RAPID ASSESSMENT STUDY

TOWARDS INTEGRATED PLANNING OF IRRIGATION AND DRAINAGE IN EGYPT

IN SUPPORT OF THE INTEGRATED IRRIGATION IMPROVEMENT

AND MANAGEMENT PROJECT (IIIMP)

FINAL REPORT

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IPTRID SECRETARIAT
Rome, June 2005

PREFACE

In March 2004, the IPTRID Secretariat and officials from the World Bank were discussing how best to utilize the financial resources allocated by the Bank to the Programme as part of their yearly support. At the same time, the Bank was engaged in conversations with the Ministry of Water Resources and Irrigation of Egypt on how to strengthen the ongoing preparations for the Integrated Irrigation Improvement and Management Project (IIIMP). Thus, it followed naturally that IPTRID was asked to take part in this process. There was, however, a time constraint since any activity undertaken by IPTRID had to be proposed - and implementation had to be underway - before the end of the Bank's 2003 fiscal year, only a few months away.

The Secretariat decided to take up the challenge and requested two of its Consultants, Mr Wilfried Hundertmark and Mr Maher Salman, to look into this matter. An activity was then designed in two phases: a) A Rapid Assessment Study of irrigation and drainage development in Egypt; particularly focussing on the appropriateness of utilizing the participatory and multi-disciplinary conceptual framework, known as DrainFrame, developed by Bank staff and; b) A Stakeholder Workshop in which the findings of the study would be presented and discussed involving broad participation. The proposal was well received and the three parties Egypt, the World Bank and IPTRID decided to proceed. However, one more hurdle had to be surmounted: the funds allocated by the Bank to IPTRID could not cover the total cost of the proposed activities. Once again, the Secretariat decided to overcome this constraint. Besides the Bank, the Secretariat drew funds and human resources from the United Kingdom Department of International Development (DFID); the FAO, through its Regional Office for the Near East (FAO/RNE) and its partner HR Wallingford. In this way, and within a very limited time frame, the Secretariat managed to design and piece together a rather complex activity.

From 26 May to 19 June 2004, a team composed of six international and five national consultants, under IPTRID leadership, conducted the Rapid Assessment Study in the Mahmoudia command area located in the northwest part of the Nile Delta in Beheira governorate, Egypt. Utilizing the DrainFrame approach the following principal steps were taken: (a) initial analysis of the current problematic situation; (b) function-oriented identification of landscapes and land and water control systems; (c) value-oriented stakeholder assessment; (d) participatory assessment of problems and opportunities; (e) participatory analysis of anticipated changes; (f) participatory impact assessment and (g) institutional appraisal.

The second phase, the Stakeholders Workshop, took place in Borg Elarab near the project area, from 6 to 9 October in collaboration with the Ministry of Water Resources and the Irrigation and the Drainage Research Institute (DRI). The high level workshop brought together nearly fifty participants including high-ranking government and non-government officials. Particular attention was given to the participation of local stakeholders from Ministry districts, water user organizations and water boards. Representatives from the Ministries of Agriculture, Health, Environment and Water Supply and Sanitation were among the participants.

While I will leave it to the reader to appraise the methodology and quality of the activities undertaken, as well as to judge the importance and relevance of the results, it is sufficient to say that IPTRID has received several expressions of satisfaction from both Egyptian and Bank professionals on the job done. In fact, it has been announced by the Head of the Minister's Office that a task force team is to be established to propose how the study findings can be fully and rapidly incorporated into the IIMP process.

As a final note, I would like to thank again all the eleven members of the study team. Their names are not reproduced here as they are dully recognized elsewhere in the document. Likewise, I must again thank the World Bank, the various donors involved and the Egyptian institutions and professionals that were associated, in their various ways, with the study. Finally, special thanks are due the IPTRID Secretariat support staff: Edith Mahabir and Giulia Bonanno di Linguaglossa, who bore the brunt of the rushed activities in preparation of this Final Report.

