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PLAN FOR THE FORMATION OF A
A STRATEGIC RESEARCH UNIT

WATER RESEARCH CENTER
EGYPTIAN MINISTRY OF PUBLIC
WORKS AND WATER RESOURCES

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Preface

This document is a report prepared by Jack Keller, David Secker, and Alan White during a mission to Egypt in April 1993 in support of the design of a research unit in the Water Research Council. This initial report formed the final program now scheduled for implementation in October 1993.

List of Acronyms

BCM	Billion cubic meters
EEIP	Economic and Environmental Impacts Program
IID	Imperial Irrigation District
IIRE	Integrated Irrigation Reuse and Efficiency Program
MIS	Management information systems
MMTs	Millions of metric tons
MPWWR	Ministry of Public Works and Water Resources
MWD	Metropolitan Water District of Southern California
NGO	Nongovernmental organization
PIDS	Program on Integrated Data Systems
SRU	Strategic Research Unit
WCOR	Water Conservation Operations Research Program
WRC	Water Research Center
USAID	United States Agency for International Development

Executive Summary

The Egyptian Water Research Center (WRC), which supports the Ministry of Public Works and Water Resources (MPWWR), has identified the need for building Institute capacity to design and implement strategic research studies to enhance planning and policy capabilities within MPWWR. This paper assesses the structure and needs of a Strategic Research Unit (SRU) to be located within the WRC. The SRU will promote collaboration among the WRC's individual Institutes, coordinate and strengthen the policy basis of the WRC's ongoing research programs, provide technical analysis to support the MPWWR, and create a national center of excellence for assessing long-term water strategies.

With upstream supplies essentially fixed, Egypt must look at solutions emphasizing efficiency, re-use, and preservation of water quality to respond to growing demands on Nile water. To examine potential solutions, the authors suggest five program areas of priority research topics for the SRU to pursue during the period 1993-1995. The Integrated Irrigation Reuse and Efficiency strategic research program will focus on enlarging benefits from Egypt's renewable water supply. The objective is to develop and test effective strategies to increase the usable water supply in the Nile Valley-Delta water system. The Water Conservation Operations Research program will provide decision support to help MPWWR meet system-wide demands in a cost-effective way while conserving water by reducing operational losses.

The third program, Desalinization, will focus on ocean desalinization possibilities in the Mediterranean and, secondly, on control and disposal of salts in the Delta. The Economic and Environmental Impacts Program will provide research on system-wide analysis of issues relating to crop reduction, promotion, and substitution, as well as to public health dimensions of water management. Lastly, the Program on Integrated Data Systems will assess data needs and availability, produce a plan for developing a management information system, and design and implement computerized decision support tools.

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1. Introduction

Since its inception in 1975, the Water Research Center (WRC) has been charged with providing the Ministry of Public Works and Water Resources (MPWWR) with research capacity to support its role as Egypt's primary water management agency. The MPWWR's mission is to ensure both adequate quantity and quality of water for agricultural, municipal, and industrial uses. Although provision of adequate water supplies has been the dominant focus of the MPWWR's activities, water quality has recently emerged as an issue of increasing concern because of the its role in degrading Egyptian public health and the physical environment.

The WRC's mission mirrors that of the MPWWR. Its role is to provide planning-relevant analysis to the MPWWR to ensure long-term sustainable water management under the highly constrained supply conditions prevailing in the Nile Valley. Toward this end, the WRC operates in three modes (MPWWR 1989):[1]

- it assesses long-term policies for managing water resources;
- it solves technical and applied problems associated with general policy for irrigation and drainage;
- it conducts research connected with the extension of agricultural land and water resource assessment.

Thus, the WRC's mission encompasses policy research, technical problem-solving, and topical, or problem-oriented studies. To date, however, the latter two have consumed the bulk of the WRC's resources, while policy studies, with few exceptions, have received relatively little attention.

The WRC Chairman and staff have identified the need for building greater inter-Institute collaborative studies which address long-term, strategic policy issues pertinent to water management in Egypt. In a 1991 workshop (Hahn-Rollins, Youssef, and Rollins, 1991),[2] staff expressed a desire to promote joint research strategies using professionals from different institutes, to enhance communication across Institutes, to avoid duplicative and overlapping program activities, and to integrate professional staff returning from training abroad into the WRC activities quickly and effectively. Together, these concerns point to both a need and opportunity for WRC capabilities in long-term, strategic policy studies which reach beyond the technology-and topic-specific orientation of the existing Institute structure.

