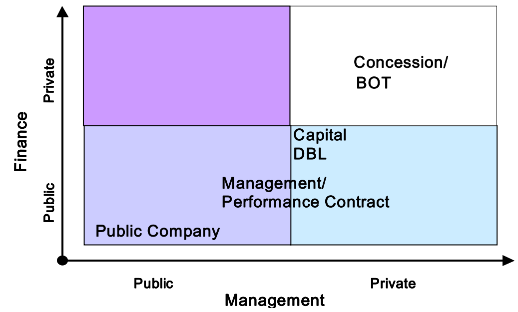
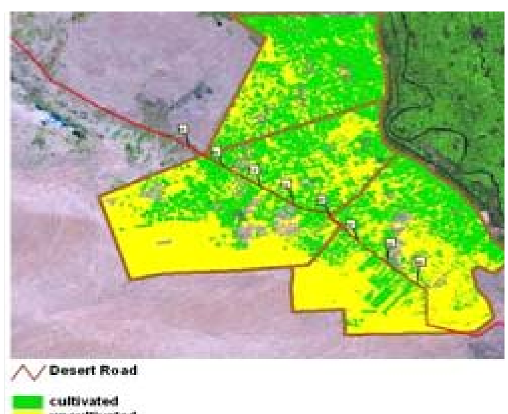




Conceptual Framework and Transaction Model for a Public-Private Partnership in Irrigation in the West Delta, Egypt





Aldo Baietti et all
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Currency Unit = Egyptian Pounds (LE)

US$1.00 = LE 6.24

ABBREVIATIONS AND ACRONYMS

Bm3	Billion of cubic meters
BOT	Build-Operate-Transfer
CAPEX	Capital Expenditures
CTP	Contour and Topology Parameters
CC	Closed Conduits
CDBL	Capital-Design-Build-Lease Contract
DBL	Design-Build-Lease
EWP	Egyptian Water Partnership
GOE	Government of Egypt
HAP	High Areas Potential
Has	Hectares
HC	West Delta Holding Company
IFI	International Financial Institution
Km	Kilometers
LE	Egyptian Pounds
MDP	Market and Demand Parameters
MALR	Ministry of Agriculture and Land Reclamation
Masl	Meters above sea level
Mm3	Million of cubic meters
MWRI	Ministry of Water Resources and Irrigation
OC	Open Channels
OPEX	Operating Expenditures
O&M	Operations and Maintenance
PO	Private Operator
PPIAF	Public-Private Infrastructure Advisory Facility
PPPs	Public-Private Partnerships
RIM	Recreation Investment Market
ROC	Reduction of Operating Costs
RR	Revenue Requirement
WUA	Water Users Association
WUE	Water Usage Efficiency

Acknowledgement

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Aldo Baietti (PPIAF-World Bank TTL) is the principal author of this report, and led the work of the team of consultants providing inputs for the report. Dr. Quosy El Dia (Project Coordinator) supervised the work of technical consultants in Egypt. Sixto A. Requena (Consultant, Economist and Institutional Specialist), wrote chapters 2, 3, and 4 of this report and Annex 5 "Institutional Options and Transaction Model for the Public Private Partnership". The Egyptian Water Partnership undertook the Stakeholders Consultations, run a survey, and prepared Annex 1 "Stake Holder Consultations and Survey Report". Dr. Nahed El Arabi prepared Annex 2, "Groundwater Assessment". Dr. Ayman Nassar undertook the technical studies and prepared Annex 3, "Technical Options Report". Ahmed Wael A Hamid (Financial Analyst), assisted in the preparation of Annex 4, "Financial Analysis and Financial Projections". Other members of the World Bank that facilitated the preparation of this report include: Maher F. Abu Taleb (Sr Water Resource Specialist), Hani El Sadani Salem (Water Resources Specialist) and Pierre-Henri Leon (Operation Analyst).

Disclaimers

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Executive Summary

Background

Since the late 1960s, commercial farmers have been reclaiming desert lands with the support of the Government of Egypt to compensate for the loss of agricultural land in the Delta due to overcrowding. The area located approximately 60 kilometers north of Cairo to the West of the Nile Delta has experienced noticeable growth since the late 1990s when Government allocated land to farmers and allowed then to irrigate these lands from groundwater sources. Today, this area is a flourishing agricultural economy estimated between $300 million to half billion dollars annually, serving both domestic and export markets in the European Union. Moreover, the area is now home to 500,000 people and provides about 250,000 jobs in the agriculture sector alone; which compensates for fifteen to twenty percent agricultural land and related activities lost due to urbanization in the Greater Delta Region[1].

However, with the rapid development over the past few years, there has been an excessive exploitation of the groundwater reserves. With about 47% of the total 255,000 net feddans under cultivation, water extraction by the year 2000 reached 870 million m3 annually, a 36.2% increase in just over a decade. Reserves are now being quickly depleted and with deeper pumping, water quality is also eroding. All this poses a serious threat to the agricultural economy and the livelihood of the families that live and work in the area.

To resolve this problem, the Government has been reviewing options to replace groundwater with a surface water for irrigation system. The goal is to minimize if not totally halt the depletion of the groundwater resource. However, there are a number of complexities in achieving this, since realistically the growers cannot be forced to connect to a new surface water system, particularly if they are expected to pay for the cost of service. It is the Government's intent to fully recover the cost of the system and to introduce volumetric tariffs to ensure correct incentives to conserve and utilize water more efficiently.

Moreover, beyond its objective to achieve full cost recovery, the Government also wishes to identify practical ways of involving the private sector in the design, operation and even financing of the new system. While the Government fully endorses the project, it is also keen to transfer as much of the related risks and to assign maximum responsibilities of the operations, maintenance and loan amortization to a private operator.

The Study Methodology

This assessment was commissioned with a grant from Public-Private Infrastructure Advisory Facility (PPIAF). It presents a conceptual framework and transaction model for implementing a surface water irrigation system on a cost recovery basis and with private sector participation.

[1] FAO reference gotten from Hani El Sadani.

Given the complexity and pioneering nature of this project concept, particularly because of the potential continuation of groundwater exploitation, the feasibility of the project had to be assessed under a markedly different approach aimed at designing and implementing a system that would largely correspond to the needs of growers, their willingness to connect to the new system and to pay the full cost of service. As such, activities would shift from the traditional supply-driven approach where demand forecasts and technical specifications guide the overall planning process, to a demand-driven approach to planning where the growers' willingness to connect and pay would guide the development of technical design options with commensurate tariffs.

A key feature of this approach relied on a promotional outreach to the farmers, soliciting their involvement in key aspects of project planning, system design, risk allocation, tariff structure and commercial arrangements. As such, at the outset a Private Growers Advisory Group composed of approximately 20 farmers from the area was established to work with the World Bank led consultant team in the initial system planning and design work.

