laid claim to the waters. In 1952, the Nasser Government immediately endorsed plans to build the High Aswan Dam. This would not only provide water and power but would also free Egypt from being the historic hostage of upstream riparian states. The subsequent 1959 Agreement for full Utilisation of the Nile Water with Sudan, secured Egypt's share of the annual Nile water flow, up to a maximum of 55.5 billion m^3.

Egypt's actual water use is higher than 55–56 billion m^3 annually supplied Nile water because part of its is discharged into the drainage system and re-used. In Upper Egypt, agricultural drainage water is discharged back into the River Nile slightly affecting the quality of the Nile water in that its salinity increases from 250 ppm (parts per million) at Aswan to 350 ppm at Cairo. In the Nile Delta, drainage water is of poor quality, however, and is mostly discharged into the Mediterranean. Surveys and monitoring have confirmed the possibility of re-using part of this water. From a few million m^3 in the early 1970s, the annual re-use volume has risen to an estimated 4.7–5 billion m^3 at present (roughly 30% of total drainage discharge).

The increasing demand for water has also stimulated groundwater exploitation. At present, Egypt is estimated to extract an annual quantity of 2.6 billion m^3 of groundwater but, with some exceptions, however, this source is also supplied by the Nile and is not considered an addition to overall supply. In the Nile Valley, the total storage capacity of the aquifer system is estimated at 200 billion m^3. This is re-charged by infiltration from the irrigation system and excess irrigation water at an annual rate of about 3 billion m^3, one third of which is extracted through productive wells. The balance evaporates from the surface or flows back to the River Nile. The Delta aquifer system has an estimated



Traditional water-lifting method

storage capacity of 400 billion m^3 and is also recharged by infiltration from the Nile-fed irrigation system and excess irrigation water. In the northern coastal belt, seawater intrusion restricts exploitation but in the south some 1.6 billion m^3 is extracted annually. Groundwater extraction is administratively controlled for drinking water but is not for irrigation. The latter occurs essentially in the tail-end parts of irrigation areas that suffer from inadequate surface water supply.

However feeble, the rare rainstorms represent about 1.5 billion m^3 over the Delta and 3–4 billion m^3 per year over Sinai, sufficient to generate and maintain a diversity of limited water resources outside the Nile Valley and Delta. They include the Nubian sandstone aquifers feeding free flowing wells in the lowest depressions of the Western Desert. These aquifers have an estimated non-renewable storage capacity of some 200 billion m^3, with salinity varying between 200 and 700 ppm. They are too deep, however, to warrant conventional agricultural use, except in a few privileged low land areas. At present, some 500 million m^3 is extracted annually. Smaller aquifers, recharged locally, include some along the Mediterranean coast (West of Alexandria and Sinai) and the Gulf of Suez. Irregular but frequent run-off in Sinai is not used at present, with the exception of a few dams for flood spreading in the North. It constitutes a potential water resource for agriculture, for rangeland improvement in Central Sinai, or for coastal development projects (tourism).

Water use

Egypt's water use is known with less certainty than its supply. Flow and extraction monitoring points are few in number, the accuracy of measurements is reportedly weak (possible margin of error of 30–40%), there is no monitoring of flow distribution downstream of the main irrigation canal intakes, and figures related to net crop water requirements are controversial (estimates vary by 25%). Estimates of water use—mostly referring to the 1990–93 situation—vary as follows:

Table 2.3 Egypt's water use balance in the period 1990–93

	Total (in billion m^3)	%
High Aswan Dam release	55.0	100
Crop consumptive use and evaporation	38.5–38.6	70–75
Industrial/municipal use	1.5–3.1	2–5
River transport	1.5–1.8	2–3
Drainage to sea	12.3–12.5	21–22

Over 95% of agricultural production derives from irrigated land. As has been indicated, some 38–39 billion m^3 of water are estimated to be 'lost' each year due to evaporation from the Nile River and irrigation canals and from crop evapotranspiration. Total agricultural water has remained almost constant throughout the last 20 years and growing demand has been met through increasing irrigation efficiency, re-use of drainage water and complementary groundwater extraction. Even with present drainage re-use and groundwater extraction, overall irrigation efficiency (defined as the ratio between water application and crop requirement) is estimated at roughly 60%. Reasons for this include: (i) non-adjustment of High Aswan Dam releases to seasonal requirements; (ii) inadequate field drainage, imposing excessive water allocation to avoid salinization; (iii) significant inequality of distribution, and (iv) the 24 hours rotation-based water application system resulting in excessive drainage flows.

Industrial and domestic/municipal water consumption estimates are indicative. Groundwater is the drinking-water source for about 20 million of Egypt's 61 million people. Many villages depend on individual water wells, some of which are not working properly. Surface water for drinking water purposes and industrial use is taken from the Nile itself (in the Nile Valley and Cairo), from the networks of primary and secondary canals which distribute 'fresh water' downstream Cairo and, eventually, the pipelines which convey Nile water to the North Sinai, South Sinai or Suez Gulf. The controversy over actual consumption figures is caused by varying assumptions about the quantity of water returned to the system in the form of domestic or industrial effluent.

Over the years, 1.5–1.8 billion m^3 of fresh water is released from the High Aswan Dam (and discharged into the sea) with the specific purpose of maintaining sufficient depth for river navigation between Luxor and Aswan during the low-water winter season. Plans are being developed to store this excess water temporarily for agricultural use in other months.

For more than 35 years the boundaries of Egypt's water sector policies have been set basically by the Nile Water Agreement, restricting the release of Nile water to the maximum amount of 55 billion m^3 per annum. During this period, pressure on available water resources has increased substantially. From 2,100 m^3 in 1960, per capita availability has dropped to less than 1,000 m^3 a figure which is generally considered to characterise a 'water stress' situtation (Howell & Allan, 1990). As overall water demand has approximated or even exceeded the maximum level sustainable, and demand for water by non-agricultural sectors of the national economy has gradually increased, the options for irrigated agriculture have become fewer. Egypt has in fact already adjusted to deficiencies in water availability for agriculture by cutting supply to some crops and areas, especially in the summer season.

Water resources planning authorities in Egypt generally paid little attention to water quality. Realising that the country's population/resource variables were set on a collision course, in 1982 a basic legal and regulatory framework was put in place by the Egyptian Government for dealing with the organisations, environmental protection and other aspects of water management. However, legislation was not enforced or backed-up with qualitative and quantitative upgrading of the specialised or other staff. In the mean time, the few data available suggest that water quality deteriorated over the years, especially in the heavily populated Delta area where the combination of industrial discharges and inadequate sewer systems exacerbate water pollution problems.

Irrigation

In Egypt, agriculture initially depended on the annual flooding of the Nile. The first agricultural revolution occurred around 3,000 BC with the start of artificial irrigation, including deliberate flooding and draining by sluice gates and longitudinal and transverse dikes. Almost 5,000 years later, in 1816 Mohammed Ali initiated Egypt's modern irrigation system with the construction of two deep-water Canals (the Mahmoudiya and the Ibrahimiya) that provided summer water for the fields in the Delta. In 1843, work started on two barrages across the two Delta branches of the Nile, but they did not function satisfactorily and were rebuilt in the early years of British occupation. The system was expanded and improved with the building of five additional barrages: two in the Delta at

Edfina (1915) and Zefta (1943) and three between Cairo and Aswan, at Assiout (1902), Esna (1908) and Naga Hammadi (1930).

To distribute water over a period of time (because one half of the Nile flow occurs in August and September) it was necessary to regulate distribution through a storage system. The first Aswan Dam was initiated in 1898, completed in 1902 and heightened in 1912 and again in 1934. After the 1952 Revolution, a much larger project for water storage was sanctioned as early as 1953 and in 1960, with technical help of the former Soviet Union, construction was started of the High Aswan Dam. The power plant began operation in 1968. The basic irrigation network and main structures is shown in Figure 2.1.