A similar theme emerges in the WRC's long-term program design. In its Third Five-Year Work Plan (1992-97), the WRC identifies the need for achieving greater policy-relevance and "customer" orientation in its research programs, particularly in regard to its institutional relations with the MPWWR and Ministry of Agriculture. To build a dynamic, responsive organization of this nature, with a capacity to conduct integrated policy studies, several objectives must be met:

- improving communications across Institutes of the WRC;
- extending linkages between the WRC and other national and international entities, including possible provision of consultancy services to such entities;
- building a strategic research capability within the WRC through a) guidance and coordination of Institute-specific research agendas and b) conduct of strategic water management research which falls outside the purview of the Institutes' agenda.

Further impetus to building the WRC's strategic policy research capabilities crystallized in the wake of the recent Roundtable on Egyptian Water Policy (Abu-Zeid and Seckler 1992).[3] Discussions at this meeting centered on long term supply/demand balances, irrigation system performance assessment and water multipliers, water use efficiency in relation to water supply and salinity, and institutional options for irrigation cost recovery. All these issues, and the lively debates they triggered, pointed to the need for enlarging the WRC's capabilities to supply decision-support information for a broad range of pressing policy questions that historically have received little or no attention within the WRC research programs.

Finally, for the USAID Cairo mission, a program to strengthen the WRC's decision to support strategic research capabilities is a timely addition to its program portfolio. This is so for two reasons. First, irrigation and water management have long been part of USAID's activities in Egypt. Programs such as the Irrigation Management Systems, Urban Water and Wastewater, and Provincial Water and Wastewater exemplify the mission's longstanding commitment to rationale water management. Building the WRC's capabilities to conduct research programs that address long-range opportunities for improving the performance of Egypt's water management while mitigating environmental damage comports well with this longstanding focus on water management. This new capability can be added with relatively little incremental burden on the mission's management resources.

Second, a recent USAID/Egypt strategy paper (Morgan et al., 1992)[4] identifies water quality as the most urgent environmental problem facing Egypt today. Because water quality is integrally related to its supply and use, the conduct of integrated quality-supply-use studies are essential to ensuring sustainable use of the resource. The WRC's position as Egypt's foremost water research organization makes it the logical host for a studies program in support of long-range strategic policy and planning.

2. Need

For all of the reasons listed in the previous section -- WRC's charter mandate, needs identified by its directorate's and staff, its position as a key contributor to Egyptian water management, and USAID's program portfolio -- a compelling case exists for creating a Strategic Research Unit (SRU) within the WRC. Specifically, we suggest a three-fold rationale for creating a SRU:

- enhanced coordination and strengthening the policy-relevance of the WRC's ongoing Institute-specific research programs, especially those conducted by the Water Management Institute, Drainage Research Institute, Nile Research Institute, Hydraulics and Sediment Research Institute, Weed Control and Channel Maintenance Research Institute, and the Groundwater Research Institute;

- provision of technical analysis to support the MPWWR in its role as Egypt's leading water planning and policy agency;

- creating a national center of excellence in assessing long-term water strategies from an economic, environmental, and public health perspective in the context of national water scarcity and resource degradation.

From a technical perspective, the need for a SRU stems from the ongoing challenge to find, test, and communicate the most promising opportunities for getting more out of Egypt's limited water resources. This will require a multifaceted research approach which transcends the boundaries of existing programs at the various Institutes. Identifying and testing potential solutions is not enough. Communicating them in a form usable to the WRC's principal customer -- the MPWWR -- is equally critical. These include MPWWR's planners and project managers, as well as irrigation system managers and irrigators themselves.

Understanding the unique configuration of the Nile Basin lends further support to the need for a SRU. This configuration raises research questions which only an integrated, interdisciplinary approach can effectively address.

Only limited possibilities are available for increasing the incoming water supply from the River Nile. In contrast, many opportunities -- some obvious and some subtle -- are available for increasing the efficient use of this essentially fixed supply. Examples range from crop substitution programs, cost-effective water reuse to enlarge the systems "water multiplier", enhanced matching of delivery systems and water demand to reduce spillage, to selective development of groundwater resources. Thus, the means for effecting "real water savings" are to reduce evaporation and evapotranspiration (ET) from vegetation, reduce salt buildup and pollution, and to hold the water high in the system when the supply exceeds the demand.

The nature of opportunities for efficiency, re-use, and water quality measures stem from the physical features of the Nile Basin. The Nile Valley and Delta form a closed water system between Aswan Dam and the Mediterranean Sea. The River Nile acts as both the supply and drainage channel between Aswan and the Delta, along with the irrigation canals in much of the Delta. Water released at Aswan Dam can be reused many times as it travels through the system. It can be recycled until it is either consumed by evaporation, becomes too contaminated for further reuse, or reaches the lower end of the hydraulic flow system where there is no place to reuse it.

An immense supply of water can be stored in Lake Nasser at the upper end of the Nile Valley and released as needed. However, because of the valley's topography there are only limited opportunities to provide in-system surface storage even for regulatory purposes. But the alluvium deposits forming the Nile Valley and Delta provide an almost continuous reservoir that underlies most of the irrigated lands.