The Egyptian Water Partnership, a local Non-Governmental Organization (NGO), was brought in to guide the promotional outreach activities and to carry out an extensive market survey of the area which were then fed to the technical team for developing the design options. A major contribution of this activity was the development of a design which combined both technical criteria as well as the needs of the market, and which ultimately became the preferred option for advancing further. Another, benefit of this activity was to better understand the existing cost structure for groundwater extraction as this would largely drive a threshold tariff needed to ensure a competitive surface water system design.

The technical work of this study concluded with the staging of a large workshop of all key stakeholders. This workshop, held on October 13, 2004, involved over 150 growers representing almost 60 percent of the West Delta project area as well as other key stakeholder groups from the MWRI and GOE agencies, the World Bank and other donors. The focus groups of growers overwhelmingly endorsed their full support of the project and restated its urgent need for implementation and their willingness to pay for the cost of service.

<u>The Preferred Technical Option</u>

This initial study purposely considered a number of mutually exclusive technical alternatives to develop the entire area, rather than just certain parts where in the short-term, the demand for surface water may be greater. The comprehensive approach was followed firstly, to decide on the most desired design for the entire area as would be done by a private land developer. Secondly, it was equally important to involve all growers in the participatory process regarding their willingness to pay and to connect to the system. It was not the intent to initially exclude any grower from the choices and trade-offs that would be available by the project. As such, this initial assessment did not include design proposals that would develop only certain parts of the area.

Three technical options were designed, costed and are presented herein. Of these, the "Market and Demand Parameters (MDP)" option was regarded as both: (i) the least cost solution; as well as (ii) the option that came closest to meeting the existing market needs and concentration of cultivated farms. The MDP option proposes to partition the area into three sectors with independent sub-systems and separate intakes. This would allow significant flexibility in phasing the actual implementation as one sector may wish to proceed faster than another. Moreover, each sector would then have its own cost structure and accordingly, its own cost recovery tariffs. The incidence of cross-subsidies, particularly of smaller farms subsidizing the larger ones, would be greatly reduced.

Through this partitioning, the high elevated area in the south would have the highest tariffs, while the lower terrace in the north would pay the lowest. More importantly, the MDP option set the boundaries for a central sector to serve most of the larger farms already under cultivation, leaving mostly uncultivated areas in the most costly southern sector. As such, the MDP is viewed as the more efficient system since the other options required the implementation of much larger networks in order to serve the existing farmers.

The total cost of the MDP for covering the entire 255,000 net feddans is estimated at LE 2.748 billion or approximately $440 million. This equates to an average of LE 1,525 per feddan per year, or just above the target threshold tariff of LE 1,500 per feddan. The total cost includes both capital investment and operating and maintenance costs, but excludes financing charges and returns. Of the capital cost, the technical team factored in the cost of on-farm investments that would be offered to farmers as an incentive to connect to the system. The inclusion of on-farm investments was also a product of the stakeholders' consultations as it became apparent that many would need to make additional investments in order to switch from groundwater irrigation to the new surface water system. This, in turn, would reduce demand risks as the operator would be assured that such investments would be made promptly in order to actualize the connection program. Other pertinent data regarding the MDP option includes:

- The most *southern sector* would cover 48,400 feddans at an average level of 110 m and at a cost of LE 1,846 per feddan. The cost per feddan in the southern sector for the MDP came slightly above the other two alternatives, but in this design option, the size of the sector is much smaller and remains largely uncultivated.

- The *central sec*tor would cover 141,600 feddans at an average of 85 m and at an average cost per feddan of LE 1,607. The MDP offered the lowest cost for farmers in this sector than either of the other two options.

- The *northern sector* was essentially the same under all three options. It would cover 65,000 feddans at an average level of 45 meters. As mentioned, the per feddan cost would be the lowest at LE 1,108. This sector also includes the largest concentration of smaller farms, making the respective costs quite competitive as well as affordable.

The technical team also reviewed a closed conduit option. While more expensive, it offers a number of benefits over an open channel system, particularly in phasing implementation, dealing with right-of-way and resettlements impediments, and water management efficiency. The decision for choosing a closed conduit over an open system should however be made by the party that effectively assumes the demand risk in a likely public-private transaction.

Financing

Actual implementation will likely differ markedly from the comprehensive approach as: (i) not all growers in any one sector; and (ii) not all sectors may be connecting during the same time or within the defined construction period. More likely, a project will be implemented in phases and in distinct financially viable modules within each sector. Follow-up technical work should explore how the actual demand will develop (as expressed in the grower's willingness to sign specific letters of intent and definitive contractual agreement) and to develop a likely phasing plan that will correspond to this demand.

The financial simulation also revealed the importance of taking advantage of the maximum number of years to amortize the capital costs of the project. As such, on a 20-year loan, it will be important to phase project modules such that each can be completed with a two year construction period, leaving the remaining 18 years for repayment of the debt. In other words, the entire project may require the programming of multiple loans to ensure that each sub-project stays within a two-year construction guideline.

The proposed financing plan assumes that 15% of the total investment cost would be financed by equity or counterpart funding, leaving 85% financed by debt. The total cost with interest charges during construction is estimated at LE 2,924 billion, $468.6 million.

Tariff Structure

Based on consultations with farmers a three-part tariff is proposed for each participating farmer, as follows: (i) a minimum annual tariff to recover the relative share of the cost of public works; (ii) a volumetric charge to recover the variable O&M expenses based on actual usage; and (iii) an annual fixed charge to recover the cost of the optional on-farm investment.

The tariff level was determined by ensuring that revenues would cover all the capital costs plus operating expenditures and debt service, plus earn a fair return over the life of the project. The average tariff for the entire area that would meet these requirements came out to LE .38 per m3 or LE 2,291 per feddan. Excluding the on-farm investment, the average tariff drops significantly, to about LE .32 per m3 or LE 1,798 per feddan annually. This tariff is in line with survey findings on current cost for groundwater extraction.

Tariffs by sector will vary from LE 1,701.05 in the northern area having the lowest elevation, to LE 2,766.72 in the southern sector with the highest. The central area converged to the average tariff level.

The tariffs will support a financially sustainable position which is expected to improve over time throughout the projection period. The Financial Internal Rate of Return (FIRR) to total invested capital is estimated at 6.5% based on constant prices. More importantly, on the total return to equity basis, the return is estimated at 21%, making the project attractive to potential investors for infusing the equity portion of the capital structure.

Again, a favorable financial scenario as projected will greatly depend on project's ability to: (i) constrain the construction program (i.e., where actual draw down of debt occurs) to a maximum of two years; (ii) realize estimates of grower's willingness to connect; and (iii) maintain adequate tariff levels through periodic cost-of-living adjustments.

