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USAID/CAIRO

Office of Irrigation and Land Development

IRRIGATION BRIEFING PAPER

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TABLE OF CONTENTS

Figures

ACRONYMS, CONVERSIONS AND TECHNICAL TERMS

CID	Consortium for International Development
Cm	Centimeter
EWUP	Egyptian Water Use and Management Project
EPADP	Egyptian Public Authority for Drainage Projects
Feddan	Unit of land measure, approx. 1.04 acres or 0.42 Hectares
GOE	Government of Egypt
IBRD	International Bank for Reconstruction and Development
ILD	Office of Irrigation and Land development, USAID
IMS	Irrigation Management Systems Project
ISAWIP	Integrated Soil and Water Improvement Project
Km	Kilometer
LE	Egyptian Pounds
Mesqa	Canal section connecting MOI branch canal and farmer's head ditches, serving 25 to 300 feddans
MG/L	Milligram per liter
MOA	Ministry of Agriculture
MOI	Ministry of Irrigation
NARP	National Agriculture Research Project
NIIP	National Irrigation Improvement Program
O&M	Operation and maintenance
PASA	Participating Agency Service Agreement
PPD	Project Preparation Department
RIIP	Regional Irrigation Improvement Project
Sakkia	Animal powered irrigation pump generally used to lift water from the mesqas
SR	Structure Replacement
TMD	Training and Manpower Development
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WPG	Water Plan Group, MOI
WRC	Water Research Center
WMP	Water Master Plan

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OFFICE OF IRRIGATION AND LAND DEVELOPMENT

IRRIGATION BRIEFING PAPER

I. Introduction:

Water is frequently taken for granted without adequate planning until shortages begin to occur. Egypt has not faced shortages since the construction of the Aswan High Dam but water use projections indicate that shortages will begin to occur in the near future. The recent African drought and current water levels in Lake Nasser indicate that the transition from water abundance to water shortages is imminent. Egypt has some time to plan for the efficient utilization and allocation of this resources and its future prosperity is dependent upon how well it meets this challenge.

This Irrigation Briefing Paper has been prepared to provide an overview for those interested in understanding Egypt's water resources and its importance in sustaining food and fiber production to meet the demand of a growing population. Water inflow and use trends and the future water requirements are discussed. The Paper summarizes the USAID irrigation program in Egypt, looks at the status of other major donor activities in Egypt, defines some of the water related problems and water policy issues, and projects additional activities in irrigation management that could benefit Egypt.

The Paper also outlines the urgency for Egypt to plan and implement a long range program to better manage their limited water resources based on needs and conditions in the Nile watershed. This urgency stems from: (1) the apparent lack of conservation measures with regard to the use of the water reserves behind the Aswan High Dam during the recent African drought; and (2) estimates that show there will be insufficient water to sustain Egypt's projected population by the year 2000 unless drastic conservation and management improvements are put into place during the next few years.

II. Setting:

Egypt's population of 50 million is growing by 2.7 percent annually and Egypt is currently importing approximately 50 percent of its food. Agricultural output is rising less rapidly than the demand from the population, and the total imports necessary to meet the 1986/87 food deficits are expected to cost approximately 3.8 billion dollars. Egypt has the potential to eliminate this deficit by increasing agricultural production through the proper utilization of improved seeds and inputs and by using appropriate intensive agricultural practices. However, to make a significant increase in agricultural production, the environment of the crops (root zone) will have to be improved. Irrigation at the proper time and in the quantities required is basic to the process of the crop being grown. In addition the root zone of the crop must also be free of water logging and/or salinity.

III. Water Resources:

The renewable water resources available to Egypt are derived from the Nile River and its watershed. The Nile River, with a main channel 6,700 km long, is the second longest river in the world and drains an area of 2,900,000 km^2. The river has two main branches (Blue and White) with headwaters in Ethiopia and Tanzania and drains parts of nine countries. Approximately 80 percent of the runoff into Egypt's Lake Nasser, which is formed behind the Aswan High Dam, is derived from the Blue Nile which drains a large portion of Ethiopia. The other 20 percent is generated through the White Nile system which begins at Lake Victoria in Tanzania.

Over the years numerous agreements have been reached between the countries involved in the watershed with regard to sharing the water resources of the Nile basin. These agreements have culminated in an agreement that Egypt would be allocated a net of 55.5 billion cubic meters of water annually at the Aswan High Dam, based on an average annual runoff from the watershed of 84 billion cubic meters. The agreements specify procedures for sharing excesses during high runoff years and sharing deficits during low runoff years. In addition Egypt and Sudan have agreed to share the cost of and the additional runoff generated by reducing evaporation losses in the swamps in southern Sudan via the construction of the Jonglei canal and other civil works. Realistically these improvements could increase Egypt's net share of the Nile River waters to approximately 58 billion cubic meters by the turn of the century and ultimately to approximately 65 billion cubic meters, if all the planned construction activities are undertaken. However, it must be noted that Ethiopia is not in full concurrence with the above mentioned agreement.

In addition to the surface water resources, usable groundwater is available in several areas within Egypt. However, the groundwater in the Nile Valley and the Delta of Egypt is not a resource in itself. It can only be looked upon as a storage reservoir that is supplied by the Nile waters through the irrigation distribution system. It is currently estimated that the potential unutilized groundwater in the Delta is less than one billion cubic meters annually, with perhaps three times this amount available in Upper Egypt.

There are two significant pockets of ancient nonrenewable groundwater under the Western Desert and the Sinai. The estimates of the amount under the Sinai have varied widely and have been as high as 25 billion cubic meters. The groundwater resources under the Western Desert have been studied in some detail. The studies indicate that the groundwater is 20,000 to 30,000 years old and is being recharged by water moving in from the southwest at the rate of 14 to 27 meters per year. There is no recharge to this area from the Nile River. Current developments are removing 460 million cubic meters (MCM) per year which is 145 MCM more than the annual recharge capabilities. Studies have indicated that it may be economical to increase development to irrigate an additional 100,000 feddans by increasing withdrawals to 730 MCM per year. At this rate of withdrawal the water table would drop less than 100 meters in 50 years. Additional economic studies are needed before full scale development can proceed.

The only other source of renewable water resources to Egypt is a very small amount of rainfall (10 to 20 cm. annually) along the north western coast. Marginal rainfed agriculture is supported by this limited precipitation.

IV. Water Inflow and Use Trends:

It appears, based on long-term stage (high water) records of the Nile river, that the runoff pattern has a hundred year cycle. Figure 1 indicates that there were low flow periods at the beginning of each century, high flow periods in the mid-century, and wide annual fluctuations. Based on this observation and on the current knowledge of worldwide weather patterns, it might be assumed that we are currently entering a low flow period for the next 15 or 20 years. However, the long-term weather patterns and water yields to Egypt could very well be changed because of man's influence through various development and use activities in the countries within the watershed. Figure 2 shows the net water inflows to Egypt at the Aswan High Dam 1/ during the past 16 years and shows that the inflows for the past few years have been significantly below the average of 55.5 billion cubic meters. The 1984-85 total inflow was less than 38 billion cubic meters surpassing the previously record low of 42 billion cubic meters in 1913-14. Although 1985-86 inflows were back to normal, 1986-87 is expected to be below average. This recent drop in inflows reflects the recent drought which had a devastating impact on those countries in the Nile watershed. As shown by the constant or slightly increasing discharge rate from the Aswan High Dam (Figure 2), Egypt is yet to be adversely affected by the African drought.

The Aswan High Dam was constructed in the mid 60s with a live (usable) storage of 135 billion cubic meters and benefited from a series of high inflow years between 1968 and 1975 which allowed the reservoir to be completely filled. Figure 3 shows the net additions to storage in the early years and a net withdrawal from storage of over 53 billion cubic meters during the past seven years. This withdrawal to meet the water requirements of Egypt has resulted in lowering the live storage content to 24 billion cubic meters as of August 1, 1986. This content represents approximately one third of Egypt's annual water

1/ Flows available for use at the Aswan High Dam after accounting for evaporation, seepage, and Sudan's share. All figures are based on Egypt's water year measured from August 1 through July 31.

Source: MOI Water Planning Group.

requirements. With below normal inflows expected during 1986-87, the water level will decline to a live storage content of approximately 20 billion cubic meters by August 1, 1987, thus adding to future uncertainties for Egypt.

Figure 4 presents the mean water inflows over the past 17 years, a high flow year (1974-75), a low flow year (1984-85) and the beginning of 1986-87. There is very little difference in inflows for the various years until the month of August when the difference between the wet and dry years becomes apparent. 1986-87 appears to be headed for a below average year based on the inflows reported for the first seven months of the water year.

Figure 5 shows the net discharge at the Dam by month for the beginning of 1986-87 against the mean discharge over the past 17 years. There appears to be no significant change as a result of the increasing shortage of water supplies. This was also the case in 1984-85 and 1985-86. Figure 6 provides the water levels by month for the past five years showing that August is the low month each year and that the overall levels have been declining as a result of the recent drought. The drop in water level behind the Dam has resulted in an approximate 21 percent reduction in the power output of each turbine as of August 1, 1985 and 1986, and the water levels are expected to return to near that same level by August 1, 1987.