The main limitations to exercising this groundwater reservoir as a conveyance and storage system are associated with the cost of pumping and the potential for picking up additional salts. To maintain a salt balance in the soil system, the drainage water must carry away as much salt as is applied through the irrigation water. However, additional salt is picked up when seepage water passes through old (or new) salt sinks or unleached marine deposits, or is pumped from aquifers that contain brackish water.

Agricultural and many of the urban and industrial uses of water result in its physical depletion by ET and direct evaporation. There are some economically and environmentally sound opportunities for reducing this depletion. For the distribution and drainage systems this involves decreasing the areas of open water surfaces and phreatophytes. For agriculture, it involves moving to less thirsty cropping programs. For industrial and urban users, it involves returning treated effluents to the Nile Basin and shying away from processes requiring large amounts of water for cooling.

Integrating the combined effects of irrigation distribution and application efficiency, surface and drainage water quality, and conjunctive use and recycling holds interesting prospects for realizing greater physical benefits from Egypt's renewable water supply. Such an integrated approach to system improvements may be the most economically, socially, and environmentally effective means for expanding the usable water supply. It focuses capital and management inputs on: 1) reuse of good quality water; 2) reduction or exclusion of poor quality water; and 3) improved localized efficiency only in areas where this would improve overall irrigation efficiency. Areas where improving localized efficiency will improve overall irrigation efficiency are where seepage and deep percolation losses would be poorly positioned for reuse or become most contaminated and diminished in value.

In sum, the case for SRU rests on the need for integrated, strategic thinking within the the WRC to enhance the decision-making capacity of MPWWR planners and policy-makers. Bringing the SRU's integrated technical, environmental, and economic research perspective to bear on the MPWWR's activities will strengthen its capacity to sustainably manage the Nile resource. With upstream supplies essentially fixed, Egypt must seek innovation solutions emphasizing efficiency, re-use, and preservation of water quality to respond to growing demands on Nile water. The SRU is designed to play a leading research role in finding innovative, workable responses to these challenges.

3. Priority Research Topics

Strategic research includes topics related to broad questions of long-term management of Egypt's water resources. Strategic planning questions cut across and complement the activities of more than one Institute and lend themselves to collaboration across the WRC units. At the same time, strategic research is particularly focused on long-range options for resource management in contrast to the specific technology and geographical focus of most Institute research programs. Thus, the thrust of the SRU program is to support integrated resource management at the MPWWR by provided data and technical analysis essential to long-term strategic planning issues. Such data and technical analysis will fortify the MPWWR's capabilities to characterize and choose among options for long-term planning and policy-making.

What types of research fall within the purview of an SRU? the MPWWR faces a host of long-term policy and planning challenges that raise issues to which the SRU may make a valuable contribution. Discussions with the SRU Chairman, various Institutes, the Soil and Water Research Center and the MPWWR Planning Sector point initially to five programs areas for the 1993-95 period: (1) Integrated Irrigation Reuse and Efficiency; (2) Water Conservation Operations Research; (3) Salinity Control and Desalinization; (4) Economics and Environmental Impacts of Water Management Options; and (5) Integrated Data Systems.

The following discussion presents the rationale and objectives, initial activities, and the WRC's manpower requirements for each of these program areas.

Program No. 1. Integrated Irrigation Reuse and Efficiency

Rationale and Objectives

The Integrated Irrigation Reuse and Efficiency (IIRE) strategic research program will focus on achieving greater physical benefits from Egypt's renewable water supply. This effectively has the same result on the quantity of water available for use as increasing the actual inflow of water to the system.

The research will be designed to integrate the following in the most opportune ways and evaluate their combined effects in terms of potential physical benefits:

- improvements in irrigation distribution and application efficiency,
- management of surface and drainage water quality,
- enhancements of conjunctive use and recycling, and
- reduction of salt loading that results from brackish seeps and sea water intrusion.

IIRE's goal is to synthesize the concepts of water use efficiency, quality, salt loading, and reuse in order to capitalize on the synergism between them. While these four concepts traditionally have been (and, to some extent, need be) considered separately, integration of the four into a systems framework offers a highly promising research direction to rationalizing long-term water management in the Nile Basin.

The benefits of integration are many. For example, the current strategy for reuse projects is to take the quality of agricultural drainage water as fixed and then attempt to reuse it to the maximum extent feasible. For irrigation efficiency improvement projects, it is typical to search for places where localized distribution and application efficiencies are low and try to improve them.

Dealing with salt loading that results from brackish seeps and sea water intrusion requires devising strategies for control that are economically justified. This, in turn, requires dealing with a number of research topics pertaining to cost effective opportunities for improving water quality in the Nile Delta water system. Such topics include reducing sea water intrusion from the Mediterranean Sea and developing strategies for handling pockets of brackish water and brackish water that drains or seeps within and along the fringes of the alluvium area.