Proposed Transaction Model

A recent study[2] reviewed 21 cases of projects that involve some level of private sector participation, most of which were in the form of service contracts for O&M and of financing schemes for farmers to invest in on-farm pumping equipment. The closest project to the one proposed in the West Delta is the Guerdane Concession Project, recently completed successfully in Morocco. However, after a number of failed bids this concession agreement could only be realized with substantial subsidies by Government to reduce the related risks of the private sponsors.

The West Delta project promises major challenges for successfully involving the private sector. On the other hand, there are a number of strong points which raise optimism, most notably: (i) the strong interest expressed by farmers to connect to a surface water systems and their willingness to pay the required tariff to sustain it financially; (ii) the fact that groundwater is depleting; and (iii) that farmers already have made substantial investments in the area that can only be sustained through surface water for irrigation. There is no doubt that in the long-term, the proposed surface water system would be financially sustainable as the water options decrease for growers. The issue that remains is how many landholders in the area will be willing to make the financial commitment in the near term to ensure the project's financial sustainability at the outset.

The study team studied the appropriateness of a number of different public-private models with different risk allocations between public and private parties. The choice of PPP model was largely governed by a number of considerations including: (i) transferring to the extent possible from public to private, the various risks associated with the project; (ii) realize the Government's objective for cost recovery and for the project to sustain itself financially throughout its project life; (iii) the ability to mobilize long-term financing in order to render tariffs affordable; (iv) ensure the maximum possible mitigation of demand risk by linking the planning and construction scheduling to actual operation; and (v) ensure an appropriate balance of risk and return, at the same time being mindful that the absolute level of financial commitment may deter private sponsors and lenders.

Based on these considerations, the Design-Build-Lease (DBL) is considered as the preferred transaction model for the West Delta. The DBL attempts to divide risks between the public and private parties, but more to an extent than performance management contracts and less so than a full concession. The scheme essentially contracts a private operator to design, construct and

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[2] PPP in the Irrigation and Drainage Sector: The Need for a Professional "Third Party Between Farmers and Governments, Henri Tardieu's French Team, 2004

assume the full responsibilities of operating the system including, the associated demand and commercial risks. The public sector would in turn assume the ownership of the assets and undertake the financing responsibilities and related risks including, the currency risk which would arise from potential devaluation of the local currency. In this case, it is proposed that the holding company under the MWRI would assume these functions.

Upon completion of construction, the private operator leases the assets from the government along with a concession to operate the system for the entire area for which it pays a lease fee through the life of the contract. The lease fee would correspond to the debt service obligation of the public sector. In the proposed DBL scheme, the private operator would also be required to raise the equity financing. This contribution is channeled through a special purpose company so as not to intermingle the funds of the various parties. The equity would be repaid along with returns over the life of the contract in either graduated or equal installments.

The Design-Build-Lease offers a more balanced risk allocation framework than a full concession and proposes to be the more suitable model to pursue for the West Delta. Its attractiveness to potential investors however, would need to be confirmed while advancing the project through the development of an information memorandum, “road shows” to promote the project and a due diligence period.

<u>Elements of the DBL Model</u>

The DBL scheme would include a number of features to mitigate certain risks or increase the incentives for a successful transaction. These are summarized here and include:

Features to Mitigate Demand Risks

- A competitive bid for a private operators would be based on percentage reduction of reference tariff rates for each sector.
- The execution of definitive “connect agreements” with farmers that specify responsibilities of each party.
- A tariff structure such that the minimum tariff would be equal to the pro-rated capital cost of the user.
- The submission of a security deposit by each participating farmer which can also be used by the DBL operator as an additional source of counterpart financing.
- The inclusion of connection incentives such as, the ability of the project to finance on-farm investments as well the public works.
- Water allocation rights to convey with the DBL agreement not to the farmers.
- Concession boundaries would not be fixed such that overtime the private operator can expand the system as water demand falls within the original boundaries.
- Tariff would be differentiated by sector as each would pay its own marginal cost of service.

Features to Mitigate Design and System Planning Risks

- Linking final design to actual connection program. Once the DBL operator is selected, the agreement would call for finalizing the design of the system, at which point they would be executing connect agreement from growers.
- Flexible construction scheduling. Once the initial equity injection is made, the loan portion would be drawn down very much like a credit line to complete financially viable modules of the entire system.
- Direct Financial Accountability for Over-planning and Creating excess Capacity. The DBL inherently allows for the operator to benefit or suffer the consequences of his own planning. As there will be the inherent incentive to not over-plan or over-build, some minimum project size designation must be included in the bid solicitation.

Features to Mitigate Operational and Commercial Risks

- Metered volumetric rates.
- Security staff for guarding water theft in open channels.
- Disconnection and reconnection policy with potential withholding of future water allocation.
- Fines on past due accounts.
- Price adjustment mechanisms for legitimate cost increases.

Features to Mitigate Construction Risks

- Right-of-way access provided in bid document by Government through MWRI.
- Safeguard policies in place (i.e., arrangements for environmental and cultural heritage monitoring and evaluation and international water issues).

Features to Mitigate Foreign Exchange and Financing Risks

- With regard to currency risks, the holding company would book the loan on its own accounts and charge an interest rate premium on the nominal interest rate to offset any possible losses due to fluctuations of the local currency.
- With regard to financing risks, the government would make full use of IFI lending program to source the debt portion of the financing. In addition, the bid documents would require a specified contribution of counterpart funding from the winning bidder.

Features to Mitigate Regulatory Risks

- International Finance Institutions (IFIs) could make available a number of guarantee instruments to offset political, regulatory and breach of contract risks.
- The establishment of an effective regulatory body that would oversee compliance with the responsibilities of each party and to ensure that rights of farmers are also protected. Regulatory functions and rules would be specified.

Follow-on Work

In order to advance this project concept and transaction model additional work will be needed on the following items.

- Carry out more detailed engineering and design work of selected option, particularly taking into consideration the expressed demand commitment of growers and their willingness to connect. Develop a phasing plan of financially viable modules based on intentions of farmers to connect.
- Design a construction staging plan or phasing of entire project and revise tariffs accordingly based on economic and financial viability criteria.
- Determine tariff structure and commercial policies for firming up definitive growers connection agreement that would be executed with potential operators.
- Determine bid specifications for the transaction model adopted as well as minimum project size to be implemented in first phase.
- Involve potential private operators to fully assess the attractiveness of the project and transaction model. Finalize transaction legal agreements.
- Carry out required environmental and safeguard assessments.
- Specify regulatory mechanisms and functions.