Figure 7 provides a pie chart showing the Nile River water balance for the calendar year 1982. With releases from Aswan of 58.70 billion cubic meters, approximately 32 billion cubic meters were beneficially used, including 27 cubic meters for agricultural production. The consolidated overall water use efficiency of 54 percent and the irrigation water use efficiency of 45 percent are misleading in that much of the losses from the operation of the system and from the agricultural lands are recaptured and reused several times throughout the length of the system. In many cases this requires large energy consumption in pumping water from drains back into the irrigation system, pumping water from drains into the farmers' fields and pumping from wells. The actual seasonal irrigation efficiencies at the farm level have been shown to range from 26 (inefficient system) to as high as 76 percent (efficient system). To maximize output per unit of water, the efficiency of delivery and application must be increased.

V. Egypt's Main Irrigation and Drainage System/Organization:

The Irrigation System in Egypt consists of the Aswan High Dam, eight main barrages (low dams) across the Nile River to direct water into the canal system, 48 thousand km. of public canals and drains, 80 thousand km. of private canals (mesqas) and farm drains, 450 thousand private saqias (water lifting devices) or pumps, 22 thousand public water control structures, and 560 public pumping stations.

This large complex public and private system provides irrigation water to 5.9 million feddans [2/] of irrigated land, including approximately 0.9 million feddans of new lands. Of the irrigated area requiring drainage facilities, 70 percent of the area has been provided with surface drainage canals and 55 percent of the area has been provided with subsurface drains. The MOI has plans to complete the entire drainage system within the next 10 years.

The irrigation system and the distribution of water are managed by the Ministry of Irrigation (MOI). The Ministry consists of four departments (Irrigation, Finance, Planning and Mechanical), four authorities (Drainage, High Dam, Coastal Protection and Survey), six public companies and the Water Research Center with 11 individual institutes. The irrigated area is divided into 19 Directorates for administrative purposes which are in turn are subdivided into 48 Inspectorates and 167 Districts. The 1986-87 total operation and investment budget for the MOI is 500 million Egyptian pounds or approximately LE 80 per feddan of irrigated land.

VI. Water Quality:

The overall quality of water in the Nile system is good for most purposes and very good for irrigation 3/. There are particular locations where local pollution loads temporarily exceed the ability of the Nile River to assimilate or dilute. But for the most part the quality of water in the Nile system from the Sudan border to Cairo can still be described as "good". Downstream from Cairo, in both the Rosetta and Damietta branches, some deterioration does occur. The quality in the irrigation water canal system is also good, although there is more variation both spatially and temporarily. The water quality in the drainage system varies from good to polluted.

There have been no comprehensive water quality studies in Egypt that are in sufficient detail for determining the full impact of multipurpose development. However, based on individual studies carried out in different areas of Egypt, the following general water quality information is available.

The total dissolved solids at Aswan range from 175 to 180 mg/l during the year, increasing to 200 to 210 at the Delta Barrage (Cairo), and further increasing to 312 to 460 at Damietta and 296 to 392 at Rosetta near the Mediterranean Sea. Concentrations, below 1500 mg/l are considered suitable for irrigation at today's level of management knowledge.

The return flows from agricultural drains south of Cairo are of generally good quality with 95 percent being below 800 mg/l while the drains in the middle Delta have flows generally below 1000 mg/l. However, the drains in the Western and Eastern Delta generally have high values of totally disolved solids greater than 1500 mg/l and are not suitable for irrigation unless they are diluted with good quality river water.

2/ One feddan equals 1.038 acres or 0.420 Hectares

3/ There have been concerns raised regarding high bicarbonate concentration and the resulting hazard to clay soils. Investigations are required.

There are many exceptions to the above statements near the larger towns and cities where industrial and municipal waters discharge into the canal or drainage system causing localized pollution problems.

The groundwater drawn from the alluvium in the Nile Valley is generally of good quality except along the edges of the valley where irrigation causes some leaching of desert soils. Wells in the southern half of the Delta produce good water; but in the northern half of the Delta, salinity increases towards the coast. The total disolved solids in the Nile Valley, Western Desert, and south of Tanta in the Delta are generally less than 1000 mg/l. As one moves towards the Coast from Tanta, the values raise rapidly to 4000 at Kafr El Sheikh and 40,000 mg/l near the coast.

VII. Future Water Requirements:

Figure 8 shows the estimated Nile River water balance for the year 2000. It has been estimated that to increase agricultural production sufficiently to eliminate the food deficit over the next 15 years that approximately 39 billion cubic meters of water will need to be available for consumptive use of crops compared to the current level of 27 billion cubic meters. In addition, industrial and municipal water requirements will raise from the current level of 2.2 (Figure 7) to 4.9 billion cubic meters. Current available information indicates that Egypt cannot rely on much more than 58 billion cubic meters of net water supplies being available per year during the next 15 years, assuming average inflows. As such, the only way to increase the amount of usable water supplies for consumptive, municipal, and industrial use is to increase the water use efficiency within Egypt. This will require increasing the overall system efficiency. Since the main water user is irrigation, the overall irrigation efficiency will have to be increased from the current level of approximately 45 percent to 67 percent, or 12 percent over the next 15 years. Under the current management conditions and physical systems available to Egypt, including the pumping network for water reuse, this is not an unrealistic goal. In addition to improving the irrigation efficiencies, the MOI is investigating ways of reducing losses to the sea. It is estimated that approximately four billion cubic meters of water, could be saved annually by better management of the hydroelectric and navigation release in the winter when they exceed the irrigation demands.

VIII. USAID Project Status:

A. Egyptian Water Use and Management Project (263-0017)

After the return of USAID to Egypt, the Mission became involved in the irrigated agricultural arena with the initiation of the Egyptian Water Use and Management project (EWUP) in 1976. This project, with a 13 million-dollar USAID input, was designed as an adaptive research project to develop appropriate irrigated agricultural packages of technical and nontechnical approaches for improving agricultural production and increasing the overall social and economic well being of the small farmer. The project initiated a diagnostic analysis approach to identify problems and their solutions at the farm level pertaining to water application, delivery and drainage systems, and related agronomic and social economic conditions. The project then tested the various proposed solutions through project trials on farmer's fields to verify the utility and acceptance of the most feasible alternatives. During the implementation of the EWUP project, USAID provided the services of the Consortium for International Development (CID) with Colorado State University serving as the lead university. The action research project was carried out at three sites, ranging from 1,500 to 4,000 feddans each, located in Abyuha in Middle Egypt, Beni Magdul near Cairo and Om-Sen in the North Delta. The project focused on the lower end of the distribution system, i.e., at the Mesqa level serving from 100 to 300 feddans. Typical improvements resulting from the EWUP project efforts to utilize farmer organizations, coordinate inputs, and provide physical remodelling in the system showed increases in irrigation efficiency by 60 percent, reduction in the amount of water lifted by 34 percent, increased land area available for agriculture as a result of reorganization of farm channels by 10 percent, and increased production by 43 percent. The EWUP project was closed down in December 1984, and the output from the project is being incorporated within the ongoing project described in the next section.

B. Irrigation Management System Project (263-0132)

The Irrigation Management Systems (IMS) project has recently been expanded based on the findings of a comprehensive Irrigation Sector Review carried out in late 1985 and early 1986. The IMS project is a complex umbrella project with a USAID input of $340 million. Started in 1981, the project is currently planned for completion in September 1991. The project consists of ten sub-projects or components administered by eight Ministry of Irrigation Project Directors and involves several US consulting firms and US contractors. Two of the components require coordination with the IBRD, FAO, and UNDP. The project has activities in all 19 Irrigation Directorates that cover the six million feddans of irrigated land (old lands) in Egypt.

Contracts for the various project components use a mixture of Host Country and Direct USAID funding and the training and procurement activities involve all of the above organizations. Figure 9 provides a schematic of the project components showing each component's duration and life of project value. As of March 31, 1987 $93 million have been obligated against the project and $ 61 million expended.

A brief description of each of the individual subprojects follows:

1. Regional Irrigation Improvement Project (RIIP)
   The RIIP will plan, design, and construct a rehabilitation/ modernization program in selected canal commands covering an area of over 300,000 feddans during the life of the project.

The RIIP will establish and field test an organizational structure within the MOI capable of providing technical assistance, construction assistance, economic analysis, on-farm development assistance, and user involvement to remodel selected irrigation canal commands. The objective is to make the system more responsive to the needs of farmers and to assure that water is available in the proper quantities at the time it is needed to support increased agricultural output.

A prefeasibility study has been carried out for GOE's National Irrigation Improvement Program and forms the basis for RIIP. The national program was developed based on seven years of research and planning carried out by the Egyptian Water Use and Management Project (EWUP) with USAID.