While each strategy has merit by itself, abundant opportunities exist for reusing uncontaminated water within the Nile Valley-Delta system, and what appears to be a loss in one part of the system is probably already part of the supply for another part. By strategic placement of irrigation improvements, the quality of the drainage water can be affected. Where the seepage and deep percolated water losses from irrigation are of good quality, it may be more cost-effective to simply reuse the "loss" water. Where the lost water is of poor quality, it may be more cost effective to improve the irrigation efficiency rather than to reuse or waste the water.

In this context, the objective of the IIRE Program is to develop and test strategies that can be used to effectively increase the usable water supply in the Nile Valley-Delta water system. The research efforts will be focused on seeking the optimum tradeoffs between irrigation efficiency and drainage water reuse throughout the system. These tradeoffs will incorporate salinity tolerance and crop needs, as well as possibilities for reducing salt loading.

Initial Activities

In its first two years, IIRE will develop a research program oriented around several propositions pertaining to enhanced water use. Under the direction of the Program Manager, and in conjunction with several WRC Institutes, activities will be structured around exploring the following linked propositions which lie at the interface of water quantity and water quality.

Assuming an average of 10% of the applied water is required for leaching, the system-wide average irrigation efficiency at the localized level is probably between 45 and 50%.

However, because of reuse through recycling water from open drains or conjunctive use of groundwater, the overall efficiency for the Nile Valley-Delta water system is on the order of 85%.

The River Nile provides a very high quality supply of water to this large closed water system, much of which has been leached for centuries. Therefore, it may be practical to achieve a basin-wide irrigation efficiency between 90 and 95%. But by using the present costly strategies for recycling and improving localized irrigation efficiencies there is limited potential for increasing it by more than 1 or 2%. This is because the average salinity of the drainage water being discharged to the terminal lakes and sea is already so high that the potential for additional reuse by agriculture is very limited.

The reason the salinity is so high is because roughly 20 million metric tons (MMTs) per year of salt is picked up from subsurface sources, mostly within the Delta. The annual salt load passing Aswan is only about 13 MMT and the annual salt loading from fertilizers and urban wastes is roughly 3 MMT. In view of this, any strategy for improving basin-wide irrigation efficiency should focus on reducing the salt loading while still maintaining a favorable salt balance in the soil. It must incorporate salinity monitoring to guide the selection and application of procedures for reducing salt pickup and direct disposal of as much high saline water as practical.

Improving localized irrigation efficiencies by such practices as canal lining and improved on-farm systems can only be an effective part of the strategy for improving basin-wide efficiency in selected areas. Such areas are where the water in excess of crop ET is irrevocably lost to salt sinks, where there is danger of salt water intrusion due to over-pumping in coastal areas, or where the drainage water is highly saline.

The benefit of each percentage point of improvement in the basin-wide efficiency would be equivalent to an additional 0.5 billion cubic meters (BCM) of water supply suitable for agricultural use. This would be enough water to irrigate an additional 100,000 acres of land with the current crop mix.

Water can be transferred to any location within the Nile Valley-Delta water system with little difficulty. There would be no adverse effects if the transferred water represents real savings and would have been unsuitable for reuse. For example, water conserved by improving irrigation efficiency within a salt sink area (such as an area in the Eastern Delta with high drainage water salinity or near Monzala Lake) can be transferred to Cairo. This is simply done by delivering the water to Cairo that is no longer required downstream.[5]

A considerable portion of the salt loading is probably caused by brackish water that seeps from the irrigated lands around the fringes of the Valley and Delta and from sea water intrusion. Containment, removal or rejection, collection and disposal, and desalinization are techniques that can be considered for reducing the salt loading.

Desalinization may be promising where increased fresh water supplies are needed at critical locations. Drainage water could be sufficiently upgraded for reuse by using reverse osmosis to remove some of the salts. For example, desalinization could be used to obtain some fresh water from brackish sources while concentrating the salts in the residual brine and disposing of it outside the irrigated area. The residual brine would be easier to dispose of than the bulkier supply of brackish water. Desalinization could also be considered as a means for obtaining some usable water from brackish drainage flows as an alternate to mixing with fresh water to make it suitable for reuse.

The bulk of the actual fieldwork and research will be conducted within the following WRC Institutes: Water Distribution and Irrigation Systems; Drainage; Groundwater; Nile; Hydraulics and Sediments; and Weed Control and Channel Maintenance. As in all SRU activities, the program staff will serve in a combination of project design, execution, and coordination roles.