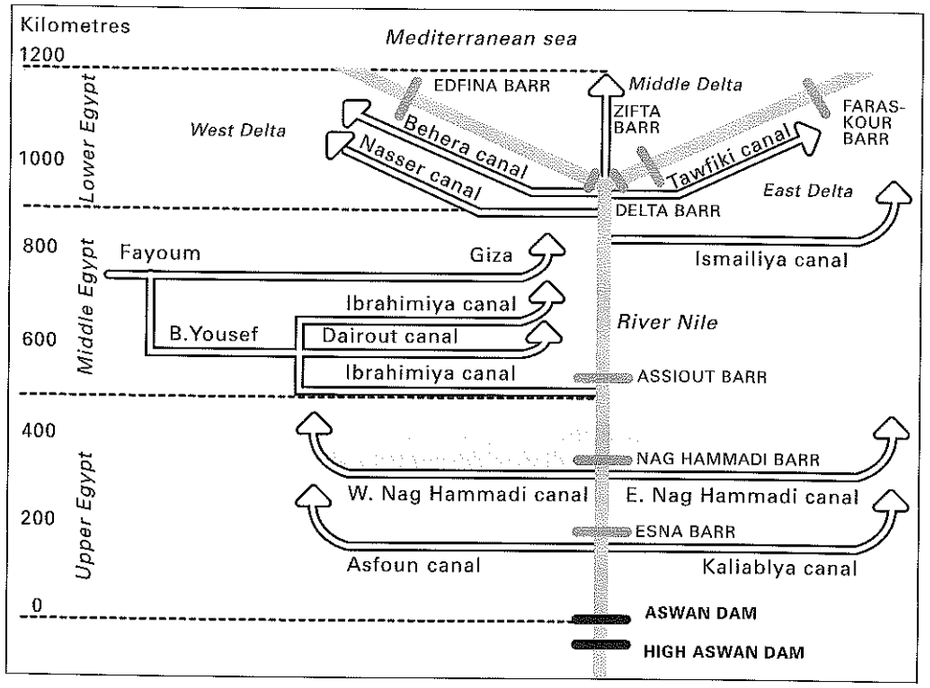


Figure 2.1 Schematic diagram of the irrigation system

Upon Dam completion in 1968, the Egyptian Government embarked upon an ambitious land reclamation programme. This renewed interest in reclamation stemmed primarily from the Government's need for an outlet to meet the demands of a growing population. The political and social significance of this was the main reason for the Government's insistence on expanding its reclamation efforts in the face of widespread criticism of the economic costs and high water consumption. Since then, some 1.6 million feddan of new land have been brought into cultivation. The total cultivated area did not increase substantially, however, because roughly 1.2 million feddan of old lands were lost to

urban encroachment. As a result, the cultivated and cropping area served by the irrigation network remained resp. 5.7–5.9 million feddan with an unchanged cropping intensity of roughly 1.9).

The irrigation system covers a series of command areas or irrigation sub-systems served by a main (secondary) canal. These canals feed clusters of farms with irrigation water through offtakes. Each offtake diverts water to a farm delivery system or 'mesqa' serving between 50 and 500 feddan. Except in Fayoum and some small areas elsewhere in Egypt, water is supplied below ground level so that farmers are obliged to lift water onto their land. Mesqas are owned, operated, and maintained by the group of farmers that they serve. Water is further conveyed by waterwheels or pumps to 'marwas' belonging to individual farmers.

In principle, water is allocated initially to command areas on the basis of predicted cropping patterns. The initial allocation is made at central Government level (Central Directorate of Water Distribution) and adjustments are made in response to requests from users. Regional Irrigation Directorates plan the distribution of water within their respective command areas.

Primary and secondary canals are basically operated by the delivery of measured discharges and volumes of water. The rest of the system is operated by maintaining specified water levels downstream of regulators, with no explicit control or measurement of discharges. Although these levels may originally have been related to discharge, determination of the required levels now appears to be based mainly on accumulated experience, with adjustments made from time to time to avoid escape flows and to alleviate tail end shortages. In general, the only points in the canal system at which discharges are routinely controlled and recorded are the heads of secondary canals and the boundaries between irrigation directorates. Measurements at these points are based on a combination of current metering and calibration of structures. Operating records are also kept for the main irrigation pumping stations.

Primary irrigation canals run continuously, while supply rotation is practised at the command area level, either between whole command areas or between different parts of the larger command areas. The rotation schedule varies according to the season and cropping pattern. The main rotations used are: two-turn rotations either of four or seven days on/off and three-turn rotations of five days on/10 days off. The most common method of ensuring that water is delivered equitably is by adjusting the rotations. In addition, there is a three week general closure of the entire system in winter (January in Upper Egypt and late January/February in the Delta area).

Drainage

Egyptian agriculture has historically been blessed with Nile waters that contained a very low concentration of salt and which annually flooded the Nile Valley, thus flushing salt from the soil. Salinity was thus never a problem. Due to several decades of perennial irrigation, however, the water table has gradually risen with a consequent increase in soil salinity and reduced plant production.

To prevent deterioration of the soil an open drainage system was constructed, beginning around the turn of the century in the northern part of the Delta and gradually being extended to other parts of the country. Farmers did not fulfil their duty to connect each plot with the open drainage channels, however, mainly because they could not afford to lose the 10–15% of land area that the ditches would have occupied. As a result, the open drainage system was neither complete nor sufficiently effective to have any significant control over the water table, especially in the heavy clay soils of the Delta. Effectiveness was further restricted by inadequate maintenance.

In view of the inadequacy of conventional open drainage methods, research into sub-surface or field drainage systems was initiated in 1938 at 15 experimental stations in different parts of the country. By 1952, pilot projects had been extended to approximately 50,000 feddan. Encouraged by the results, a law was passed in 1956 giving the Government responsibility for the execution of sub-surface drainage. An ambitious 30-year programme was drawn up to cover all areas under perennial irrigation with tile drains, but organisational and financial constraints forced the Egyptian Government to scale-down these plans. By 1965 the sub-surface drainage area barely exceeded 300,000 feddan. In the mean time, more modern techniques of plastic pipe drainage were being studied and tested through an FAO pilot research project, covering five areas of up to 2,000 feddan each.

In 1968, the commissioning of the High Aswan Dam gave rise to development opportunities as well as challenges. In relation to irrigated agriculture, it opened the possibility for large-scale expansion of the perennial irrigated area. The additions to irrigation water supplies were to aggravate the drainage problem, however, forcing the Government to accelerate the introduction of measures to counteract extensive deleterious effects on groundwater levels. Although the priority attached to the drainage programme increased greatly after 1966 and plans were drawn up for draining a million feddan in the Delta during the next five years, progress continued to be slow, hampered mainly by budgetary constraints and the lack of technical and organisational skills. Eventually, the Government solicited the help of the international donor community, including the World Bank, to assist in the accelerated implementation of its field drainage programme. In 1973, a

specialised agency—the Egyptian Public Authority for Drainage Projects (EPADP)—was set up to carry out the programme. Five projects costing a total of US$ 852 million were supported by the World Bank in the period 1970–96 with co-financing from United States, the African Development Bank, Germany and the Netherlands. The main characteristics of the five projects and the ongoing (sixth) project are summarised in Table 2.4.

Table 2.4 Egypt—Main characteristics of World Bank financed field drainage projects (1960–95)

		NILE DELTA I	UPPER EGYPT I	UPPER EGYPT II	NILE DELTA II	DRAINAGE V	NDP (ongoing)
signing date		04/70	06/73	06/76	07/77	03/86	03/92
actual completion		12/80	06/83	06/89	06/86	04/94	03/00(e)
total cost estimate	US$ m	198.9	119.6	166.9	192.2	174.3	290.0(e)
WB loan/credit	US$ m	26.0	36.0	50.0	66.0	63.0	120.0
co-financing				USAID	KfW	Netherlands ADB/ADF	KfW
rem. open drains	km	1,700	775	1,226	1,400	640	1,200(e)
field drains							
– new	Feddan	950,000	300,000	335,000	400,000	549,000	590,000(e)
– rehabilitation							130,000(e)

field drainage completed by 1/11/93	Nile Delta (feddan)	Upper Egypt (feddan)	Total (feddan)	
World Bank	1,823,500	846,100	2,669,600	67.7%
Netherlands	44,000	0	44,000	1.1%
Canada	27,300	0	27,300	0.7%
Egypt	834,000	365,500	1,199,500	30.5%
Total	2,728,800	1,211,600	3,940,400	

Source: EPADP, World Bank Project Completion Reports and Project Appraisal Reports.