The RIIP will be carried out in four phases within each area to be improved: (1) constraints to improved agricultural production will be identified; (2) a feasibility study of potential solutions will be carried out to identify the least cost alternatives; (3) the selected alternatives (which must be technically sound, economically viable, and socially acceptable) will be designed and implemented; (4) the implemented solutions will be monitored and evaluated to improve the effectiveness of future improvements.

The total USAID contribution to the RIIP will be $105.9 million including approximately 580 person months of technical assistance, 380 person months of nondegree training, and five persons receiving degree training. The initial TA is being provided by the Consortium for International Development (CID) and additional TA will be arranged during FY 87.

USAID will help finance improvements such as water control structures, monitoring systems, canal lining, canal crossings, canal excavation and/or realignment, land leveling, farmer organizational efforts, a grass-roots irrigation advisory service, support commodities, training, and technical assistance. The TA will focus on three areas within the country and construction on eleven areas. The TA for the eight additional areas is to be provided for by the UNDP in coordination with the USAID program. The TA will result in the development of a multidisciplinary approach to problem identification within canal commands, development of cost effective and economic solutions, and implementation and evaluation of the selected interventions. The MOI staff capability will be developed to handle a national program of canal command modernization and rehabilitation.

2. Structure Replacement (SR):
The SR component is aimed at the smaller structures in the irrigation system--intake regulators, head regulators, weirs, tail-escapes, spillways, bridges, and crossing structures. It is also aimed at improved quality of structures and assuring that they are built to MOI specifications. During Phase I, over

3,000 structures were replaced or rehabilitated. During Phase II, which is currently underway and will be completed in FY 89, an additional 6,500 structures will be replaced by structures of acceptable quality or rehabilitated. The SR component complements the new RIIP activities and removes the backlog of old and existing nonfunctional irrigation structures in the system.

The total USAID contribution to the SR component will be $76.1 million, including approximately 78 person months of technical assistance, 25 person months of nondegree training, and 80 percent of the cost of the structures.

An important aspect of the SR program is the increase in the MOI budget for maintenance of structures so that the large backlog of nonfunctioning structures will not build up again. The MOI budget has been increased to satisfactory levels so that, with the elimination of the structural backlog at the completion of the SR component, the small structures maintenance can be kept in a satisfactory condition.

TA provided by Harza Engineering Company is resulting in design and construction specifications being upgraded and quality control improved.

3. Preventative Maintenance:
Preventive maintenance has not been a high priority activity in the field level units of the MOI, resulting in the undesirable state of maintenance of most of the irrigation system.

The preventive maintenance system will give the selected Directorates the equipment and staff training necessary to perform first echelon maintenance. It will also install the procedures to plan for, manage, and control higher levels of maintenance, including replacements that are contracted out.

The initial phase of the preventive maintenance component is progressing with the establishment of a preventive maintenance organization in the Gharbia Directorate. With the implementation of this unit, the MOI has committed to reorganize, staff and fund this vital element needed to assure proper and reliable maintenance of the system. Once operating, this unit can act as a model for extension to the other 18 Directorates in the irrigated areas.

Associated with this program is a proposed IBRD assistance package to strengthen the channel maintenance work throughout the country. The main focus of the IBRD program is on improving the capabilities of the MOI Public Excavation Companies which carry out most of the large channel maintenance work.

To assure full coordination between the IBRD and USAID activities and obtain involvement of the private sector, USAID will provide assistance to MOI regarding the IBRD program focusing on TA, equipment and vehicle for the MOI, and support for bringing the private sector into the channel maintenance program through procurement of mesqa and small channel improvement equipment.

Under this component USAID will provide $39.8 million including approximately 290 person months of technical assistance to be arranged during the summer of 1987 and 80 person months of non-degree training. The end result of this effort will be a preventive maintenance program, tested, accepted, functional, and fully staffed in at least six Directorates. The Directorate level organization and training mechanism can then be replicated throughout the remaining 13 Directorates.

4. Main System Management (Telemetry):
Management decisions to increase or diminish water flows at key points throughout the irrigation delivery system will be improved by a telemetry data collection system. This system will provide real time data to the managers of the system resulting in improved management and reduction of waste and irrigation shortages.

The initial phase of the telemetry system, currently being installed by the RET Corporation of Springfield, Virginia, will provide detailed data (basically water levels) on the hydrology and other characteristics at 255 specific points in the irrigation system. This project will now be expanded to increase the kinds of data (flow rates, water quality, communications), as well as the number of data collection points in the system (300 additional points). Data are assembled utilizing meteor burst transmission of collected data to computerized stations at both Cairo and Aswan.

This component will also assist the MOI in experimenting with automation of control gates in a pilot area (Salheya Canal command) of the irrigation system. The pilot effort will define the resulting decrease in operation losses and improvement in irrigation efficiencies. A communications network and canal feasibility studies for determining the economic extent of automation will also be financed under the Project. TA will be arranged during FY87 and implementation will be considered on a case by case basis after analysis of the results of each study.

The total USAID contribution to this component will be $32.3 million, including approximately 285 person months of technical assistance and 60 person months of nondegree training. In addition to the infrastructure mentioned above, the TA will build the capability within MOI to operate and maintain the installed system and plan, construct and operate the expanded systems in the future.

5. Planning Studies and Models:
The MOI, through its Water Planning Group (WPG), has developed a number of computer models that are designed to increase the

operating efficiency of the whole system. These models fall into two groups. One group concerns inflow simulation to predict flows into Lake Nasser from the area above the Lake, i.e., the basic source of water supply. This group also includes the operating rules of the High Aswan dam (HAD), i.e., how the stored water supply is to be released in accordance with power, navigation, irrigation and other needs.

The other group of models is concerned with the service area between the HAD and the Mediterranean Sea. They are used to analyse the impact of the water delivery system on agricultural policies and programs, and vice versa; plan the distribution of water through the system; and provide detailed operating parameters, such as gate movement schedules, for operation of the system within a specified set of system operating constraints.

The development of these two groups of models has been assisted by the UNDP, starting in 1977. During the past two years, IBRD and UNDP, with USAID participation, have carried out two review missions and found the project as having a positive and beneficial impact on developing the models needed to properly plan and operate the irrigation and drainage system. Due to funding constraints, the UNDP assistance will be phasing down. The UNDP has requested USAID to finance further refinement of the two groups of models and the addition of several new models to the two groups.

The objective of this new IMS component is to benefit from the time and effort spent thus far developing a basic set of models by providing a minimal investment (one percent of the total IMS cost) to take the models to the fully integrated operational stage where they can be used by decision makers to test impacts of various policies. The UNDP will continue to provide a minimum TA input to assure full coordination with the previous program.

The total USAID contribution to the component will be $5.4 million including approximately 128 person months of technical assistance and 75 person months of nondegree training. As a result of this support, the MOI will be able to finalize all models and develop procedures to incorporate model results into the planning, operation, and decision making process of managing Nile River waters. In addition, other departments within MOI will be provided with key models and appropriate training to use them in their planning, design, and operation activities.

6. Professional Development:
The IMS Project has been supporting a Training and Manpower Development Unit (TMD) which will now form the nucleus of this Professional Development component.

In late 1985, a training assessment team carried out an analysis to determine the training needs of the MOI, investigate alternative training facilities, and recommend an action program. The National Irrigation Training Institute (NITI) concept was found to be the least cost alternative to meet the MOI training needs.

The NITI will provide a structured in-service training program for the five to seven thousand professional and 70 to 80 thousand nonprofessional staff of MOI, plus some from the Ministry of Land Reclamation. Training will be in over 60 subject matter areas. NITI will have the capability to provide high quality training to 2,500 students per year focusing mainly on the professional staff.

The NITI will build on the TMD and embody a multi-disciplinary approach to technical training and will utilize an action research focus under field conditions. Management training will be organized by NITI but will be carried out mainly at the existing center for Agricultural Management Development and other regional and national training centers and universities.

USAID will provide a total of $11.8 million including approximately 225 person months of technical assistance to be obtained during late 1987, 150 person months of nondegree training, 12 persons receiving degree training, and limited commodities to assure that the Professional Development component is fully developed.

7. The Water Research Center:
The scope and complexity of the MOI responsibilities for the irrigation system involve a wide range of scientific disciplines and widely varying subject matter areas. The Water Research Center was created by MOI to do the basic research and be the reservoir of knowledge on all aspects of the irrigation system. To serve this purpose, 11 separate research institutes were created and are fully operational. The Water Distribution and Methods of Irrigation Research Institute was the implementing agency for the USAID-supported Egyptian Water Use and Management Project (EWUP). The Weed Research Institute will be involved in the currently proposed Preventive Maintenance component.