In addition to working with the WRC Institutes, it will also be essential to arrange a cooperative arrangement with the Soil and Water Research Institute of the Agricultural Research Center. This cooperative agreement should cover organizational, technical, and financial terms and conditions ensuring cross-fertilization of research activities and expeditious access to data essential to IIRE. Of special importance is a sound working relationship with the Institute's Soil Physics and Chemistry, Water Requirements, Improvement & Conservation of Cultivated Soils, and Field Drainage Research Divisions. Access and input to the Institute's Geographic Information System and Remote Sensing capabilities will be invaluable to accomplishing IIRE's objectives. This will avoid duplication and redundancy in gathering and codifying field data already available or in the process of becoming part of the Institute's GIS. These agreements will be secured in the early months of IIRE.

Manpower Requirements

The following WRC staff and illustrative areas of expertise will be required for implementing IIRE Program during its first two years:

Principal Investigator	Water resources engineer
Senior Associate	Irrigation engineer
2 Junior Associates	Soil scientist, agricultural engineer

Program No. 2. Water Conservation Operations Research

Rationale and Objectives

The MPWWR does a commendable job of managing and operating the huge Nile Valley-Delta water system complex given the state of the physical works and complexity of the task. Having water releases and deliveries match demands and handling the unavoidable mismatches to conserve precious resources is a formidable undertaking. Flow management and operational services that have been sufficient until now will require upgrading as the need to conserve water and the difficulty of maintaining water quality intensifies. The WRC can and should provide essential research support for making the critical decisions that will be needed to reduce mismatches and handle the residuals.

Localized mismatches can result in spillage if the mismatch is positive and water deficits if they are negative. In the Nile Basin's closed system the internal spills are captured and available for reuse elsewhere except when they occur at the open end along the Mediterranean Sea. In some cases deficits can be offset by drawing from surface water storage or pumping from groundwater storage, but needed storage and the facilities for utilizing it are not everywhere available. Consequently, in such cases the users suffer losses in production.

The Water Conservation Operations Research (WCOR) program will focus on: 1) understanding the nature and consequences of the mismatches between the deliveries of water releases and the associated demands through the Nile Valley-Delta System; and 2) possibilities and strategies for coping with existing and unavoidable mismatches in the future.

The purpose of the research is to provide decision support to enhance the MPWWR's ability to meet system-wide water demands in a cost-effective way while conserving water by reducing operational losses. The research objectives are: 1) to develop a macro understanding of how the system is now functioning and a crude idea of the resulting system-wide balance between supply and demand (by districts using a weekly or monthly time step); 2) to develop cost effective, workable strategies for forecasting system-wide demands in a more timely manner in order to reduce supply/demand mismatches; and 3) to investigate and prioritize the opportunities for increasing the capacity of the combined surface and groundwater system to handle supply/demand mismatches.

Initial Activities

The initial activities of the WCOR research program will focus on understanding the existing operational situation and capacity for handling supply/demand mismatches. This will necessitate looking into operational and structural aspects of the system.

Investigations will be conducted at the macro system-wide level to: 1) develop a general understanding of how the Nile Valley-Delta water system is now operated; 2) understand how well the reservoir releases are meeting demands at the reach or zone level on a monthly time-step; and 3) understand how supply/demand mismatches are being handled.

These baseline investigations will be followed by studies related to the following questions:

- What are practical means by which the demand forecasting capability can be improved? In addition to the ordinary forecasting strategies that rely on empirical estimates of crop water requirements, techniques for incorporating the collective decision making processes of farmers and their general soil/water/salinity environment will be considered. Predicting the overall influence of the collective management decisions of the farmers is necessary to avoid the kind of gross mismatch that occurred for the 1993 cotton planting. In 1993, water releases for cotton planting were about ten days too early. This resulted in early spills followed by shortages when the water was actually needed.

- What underutilized facilities are available or can readily be made available for dealing with supply/demand mismatches? Answering questions in this study area will involve investigating opportunities to use the limited surface water storage possibilities to the fullest extent possible. Relatively small amounts of surface storage (such as the pool depths behind barrages and water in drains) can sometimes be effectively utilized to handle localized mismatches. Strategically exercising or utilizing the groundwater reservoir may also provide considerable capacity for handling nearby mismatches.

- Where is increased on- or in-system storage most needed, and what are the physical possibilities for developing it in a cost effective and environmentally sound manner? These questions will be investigated at the reconnaissance level. Such possibilities as off-stream storage along the fringes of the basin and utilization of the northern lakes would be considered. Such studies would involve revisiting the earlier work related to using Lake Burulus as a terminal reservoir and as integral components of a sea water intrusion barrier project.

- What types of models or planning tools are available, or could be made available to the MPWWR to facilitate its design and ongoing adjustments to the Nile delivery system? MPWWR currently has access to many types of computer tools, and with the assistance of a U.S. expert, is further expanding its inventory. Reviewing these models for applicability to the delivery system questions raised in this program will identify opportunities, shortcomings, and needs for applying such tools on an ongoing basis.