1. Introduction

1.1 Background

The area located to the West of the Nile Delta has experienced noticeable commercial agriculture growth since the late 1980s when Government allocated land to farmers and gave them rights to irrigation from local groundwater sources. Farming production flourished and numerous small, medium, and large-scale farming investments took place, some with substantial capital expenditures. The area under study in the West Delta region is now home to 500,000 people and provides about 250,000 jobs in agriculture alone. It is considered a highly productive area that could attract agricultural activity away from the heavily populated areas of the Nile Delta.

However, the rapid development that took place over the past few years was achieved through excessive exploitation of groundwater reserves which are now being quickly depleted. In order to maintain or expand the economic activity of the area, water supply needs to be improved and made sustainable over time.

1.2 Project Description and Objectives

In order to reverse the situation, the Government has been reviewing options for developing surface water for irrigation in the West Delta area that would minimize if not totally halt the depletion of the groundwater resource. In doing so, it has recognized that its approach to project planning in the West Delta cannot be supply driven and must take into account the existence and needs of the current growers in order to render any new system economically sound. Growers cannot be forced to connect to the new system and the proper incentives must be provided to make a surface water for irrigation system financially viable.

Moreover, in line with new sector policies, the Government is seeking to achieve full cost recovery and to identify practical ways of involving the private sector in the design, operation and even financing of new surface water for irrigation systems. The Government has identified an initial area involving 255,000[3] net feddans in the West Delta for investment under this new philosophy of full cost recovery and Public-Private-Partnership (PPP).

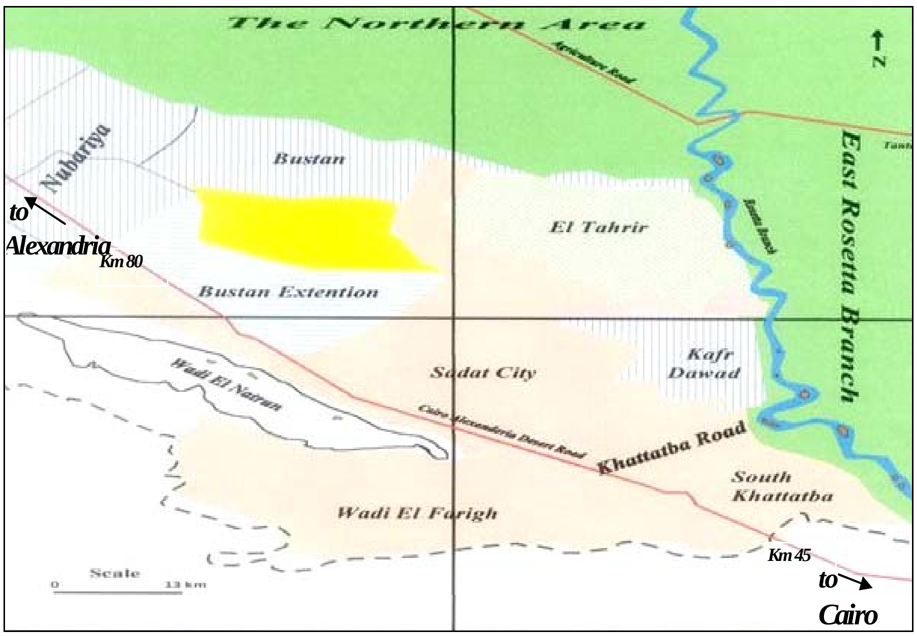
Moreover, the Government wishes to introduce volumetric pricing to promote water conservation and maximize returns to farmers of per cubic meter of water utilized. It is the Government's intent to assign maximum responsibilities of the related operations, maintenance and loan amortization to a private operator, who would be selected through a competitive bidding process.

[3] Net cultivable land area estimated of 255,000, of which gross area is estimated between 289,000 and 291,000, depending on source.

1.3 Study Area Location and Technical Characteristics

The study area (West Delta or area) is located on both the East and West side of the Cairo-Alexandria Desert Road, between km 45 and km 80; the net cultivable area is estimated at 255,000 feddans (Figure 1.1. below). The area lies in three different governorates (Cairo, Minufia, and Behaira) and is located in El Tahir Plain, Wadi El Natrun, and Wadi El-Farigh. Its altitude ranges from 17 to 120 meters above sea level. Generally, it slopes upward from the most northern part of the area to the southern part. The Cairo-Alexandria Dessert Road crosses the area, leaving one full third on the west side and the remaining on the east side.

Figure 1.1: Map Showing Location of Project Area



Desert reclamation in the area first started in 1985 driven largely by private sector investments on commercial farming. The Wadi El Natrun aquifer, located about 60 kilometers north of Cairo was first utilized by 1990, roughly 70,000 feddans were placed under cultivation. Over time, these areas were expanded to the current 255,000 feddans that form the area today.

Groundwater reserves are now being quickly depleted. While aquifers in the area are rechargeable, extraction has well exceeded the recharge rates. The annual water extraction has increased from 664 million m3 in 1990 to above 874 million m3 by the year 2000 (with 130,000 feddans under cultivation). Groundwater extraction is currently estimated well above these levels[4] as additional land has been placed under cultivation.

During the past ten years the water table has dropped more than 15 meters in some places. This not only has imposed additional pumping costs, but has also led to much lower water quality, in some cases not suitable for agriculture. Water quality and availability are now the main constraints to sustained agricultural activity in the area. Unless the situation is reversed, the water table is expected to drop further at an average rate from 1 to 2 meters per year in many parts of the project area. The degradation of water quality and availability will undoubtedly place at severe risk an annual agricultural economy currently estimated between US$300 million and US$500 million.

1.4 Study Methodology

The World Bank and the GOE agreed to study the situation in the West Delta and to develop a conceptual framework and transaction model for implementing a surface water for irrigation system on a full cost recovery basis and with private sector participation.

The Bank obtained a small grant from the Public-Private Infrastructure Advisory Facility (PPIAF) to lead this study consisting of the following main tasks and leading up to the development of a PPP transaction model.

- Development of a number of technical options to bring surface water for irrigation to the study area along with preliminary cost estimates that can be presented for decision-making to existing growers and policy makers.
- Consultations with growers and identification of the most feasible technical solution, taking into account the growers willingness to connect at given tariffs levels and an agreed set of underlying guidelines and principles.
- Development of a framework for the tariff setting process based on volumetric rates and other policy objectives which may lead to differentiated tariffs for large and small holders, based on the reality that some growers may continue using existing groundwater sources.
- Development of financial and management options to exploit viable funding sources, whether public or private and to ensure the efficient management and maintenance of the new investments.
- Development of a workable PPP model that will align financial incentives and that will allocate risks fairly among the different parties, including the private sector/operator, the Government of Egypt, and the farmer community.

[4] Satellite imagery shows that about 47% of the area is currently under cultivation which would indicate groundwater extraction of close to 1 billion m3 per year at historical rates.