The total USAID contribution to the WRC will be $32.1 million, including approximately 479 person months of technical assistance. CID is currently providing limited amounts of TA. During 1987 MOI and USAID will arrange for additional TA support. The objectives of this component will be to strengthen the existing staff of all eleven institutes with TA and a significant amount of degree training (26 PhD and 44 MSc) and nondegree training (468 person months). In addition the institutes will improve their capabilities to utilize private contractors, universities, and other research organizations to carry out special research projects rather than increase core staffing.

8. Project Preparation Department:
The Project Preparation Department (PPD) was created by MOI under the original IMS program to provide international quality economic and technical feasibility analyses of investment options open to the MOI and to prepare reports in English for submission to international financial agencies and foreign donors. The PPD also serves in a staff capacity for the Minister of Irrigation to provide economic and technical analysis of various developmental problems as assigned by the Minister.

The PPD, supported by Harza Engineering Company, has turned out a number of studies of acceptable quality. For example, its North Zifta feasibility study demonstrated: (1) the proper methodology for carrying out such studies and (2) the importance of such studies in making funding decisions.

The total USAID contribution to the PPD component will be $10.7 million, including approximately 400 person months of technical assistance and 25 person months of nondegree training.

9. Survey and Mapping:
Part of the normal planning/design apparatus for irrigation systems is high quality aerial photography and detailed topographic maps.

Most of the cadastral and topographic maps currently in use for planning and designing irrigation improvements were prepared between 1900 and 1945. Most of these maps are not adequate for preparation of feasibility studies or detailed project planning. In addition, accurately scaled aerial photography is not available for the irrigated areas of Egypt.

During 1987 this component will arrange for and finance contracts for aerial photography, new cadastral maps for about five million feddans of the irrigated lands, and large scale contour maps of all the agricultural land. It will also provide training and equipment to the Egyptian General Survey Authority to upgrade its capability to provide certain mapping services.

The total USAID contribution to the Survey and Mapping component will be $6.1 million, including approximately 130 person months of technical assistance and 40 person months of nondegree training.

10. Miscellaneous Technical Assistance and Commodity Procurement:
This component is a residual supply of technical, commodity, and training assistance to cope with problems not addressed by the other components or to take advantage of particular developmental targets of opportunity.

To date over one million dollars have been utilized for special studies carried out in conjunction with other donor agencies, nondegree training for MOI officials outside the normal IMS components, project evaluations, invitational travel in conjunction with IBRD projects, and miscellaneous procurement.

In the future this component will provide an additional $4.6 million to help MOI strengthen their monitoring and evaluation procedures by providing TA and commodities. In addition, TA will continue to be made available for special needs such as the Upper Nile Barrages panel, the panel reviewing the progress on Esna Barrage, and other special projects.

C. Irrigation Pumping (263-0040)

The Irrigation Pumping Project was initiated in 1977 to install 37 large pumping stations along the Nile River from Aswan to just south of Cairo. A loan of $11 million and a grant of $8 million were provided to the GOE. The pump stations are designed to provide reliable irrigation to areas along the Nile River which are not currently served by the gravity canal system.

This project is being managed by the USAID office of Infrastructure Development and indications are that all the pump stations will become fully operational during FY 87.

D. Applied Science & Technology (263-0016)

This USAID project has a component that is providing $136,000 to assist MOI carry out a study of New land Development. The study is being implemented by the Water Distribution and Irrigation Systems Research Institute of the Water Research Center which is providing LE 385,000 towards the study effort.

Interdisciplinary research teams are carrying out studies in three project areas on existing new land developments. The irrigation systems being studied include sprinkler, drip, and several types of surface irrigation.

The project began in May 1984 and is scheduled to last for four years. Phase I (May - September 1984) consisted of research design, selection of staff and field research sites, determining measurement criteria and procedures, literature review, and preliminary data collection. Phase II is scheduled to last for three years and entails field measurement of experience in a variety of reclamation settings during three successive crop years. Phase III, final analysis and report writing, will begin in late 1987.

E. Commodity Import Program

The USAID Commodity Import Program is available to the MOI for the procurement of needed commodities. For example if the MOI requires pumps, they agree to transfer their line item budget in the equivalent cost of the pumps to MPIC who in turn requests USAID to fund the items to be imported. Since 1975 MOI has imported over $15 million worth of commodities through the CIP, mainly in the areas of spare parts and pumps.

IX. Other Donor Activities in Irrigation and Drainage

A. Canadian Bilateral Development Assistance Program

The Canadian Government is assisting the Ministries of Irrigation and Agriculture with the implementation of the Integrated Soil and Water Improvement Project (ISAWIP). Phase I, financed through a $1.8 million grant, provided Canadian consultants from the Government departments of Energy, Mines, and Resources to conduct basic data collection and surveys on 90,000 feddans in Dakahliya in the North East Delta.

Phase II, if approved, will carry out implementation of improvements to the irrigation system similar to the USAID Regional Irrigation Improvement Program mentioned above. Both activities (CEDA and USAID) are being managed by the same unit within the MOI to assure full benefits from the lessons learned.

B. United Nations Development Programme

A three-phase program was started in 1977 to assist MOI in establishing a water resources master planning unit. With a total contribution of $3.65 million, the project will be completed in 1988. The project has resulted in the establishment of a Water Plan Group (WPG) within the MOI Planning Sector. The WPG is staffed and equiped to carry out a wide range of planning and implementation activities. The WPG is assisted by IBRD-funded short-term specialists, and USAID will provide further support through its IMS project.

C. The Bank Group

The IBRD and IDA have supported a large drainage program in Egypt since 1970. Agreements, totalling $178 million, providing underground drains covering 3.1 million feddans have been implemented. These agreements also included 2.56 million feddans of open drains, construction of 22 new drainage pump stations, and the rehabilitation of two existing pump stations.

Most recently the Drainage V Agreement was signed providing $68 million of support to the Egyptian Public Authority for Drainage Project's (EPADP) 10-year program of drainage works. A gross area of 1.33 million feddans will be covered under the new project, bringing the total area provided with adequate drainage to 4.4 million feddans. It has been estimated that the ultimate need is approximately 4.7 million feddans.

D. Others

Italy is providing $6 million for the construction of the Damietta barrage on the Damietta branch of the Nile. Japan is currently financing some small land reclamation projects, and the Dutch Government is supporting a rural development and irrigation project covering 350,000 feddans for El Fayoum.

The Hamoul Drainage and Soil Improvement Project, approved by the European Economic Community, covers 65,000 feddans reclaimed from Lake Burullus in the early sixties. The project area is located in Kafr el Sheikh Governorate. The five-year project includes ditching and land improvement works in 30,000 feddans, installation of pipe drains in 35,000 feddans and improvement of irrigation infrastructure. Total project cost amounts to US $40 million.

X. Definition of Irrigation Management:

The term "Irrigation Management" has come into its importance during the last decade and is an outgrowth of the evolution of on-farm water management and irrigation water management work carried out since the 1960s. Irrigation Management is a mixture of science and art and is not fully understood. There are no formal degrees offered in Irrigation Management.

Irrigation Management can be defined as the process by which water is manipulated and used for the production of food and fiber. This is a comprehensive definition in that it includes water resources, dams, reservoirs, codes, laws, canals, institutions, farmers, soils, crop inputs, and cropping systems. Irrigation Management has to do with how these physical, biological, chemical, technical, legal and social resources are combined and orchestrated along with the essential knowledge, skills and motivations required to achieve improved food and fiber production in terms of a stated set of performance goals.

Irrigation Management is especially important to Egypt because of the major effect of irrigated agriculture on the economy. In Egypt and elsewhere, most of the engineering principles to improve Irrigation Management have been known for years. What is not known is how to devise an Irrigation Management program based on the physical and cultural interfaces in each location. One of the most underrated and misunderstood dimensions of irrigation management today is that of the individual and collective irrigation behaviour of farmers.

Government officials and donors are slowly realizing the high economic, social and political costs involved when farmers and users play only a passive role in irrigation projects. What is still not well understood is how to match technologies and management modes with different physical and social environments. Likewise, we need to learn how to diagnose and reform key social organizations and institutions, discover better ways to utilize farmer clients more effectively by giving them a sense of ownership in irrigation systems designed to serve them, and find the proper set or mix of policies which provide incentives which will really motivate farmers. This is hardly possible until all professionals and agencies concerned provide the adequate incentives, institutional support, and services which will in fact make improved production possibilities a reality.

The EWUP, described under VIII.A. above, developed ways of accomplishing Irrigation Management on a small scale, and the RIIP, under VIII B.1., will apply those lessons on a larger area. However, there is still much to be learned. EWUP showed the value of the interdisciplinary approach using a team of engineers, sociologists, economists, and agronomists to identify Irrigation Management problems and develop and implement solution to those problems.

XI. Policy Issues:

As Egypt progresses towards improving the water use efficiency of the river and canal system, numerous existing policies will have to be reviewed and modified and additional policies established. An Interministerial Water Planning Committee has been established, headed by the Ministry of Irrigation and having representatives from eight other ministries. This body is responsible to review the impact of all proposed projects involving the use of water and has the authority to set policies as required. As the Ministries' existing computer modelling capacity improves, their capacity to test the impacts of alternative policy reforms will increase many fold.