The bulk of the actual fieldwork and research will be done within the following WRC Institutes: Nile; Hydraulics and Sediments; Water Distribution and Irrigation Systems; Groundwater; Drainage; and Weed Control and Channel Maintenance. As in all SRU activities, the program staff will serve in a project design and coordination role.

Manpower Requirements

the WRC manpower requirements and illustrative areas of expertise for the WCOR program during the 1993-1995 time period are as follows:

Principal Investigator	Water Resources Engineer
Senior Associate	Hydraulics Specialist
Junior Associate	Irrigation Engineer

The Principal Investigator must be an able coordinator and innovator who is well acquainted with the physical and managerial aspects of the Nile Valley-Delta water distribution system. The success of the WCOR program will depend less on the disciplinary training than on the team's familiarity with the system and their ability to reason and think comprehensively about how complex systems operate. This includes the human and the physical/mechanical dimension of water delivery and use.

Program No. 3. Desalinization

Rationale and Objectives

Desalinization is practiced in several countries in the Middle East to augment water supplies. An alternative application, suggested in Program 1, is to reduce salt levels in reused or brackish waters in non-ocean locations, a process now in practice in a few locations in Florida. Desalinization in this context -- targeted, dispersed, and upstream -- contrasts with conventional large scale, ocean-water projects -- in Egypt's case, desalinization of Mediterranean waters.

The Desalinization Program is a short-term effort principally focused on the role of ocean and estuary-based desalinization applications as an option in Egypt's long-term water management strategy. Its major goal is to assess the state-of-the-art ocean desalinization technologies from a cost, scale and performance perspective.

Initial Activities

Initial activities in this research program will focus on ocean desalinization possibilities in the Mediterranean and, secondarily, on control and disposal of salts in the Delta. The investigations will focus on salt loading caused by brackish water that seeps from the irrigated lands around the fringes of the Delta and from sea water intrusion. Desalinization will be considered where special fresh water supplies are needed.

The Desalinization Program may extend its research agenda to include studies of the northern lakes. This might involve a strategy for using them as terminal reservoirs and as integral components of a sea water intrusion barrier project.

The work for this research program will involve investigating various methodologies, facility characteristics, and cost factors of salinity control and desalinization. The Program will require special assistance from the following Research Institutes of the WRC: Water Distribution and Irrigation Systems; Drainage; Groundwater; and possibly the Nile. It would also be very helpful to be able to access the Geographic Information System and Remote Sensing Capabilities of the Agricultural Research Centers' Soil and Water Research Institute.

Manpower Requirements

The WRC manpower requirements for the Desalinization Program during the 1993-1995 time period are as follows:

Principal Investigator (Year 1)	Civil/Mechanical Engineer

Program No. 4. Economic and Environmental Impacts Program (EEIP)

Rationale and Objectives

A major strategic research task for the WRC is to integrate its present technical expertise in the Institutes with assessments of the economic and environmental aspects of water resource utilization. Pressures to do so now originate externally from donors and international environmental NGOs and may soon come internally from Egyptian NGOs. Economic and environmental impacts assessments over time should become integral to the WRC research as the pressure from population and economic activities on the limited water resource base of Egypt intensify.

For example, in the increasingly constrained system of the Nile Basin, it is necessary to recycle drainage water to expand the effective supply. But with recycling comes an increase in environmental and health hazards from concentrating pollutants in the system. Such concentration potentially exposes humans via ingestion, inhalation, and dermal contact. Valuable fish stocks may also be depleted if chemical toxins reach high levels. Assessing the human health and ecological risks of such a strategy, and translating such risks into economic terms, is essential for designing long-term water management strategies. Such assessments allow the planner and policy maker to assess the true social costs of various options in considering alternative water management strategies.

Initial Activities

In the 1993-95 period, EEIP will work with other Institutes in assessing two key issues:

- What is the economic rationale and consequence of crop substitution as a water conservation strategy? Some donors believe that Egypt should reduce its production of rice and sugar cane because they require large amounts of irrigation water. But in a closed water resource system such as the Nile Basin, drainage water from irrigation is recycled. Sugar cane, for example, is grown in the upper Nile and all the drainage from this crop is reused downstream.

  EEIP will investigate the interaction between crop water requirements, water recycling, and crop substitution from an economic and environmental perspective. Under Nile conditions, the appropriate calculation of water use by crop is not the irrigation requirement but the consumptive use of water through actual evapotranspiration. In the same crop season (under the same potential evapotranspiration), the consumptive use of water per day of rice and sugar cane is no more than 25% larger than other crops like maize. Depending on the economic value added per unit of consumptive use, there may be either substantial or little (if any) advantage in terms of the economic value of water in reducing sugar cane and rice production in the upper Nile region.