The improvement and remodelling of open drains has generally presented the least problems. The activity critical to the completion of projects in the past has been the installation of sub-surface drainage. By the end of 1994, the total area with installed sub-surface drains slightly exceeded 4 million feddan, roughly 60% of the total cultivated area. That figure is increasing annually by 170–190,000 feddan. The installed sub-surface drainage system consists of a network of lateral and collector drains. Lateral drains, about 200m long, originally consisted of pipes of fired clay. In 1938, these were replaced by concrete tiles and since 1979–80 corrugated perforated polyvinyl chloride (pvc) pipes are used. Lateral drains discharge into collectors which evacuate drainage water into the open. They are generally constructed of plain or reinforced concrete pipes.

2.4 Legal and institutional framework

The legal framework

Until fairly recently, the principles ruling water laws derived largely from the traditions of Islamic countries regarding water rights and sharing, as codified by the Shari'a: individual shares, based on entitlement, seasonally revised according to estimates of the total available supply, decreed by the Qawanin-Hukm (Governor's or Oasis head decree). As water distribution and management became increasingly complicated, new legislation was formulated in the 1970s and 1980s, providing the basis for Government action in regulatory and operational areas and establishing the context for action by non-governmental entities and individuals. Most of this legislation was promulgated in the context of World Bank or USAID-financed sector aid programmes.

The basic Irrigation and Drainage Law (*Law 74, 1971* later replaced by *Law 12, 1984*) regulates the use of water, including groundwater, and provides equity to the user. It also regulates the operation of mesqas and drains and water-lifting devices. It controls water rights, sets priorities between users, the beneficial and harmful use of water, financial aspects and penalties.

Law 213/1994 amended the Irrigation and Drainage Law 12/1984 and legalises private Water Users Associations at the farm level. It further provides the legal framework for recovering capital costs of improved irrigation facilities at mesqa level.

Law 93/1962 concerning drainage of liquid waste, regulates the discharge of wastewater into sewer systems. Further Ministerial Decrees specify standards for liquid waste disposal to sewers for use in irrigation and in case of application to the land. The *River Nile Protection Law* (*Law 48, 1982*) imposes licensing on the discharge of all effluent, specifies quality standards for effluent, prohibits the use of drainage water unless its suitability is ensured, entrusts the Ministry of Interior with control of waterways (Police), provides authority to the irrigation engineers of the MPWWR to inspect. By-laws, issued by the MPWWR, further specify fields of application, regulation and standards. *Law 4/1994* on Environmental Protection describes the tasks of the Egypt Environmental Affairs Agency, provides general rules for the protection of the environment, regulates air pollution and the use and protection of the marine environment.

Other laws and decrees are more specific: for example, Law 27/1982 regulating public water resources used for drinking and domestic use and Ministerial Decree 2703/1966 of the Ministry of Health, establishing the Supreme Committee for Water. This Committee has to set standards for drinking water, swimming, etc. and to approve water treatment

projects Ministerial Decree No 380/1982 of the Ministry of Industry requires new industries to include equipment to prevent pollution in the technical specifications of the project.

The institutional framework

In Egypt, as in many other countries, Government activities are organised in such a way that each type of water use is dealt with by a separate department or agency. Water quantity and quality issues, and health and environmental concerns are also considered separately, as are matters related to surface and groundwater. Problems of co-ordination and the fragmentation of decision making are common occurrences.

Under Law 12/1984, the *Ministry of Public Works and Water Resources (MPWWR)* has overall responsibility for appropriating and distributing water and for managing drainage, groundwater and the Mediterranean coastline. In addition, under Law 48/1982, the Ministry has the responsibility for controlling the inflow of pollutants into public waterways.

The *Egyptian Environmental Affairs Agency (EEAA)* has a co-ordinating role in all aspects of environmental protection, such as legislation, environmental impact assessment, monitoring and dissemination of information.

The *Ministry of Agriculture and Land Reclamation (MARL)* initiates policies related to farm production and cropping patterns. It is also charged with the implementation of irrigation works downstream of the branch canals. Within the Ministry, the Executive Agency for Land Improvement Projects (EALIP) and the Public Authority for Land Reclamation in the New Valley and Other Desert Areas (PALR), are involved in water conservation. The General Authority for Rehabilitation Projects and Agricultural Developments (GARPAD) is responsible for the design and implementation of desert reclamation schemes which are subsequently transferred either to Public Sector Agricultural Companies or (during the last years) to the private sector. The Agriculture Research Centre (ARC) includes 16 research institutes, 5 laboratories and 36 research stations. Among the institutes, the Soil and Water Institute has research capability in the field of land improvement through raising drainage efficiency and optimising water use.

The National Organisation for Potable Water and Sanitary Drainage (NOPWASD) of the *Ministry of Housing, New Communities Construction and Public Utilities* is responsible for planning, design and construction of the drinking water and sanitation system, including water supply and sewage treatment. Special organisations (semi-autonomous Authorities) have been formed for Greater Cairo, Alexandria and the Suez Canal Cities.

The *Ministry of Health* is responsible for setting standards for potable water sources, drainage water that is mixed with other water, and discharges from municipal and industrial treatment plants and from river vessels. It is also entrusted with monitoring municipal and industrial effluents.

Under the *Ministry of Industry*, the General Organisation for Industry (GOFI) is responsible for planning the prevention or treatment of industrial effluent.

Other ministries with an interest or role in water resources management are the *Ministry of Transport and Communications* (navigation requirements, disposal of oil and waste from river vessels), the *General Authority for Fish Resources Development* (under MALR), the *Ministry of Electricity and Power Production* (discharge of cooling water) and the *Ministry of Tourism* (floating hotels and tourist vessels).

The Ministry of Public Works and Water Resources (MPWWR)

The Ministry of Public Works and Water Resources is the government body that authorises water use and is responsible for management and administration of the national water resources. The Ministry schedules releases from the High Aswan Dam, approves diversions from the system and has the authority to implement national water quality legislation. At present, it employs some 88,000 people including an engineering staff of some 2,360.

The Ministry has four Authorities, three Departments, two Sectors, a National Water Research Centre and various staff offices reporting directly to the Minister. The National Water Research Centre and the Planning Sector, handling research and long range project and programme planning, are responsible for specific functions. The other organisational units are responsible for programmes which include such functions as the operation and maintenance of facilities, the design and construction of facilities, and some regulatory activities.

Most Authorities, Departments, Sectors and the NWRC have their own administrative offices. Away from headquarters in Cairo, the Ministry's organisation is by Directorate. Most of the Authorities and Departments have Regional Directorates. Activities of the most relevant Ministerial units are summarised below.

The *Planning Sector (PS)* is responsible for formulating and developing water sector policies and long-term strategies. The Sector has units for programme planning, project planning, computer modelling, water forecasting and the development and operation of a water management information system.

The *High Aswan Dam Authority (HADA)* was established in 1972 after construction of the Dam. It is responsible for operating and maintaining High as well as the Old Aswan Dam. In co-ordination with the Irrigation Department, releases from both dams are set on a daily basis and regulations are managed by the Authority. Studies on sedimentation and the water quality of Lake Nasser as well as evaporation losses are conducted by this authority in co-operation with the Nile Research Institute (formerly, the HAD Side Effects Research Institute) of the NWRC.