Carlos Garcés-Restrepo
IPTRID Programme Manager

Rome, 1 June 2005

EXECUTIVE SUMMARY

Study objective and approach

The purpose of the present study is to complement the preparations for the Integrated Irrigation Improvement and Management Project (IIIMP) using an independent multi-disciplinary perspective. It is believed that by taking this integrated approach the primary and secondary benefits of the IIIMP may be identified and the social and environmental hazards and risks evaluated. Ultimately, the study's findings will lead to better choices for physical interventions, ownership and broader support from stakeholders. At the same time, it is foreseen that the project will meet the need for sustainable and cost-effective development and address the critical risks associated with its implementation.

The conceptual framework for this multi-disciplinary rapid assessment study is based on the DrainFrame approach (Abdel-Dayem *et al*., 2004), which provides a coherent framework that can facilitate the formulation of adequate water resources management interventions. It implies an iterative, circular process of descriptive and diagnostic steps at various landscape levels. As the DrainFrame approach is based on the active participation of stakeholders (people and institutions) there is an appreciation of the diversity of existing water resource use and management situations.

The team realized at the start of the study that the DrainFrame approach should be made operational in a "real life situation". This implied conversion from a theoretical approach to a practical and tangible team-oriented methodology. Most important, the methodology needed to be adjusted to more visibly accommodate institutional aspects into the analytical process. The following principal steps were taken:

- Initial analysis of the prevailing problematic situation
- Function-oriented identification of landscapes and land and water control systems
- Value-oriented stakeholder and institutional assessment
- Participatory assessment of problems and opportunities
- Participatory analysis of anticipated changes
- Participatory impact assessment
- Appraisal

Findings

Anticipated impacts of IIIMP on water distribution

The findings described are based on the observed and monitored impacts induced by interventions made under the Irrigation Improvement Project (IIP).

Inequity of water supplies and distribution had been identified as farmers' key problem in unimproved *mesqas* where head-end users are favoured at the expense of tail-enders. The problem may be attributed to a number of negative factors associated with the production of irrigated crops, including delayed crop establishment, reduced crop development and yields as well as frequent crop failure. This, in combination with insufficient availability and lack of access to water resources (shortage of water supplies) at the level of branch and *mesqa* canals, has led to frustration and a loss of many smallholders' farm income. Problems generally arise from an inconvenient rotation system and uncoordinated operation of individual diesel pumps that have a pumping capacity ten times that of the traditional animal-driven *sakias*. In most unimproved places, pumping is carried out during the daytime. Farmers' poor understanding of their crops' irrigation requirements leads them to pump as much as they can afford

during daytime along *mesqas*, even though water services to tail-end users may remain unsatisfied. Night irrigation from *mesqas* is less frequently seen and substantial water spillage into drains can be observed at night when water levels inside *mesqas* rise above ground level.

In the absence of operational rules and regulations for the operation and management of individual pumping from *mesqas* and branch canals, many farmers have adopted a coping strategy that involves the reuse of water from open drains – even if the drainage water is saline. This practice is well documented as unofficial water reuse.

At the *mesqa* level, IIP has effectively reduced the problem of water inequity and supply shortages. This has been achieved through a mix of technical and institutional interventions. Those carried out using the Irrigation Improvement Project's (IIP) technical interventions have meant a change in the water supply systems, from rotational to continuous flow in combination with gravity flow in raised open *mesqa* canals or buried pipes operated at low pressure. At the time the mission visited the field, continuous flow conditions had not been reached, which renders the assessment of this intervention incomplete.

The construction of lined canals and buried pipes has considerably increased conveyance efficiency. Individual pumping has been replaced by a centrally operated pumping system that is managed by water users who are now members of water user associations (WUAs). Notably, the shift from individual to collective pumping has resulted in considerable cost savings in the order of one third.

Impact on water reuse

Current system operations suggest that the interventions had no noticeable "water saving effect" after the change in farmers' irrigation practice. Farmers still apply irrigation water in excess of crop needs and leaching requirements, negating IIP's progress in reducing management losses. There is potential scope for farmers to adopt improved irrigation practices and on-farm water management.