- What is the relationship between water use, reuse, and spread of vector borne diseases in the Nile system? Pathogens and parasites are viewed by some as the paramount human health risk in rural areas. Understanding how such risks are created and spread through water use and consumption will add a much needed dimension to assessing water management options. Through a systematic risk assessment of water-borne diseases, a clear picture of the magnitude of the problem and mitigation possibilities will emerge.

These conditions suggest a promising strategic research area which would bring system-wide analysis to issues of crop reduction, promotion, and substitution, as well as to public health dimensions of water management.

Manpower Requirements

The WRC staff for the EEIP during its initial two years, with illustrative expertise, are as follows:

Principal Investigator	Economist
Senior Associate (Year 2)	Environmental Scientist

Program No. 5. Program on Integrated Data Systems (PIDS)

Rationale and Objectives

Integrated water resource planning requires the continuous development and transfer of data between the WRC research units, the MPWWR Planning Sector, and other data developers and users such as the Ministry of Agriculture/Soil and Water Research Center. PIDS is designed to meet the need for reliable, easily retrievable, usable, and updatable data to contribute to MPWWR's policy and planning activities.

The need for high quality is multi-dimensional. From the MPWWR's perspective, fulfillment of its planning and policy mission is dependent on the availability of high quality data relating to all aspects of water management in the Nile basin. the MPWWR's Planning Sector has identified a range of new and/or more usable information which the SRU can help provide, including: seepage rates, consumptive use for individual crops, groundwater extraction potential, actual and potential water re-use, and -- most recently -- ecological impacts of the Nile water supply and distribution system.

From the WRC's perspective, understanding the data requirements of the MPWWR's planning and forecasting activities is essential to fashioning a relevant Institute-specific and overall SRU research agenda. Activities within the Drainage Institute, the Groundwater Research Institute, the Water Management Institute, the Nile River Institute and other WRC units have much to contribute to the MPWWR's Planning Sector, provided the data is easily accessible and targeted to the MPWWR staff. Toward this end, the PIDS program is designed to bridge the WRC's data development activities with the MPWWR's information needs. In this capacity, PIDS will serve as data developer, repository, supplier, and quality assurer in executing its mission.

Initial Activities

PIDS will be initiated with two complementary activities: (1) a MPWWR data needs assessment performed in conjunction with the Planning Sector, with special focus on the data needs to support Programs 1 and 2 of the SRU; (2) a data availability survey, both within and outside the WRC Institutes, again focused on Programs 1 and 2.

The data needs assessment will proceed in conjunction with Planning Sector staff. The assessment will encompass a review of all planning and forecasting activities, including the structure and data requirements of supply and demand models used by the Sector. Data needs will cover both aspects of integrated management of the Nile Basin, exemplified by the following scheme:

- Demand Configuration
  - Spatial distribution of users
    - agricultural
    - municipal
    - industrial
  - Per unit demand characteristics
    - agricultural/by crop
    - municipal
    - industrial
  - Crop use patterns
  - End use consumption characteristics
    - Crops (consumptive use)
    - Municipal
    - Industrial
- Supply Configuration
  - Local
    - Local reservoir
    - Groundwater
    - Drainage systems
    - Drainage water quantity and quality
  - Nile River

Diversion points
Withdrawal quantities
Canals
Hydropower sites and headflows

In the early months after program start-up, staff from PIDS and the Planning Sector will agree beforehand on the most appropriate structure for the data needs assessment.

Following this assessment, PIDS will proceed with a data availability assessment. This will begin with a review of data development and management practices within all relevant WRC Institutes. Following this, PIDS staff will look outside of the WRC for data which may meet MPWWR's needs including, for example, Ministry of Agriculture, Ministry of Industry, and Ministry of Health sources. Questions of access to external sources will be addressed early in the program through a cooperative agreement. This agreement will set forth the terms and conditions for participating in the PIDS data availability survey, addressing issues of accessibility and financial support for activities undertaken for the benefit of PIDS activities.

This initial activity will produce a report detailing data needs and availability; a plan for developing a management information system (MIS) to integrate and provide access to data sets from within and outside the WRC; and prioritization of the MPWWR data needs; a plan and initial efforts to develop data in the priority areas which fall within the purview of the WRC but is not currently generated by the WRC. It will also produce a plan and initiation of a data development, which is currently generated by the WRC but is not in a format usable by MPWWR; a plan, including firm agreements and financial arrangements, and initiation of actions to integrate data from outside the WRC; and, finally, a specific timetable to begin delivery of data to the Planning Sector of the MPWWR.