Reflecting the fundamental importance of operating the water distribution system, the *Irrigation Department (ID)* is by far the largest unit of MPWWR currently employing a staff of some 39,000 (out of 88,000 employed by the Ministry). Under the direction of a first Under-Secretary, it is responsible for five sectors: Irrigation, Horizontal Expansion and Projects, Nile Water, Dams and Big Barrages and Administration and Finance. The Department is represented in the field by 22 Irrigation Directorates covering irrigation areas varying between 170,000–600,000 feddan. The Directorates are further subdivided into 41 Inspectorates and 167 Districts. The Department is also responsible for the maintenance of canals and associated structures. Most of this work is carried out under contract by public or private companies. All contracts are handled by the Irrigation Directorates and maintenance budgets are controlled by the Directorates. Some work is carried out by labourers directly hired by Directorates and Districts.

The *Egyptian Public Authority for Drainage Projects (EPADP)* was established in 1973 to implement drainage projects. In 1979, it was also given responsibility for maintenance of open drains. The Under-Secretary for Maintenance in EPADP administers nine field Directorates which in turn, are divided into 50 Centres and 214 Sub-Centres. Directorates range in size from 150,000 to 300,000 feddan of drained land and Centres from 40,000 to 50,000 feddan. The staffing structure and management functions of Drain Maintenance Directorates and Centres are similar to those of Irrigation Directorates and Districts, respectively.

The *Mechanical and Electrical Department (MED)* is responsible for the operation and maintenance of all pumping stations (irrigation and drainage) throughout the country. It is structured along regional lines. It has two Central Directorates for Operation and Maintenance, one for lower Egypt in Tanta and the second in Nag Hammadi for Upper Egypt.

The need to further strengthen and expand Egypt's research capacity became urgent after construction of the High Aswan Dam. Sedimentation and degradation problems appeared, the Nile River morphology changed, water tables started to rise as a result of the shift to perennial irrigation and pollution and other related issues required new research.

Accordingly, MPWWR integrated all research units into one Centre with a separate identity. In 1975, a Presidential Decree ordered the formation of the Water Research Centre (WRC) to serve the needs of the country and specifically of the MPWWR. In 1994, WRC was elevated to University status and renamed the *National Water Research Centre (NWRC)*. The internal organisation chart of the Centre was slightly modified and some of the member research institutes were also renamed to better reflect the nature of the research area covered and the type of problems dealt with.

From a small MPWWR office in 1975, the Centre developed into a well-established administrative body with a highly qualified cadre of 25 and a management staff of six including the Chairman who has ministerial rank. Apart from administrative offices, there is also a central information and documentation centre.

Since 1975, NWCR supervises and co-ordinates the work of 11 research institutes active in the field of water resources management and development, i.e. the Drainage Research Institute (DRI), the Research Institute for Groundwater (RIGW), the Water Management and Irrigation Research Institute (WMRI), the Nile Research Institute (NRI), the Hydraulics Research Institute (HRI), the Channel Maintenance Research Institute (CMRI), the Water Resources Research Institute (WRRI), the Survey Research Institute (SRI), the Construction Research Institute (CRI), the Mechanical and Electrical Research Institute (MERI) and the Coastal Research Institute (CORI). Another, the Climate, Water and Environment Research Institute (CWERI) is in process of formation. The various institutes represent different disciplinary skills falling into a rather narrow technical range. Plans to redraw the fragmented research sector chart failed on account of strong opposition to internal management reform. Some physical integration was achieved in 1987 when all but one institute moved to a common water research complex near de Delta Barrage (the Coastal Research Institute remained in Alexandria).

Apart from supervising and co-ordinating the work of its member institutes, NCWR is charged with the establishment of the Central Water Quality Laboratory (currently under construction) and the set-up of a national water quality monitoring network. It also plays an important role in mobilising external (read donor) research support and represents Egypt in numerous international professional organisations in the field of water resources management.

2.5 Policies and issues

Sector policies

In the last quarter of the 20th century, the Egyptian economy has moved from a position where it had sufficient water for all its economic needs to one of deficit. By the early 1970s, supply management options had ceased to be available and for the next two decades new major water needs were basically met by importing water in the form of food substitution. Under the circumstances, the Government's decision to reclaim large amounts of land raised questions about the feasibility of the ambitious land expansion plan. MPWWR had to work out a more general strategy for the development of water resources through maximising use and fully exploiting available resources. In the period 1978–85, long-range planning tools were developed and alternative scenarios elaborated for future water use and supply based on various rates of agricultural development and water use increases. The planning effort culminated in the preparation of the national Water Master Plan (WMP, 1986). This made recommendations for future studies and activities and also developed an original set of mathematical models to be used in planning, setting water resource policy and operating the water storage and supply system.

Interaction and feedback between the planning effort and policy-decision making bodies was weak, however. While the Egyptian Government continued to favour high-profile land reclamation schemes, a number of actions were taken to increase water use efficiency in the old lands such as: (i) limitation of water releases for power generation and transport only; (ii) reconstruction of the Esna Barrage; (iii) spreading the winter closure over a longer period, and (iv) construction of a large number of drainage water re-use pumping stations and schemes.

Meanwhile, the US$ 340 million USAID-financed Irrigation Management Systems Project was launched to improve water resource management at the level of the canal system, on-farm management, drainage and main system management. Under this project, some 19,500 small and medium irrigation structures were replaced, rehabilitated or reconstructed and preventive maintenance schemes were introduced in six Governorates. Some 100,000 feddan were targeted to raise on-farm water management efficiency through physical remodelling, the establishment of legally organised private Water User Associations (at the mesqa level) and the set-up of an Irrigation Advisory Service to assist farmers regarding on-farm irrigation practices (USAID, 1991; USAID, 1995).

The other area of reform was the drainage system. Although Egypt worked hard at providing drainage, the system remained inadequate for many years. As mentioned earlier, a World Bank programme helped to install field drains in 4 million feddan. This was an

investment that played and continues to play an important role in optimising water resources within the current allocation and in increasing productivity by lowering the water table.

The strategy for water demand management, which was largely involved with engineering and agricultural aspects, gradually placed greater weight on economic and environmental aspects in order to capture issues relevant to future resource development and to deal with the pervasive effects of poor quality water on the availability of natural resources and on human well-being. Early in 1982, important legislation was promulgated to control the quality of the Nile water. As such, the River Nile Protection Law 48/1982, together with the simultaneous creation of the Environmental Protection Authority, represented a major policy initiative to prevent further Nile pollution and to protect Egypt's internal waters and lakes. However, the law was not backed up with adequate funding for policing, trained manpower, or laboratories for analyses and carrying out monitoring and inspection. As a result, enforcement was rather ineffective (USAID, 1992).

Policy concerning water quality gained further momentum through the formulation of the Environmental Action Plan (EAP) in 1992 and the new Law 4/1994 on Environmental Protection. EAP proposes that the first priority should be to protect the Nile River and its branches and the second to improve water quality in secondary waterways and drains. Once again, however, political and financial support to implement EAP, particularly its water resources component is slow in appearing.

Main policy issues

Over the years, MPWWR's policy development and re-formulation capability has been focused on technical issues. The area where reforms have been identified but not yet been initiated, is that of *water pricing*. Given that water is essential for life, water allocations have so far been based primarily on political and technical considerations rather than economic criteria. Because the expansion of water supply was politically expedient, pricing and demand management have been given much less attention. In paying little or nothing for their publicly-supplied water (at least not directly and transparently), farmers and users in general have little incentive to refrain from growing water-intensive crops or to conserve water. The need for fiscal incentives to adopt water-saving technologies and complementary demand management programmes has become all the more urgent in an increasingly liberalised economy, based on price competitiveness.

Recently, the Government has come to recognise the benefits of *privatisation* and increased *user participation* in managing and maintaining the water distribution network.

Given that water is essential for life, the Government's involvement reflected its concern that exclusive reliance on unregulated markets would not work. The result has been a general lack of user participation and over-reliance on government agencies to develop, operate and maintain water systems. The fiscal crisis that began in the early 1980s, the deteriorating irrigation system and the still inadequate water supply infrastructure, exposed serious institutional deficiencies. These included lack of motivation and accountability among agency staff, high levels of political interference, and inadequate concern for the needs of end-users. In the period 1993–95, Water User Association and Irrigation Advisory Services (IAS) legislation was introduced and applied on a pilot scale as a means with which to enhance participation and effectiveness in water management. Similar arrangements in new land to operate pumping stations at the farm level have been forthcoming. While this was a step in the right direction, the new policy initiatives have yet to produce the expected benefits (USAID, 1992).