According to the preliminary findings of IIP's monitoring and evaluation component, unofficial reuse of drainage water has widely disappeared along improved *mesqas*. Also, water has been prevented from escaping from *mesqas* into open drains. Now the concern is that having eliminated the unofficial reuse of drainage water this will have a negative effect upon project water use efficiency, if official reuse remains unchanged. The positive effect of irrigation efficiency gains at the level of *mesqas* may be counterbalanced by the loss of the "multiplier effect" of unofficial water reuse at that level; thus creating an opportunity to expand official reuse.

Impact on drainage and soil salinity

The effects of IIP's technical interventions on the performance and function of existing land drainage systems are not fully understood yet. It is assumed that the anticipated effect of improved *mesqa* design, through IIP intervention, would lead to a decrease in seepage losses, and hence to lower water tables, and reduced drain discharge of the laterals. The population reported that water tables in the project area have risen and rendered the discharge capacity of drainage systems less effective. There is therefore a need to review the applied drain design criteria if irrigation practices are permitted to change in this way.

In future, on-farm irrigation practices may change because of the IIIMP, so there is a need to maintain farmers' awareness of soil salinity control and leaching practices. The drainage systems may require operational monitoring to effectively remove salts and avoid the risk of lowered soil fertility and increasingly unsustainable conditions.

Impact on the socio-economic situation of farmers

The appraisal of the socio-and agro-economic effects of improved irrigation suggests that increased availability of water has augmented the productivity of irrigated crops by 12 to 15 percent on average. At the same time water productivity has increased, which primarily can be attributed to improvements in agricultural production technology. For example, farmers in the study area report they have widely adopted the use of short-duration rice varieties. This has shortened the time from transplanting to harvest by up to four weeks and helped save a considerable amount of irrigation water. The shortening of rice cultivation by four weeks has created a window of opportunity for the cultivation of an additional crop, which takes advantage of the freed land and water resources. The net effect of water savings through the adoption of short duration rice varieties is hence balanced by the farmers' intensification strategy. It is assumed that improved irrigation has augmented farmers' income, although gains probably fall short of expectations assumed at the project design stage.

Significant gains in productivity may be attributed to the installation of the land drainage system. According to the findings of a case study on integrated drainage management in Egypt, the incremental benefits of improved drainage amount to between US$250 and 350, depending on location and soils. These incremental benefits of drainage intervention need to be appreciated by the IIIMP in order to acknowledge the importance of drainage in an integrated water management system.

The study has identified a considerable opportunity for the profitable use of drainage water outside the project area generating income from aquaculture, fish farming and horticultural production. The technology used is based on the amelioration of saline soils through layering of sand and the use of untreated, but highly fertile drainage water from agricultural use. Benefits created by far outweigh those of traditional fisheries and fruit production systems using freshwater. According to an entrepreneur from within the study area, the value generated from a fish pond of one *feddan* is equivalent to 50 to 100 *feddans* of cropped land.

In the context of water-managed land (irrigation and drainage) the concept of water productivity ("more crop per drop") appears to be too narrow, as the use of water in an integrated system creates benefits other than additional agricultural production. The expression might well be replaced by the broader concept of "more value per drop" allowing for the inclusion of beneficial use of water for other uses.

Controlled drainage

As farmers appear to be changing over to rice cultivation, despite clear regulations on its area, there is an opportunity to control drainage, which offers considerable water savings to rice growers who would otherwise face substantial losses through the drainage system. To date, the technology is well developed and readily available for pilot testing in areas where rice, maize and cotton are cultivated concurrently. The successful use of controlled drainage requires that farmers agree to operate and manage the technology jointly and in mutual interest. Water user organizations may play a significant role towards the success of the operation and management of this technology.

Water quality

The DrainFrame analysis has identified a number of serious water quality problems with multiple causes, effects and impacts on the livelihoods of both the rural and urban population within the study area. Water quality monitoring programmes and studies suggest that nearly all water quality indicators show alarming levels. Open drains and irrigation canals cutting through rural and urban settlements have turned visibly black, indicating anaerobic conditions, which is confirmed by the alarming levels of biological oxygen demand (BOD) and incidences of poor health.