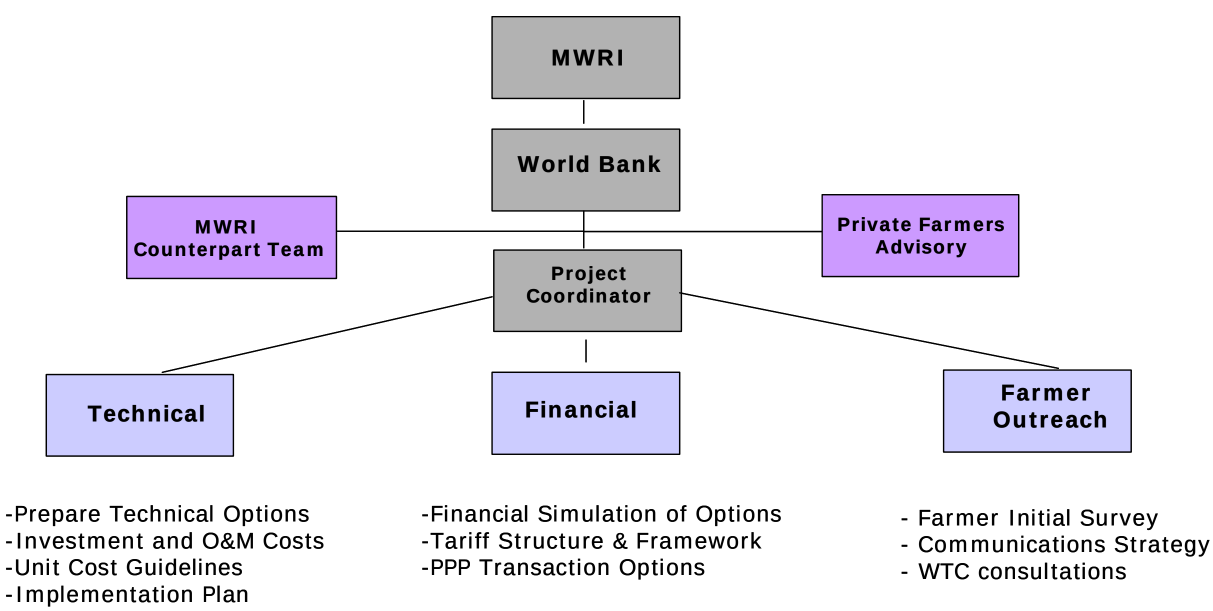
The above will provide the Government with: (i) information on how to ultimately implement a potential project; (ii) understand better its own roles and responsibilities through implementation as well as those of other public agencies and private parties; (iii) understand the financial requirements of the project, including its own financial commitments needed to ensure sustainability; and (iv) develop a potentially viable framework for private participation in irrigation infrastructure that can thereafter be used for other areas needing reclamation.

1.5 How the Work was Organized

Given the pioneering nature of the case, particularly in regard to the potential continuation of groundwater exploitation in the area, the feasibility of the project had to be assessed under a markedly different approach aimed at designing and implementing a system that would largely correspond the to the needs of growers, their willingness to connect to the new system and to pay the full cost of service. As such, activities would shift from the traditional supply-driven approach where demand forecasts and technical specifications guide the overall planning process, to a demand-driven approach where the grower's willingness to connect and pay guide the development of technical design options and reference tariff levels.

Therefore, the assessment would be based on: (i) the farmers' needs and demand criteria; (ii) the assessment of growers' willingness to pay full cost recovery tariffs for water for irrigation services; and (iii) the development of a transaction model to involve the private sector in the construction, operation and possibly the financing of the surface water for irrigation infrastructure. The chart below shows how the work was organized in order to responds to the needs of the demand-driven approach.

Figure 1.2: Study Team Organization



A key feature of this approach relied on a promotional outreach to the farmers in the area and their involvement in key aspects of project planning, system design, risk allocation, tariff structure and commercial arrangements. As such, at the outset a Private Growers Advisory Group (Advisory Group) composed of approximately 20 farmers of the area was established to work with the Bank led consultant team in the initial system planning and design work. The Advisory Group met both formally and informally with the consultant team to iron out design issues, discussed operation assumptions, reviewed tariff structures and other policies which would influence their support of the project. The Advisory Group ultimately became and important force in furnishing information and promoting the project concept to other farmers.

The Egyptian Water Partnership, a local Non-Governmental Organization (NGO), was brought in to guide the promotional outreach activities and to carry out an extensive market survey of the area which was then fed to the technical team for developing their design options. A major contribution of this activity was the development of a design option which combined both technical criteria as well and the needs of the market, and which ultimately became the preferred option by the growers for further study. Another benefit of this activity was to better understand the existing cost structure for groundwater extraction as this would largely drive the threshold tariff needed to ensure a competitive surface water system design.

The other important element in the organization of the work was the development of a financial model that would be able to quickly translate technical cost data into financial projections a tariff estimates. This allowed immediate and dynamic interaction with the technical design and farmer outreach teams in resolving specific project design assumptions.

The interaction with Ministry counterparts also greatly aided the technical design process, especially in the formulation of key policies that would guide the design and transaction model.

In line with the approach to involve key stakeholders in the planning process, the technical work of this study concluded with the staging of a large workshop of all key stakeholders. This workshop, held on October 13, 2004, involved over 150 growers representing almost 60 percent of the West Delta area as well as other key stakeholder groups from the MWRI and GOE agencies, the World Bank and other donors. The main objective of this successful workshop was to disseminate the results of the technical work and to assess the level of interest among growers in support of a potential project and particularly, their willingness to pay full cost recovery tariffs. The focus groups of growers overwhelmingly endorsed their full support for the project and restated its urgent need for implementation and expressed their willingness to pay the estimated cost of service.

1.6 Study Limitations and Caveats

It is important to underscore that this study is principally a conceptual one, and primarily designed to develop a framework for a PPP transaction model for a possible project. While it is viewed that the study was able to exceed these objectives in many respects through the successful completion of a number of activities and analytical tools including, the preliminary drafting of the growers connection legal agreement, the technical work should not be construed to complete the full list of tasks that would be performed in a full feasibility assessment of the project. For that, additional preparatory work is essential.

Also, this initial study intentionally considered a number of mutually exclusive technical alternatives for the comprehensive development of the entire area rather than just certain parts where the initial demand for surface water may be greater. This may be incorrectly construed as naive since in reality not all farmers will connect in the two year period of time that has been assumed, meaning a potentially much smaller system initially, with a flexible construction program.

Notwithstanding, the comprehensive approach was purposely followed firstly, to decide on the most desired design for the entire development of the area as would be done by a private land developer. Secondly, it was important to include all growers in the participatory process regarding their willingness to pay and connect to the system. Growers should be advised of the choices and trade-offs that are available by the project. As such, the technical options excluded proposals to develop only certain parts of the area. In latter phases, the designs will be modified according to the actual willingness to connect and will include the following other items.