Technical constraints

The most pressing technical problem that confronts Egypt's irrigation system is the limited control over water supplies: many structures are partially functional, and there are deficiencies in system management. Improved management of the irrigation system would reduce the need for drainage. Options for improvements are limited, however, because: (i) the irrigation water is privately pumped by farmers; (ii) most irrigation canals are below ground level; (iii) the age-old rotation system would need to be altered; (iv) investments in irrigation structures and improvement of their operation would need to be throughout the entire system, probably resulting in higher costs than the construction of localised pipe drain systems; and (v) better management practices would not necessarily provide additional water for irrigation.

With respect to drainage, the government has progressively developed design criteria adapted to the country's specific conditions. Further improvements are still needed in technical designs, construction management and quality control, techniques for rehabilitation of old systems, monitoring, and the evaluation of maintenance and operations.

Institutional constraints

Numerous project progress, evaluation and sector reports refer to the fragmented institutional framework and rigidities of the Egyptian Government structures hindering efficient water management.

Weeds blocking irrigation system

The MPWWR has an elaborate *organisational structure* which has been growing and expanding with time. Although the creation of different Sectors and Departments appears to have responded to need, the fragmentation of programmes and functions among many Ministry units has led to considerable duplication of activities and resources, especially at the field level. Operation of the MPWWR's water storage, delivery and drainage facilities and maintenance and construction activities, is spread among at least four units. Reviews of other government water resources organisations made clear that this type of structure results in inefficient use of personnel, supplies and equipment.

Over the years, there has been a tremendous investment to build up and strengthen the research capacity. This involved the acquisition of modern research equipment and facilities and training hundreds of staff. Relations between the NWRC research community and the main users of the research results have been problematic.

A lack of clear policies and programmes related to science and technology make it difficult to communicate needs clearly to the researchers. On the other hand, researchers have not always been effective in communicating their results and findings in a user-friendly manner to non-researchers. Although in principle the research effort is problem- and policy-oriented, researchers tend to translate and further elaborate problems into their own often strongly discipline-based frames of reference. Also institutionally, there is

insufficient incentive to ensure active interaction and collaboration between policymakers and/or managers, and researchers.

A key characteristic of the MPWWR is the high degree of *centralisation* of decision making authority and the *inadequacy of the communication* of information among MPWWR units and between the MPWWR and other key Governmental organisations, slowing down programme accomplishment. Co-ordination and exchange of information is often dependent on personal relationships between managers. The process for co-ordination and exchange of information within and between ministries is bureaucratic. Committees were formed for improvement of co-ordination between the various agencies dealing with Nile water issues. It is largely felt that co-ordination can best be achieved by actual co-operation at the level of execution of programmes and projects. A particular bone of contention has been and still is the co-operation and co-ordination between the Ministry of Public Works and the Ministry of Agriculture and farmer communities.

Over the years, the MPWWR and Governmental organisations in general continued to face serious problems in their *compensation policies*. With low salaries, employees are looking for other means to earn an income and meet living expenditures. Currently, base salaries for engineers generally fall between LE 80 and LE 200 (US$ 23–58) per month while Department Chairmen (First Under-Secretary) receive a basic salary of about LE 550 (US$162) per month. Ministry attempts to overcome the problem of the low basic salaries include 'incentives' payments and annual bonuses. Overall then, most engineers in the Ministry can expect to take home between LE 200 and LE 500 (US$58–147) per month. These rates are still considerably below what is paid by the Egyptian and foreign private sector. Estimates of the percentage of MPWWR staff having some kind of outside employment vary. If all types of employment are included, it may exceed 80%. Aside from the negative impact the compensation system has on performance, there is no link between compensation and performance and little relationship between performance and promotions. Employees' continuous concern for increasing their compensation means that other kinds of motivational devices, such as special recognition for good work, generally have not been effective (USAID, 1995).

Another factor affecting institutional performance, has been the hierarchical *staffing and career development* policies in the public sector. Nearly all the professional staff of the MPWWR and research institutes are civil engineers. Because of the dominance of civil engineers and the fact that promotions to top positions are only available to them, other disciplines feel little loyalty to the Ministry. The job assignment policy for engineers makes all engineers into generalists. While generalists are appropriate for some positions, the assumption that all engineers can do any job leads to a mismatch between a person's strengths and the job to which he/she is assigned. The lack of skills in the non-civil

engineering field dramatically increases the need for training in specialised fields such as computer programming, economic and financial analysis and other non-technical fields of expertise.

Except for some specific positions, job transfers, career advancement, and promotions are primarily based on seniority (with some consideration for experience and performance) and not linked to training requirements (USAID, 1995).

2.6 Donor support

Context

The Egyptian economy has benefited from extensive donor support since Independence in 1952. In the period up to 1973, during which Egypt sought to expand its energy supply and develop its industrial base, the former Soviet Union provided some US$ 4.22 billion in loans, some of which were used to build the Aswan High Dam. In 1967, Kuwait, Saudi Arabia and Libya agreed to provide some British Pound 95 million each year while aid from the oil-producing states rose significantly in the 1970s, to an average over US$ 1 billion a year between 1973 and 1979. Egypt's signing of the peace treaty with Israel in 1979 caused this financial support to be cut off but at the same time the USA greatly increased its aid with a view to ensuring that peace with Israel be maintained. Since ties with the Arab world were restored in 1987, aid from the Gulf states and lending agencies has again increased, particularly after August 1990 when Egypt was rewarded with around US$ 2 billion in cash injections and a US$ 7 billion debt write-off for its pivotal role in forming the Arab coalition to liberate Kuwait. As a result, the level of gross official development assistance from OECD and OPEC member countries soared from US$ 1.75 billion in 1987 to as much as US$ 10 billion in 1991, making Egypt the world's largest recipient of foreign aid. As a result of US budgetary pressures and strong lobbying from the influential anti-aid groupings in the US Congress, the US annual economic grant of roughly US$ 1 billion was cut during the following years but still remained very substantial. At US$ 550 million a year, it still exceeds the (average) combined assistance of other Arab and OECD countries (including the Netherlands) and multilateral agencies such as the World Bank, the European Union and Arab development banks.

A substantial part of total donor assistance has been expended on project and/or policy-based programme assistance in the drainage and water management sector. The size and evolution of individual financial contributions cannot be assessed, however, in the absence of reliable and comprehensive statistical data. The following review of principal donor

activities has the objective of identifying respective fields of interest only and possible areas of overlap with the Netherlands-financed sector programme.

USAID

USAID has contributed well over US$ 1 billion to the Egyptian agricultural sector over the past 20 years for research, credit and improved water management. The Egypt Water Use and Management Project (EWUP) 1975–84 was an integrated research project to test farm level improvements in irrigation water delivery in three areas, namely Kafr El Sheikh, Gizeh and Miniya. In a number of representative pilot areas, on-farm water management constraints were identified and corrected, including shortcomings in drainage systems. In 1981, the US$ 13 million assistance programme was expanded and followed up by the Irrigation Management Systems (IMS) Project which supported: (i) a country-wide structural replacement programme for the irrigation system; (ii) development of a major training programme and a country-wide preventive maintenance programme; (iii) provision of technical and financial assistance for the existing Regional Irrigation Improvement Project and the National Water Research Centre; (iv) installation of a telemetry system to monitor the Nile River and major canal flows; (v) development of a major training programme and construction of training facilities; (vi) development of computer models for the irrigation distribution system; and (vii) preparation of detailed topographic and aerial photography of the irrigated lands of Egypt. The massive investment programme, involving some US$ 340 million, provided USAID's vehicle for amending existing irrigation legislation (Law 12/1984 and Law 213/94 clarifying and consolidating farmer obligations in respect of capital repayment and of operation and maintenance of the tertiary irrigation system). Its completion was scheduled for September 1996.