Open channels (canals and drains) function as dumping grounds for a wide variety of organic and inorganic domestic waste. In the absence of suitable landfill and garbage collection systems this waste blocks and contaminates the open canals.

Among the most worrying symptoms are those that pose a serious health risk to the population and require immediate attention. Examples include water-borne diseases such as bilharzia and diarrhoea. It is considered vital that IIIMP adequately address the problems of waste disposal in canals to eradicate the negative effects of urban pollution on the water bodies.

IIIMP may have a detrimental impact on water quality. It is expected that the solutes (salts, nutrients, pesticides) from agricultural land will accumulate as an intended wash out effect of the proposed leaching practices. As a matter of principle an evaluation should be made of the potential risk related to the deteriorating quality of the drainage water and how it might affect secondary stakeholders, particularly those depending on domestic supplies of reused drainage water from irrigation canals.

There is a distinct difference between domestic and agricultural waste, as compared to industrial, and how water quality is affected. According to the MWRI water quality unit, the daily intake of 270 tonnes of industrial biological oxygen demand is equivalent to that of six million people discharging domestic waste into canals and drains. Although, inexpensive technology can be used to oxidize and decompose domestic waste, industrial wastewater sanitation requires more sophisticated technology and investment.

The magnitude of the water quality problems calls for the development of a Pollution Management Plan. It is proposed that IIIMP include a waste management system to take care of rural and urban water pollution. In this way, the looming water quality crisis may be avoided. Incentives should be considered to facilitate the improvement of industrial water sanitation facilities and to reduce pollution caused by their waste.

Institutional development

IIIMP provides a unique opportunity to translate the integrated water resource management concept into institutional arrangements based on water user participation, which is highly valued by all stakeholders involved. The scope for practical institutional building at all levels is considerable, starting with the *mesqa* and branch canals up to the main and sub-regional level. The study identified the need to strengthen water user associations in management skills such as planning, prioritizing work, accounting and financial management.

Water boards and branch canal water user associations have been identified as effective institutions for local water resource management built around suitable design principles, multiple stakeholder involvement and the existence of a set of rules and regulations for water allocation and control. Such institutions can play an important role in the identification, prioritization and budgeting of water works. Stakeholders include farmers, domestic households and industrial facilities. The prevailing institutional design principles are effective and should be considered within IIIMP as an opportunity for successful institutional integration.

Water boards are currently restricted to the level of branch canals and so far are not legally recognized. If these institutions are to be operational, it is important that their legal status be clarified so they can become the cornerstone of water resource legislation in Egypt. It appears that the branch canal will be the most appropriate level for the integrated management of irrigation and drainage. Plans are underway

to establish district water boards to assume responsibility for integrated water resource management at a higher level. Prevailing institutional design criteria are at an early stage and appear to be provisional.

The DrainFrame analysis has identified the need for much improved coordination of water resource allocation and management at the strategic level of basins and sub-basins, involving stakeholders from various sectors. Existing regional water resource management committees that coordinate the activities of MWRI directorates and sectors could be further developed into fully fledged coordinating bodies based on broad stakeholder involvement. Important stakeholders have been identified that include fishermen, industrial and domestic users as well as representatives of environmental agencies.

The establishment of a body for integrated water resource management at the sub-regional level requires substantial capacity development to define its direction, role and responsibility. Ideally, the sub-regional body would link IIIMP with a national water resource management policy. If the concept of integrated water resource management is to be initiated and put into practice capacity development is needed at all levels: the national, governorate, district and community.

Water resource management at basin level

A study funded by Warnock International and USAID (Keller *et al.*, 1995) concludes that the basin-wide irrigation efficiency of the Nile basin between the High Aswan Dam and the Mediterranean Sea is nearly double that suggested by classical water use efficiency (73.2 percent versus 40 percent). This is due to the value of return flow, which is not taken into consideration using the classical approach of irrigation efficiency. If water reuse is accounted for, the scope for real water savings through engineering interventions is much less important than previously thought. Under water-scarce conditions, real water savings may lead to increased water use efficiency, and can come from reduced use on crops rather than from increased classical irrigation efficiency. Moreover, efficiency gains at the canal level are outweighed by the reduced opportunity for reuse further downstream.