The following is a list of some of the possible policy improvements that could be discussed with GOE as they relate to Irrigation Management:

A. Proportion of funds allocated for improvement of existing projects versus new schemes.

B. Below ground public irrigation distribution systems versus above ground system of delivery.

C. Cost recovery for water from the benificiaries, taking into account the present and planned price controls and subsidies.

D. Benefit package (monetary and merit advancement) required to retain qualified professional staff within the MOI.

E. Public versus private groundwater development to help control water tables and supplement the surface distribution system.

F. Responsibility of MOI and the farmers at the mesqa level and for the operation of the canal system.

G. Diagnostic multidiscipline "bottoms up" planning and design approach versus the engineering "top down" approach.

H. Coordination responsibilities of the Ministries of Agriculture and Irrigation.

I. Organization and staffing policies of the MOI as it begins to utilize more advanced technology.

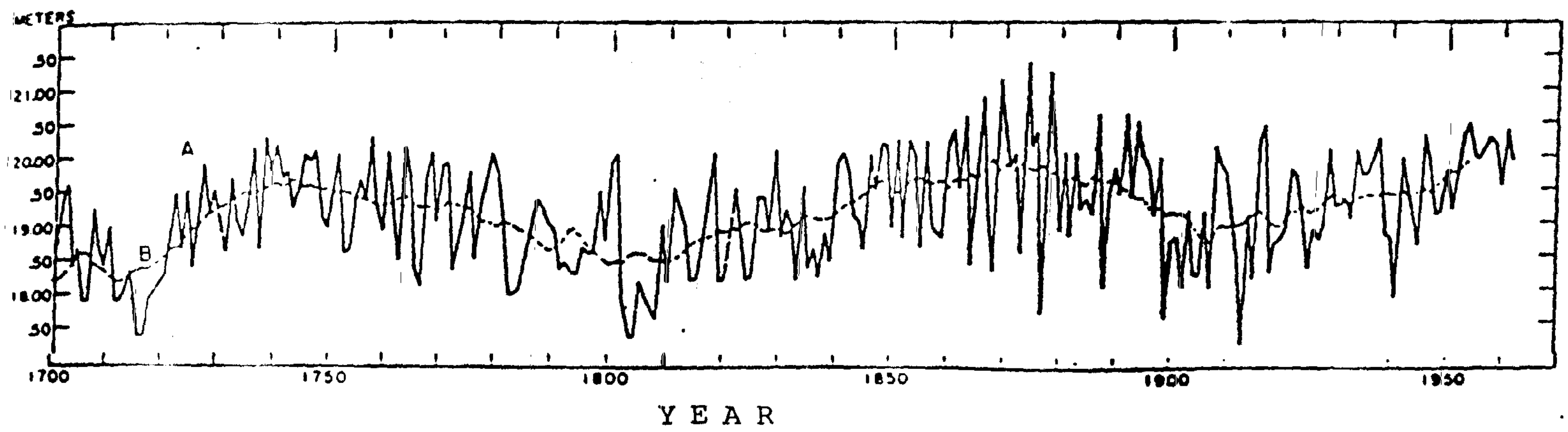
XII. Projected Activities:

In addition to implementing the current portfolio that addresses the above mentioned policies, USAID should consider assisting GOE think through its current policies regarding the development of New Lands.

There is a potential for expanding agriculture and development using ancient nonrenewable groundwater in the New Valley (Western Desert) and the Sinai. The use of this valuable resource needs careful planning and management. USAID could play an important role in the development of these groundwater resources.

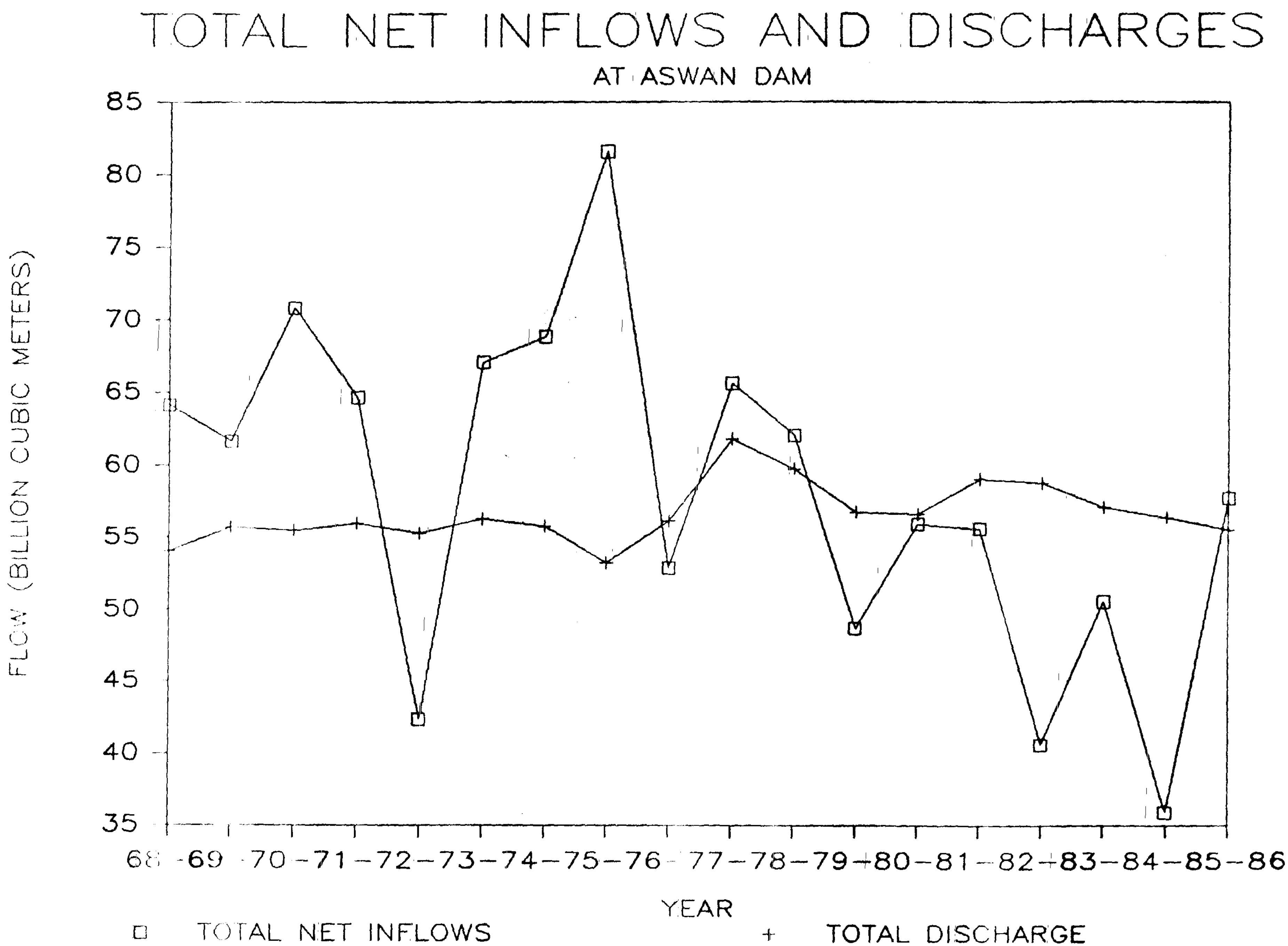
Also there are approximately 0.9 million feddans of new lands that have been developed using Nile River waters. Some additional new lands will be developed over the next 20 years, utilizing the saved water from improved overall irrigation and water use efficiencies. Studies have shown that the effectiveness of past development of new lands has been marginal in most cases. USAID should consider assisting the GOE determine how to use these new lands more effectively. Studies of the old new lands may reveal how to improve the new lands already developed and at the same time provide guidance for improving the planning and designs of future new land development. At the same time the role and benefits of more private sector involvement could be explored for providing mechanisms to improve production.

Other projects or programs that may be considered by USAID in the future would be the formation of a consortium to replace the old Esna Barrage in Upper Egypt; involvement in shore protection activities along the Mediterranean to reduce losses of agriculture lands and reduce saline intrusion; investigation of potential sodium hazards in soils, the effect on irrigation management, and methods for reclamation; and assistance in monitoring programs for water table level and soil salinity - alkalinity to assess existing drainage system effectiveness.