While phasing-out involvement in physical improvement of the water management infrastructure, USAID recently sponsored the first attempt at a comprehensive institutional analysis of MPWWR in a bid to formulate and execute an Action Plan for Strengthening Water Resource Management in Egypt (USAID, 1995). The Action Plan, focusing particularly on policy and institutional issues, has not been approved by Egypt.

Over the years, the policy-based IMS programme has been complemented by specific project assistance including: (i) a US$ 18.9 million contribution to the construction of 37 irrigation pumping stations along the Nile in Upper Egypt; (ii) a US$ 19.2 million co-financing arrangement with the WB in the drainage sector (supply of three pvc pipe factories); and (iii) another US$ 30 million co-financing contribution to the WB sponsored Channel Maintenance Project (supply of dredging and earthmoving equipment).

World Bank

Past World Bank involvement in the sector has focused directly on assisting Egypt to maintain and increase productivity in the old lands. Since 1970, the World Bank has been heavily involved in the formulation and execution of the country's national drainage programme. The involvement was initiated in December 1970 under the Nile Delta I Project. The project, the first IDA operation in the agricultural sector in Egypt, covered the improvement of drainage on 950,000 feddan. Subsequently, five more projects were approved for drainage implementation: Upper Egypt I, Upper Egypt II, Nile Delta II, Drainage V and National Drainage. The last (and largest) project was launched early in 1992 and heralded a new phase in Egypt's drainage programme insofar as it includes renewal of existing but ineffective field drainage systems on 130,000 feddan.

In general, World Bank/co-financial funding covered the foreign exchange costs of the drainage programme (construction and drainage equipment). The first credit/loan agreement was the principal vehicle for introducing far-reaching legislation in the irrigation and drainage sector. Section 3.06 of the credit agreement required the Egyptian Government to make suitable arrangements to ensure the recovery from users of irrigated land of: (i) the maintenance cost of field drainage, and (ii) the capital invested in tile drainage over a period of two years without interest. This requirement was complied with in October 1971 when the country's basic Irrigation and Drainage Law was approved (Law 74/1971).

Support to the drainage sector was backed up with three other major loans, totalling some US$ 120 million, to modernise the country's channel maintenance capabilities and to rehabilitate a series of pumping stations. The outcome of the Channel Maintenance Project was unsatisfactory: by and large, the project failed to introduce more cost-effective and channel preserving methods or to address the complexity of the institutional and organisational issues involved. Two Pumping Station Rehabilitation Projects, implemented by the MPWWR Mechanical and Electrical Department (MED), were successfully completed, however.

In the early 1980s, the Bank made an unconvincing exception to its sector priorities in financing a new land reclamation project in the West Nubariya area. This complex project suffered from major design and implementation problems. Bank implementation assistance could not prevent the scheme from running into major irrigation water supply problems that affected yields and farm income. As a result, the outcome of the investment was disappointing and World Bank steered clear of new land development in favour of continued support for drainage (of the old lands).

Meanwhile, the World Bank served as the executing agency for two UNDP-funded projects, i.e. the Water Master Plan for planning water development and use, and the Irrigation Rehabilitation Project to help prepare a scheme to improve the irrigation infrastructure and efficiency in the use of irrigation and drainage water. In 1992, the Bank co-ordinated the drafting of the Egyptian Environmental Action Plan providing a framework for dealing with the main issues constraining effective environmental management, including appropriate legislation and enforcement measures, institutional responsibilities and economic aspects of environmental degradation. The initiative eventually led to the enactment in January 1994 of the Environmental Law no 4/94 mentioned earlier.

In an effort to integrate the USAID-financed IMS project components more solidly into MPWWR's operations, early 1994 the Egyptian Government requested follow-up support from World Bank to improve three irrigation systems in an area of about 250,000 feddan located in two Governorates (Kafr el Sheikh and Beheira). This request eventually culminated in the formulation and approval of the Irrigation Improvement Project, involving US$ 80 million of Bank loan and credit funds (estimated completion date 30 June, 2002). This 'take-over' of the USAID irrigation improvement programme consolidated the Bank's position as main donor in the drainage and irrigation sector in Egypt.

Other donors

Apart from the Netherlands, a number of other donors have been and still are directly and indirectly contributing towards improving Egypt's irrigation and drainage infrastructure and management of its water resources.

Since 1976 Egypt has been eligible for Canadian bilateral assistance through the Canadian International Development Agency (CIDA). Since then, CIDA's bilateral assistance to Egypt has varied between US$ 20 and 25 million per year, all on a grant basis. In the drainage and water sector, CIDA financed two important projects. One was the Integrated Soil and Water Improvement Project (ISAWIP), a US$ 50 million integrated irrigation and drainage development programme to improve agricultural production in an 80,000 feddan area in Dakahlia Governorate. The other was the River Nile Protection and Development Project (RNDP), whose principal objective was to identify and prepare projects to achieve and protect optimum water usage of the Nile River. Phase I was concluded in 1992. The on-going Phase II commenced in late 1993 and supports the establishment of a Nile Water Strategic Research Unit and Central Laboratories for Environmental Water Quality Monitoring, both within the NWRC.

Involvement in Egypt's environmental programme was further deepened under the (ongoing) Environmental Information System Project to establish linking key Governmental agencies within the new integrated management responsibilities of the Egyptian Environmental Affairs Agency.

Together with Japan and Italy, the EU was involved in conducting water resource assessment studies in the Sinai peninsula and land reclamation schemes in the Eastern and Western Delta. The most prominent scheme was the Kafr el Sheikh (Hamoul) Soil Improvement Project, an ECU 8 million pilot drainage and soil improvement programme covering 65,000 feddan of land reclaimed from Lake Burullus.

In the 1975–95 period, the Kreditanstalt fur Wiederaufbau (Germany) co-financed two of the six drainage projects mentioned earlier. The last co-financing agreement included a DM 2.5 million allocation to strengthen the monitoring and evaluation capabilities of the executing agency EPADP, an activity which had been largely neglected under the parallel-financed World Bank and Netherlands assistance programmes.

Apart from co-financing one of the drainage projects, the African Development Bank is currently providing financial support to the Drainage Research Institute for research into the impact on crop yields of lowering irrigation water quality standards and for the formulation of appropriate guidelines for drainage water irrigation management.

3 Policy and programme characteristics

3.1 Policy

Since 1975, Egypt has been eligible for Netherlands bilateral aid. The initiative to establish a bilateral aid relationship was inspired by: (i) the Netherlands' desire to improve relations with countries in the Middle East after the 1973 oil boycott and secure peace, security and international order in the area; (ii) the importance of Egypt as a market for Netherlands exports and investments and; (iii) a basic commitment to assist poorer, developing countries to meet their development needs.

Discussions with individual ministries yielded a series of project ideas and suggestions, mostly in the field of land drainage and irrigation. The ideas were followed-up by a number of project identification and formulation missions and formed the basis of the first country policy paper prepared in 1977. Apart from outlining the general principles of assistance policy, the document emphasised the need for sectoral and geographical concentration, the preference for project aid and for projects yielding rapid and tangible results. Agricultural infrastructure was listed as a priority sector. The principal reasons for this were the urgent need for rebuilding the infrastructure destroyed in the preceding wars and the available Netherlands expertise in this field. The document rejected the idea of supporting research in the water sector because: (i) numerous research projects had already been undertaken by a vast number of Egyptian researchers, and (ii) the level of available Egyptian expertise was reportedly high. In retrospect, the document provided little or no guidance for further programming of activities. With respect to the water sector, no comprehensive analysis was made of Egyptian policies and sector development constraints and no reference was made to the activities of other donors.

No country or sector policy documents were produced in the next seven year period up to 1985. Many of the projects initiated during the 1975–80 period ran into implementation problems and under-commitment, and disbursement of the aid allocation was the most important concern.