The analysis identified a need for much improved coordination of water resource allocation and management at the level of strategic regional planning involving stakeholders from various sectors. The establishment of a body for integrated water resource management would require substantial capacity development in order to define its direction, role and responsibility.

Recommendations

The findings of this study suggest that the current planning and design of irrigation and drainage in Egypt requires the adoption of a broader approach (DrainFrame) that is multi-sectoral, multi-disciplinary and based on stakeholder participation. The approach provides a platform for the formulation of adequate water resources management interventions at various organizational levels. DrainFrame provides an opportunity for local participatory planning. It will allow planners to identify additional economic, social and environmental benefits that are directly or indirectly attributable to the project. IIIMP should be broadened to cover the wider basin level to take advantage of existing and potential opportunities for downstream use created by the project, for example, fish cultivation. Equally, the cost of lost opportunities could be considered such as the pollution impact on fisheries.

The adoption of the DrainFrame approach by the IIIMP provides the opportunity of including important components and interventions that reach beyond the usual boundaries of the command area. Equally important, DrainFrame may be instrumental in the integration of "soft" components into the

project concept of IIIMP that overcome the existing border between the water and agricultural sectors. Other examples include waste and environmental management plans.

DrainFrame is well suited to the IIIMP feasibility study as a diagnostic tool. On the other hand, if it is to be used for project planning and design it would need further elaboration and the findings of the present DrainFrame exercise quantified. Only then can the identified landscape functions be prioritized and beneficiaries precisely identified and targeted.

Integrated water resource management should be introduced at all appropriate levels from field to basin level. Current efforts to improve the management of irrigation supply should be accompanied by improved measures to manage water demand. Agricultural improvement technologies should be integrated into IIIMP and farmers educated in the use of IIIMP water savings (training should be held separately at both farm and *mesqa* levels).

The concept of effective efficiency at the basin level should be promoted in order to achieve IIIMP's overall goal of increased water use efficiency. Translated to the level of *mesqas*, real water savings can be achieved through increasing the productivity per unit of water used. Benefits will be generated through higher crop yields and increased net revenues per unit of water used.

More attention should be given to on demand management of the system of agricultural water use. It is only when supply management interventions are accompanied by demand management can there be viable water savings. Otherwise, savings at one level of the system will be outbalanced by efficiency losses elsewhere.

Key to the integration planning, design and management of irrigation and drainage systems is an appreciation of the functions each sub-system fulfils in meeting overall project objectives. Values that stakeholders associate with system functions need to be further quantified by IIIMP. Thus, the improved technical, economic, financial, institutional and environmental choices made will be both effective and socially acceptable. The aim is to encourage stakeholders to promote sustainability in their operations over and above increased crop productivity.

There is a felt need to introduce broad institutional development, based on stakeholder participation within a National Water Resource Policy. This will require substantial investment in the capacity development of farmers and water user institutions.

The establishment of a body for integrated water resource management at the level of the sub-region requires substantial capacity development to define its direction, role and responsibility. Ideally, the sub-regional body would link IIIMP with a national water-resource management policy. Capacity development is required at all levels including the national, governorate, district and community to ensure that integrated water resource management may be put into practice at all levels.

The branch canal appears to be the most appropriate level for integrated management of irrigation and drainage. Plans are underway to establish district water boards that will assume responsibility for integrated water resource management at a higher level. Current institutional design criteria for district water boards are at an early stage and appear to be encouraging. The analysis identified a need for much improved coordination of water resource allocation and management at the strategic

regional planning level involving stakeholders from various sectors. The establishment of a body for integrated water resource management would require substantial capacity development to define its direction, role and responsibility.