- Carry out more detailed engineering and design work of selected option, particularly taking into consideration the expressed demand commitment of growers and their willingness to connect.

- Design a construction staging plan or phasing of entire project of and revise tariffs accordingly.

- Determine tariff structure and commercial policies for firming up definitive growers' connection agreement that would be executed with potential operators.

- Determine bid specifications for the transaction model adopted aw well as minimum project size to be implemented in first phase.

- Involve potential private operators to fully assess the attractiveness of the project and transaction model. Finalized transaction legal agreements.

- Carry out required environmental and safeguard assessments.

1.7 Reading the Report and Main Outputs

This report presents a summary of a number of technical studies carried out from the PPIAF funded activities and is organized as follows:

- Following this introduction, section 2 presents the findings from survey of growers and willingness to pay for water for irrigation services. The full technical report is presented in Annex No. 1.

- Section 3 presents the summary of the groundwater conditions in the study area, the full technical report of which is presented in Annex No. 2.

- Section 4 reviews the technical design options and presents investment cost data for each alternative reviewed. Again the full report for the technical work is presented in Annex No. 3.

- Section 5 summarizes the financial aspects on the preferred technical option. Full financial projections and reference tariffs of this option as well as the other options are included in Annex No. 4.

- Section 6 reviews the various public-private options, the risks involved in implementing the project and recommends a transaction model. The section further identifies other elements which can be incorporated in the transaction model which can help mitigate certain risks. Annex 5 provides additional information of the PPP options. Annex 6 includes the draft “growers’ connection legal agreement” which would be utilized for firming up demand in the next phases of this preparatory work.

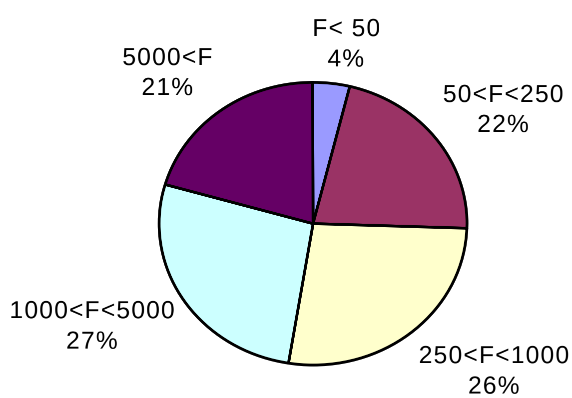
2. Consultations with the Commercial Farming Investors

The market survey reviewed the characteristics of the area and of the individual farmers, and their perceptions about the deterioration of both water availability and quality. It also identified the views of growers in relation to the construction and operation of a surface water system, their willingness to connect to such a system and their willingness to pay for the needed infrastructure investments and the related O&M costs. The findings are based on consultations with the farmer community, through the Private Advisory Group, and a survey with a sample of 163 farmers-investors representing all farm sizes and sectors in the area implemented by the Egyptian Water Partnership. The sample represents an area of 114,500 feddans, or 45 percent of the total project area.

2.1 Characteristics of Farms in the Project Area

Land tenure. According to a number of recent studies, the total area is presently sub-divided into 961 lots. The actual number of farmers is much higher though because many of the lots have been partitioned into smaller holdings which are not officially registered as separate. According to the most current reliable list of landowners provided by the General Authority for Rehabilitation Projects and Agricultural Development, 760 lots (or 80 percent) hold official ownership documents.

Figure 2.1: Land Tenure and Crop Patterns in the Area



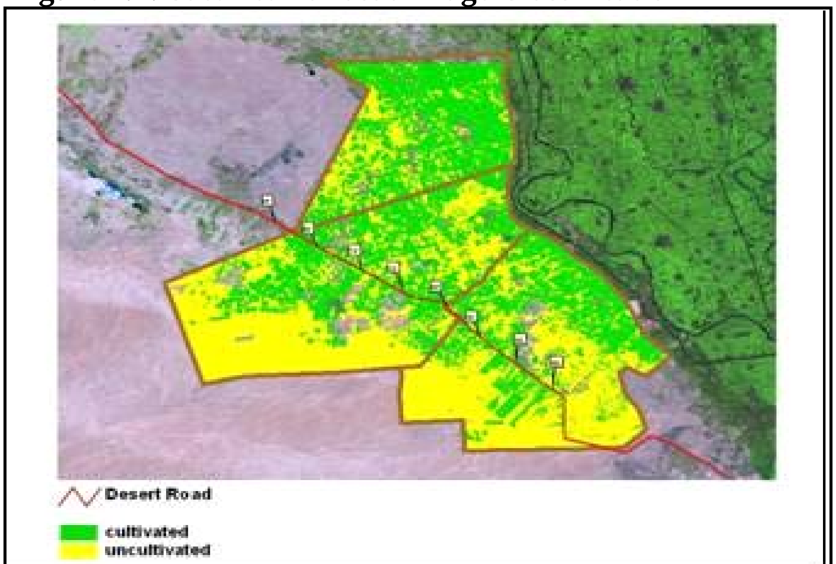
Size of farm	F< 50	50<F<250	250<F<1000	1000<F<5000	5000<F
# of farmers	403	366	162	23	7
Fruits	74%	69%	65%	69%	72%
Vegetables	16%	10%	15%	15%	15%
Field crops	0%	6%	10%	6%	3%

Figure 2.1 summarizes the characteristics of farms in the area with respect to number of lots, farm sizes, land ownership, and crop patterns. As shown, most of the area is covered by larger farms while most in number are of smaller lots. This is evidenced by: (i) 74 percent by land area

consists of farms of 250 feddans or larger, representing 192 lots; and (ii) 22 percent of the area is represented by farms between 50 to 250 feddans involving 366 lots.   While farms less than 50 feddans only represent 4 percent of total area and involve 403 lots. Most small holders work under associations to irrigate their lots. We can also see in the table of Figure 2.1 that the dominant crops are high value fruits and vegetable.

Cultivated land in the study area. According to a land satellite imagery of January 2002, more than 47% of the gross area of approximately 291,000 feddans is currently under cultivation. The table at the bottom of Figure 2.2 shows the cultivated and uncultivated areas in green and yellow respectively. The Southern sector is the most undeveloped with 61 percent uncultivated area. The uncultivated areas are in the most southern part of this sector and west of the Cairo-Alexandria Road. The uncultivated area in the Central sector is 58 percent, mostly on the west side of the Cairo-Alexandria Road. The Northern sector is the most utilized of the three sectors and is only 30% is uncultivated.