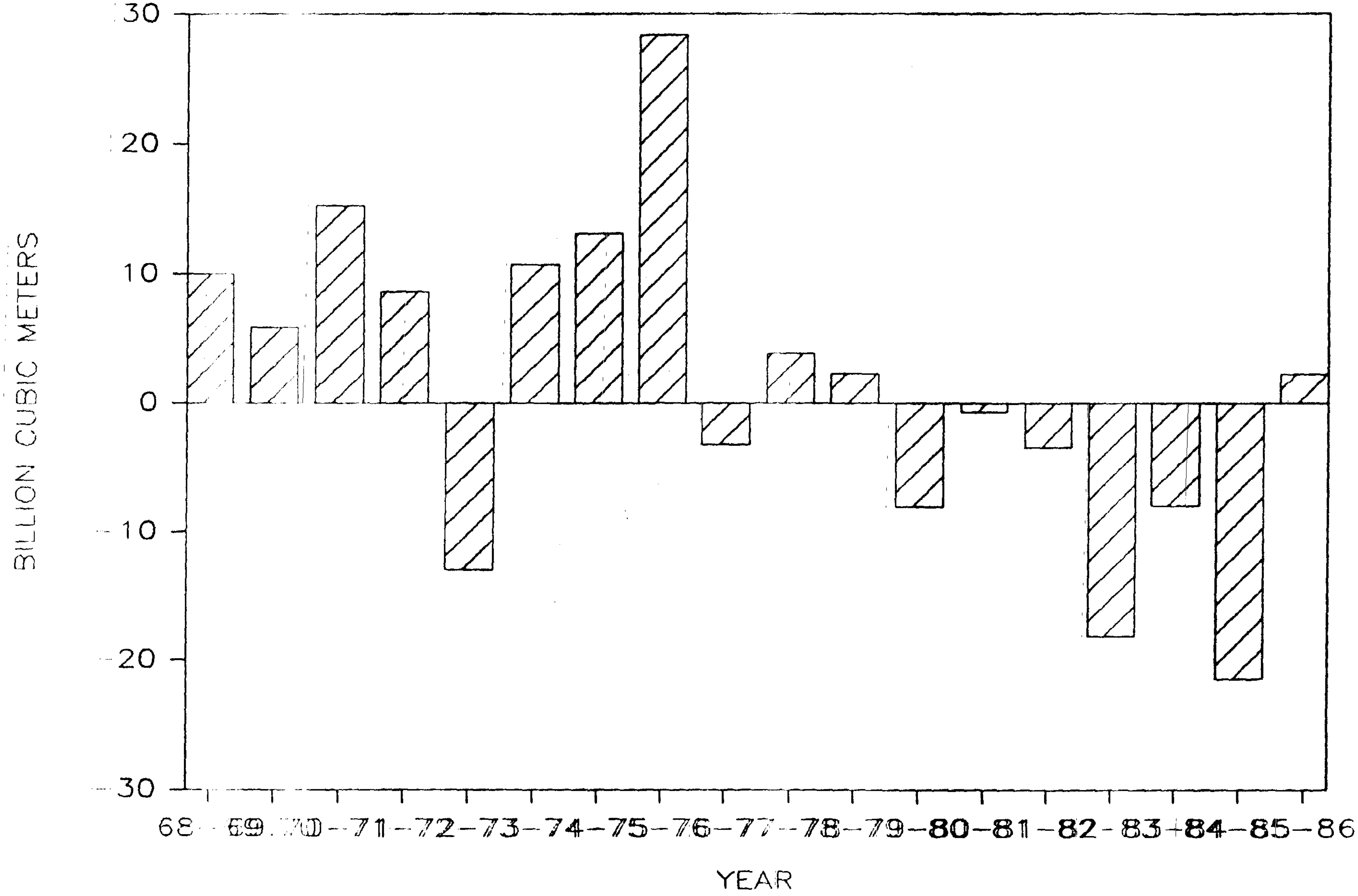
Variation in the high water stages of the Nile River

FIGURE 1


TOTAL NET INFLOWS AND DISCHARGES
AT ASWAN DAM
85
80
75
70
65
60
55
50
45
40
35
FLOW (BILLION CUBIC METERS)
68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86
YEAR
TOTAL NET INFLOWS
+ TOTAL DISCHARGE