There is a need to improve the collection rates for irrigation and drainage improvement cost recovery. It is also recommended that individual *mesqa* water user associations, rather than the individual landholder be the charging unit, assuming that the *mesqa* water user associations are able to develop agreed-upon lists of their members and holdings. On the other hand, the recommended unit for the assessment of drainage improvement cost recovery would be the branch canal user organizations rather than the water user associations or the collector user associations.

The implementation of the proposed cost recovery mechanisms entails a number of changes and new responsibilities; however, discussing and evaluating such changes and responsibilities is beyond the scope of this study. Water user associations at the *mesqa* and branch canal levels need to be institutionally strengthened by making them the legal units for cost recovery assessment allowing them to make payments in the name of their members. An investigation should be made as to whether non-agricultural users should contribute to cost recovery or not. So far, municipal, industrial or other users do not pay for the water and drainage services provided by the MWRI.

Considering the importance of public health concerns, related to water quality and the multifunctional nature of the irrigation and drainage system, the so-called "external sources of pollution" should be a central element in any water resources management project. Interventions into the irrigation and drainage systems have an impact on one or more of the functions performed by these systems. In addition, direct or indirect secondary effects on the environmental functions, for instance water bodies, needs to be carefully considered.

Environmental management is urgently needed to control and reduce pollution, especially from the industrial sector. Modern pollution management should be introduced as a vital component of the IIIMP cycle.

On the wider basin level, the view of IIIMP should be broadened to exploit existing and potential opportunities for downstream use created by the project, for example fish cultivation. Equally, the cost of lost opportunity could be considered such as the impact of pollution on fisheries.

Finally, there is a continuing urgent need for research concerning the processes that govern water use and irrigation efficiency, groundwater dynamics, drainage water quantity and quality and reuse practices.

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ACRONYMS AND ABBREVIATIONS

APRP	Agricultural Policy Reform Programme
ARD	Agriculture and Rural Development Department of the World Bank
BCM	Billion cubic metres
BCWUA	Branch canal water user association
BOD	Biological oxygen demand
COD	Chemical oxygen demand
CUA	Collector user association
DAS	Drainage Advisory Service
DFID	United Kingdom Department of International Development
DrainFrame	Drainage Integrated Analytical Framework
DRI	Drainage Research Institute
EA	Environmental assessment
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental impact assessment
EMP	Environmental management plan
EPADP	Egyptian Public Authority for Drainage Projects
EQIP	Environmental Quality Incentives Program
ERR	Economic rate of return
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GARPAD	General Authority for Reclamation Projects and Agricultural Development
GDP	Gross domestic product
GIS	Geographic information system
GOE	Government of Egypt
IAS	Irrigation Advisory Services
LAU	Local administrative units
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department
I&D	Incision and drainage
IFAD	International Fund for Agricultural Development
IIP	Irrigation Improvement Project
IIIMP	Integrated Irrigation Improvement and Management Project
IMT	Irrigation management transfer
IRU	Institutional Reform Unit
IWRM	Integrated water resource management
KfW	Kreditanstalt fur Wiederaufbau (German Bank for Reconstruction)
Km	Kilometre
LE	Egyptian pound
m	Metre
mm	Millimetre
MADWQ	Monitoring and Analysis of Drainage Water Quality project
MALR	Ministry of Agriculture and Land Reclamation
M&E	Monitoring and evaluation
MED	Mechanical and Electrical Department of Ministry of Water Resources and Irrigation
MEP	Monitoring and Evaluation Programme

MIS	Management information system
MPN	Most probable number
Msl	Mean sea level
MWRI	Ministry of Water Resources and Irrigation
NAWQAM	National Water Quality and Availability Management project
NWRC	National Water Research Center
NDP	National Drainage Project
NGO	Non-governmental organization
NPSRP	National Pumping Station Rehabilitation Programme
O&M	Operation and maintenance
PCD	Project concept document
PRA	Participatory rural appraisal
RIGW	Research Institute for Groundwater
SAR	Staff appraisal report
SEA	Strategic Environmental Assessment
SOGREAH	Société Grenobloise d'Etudes et d'Applications Hydrauliques
STW	Sewage treatment works
WBP	Water Board Project