Figure 2.2: Satellite Landsat Image Classification



Sector	Total area	Cultivated	%	Uncultivated	%
Southern	105	41	39%	61	61%
Central	123	51	42%	72	58%
Northern	63	45	70%	18	30%
Total	291	137	47%	154	53%

2.2 Main Groundwater Problems as Perceived by Investors

The three main problems perceived by farmers in relation to groundwater. Farmers' main problems with regard the groundwater source are increased salinity of water (77 percent), low water level (59 percent), and increased groundwater costs (52 percent), see Table 2.1 below. The table also shows the average water level for each size category of lots. Some of the principal findings include:

- All farmers, regardless of size, consider that water salinity is a substantial problem, although less pronounced for medium scale farmers with landholdings between 50 and 1000 feddans.

- The low water table is a second major problem for investors, particularly those with large landholdings. All 100 percent respondents with landholdings between 1000 and 5000 feddans reported the low water table as their biggest concern. These larger farms are currently pumping at average water levels between 102 and 140 meters.

- The increased cost of water also registered a significant problem among the farmers, but mostly for farmers with landholdings between 1000 and 5000 feddans. Oddly enough, in the survey, the "cost of water" did not come up as a major concern among the largest farms with water levels averaging 140 meters. At these pumping levels one would assume that the related costs might be about twice as much as those of small landholders and would therefore be reflected highly in their concerns.

Table 2.1 Investors' Perception of Groundwater Problems

Groundwater Concerns	<50	50<F<250	250<F<1000	1000<F<5000	>5000	Weighted Average
Increased Water Salinity	72%	50%	67%	92%	100%	77%
Low Water Level	27%	28%	42%	100%	67%	59%
Increased Water Cost	41%	47%	33%	92%	33%	52%
Average water level	59	61	58	102	140	-

Cost of Pumping Irrigation Water. The costs of groundwater extraction include capital investment and operating & maintenance costs. Both appear high according to the survey results:

- *The capital costs comprise the costs of machinery, pumps, filters, and pipes.* The survey results show that the machinery investment cost for a single well ranges from a minimum of LE 4,000 to a maximum of LE 25,000, with an average of LE 8,830. The investment cost for filters ranged from LE 1,000 to LE 15,000 with an average of LE 5,800. The investment cost for pumps ranged from LE 5,000 to LE 200,000, with an average of LE 40,200. The investment cost for the generator ranged from LE 5,000 to LE 650,000, with an average value of LE 70400. Summing up these costs yields an average of LE 123,230 in equipment costs per well.

- *Operation and Maintenance Cost.* According to the survey results, the cost of operating and maintaining the irrigation network per feddan per year ranged from LE 1,000 to LE 12,000, with an average of LE 1,768 per year. Costs of the operation include the power and labor needed for system operation. The cost of the maintenance per feddan includes spare parts and cost of repairs. Note that these values are in line with preliminary estimates of a full cost recovery tariff, as will be presented in Section 5.

Cost of Pumping Irrigation Water at Dina Farms. Dina Farms provided financial information regarding their costs related to groundwater irrigation; which were disaggregated into capital, and operation and maintenance. Dina Farms estimate[5] is LE 0.32/m3. This estimate can be considered a proper rate for one of the best wells at Dina Farm, but for other wells this may vary depending on specified well efficiency and altitude.

2.3 Revealed Willingness to Connect and to Pay for the Investment and O&M Costs

Since the early 1990s, the area has blossomed as an important agricultural center serving both domestic and export markets. The value of the economy is presently estimated to range between $300 million to half billion dollars annually. Consultation meetings with the focus groups of farmers and the market survey finding reveal a strong interest in a new surface water for irrigation system in order to sustain the economic livelihood of both investors and workers in the area. Almost overwhelmingly, growers voiced their strong interest for a project through their willingness to connect and to pay the full cost of the service.

Willingness to connect to a surface water system. The survey revealed that the great majority of farmers would be willing to connect to a new surface water for irrigation system (90%) and support their expressions of interest with signing a definitive connection agreement (84%); see information in Table 2.2. This was confirmed in the stakeholder workshop held on October 13, 2004 in Cairo, involving over 150 growers representing almost 60 percent of the cultivated area in the West Delta. The overwhelming support came after the disclosure of tentative volumetric tariffs, and the need for the growers to execute a willingness to connect agreement, and to submit a security deposit.

Table 2.2: Willingness to Connect to Surface Water System and to Sign Connection Agreement

Willing to Sign Connect Agreement	<50	50<F<250	250<F<1000	1000<F<5000	>5000	Weighted Average
Yes	88%	81%	92%	92%	67%	84%
No	12%	19%	8%	8%	33%	16%
Willingness to Connect						
Yes	85%	97%	92%	100%	67%	90%
No	15%	3%	8%	0%	33%	10%

Farmers' willingness to pay for investment and O&M costs. The great majority of farmers would be willing to pay for surface water for irrigation when made available. Of this the total surveyed:

(i) 36 percent would pay up to LE 35/m3 (US$ 0.06),
(ii) 45 percent would pay up to LE 0.30/m3;
(iii) 76 percent would pay up to LE 0.25/m3;

[5] Cost of pumping is made of capital and operation and maintenance costs. Capital costs, including drilling wells up to 240m deep about LE 120,000 and pump cost, LE 120,000. Assumption: well life, 10 years. Therefore the components of the costs of pumping are: Capital costs: (1) Well depreciation cost, LE 0.025/m3; (2) Pump depreciation cost LE 0.09/m3; and, Operation and Maintenance (O&M) costs: (3) Electricity/m3 cost LE 0.18/m3; (4) labor and maintenance, LE 0.020/m3. Therefore, total cost of pumping one m3 at Dina Farm is = (1) +(2) + (3) + (4)= 0.025 + 0.09 + 0.18 + 0.02 = LE 0.315/m3. Included in pre-feasibility study by Eng. Farouk Shaheem.

(iv) 91 percent would pay up to LE 0.20/m3; and
(v) 100 percent would pay up to LE 0.15/m3.

Preferred modes of payment as a basis for full cost recovery tariffs. Among those who are willing to pay, 49 percent would prefer to pay on a "per feddan basis". Thirty percent would prefer to pay on a combined "per feddan (e.g., capital costs) and per cubic meter (e.g., O&M) basis". The remaining 21 percent of farmers would prefer to pay strictly on a "per cubic meter basis" (see information in Table 2.3).

All groups of farmers except the largest landholders (those with farm sizes bigger than 5,000 feddans) would prefer to structure tariffs on a "per feddan basis". The Largest farmers on the other hand preferred a combined structure involving tariffs both and "per feddan" and "per cubic meter". Based on this finding, full cost recovery tariff can be structured in such a way that repayment of capital investments is done on a per feddan basis while variable O&M costs are recovered based on volumetric consumption.