In 1985, DGIS introduced the four-year country programming system. The three country programme documents produced since then, were characterised by vaguely formulated statements on the importance of the Egyptian drainage and irrigation sector and food production, the crucial role of government institutions, the need to strengthen research and management capabilities and the complementarity of Netherlands expertise in the sector. Again no specific objectives, development priorities or concrete targets were set for sector assistance and linkages with the overall policy objectives of poverty reduction, environment and women in development were poorly documented. On one occasion (the 1990 Annual Plan), the need for further elaboration of the water sector assistance policy was explicitly mentioned. Re-assessment of sector development objectives and priorities would be part of the evaluation of the activities of the sector programme's main advisory body, the Egypt–Netherlands Advisory Panel on Land Drainage. That evaluation was concerned primarily with the role and functioning of the Advisory Panel itself, however, and the elaboration of a better documented sector assistance plan was not followed-up.

In retrospect, it appears that neither the Egyptian nor the Netherlands Government had rationally elaborated country and/or sector co-operation development plans with prior definition of objectives, properly assessed training and capital aid needs and expected outputs.

Instead, an approach was adopted involving learning from experience, emphasising feed-back and the correction of errors rather than trying to eliminate deficiencies in design. While there was certainly a rationale for this pragmatic approach during the first 5–10 year period of the co-operation programme, there was little justification for it in the later stages when: (i) a water sector specialist was permanently stationed at the Netherlands Embassy (since 1987); (ii) a highly respected Advisory Panel of sector experts was in place since 1975 to advise on sector policies and priorities and; (iii) the longer-term presence and availability of quality expertise in the sector offered ample opportunity to properly assess the development constraints of the sector and its institutions. In the absence of a mutually agreed long-term, strategic approach, the project identification, design and implementation process were primarily guided by consultants and the Advisory Panel.

3.2 Main programme characteristics

Brief history

The Netherlands involvement in the Egyptian water sector starts in 1975 when a technical mission was fielded to examine the possibilities of a project of technical co-operation between the two countries in the field of land drainage. On the basis of discussions

with EPADP, the Governmental agency charged with execution of the land drainage programme, the idea was put forward to establish a high-level Advisory Panel of drainage experts. Apart from analysing '*the various problems standing in the way of an accelerated programme of land drainage in the country*', the Panel would formulate recommendations on how to proceed and would advise on the introduction of new drainage technologies. Eventually, the mission's report (June 1975) was the starting point of the *Advisory Panel for Land Drainage Project (APLDP)*. Apart from covering the operational costs of the expert Panel meetings (twice a year), the Netherlands contribution covered the cost of stationing a small team of expatriate experts in Egypt to assist EPADP and the newly established Drainage Research Institute (DRI), in the implementation of the Panel's recommendations. The technical assistance project was extended over a period of eight years and complemented with direct financial support for the procurement of drainage construction equipment (East Bahr Saft drainage project).

In the 1975–80 period, a second technical assistance programme was identified and formulated in the field of (irrigation and drainage) channel maintenance. The objective of the *Aquatic Weed Control Project* was to assess channel maintenance practices and to evaluate different technical weed control alternatives. Eventually, the project marked the establishment of the Channel Maintenance Research Institute (CMRI) which was designated as project counterpart organisation. Facing important institutional and financial constraints, the mechanical weed control research programme was soon abandoned and the project focused on biological weed control by grass carp. The follow-up *Grass Carp* and *Delta Breeding Station* Projects assisted the Institute in setting-up the first, larger-scale breeding and raising experiments of grass carp in Egypt.

In 1983, the Advisory Panel for Land Drainage Project was restructured 'in order to keep the Panel within its stated objectives and within a clearly defined framework'. Agreement was reached on the concept of formulating specific research and general support projects each with clearly defined objectives, detailed plans of operation and agreed budgets. While the project as such was extended, drainage research support (to the Drainage Research Institute) was continued under two separately formulated and parallel funded technical assistance projects.

The objective of the *Re-use of Drainage Water Project* was to assist DRI in developing a mathematical model for predicting drainage water quantities and quality under different water management scenarios and in setting up and operating a nation-wide drainage water monitoring system. The mathematical modelling exercise was phased out in 1996. Assistance to the monitoring programme was stopped in 1994 but resumed under the recently approved *Monitoring and Analysis of Drainage Water Quality Project*.

The *Drainage Technology and Pilot Areas Project* supporting DRI's research effort in the field of covered drainage was phased-out in 1994 and followed by the on-going, more comprehensive research assistance programme—the *Drainage Research Programme*—covering a wide variety of drainage-related research subjects.

Parallel to the DRI drainage research support programme, the *Drainage Executive Management Project (DEMP)* was launched in 1984 to improve EPADP's construction planning and management practices and to increase its drainage system design, monitoring and supervising capabilities. DEMP is currently in its fourth phase and is scheduled for completion early in January 1998. The technical assistance programme was complemented with two direct contributions to the on-going drainage construction programme i.e. the *East Bahr Saft* drainage project and a co-financing contribution to the World Bank financed *Drainage V* project.

Early in 1984, acting upon indications that vertical drainage could be a technically and economically feasible alternative to horizontal drainage, the Netherlands agreed to assist the Research Institute for Groundwater (RIGW) in carrying out a vertical drainage feasibility study. This was the starting point of a long-term technical assistance relationship with the Institute. As in the case of DRI, the assistance was channelled through two separately formulated and financed projects, i.e. the *Vertical Drainage Study* and the *Development and Management of Groundwater Resources Project*.

The Vertical Drainage Study was followed-up under the *Feasibility Study of Groundwater Development*, later renamed *Groundwater Development for Irrigation Project* and ultimately extended under the *Control of Waterlogging and Salinization Project*. As the naming of the project suggests, the scope of the vertical drainage research programme was gradually widened by focusing attention not only on the drainage aspects of groundwater extraction but also on irrigation water management practices that created the waterlogging problems in the first place. Ultimately, however, the scope for vertical drainage appeared limited and the 10-year research and technical assistance support programme was phased-out in 1994.

The basic aim of the *Development and Management of Groundwater Resources Project* was to strengthen research capabilities in the field of groundwater resources assessment and the formulation of groundwater development and management plans. To better reflect the scope of work and character of the assistance programme, the project was renamed in 1994 into the *Environmental Management of Groundwater Resources Project* (EMGR). The corresponding technical assistance agreement expires in February 1998.

Under guidance of the Advisory Panel on Land Drainage, the Netherlands also funded a cluster of technical assistance projects to strengthen water management capabilities at the regional level. In 1984, the *Fayoum Water and Salt Balance Study* was formulated in collaboration with the Fayoum Governorate Administration, the regional offices of the Irrigation Department and the Drainage Research Institute. Intensive discussions on the use of advanced computerised water management modelling followed and formulation of the follow-up *Fayoum Water Management and Drainage Improvement Project* took more than two years. In the meantime a second technical assistance project, the *Fayoum Weed Control Project* was launched early 1989, for testing mechanical and manual cleaning of irrigation and drainage canals at the regional level. Upon recommendation of a joint evaluation team, the two projects were extended and merged in 1994 into the *Fayoum Water Management Project*. This project is currently in its fourth year of implementation and due to be terminated at the end of October 1998.

The Fayoum technical assistance programme was backed up with a direct financial contribution to the design and construction of the *Batts Pumping Station*, the main drainage water re-use pumping station in Fayoum.

The scope of the sector co-operation programme was further widened in 1986–87 with approval of the *Hydraulic Studies Project*. Another technical assistance project supporting the Hydraulic Research Institute (HRI), the most prominent water sector research organisation in Egypt involved in hydraulic engineering research. The technical assistance contract of the supporting consultant has been extended three times, the latest in 1994.

Meanwhile, the Netherlands continued to fund the operational cost of the high-level Advisory Panel on Land Drainage Project, the mandate of which has continuously been extended up to the present, with an interruption in the period February 1990–September 1992.

In the last ten-year period, all of the earlier programmes and projects mentioned above were continuously extended (and sometimes expanded); only two new projects were identified. The objective of the *Strengthening of the MPWWR Planning Sector Project*, started in October 1994, was (and still is) to strengthen the MPWWR Planning Sector which is formally responsible for developing policies and long-term strategies in the field of water resources. In 1995/96, the *National Water Quality Monitoring Network Project* was funded to advise on the set-up and design of an integrated national water quality monitoring network.