A logical complement to PIDS' data assessment is a review and selective application of computerized decision support tools. Many such tools are available, ranging from flexible user-friendly designs aimed at long-range, macro-level assessment of supply and demand scenarios, to those which are more site-specific and facilitate design and operation of water management systems. An example of the former is the Water Evaluation and Planning system, which WRC and MPWWR Planning Sector staff were exposed to in a May 1993 workshop. An example of the latter is The Command Area Irrigation Requirement Model, which estimates daily, weekly, monthly, and seasonal irrigation requirements for any size area, such as a farm or the area served by a mesqua or a distributory.

Whether macro level and scenario-oriented, or micro level and operational/design oriented, decision support tools can provide a useful framework for structuring data collection, identifying data gaps, and facilitating options analysis. If properly applied, they can add flexibility and economy to all the SRU's research programs. Thus, as part of a broader workplan, PIDS will inventory what tools are available, examine how they fit with its research priorities, and examine how they might be adapted to Egyptian needs, preferably by WRC staff itself. Whenever the SRU decided to obtain a tool, a training session will be arranged to ensure that users understand its purpose, structure and adaptability. The objective is to transfer the reasoning skills embodied in the tool such that adaptation, and new tool development, are securely implanted in SRU and other units of the WRC.

Manpower Requirements

The following are estimates of WRC professional staff requirements and illustrative fields of expertise for PIDS through September 1995.

Principal Investigator	Management information systems(MIS)
Junior Associate	Computer science/MIS

4. Organizational Issues

Success of the SRU depends heavily on its ability to maintain a strategic, long-run, "big picture" perspective on the WRC's activities; on its capacity to mobilize the WRC staff in several Institutes toward strategic research objectives; and on its effectiveness in cooperating with both SRU data suppliers and users, especially those within the MPWWR. The SRU's organizational structure mirrors these goals.

First, the Director of the SRU will answer directly to the WRC Chairman, or, should the position be created, a new Deputy Director. Because of the SRU's integrative mission, it is critical to ensure regular and easy access to the WRC Director and Deputy. Placing it at the level of staff department rather than Institute level would serve this objective.

Second, a Steering Committee comprising collaborators within and outside the WRC will review annual program plans and individual research program priorities and progress. Precedent for such a Steering Committee can be found in the Hydraulics and Sediment Research Institute. In this case, a group comprising representatives of the MPWWR Planning Sector, the WRC Nile River Institute, the Ministry of Electricity, and other constituents and implementation agents meets approximately monthly to advise Hydraulics' program development. A comparable body for SRU will go a long way toward achieving early and ongoing activities, milestones, and plans for future projects. Steering Committee membership will include representatives from the MPWWR units, WRC Institutes and other ministries as appropriate.

Third, core SRU staff will be complemented by liaison staff within each relevant WRC Institute. Initially, half-time liaison positions financed by the SRU program will be created in Drainage, Hydraulics, Weed Control, Nile River, and Drainage. These individuals will be charged with ensuring that SRU research programs are communicated effectively to Institute staff. In addition, liaison staff will be responsible for ensuring the timely execution of field, laboratory, and desk research activities which support SRU's five initial research programs and others which may evolve in the future.

5. Notes

1. **WRC Information Bulletin** MPPWR, Water Research Center, 1989.

2. Dee Hahn-Rollins, Mohamed I. Youssef, and Al Rollins, **Water Research Center Planning and Review Workshop** (Port Said, Egypt: ISPAN and Team MISR, 1991). Report prepared for the GOE Ministry of Public Works and Water Resources and USAID MISSION to Cairo, March.

3. Mahmoud Abu-Zeid and David Seckler, **Roundtable on Egyptian Water Policy** (Cairo, Egypt: Water Research Center and Arlington, Virginia: Winrock International, 1992). Proceedings of a seminar held in Alexandria, April 11-13 1992, sponsored by WRC and Winrock International Institute for Agricultural Development.

4. Larry Morgan et al., **USAID/Egypt Environmental and Natural Resources Management Program: A Recommended Strategy** (Washington, D.C.: Chemonics International, 1992). Prepared by Chemonics International for USAID/Egypt.

5. To illustrate this concept, there is a very large water conservation/transfer agreement between the Imperial Irrigation District (IID) and the Metropolitan Water District of Southern California (MWD) that is designed to do just this. The MWD is paying $100 million for improving the irrigation efficiency within the IID to reduce drainage losses to the Salton Sea, which is a salt sink. The anticipated water savings of 0.13 BCM which will no longer be needed for irrigation will be diverted from the Colorado River Basin 300 km upstream and delivered to the Los Angeles Basin through a 200-kilometer long aqueduct. About half of the capital improvements have been made and roughly 0.05 BCM has been authorized for transfer during 1993. This situation demonstrates the advantages of integrated resource planning which links supply and demand into a single systems perspective.