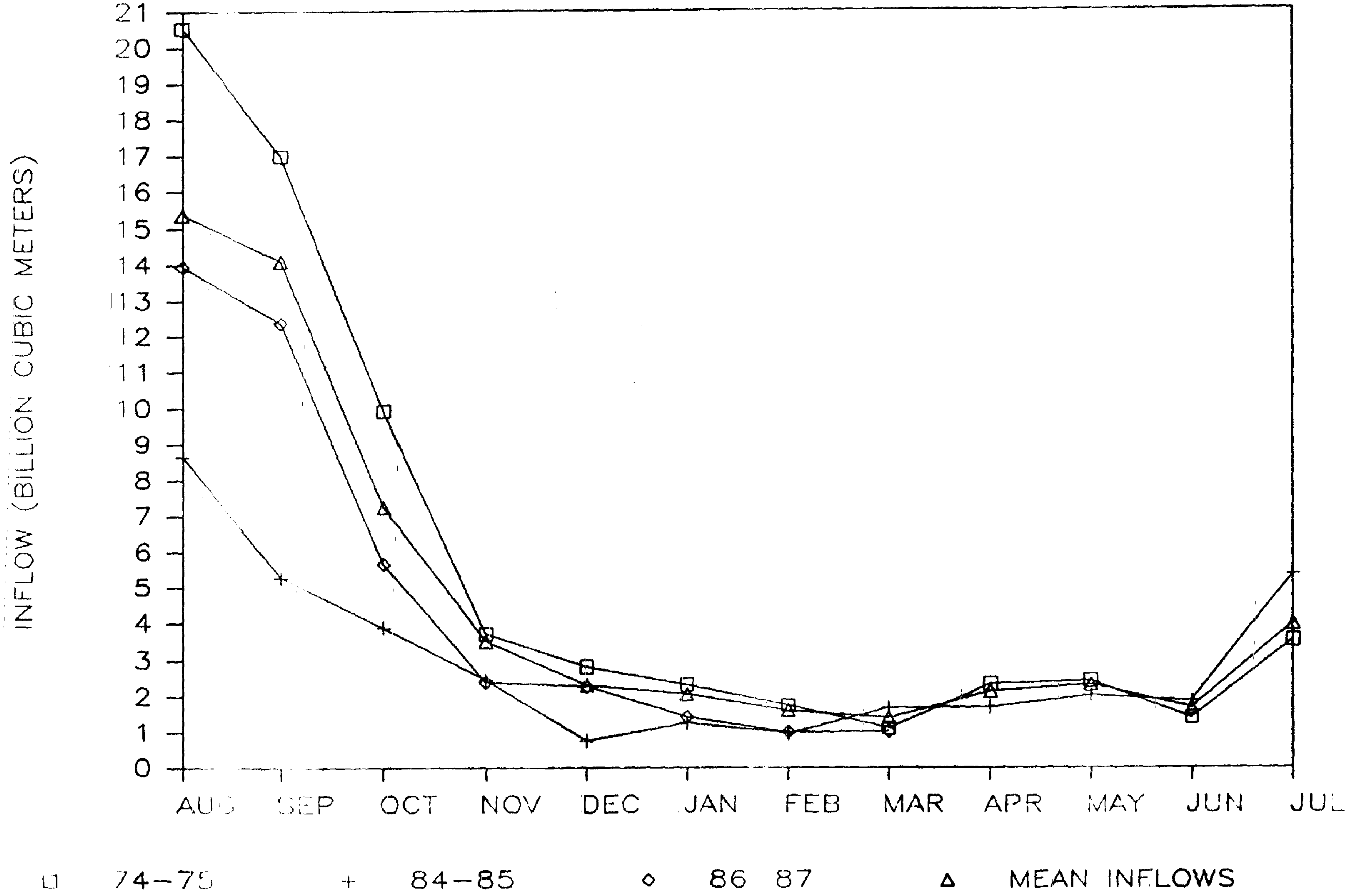
LAKE NASSER

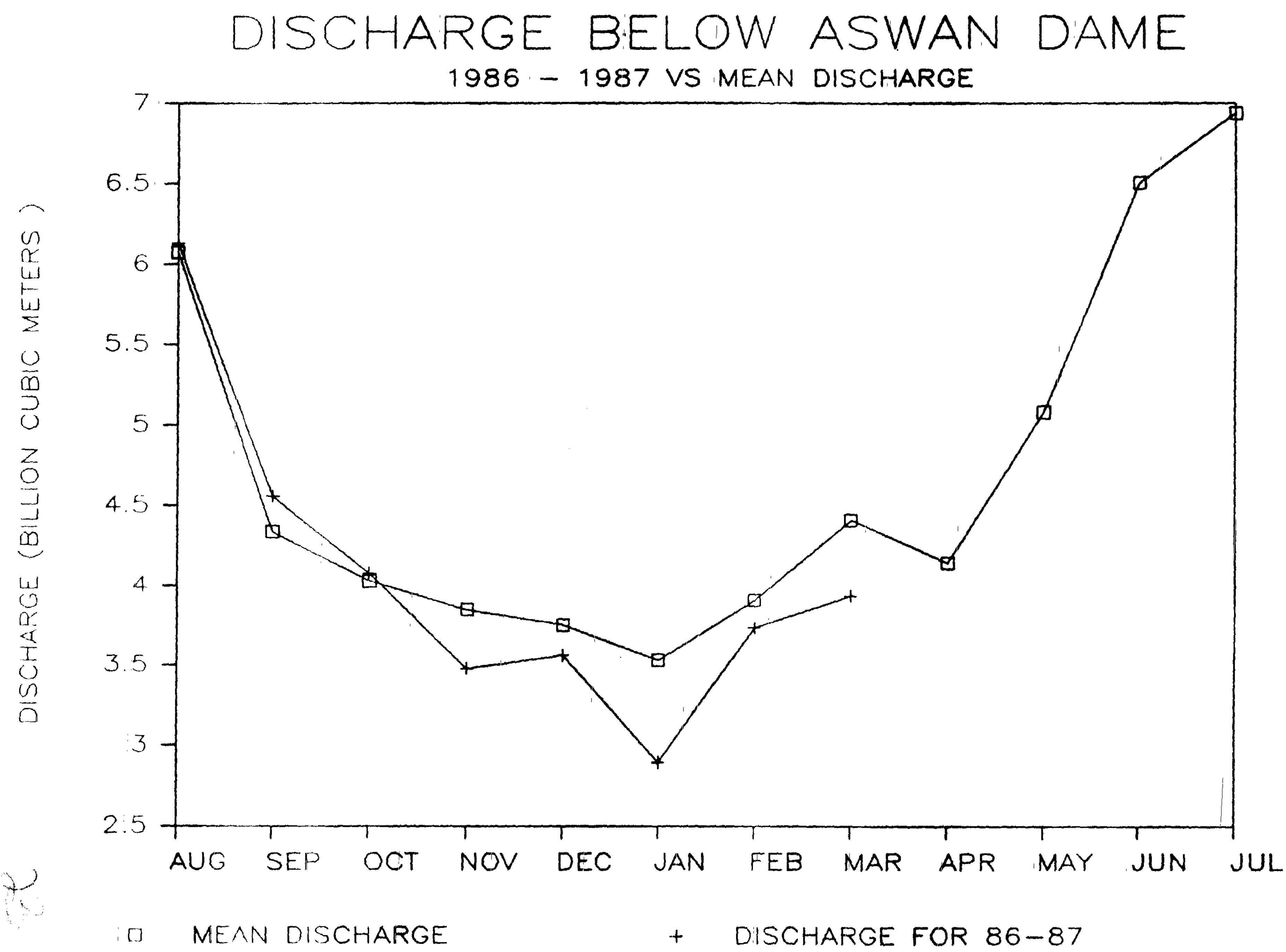
ADDITION AND REMOVAL FROM LIVE STORAGE

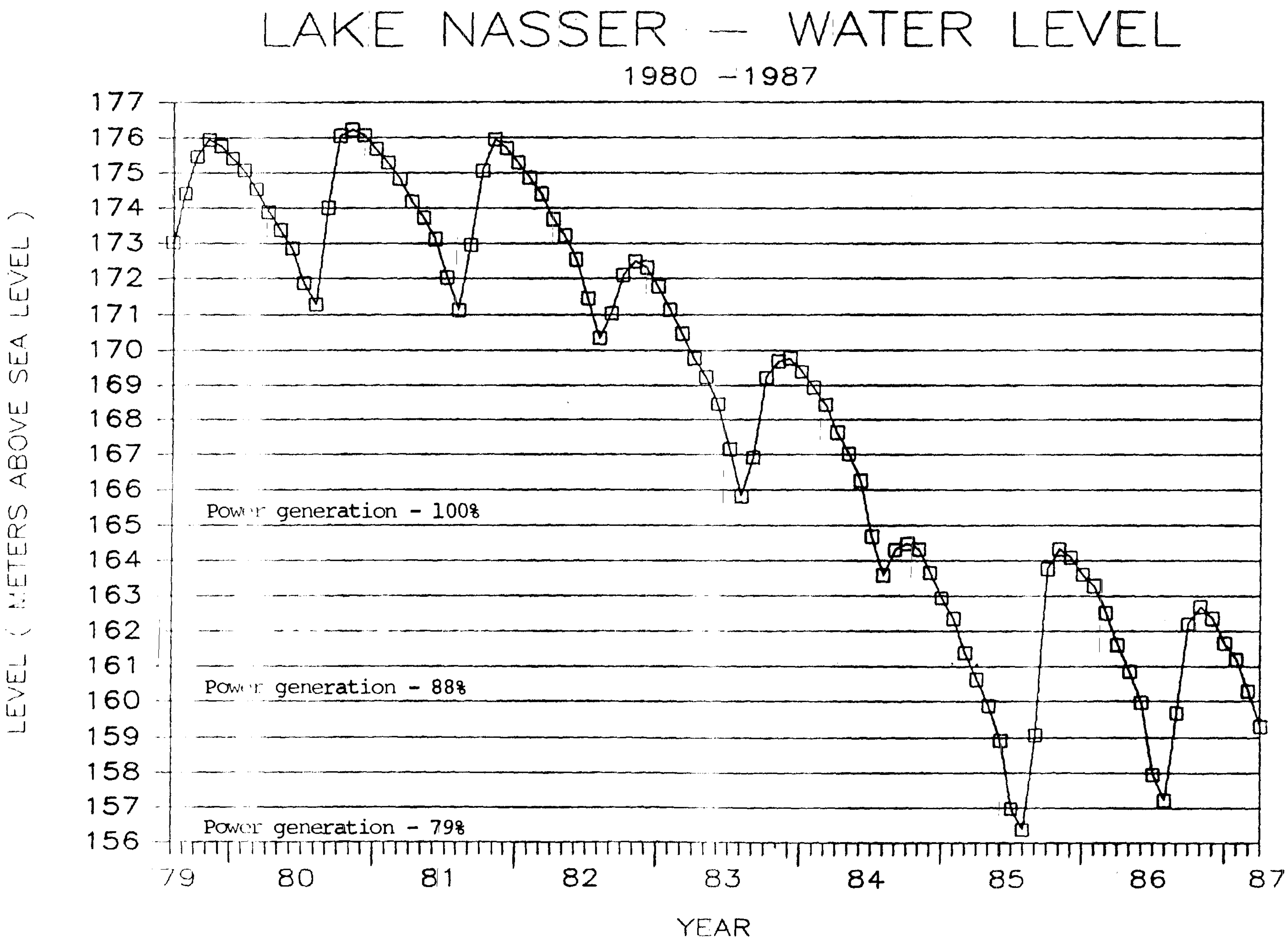


FIGURE

NET INFLOWS TO LAKE NASSER

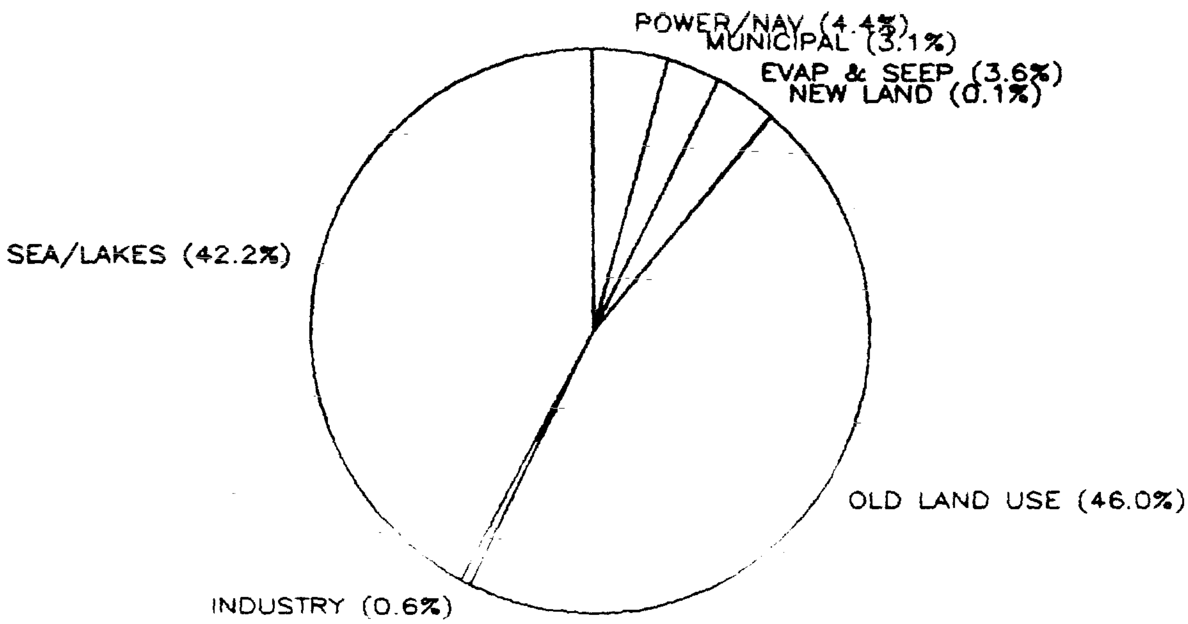



DISCHARGE BELOW ASWAN DAME
1986 – 1987 VS MEAN DISCHARGE
DISCHARGE (BILLION CUBIC METERS)
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
MEAN DISCHARGE
DISCHARGE FOR 86–87