Financial contribution

The financial contributions of the Netherlands to the drainage and water management sector in Egypt over the period 1975–96 totals roughly Dfl. 159 million. A breakdown by 5-year time periods and by major heading is presented in Table 3.1.

Table 3.1 Netherlands contribution to the Egyptian drainage water research and water management sector 1975–96 (in Dfl. 1,000)

	1975–80	1981–85	1986–90	1991–96	TOTAL	%
ADVISORY PANEL ON LAND DRAINAGE						
Phases IV–VI (1983–96)	0	1,659	3,610	1,593	6,862	
Subtotal		1,659	3,610	1,593	6,862	4.3
DRAINAGE RESEARCH INSTITUTE						
Advisory Panel on Land Drainage Phases I–III	2,657	2,793	0	0	5,450	
Associate experts (Panel)	729	1,148	0	0	1,877	
Drainage Technology and Pilot Areas	0	854	2,322	1,793	4,969	
Re-use of Drainage Water	0	2,831	2,075	3,124	8,030	
Drainage Research Programme	0	0	0	2,515	2,515	
Re-use Monitoring Programme	0	0	615	276	891	
Monit. and Analysis of Drainage Water Quality	0	0	0	1,155	1,155	
Associate experts (other)	0	0	1,809	448	2,257	
Subtotal	3,386	7,626	6,821	9,311	27,144	17.1
RESEARCH INSTITUTE GROUNDWATER						
Hydrological Training Programme	0	2,700	1,400	0	4,100	
Development and Management of Groundwater Res.	0	0	5,421	2,007	7,428	
Environmental Management of Groundwater Res.	0	0	0	3,055	3,055	
Vertical Drainage Study	0	0	450	0	450	
Feasibility of Groundwater Development.	0	0	858	114	972	
Pump sets	0	0	205	1,068	1,273	
Control of Waterlogging and Salinization	0	0	0	2,481	2,481	
Associate experts	0	0	0	312	312	
Subtotal	0	2,700	8,334	9,037	20,071	12.7
CHANNEL MAINTENANCE RESEARCH INST.						
Aquatic Weed Control	6,720	700	0	0	7,420	
Grass Carp	2,171	2,572	0	0	4,743	
Delta Breeding Station	0	3,560	170	513	4,243	
Subtotal	8,891	6,832	170	513	16,406	10.3
HYDRAULICS RESEARCH INSTITUTE						
Hydraulic Studies	0	0	3,275	5,857	9,132	5.8
SUB-TOTAL RESEARCH INSTITUTES	12,277	17,158	18,600	24,718	72,753	45.9
EPADP DRAINAGE EXECUTION						
East Bahr Saft drainage	7,427	2,417	23	0	9,867	
Drainage V	0	0	6,125	3,752	9,877	
PVC raw material	0	1,855	1,125	0	2,980	
Drainage Executive Management	0	640	5,003	13,267	18,910	
Associate experts	0	0	0	260	260	
Subtotal	7,427	4,912	12,276	17,279	41,894	26.4

(Table 1 continued)

	1975–80	1981–85	1986–90	1991–96	TOTAL	%
FAYOUM WATER MANAGEMENT						
Fayoum Water and Salt Balance Study	0	1,013	642	0	1,655	
Batts Pumping Station	0	0	5,374	1,474	6,848	
Fayoum Water Management and Drainage Impr.	0	0	2,030	3,645	5,675	
Fayoum Weed Control	0	0	3,605	3,849	7,454	
Fayoum Water Management	0	0	0	10,496	10,496	
Associate experts	0	345	232	518	1,095	
Subtotal	0	1,358	11,883	19,982	33,223	20.9
OTHER						
Strengthening MPWWR Planning Sector	0	0	0	3,034	3,034	
National Water Quality Monitoring Network	0	0	0	682	682	
Other	0	28	211	6	245	
Subtotal	0	28	211	3,722	3,961	2.5
GRAND TOTAL	19,704	25,115	46,576	67,298	158,693	100.0

Source: DGIS.

Slightly less than half of total funding (Dfl. 72.7 million) was spent on supporting the four research institutes mentioned earlier. The balance (Dfl. 86.0 million) was spent on general and direct advisory support to the drainage and water management sector. Except for three capital investment contributions to the EPADP drainage construction programme and Fayoum water management (Batts pumping station), totalling some Dfl. 31.2 million, the rest of the financial contribution covered the cost of technical assistance support to the Fayoum Governorate/Irrigation Department (Dfl. 24.7 million), EPADP (Dfl. 19.3 million) and the Government of Egypt in general (Dfl. 10.8 million).

During the early stages, when the sector portfolio was restricted to three projects, the annual assistance volume varied between Dfl. 4 and 5 million. By 1986, the portfolio included as much as ten projects and the annual disbursement rate roughly doubled to Dfl. 10–11 million.

By and large, the sector co-operation programme was a technical assistance programme, seeking to improve the performance of the research institutes and Governmental agencies mentioned. While the (technical assistance) character was maintained, the selection of new target organisations operating at the farming community level (EPADP and Fayoum Irrigation Department) brought the co-operation programme more in line with Netherlands development policies seeking to improve living standards of the rural population.

The technical assistance packages have invariably consisted of a relatively large consultancy manpower component (some 65–75%), infrastructural investment support such as cars, computers and measuring equipment (some 20–25%), recurrent cost financing (10–15%) and formal manpower training support (2–5%).

Throughout the period, the emphasis was on specialised technical training. Upon instigation of successive evaluation missions, the projects' scope of work was eventually widened to address the more fundamental institutional development constraints hindering effectiveness of the technical training effort.

With the exception of the RIGW Hydrological Training Programme (1984–87), all other packages were put out to contract with Netherlands consulting firms and/or organisations under the technical assistance procedure. In most cases, tender requirements were waived and contracts were awarded directly to the Netherlands in-house or partner consultant in association with an Egyptian consulting firm or individual Egyptian experts. Additional expatriate manpower assistance was funded from the bilateral associate expert programme.

More details on project implementation, results and impact are found the following sections of this report dealing resp. with the Advisory Panel, the water research sector, the drainage execution sector and the Fayoum water management programme. The remaining group of 'other' activities is not reviewed in detail.

4 The Advisory Panel for Land Drainage

4.1 Background

Shortly after the Egyptian–Dutch bilateral co-operation programme was formally announced early in 1975, DGIS invited a Consultant to '*examine the possibilities of a project of technical co-operation between the two countries in the field of land drainage*'. In this report, the Consultant noted that '*considering the importance of land drainage in raising agricultural production in Egypt and the high priority the Egyptian Government is giving to solving the country's water logging and salinity problems—as well as the fact that any contribution from the Netherlands should necessarily reflect fields of activity where specific Dutch knowledge is available and could be beneficial in solving these problems—the author should like to recommend to the Dutch Government that it give favourable consideration to a project of technical co-operation in the field of land drainage*' (Schulze, 1975).

Project formulation followed a stormy discussion between the Egyptian Government and the World Bank over the engagement of consultants to assist EPADP with the management and execution of the first drainage project (Nile Delta I). The Bank's viewpoint was that the project required the resolution of technical issues in which the then Ministry of Irrigation had little or no experience. The Egyptian Government agreed to this only with the greatest reluctance, considering that an engineering organisation that had operated the oldest controlled irrigation system in the world for many years did not require permanently attached outside advisers. On other occasions, it claimed that strict governmental instructions did not allow the use of credit/loan funds for foreign consultants. A consulting firm was eventually engaged in December 1970. The Government's reluctance to make use of them, however, meant that the consultants were isolated, largely ignored, and not allowed to become involved in the mainstream of project execution. When their contract ended in March 1973, no other resident project consultants were engaged. Although there was little doubt that EPADP would have benefited from direct, in-house consultancy support, the set-up of a joint Egyptian–Netherlands Advisory Panel on Land Drainage clearly responded to EPADP's explicit preference for a short-term, advisory type of assistance.