LAKE NASSER — WATER LEVEL
1980 –1987
LEVEL (METERS ABOVE SEA LEVEL)
177
176
175
174
173
172
171
170
169
168
167
166
165
164
163
162
161
160
159
158
157
156
Power generation - 100%
Power generation - 88%
Power generation - 79%
79
80
81
82
83
84
85
86
87
YEAR

NILE RIVER WATER BALANCE – 1982
(BILLION CUBIC METERS)

RELEASES FROM ASWAN DAM –	58.70
PRODUCTIVE USES	31.82
MUNICIPAL	1.84
INDUSTRY	0.34
OLD LANDS CONSUMPTIVE USE	27.01
NEW LANDS CONSUMPTIVE USE	0.03
POWER AND NAVIGATION	2.60
LOSSES	26.88
SEA & TERMINAL LAKES	24.77
EVAPORATION & SEEPAGE FROM CANALS	2.11
NILE WATER USE EFFICIENCY	54%
IRRIGATION EFFICIENCY	45%
CROPPING INTENSITY	185%
CROP CONSUMPTION USE (C.M./FEDDAN)	5,000

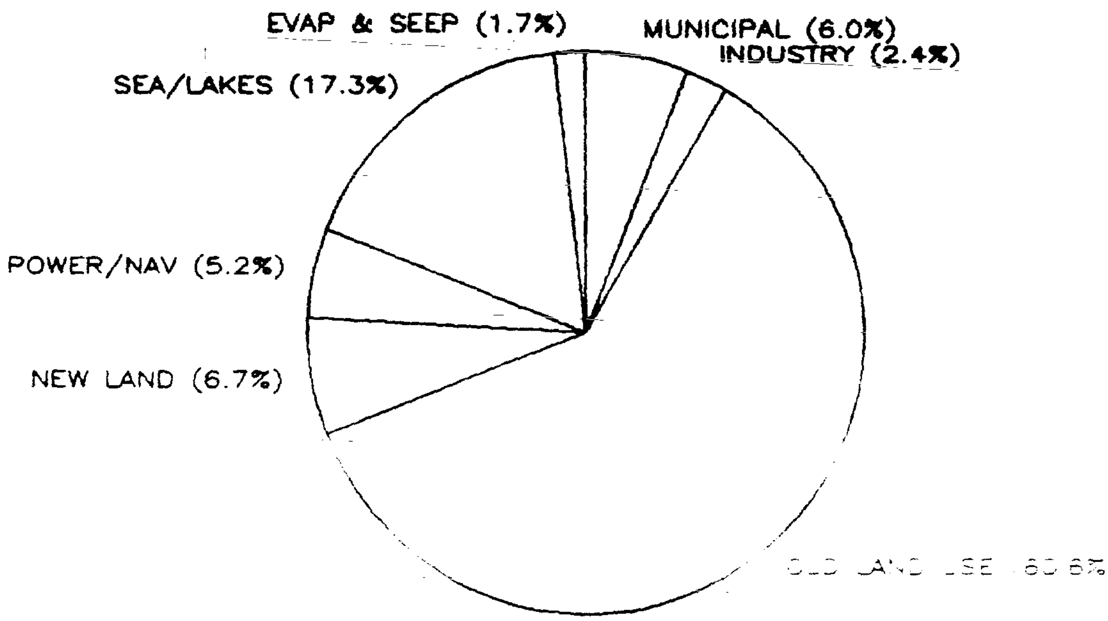


SOURCE: MOI MASTER PLAN FOR WATER RESOURCES DEVELOPMENT.
UNDP – IBRD DEC 1984.

FIGURE 8

NILE RIVER WATER BALANCE - 2000
(BILLION CUBIC METERS)

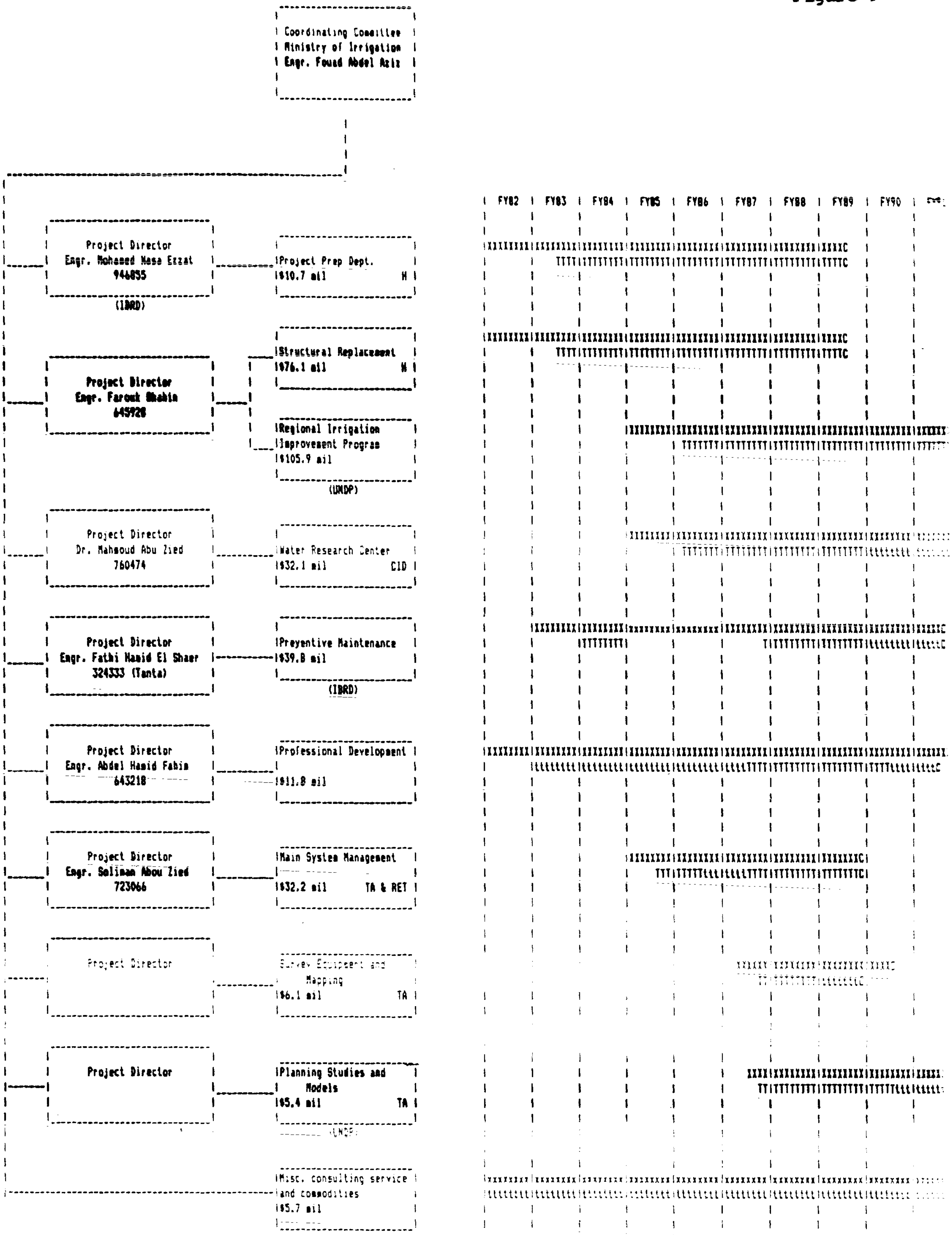
RELEASES FROM ASWAN DAM -	57.9
PRODUCTIVE USE	**46.9**
MUNICIPAL	3.5
INDUSTRY	1.4
OLD LAND COMSUMPTIVE USE	35.1
NEW LAND COMSUMPTIVE USE	3.9
POWER AND NAVIGATION	3.0
LOSSES	**11.0**
SEA AND TERMINAL LAKES	10.0
EVAPORATION AND SEEPAGE FROM CANAL	1.0
NILE WATER USE EFFICIENCY=	81%
IRRIGATION EFFICIENCY	67%
CROPPING INTENSITY	200%
CROP CONSUMPTION USE (C.M./FEDDAN)	5,400
BASED ON A POPULATION OF	65.5 MIL



SOURCE: MOI MASTER PLAN FOR WATER RESOURCES DEVELOPMENT
UNDP - IBRD DEC 1984.

Irrigation Management Systems Project

Figure 9



H = Harza Engineering Co.
CID = Consortium of International Dev.
RET = RET Corporation

$14.1 mil contingencies

xxx = intermittent sub project activity
ttt = part time technical assistance
C = activity or TA complete

XXX = full time project act...
TTT = full time technical assis...