Table 2.3: Proposed Repayment for Investments and O&M Costs

Tariff Structure	<50	50<F<250	250<F<1000	1000<F<5000	>5000	Weighted average
Per Feddan	60%	63%	67%	58%	0%	49%
Per Cubic Meter (CM)	21%	19%	25%	8%	33%	21%
Per Feddan and per CM	19%	19%	8%	33%	67%	30%

Farmers willingness to share water intakes. The survey results showed that the majority of the sampled owners (73%) agreed to share a water intake/pipe. For farm area of less than 10 feddans, 45.5% agreed and for the farm areas between 10 – 50 feddans, 79.6% agreed to share a water intake/pipe with others. For farm areas of 50 – 100 feddans, 66.7% agreed. For farm areas of more than 200 feddans, 79.3% agreed. It appears that the variety of farm areas was not affecting the acceptance of the sampled owners to share water sources intakes. It is also worth mentioning that about 23% of the total sampled owners would not be willing to share water sources with more than one user. Some farmers are afraid that the big farm owners could control the water intake and that they might not take their fair share of water. Based on the positive responses, a minimum 100 feddan connection units have been used in the design and planning done by the technical consultant.

2.4 Preferred Mode of Organization for Management of Surface Water System Infrastructure

Options for managing the surface water for irrigation infrastructure. The EWP survey presented four options for managing the infrastructure for the farmers to select from: (i) water user association (WUA); (ii) government; (iii) private sector; and, (iv) others. The results to this question is presented in Table 2.4. Respondents would prefer an operation run by a WUA, with a government administration as second. The private sector as an operator only came in third.

Table 2.4: Preferred Mode of Organization for Management of Infrastructure

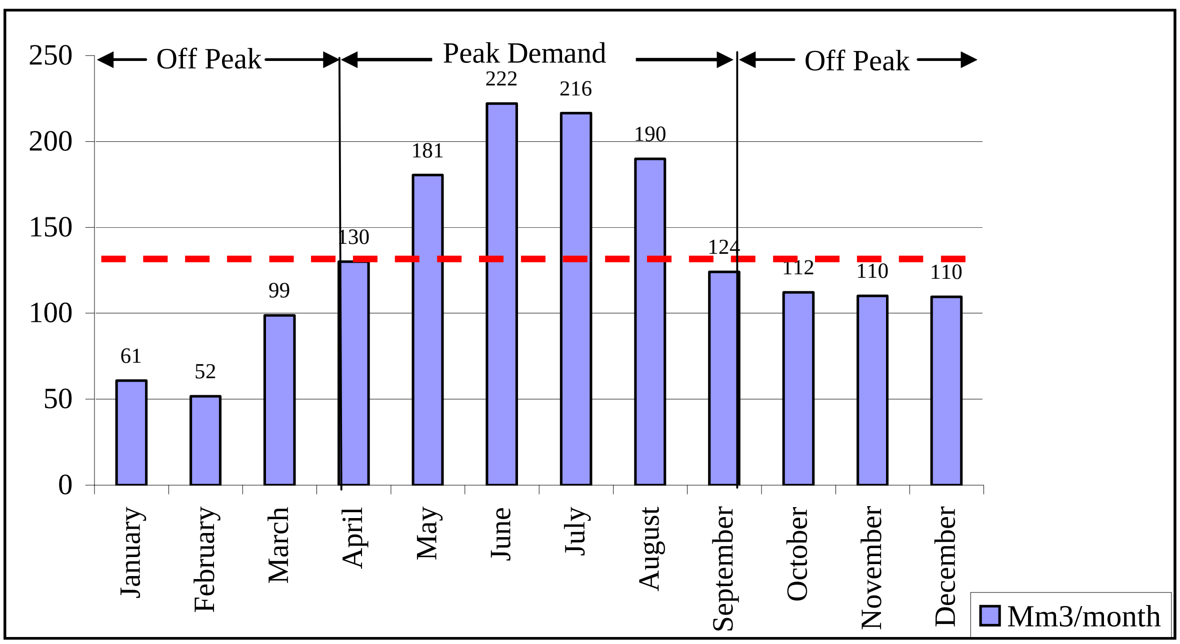
	<50	50<F<250	250<F<1000	1000<F<5000	5000<	Weighted average
WUA	59%	31%	50%	92%	0%	47%
Government	20%	53%	33%	0%	67%	35%
Private	16%	13%	8%	8%	33%	15%
Other	5%	3%	8%	0%	0%	3%

Representation of land owners. The farm owners' preference regarding who will represent them was also part of the EWP questionnaire. The results show that 64 percent prefer that the WUA represents them, while 36 percent of the surveyed owners prefer that they represent themselves. However, delegated representation if preferred by the small farmer because about 7 out of 10 small farmers are more inclined to be represented by WUAs, which compares with only 3 out of 10 in the case of large farmers.

2.5 Peak and Off Peak Demand for Water for Irrigation

Estimation of Peak and Off Peak Demand. Figure 2.3 illustrates seasonal agricultural pattern which influence peak and off-peak demand for water in the area. The peak season begins in April and ends in September, although demand above the average levels is registered on from May through August.

Figure 2.3: Peak and Off Peak Demand for Water for Irrigation in the WDP Area



Demand for water for irrigation during peak and off peak seasons. When fully developed the West Delta commercial farming area covering 255,000 net feddans will have an annual demand of water for irrigation equivalent to 1.6 billion m3 (Bm3), including on and off farm losses in an open channel system. Of that total, 1.06 Bm3, or about 66 percent, will be needed during the peak season (April-September), the remaining demand for water will be used during the 6 months of the off peak season. At the peak in June, demand will be 222 Mm3, equivalent to 86 m3 per second for a 24 hour day. It is assumed that farmers will have filtration and feeding centers that will work 24 hours a day, with a storage capacity enough for 18-24 hour.

2.6 Conclusions

- The study area is dominated by commercial farming of high value fruits and vegetables, much of which is exported to European Union countries. Farms larger than 250 feddans (100 Has) take 74 percent of total WDP area, have minimum sizes to achieve economies of scale and diversification, and work effectively in a competitive market environment. Smaller farmers work through associations to achieve economies of scale.

- According to the results of the EWP survey, bigger investors are more concerned about ground water constraints to commercial agriculture sustainability, as measured by their perception of increased salinity, lowering of groundwater table, and increased costs of pumping. However, cost of pumping comes only as a third concern for all farmer sizes.

- Many investors in the mentioned workshop also indicated that the cultivated areas in the WDP are constrained by limited availability of groundwater resources as an explanation to the fact that only 54 percent of total area is under cultivation.

- There are robust indications that the majority of farmers are willing to sign a connection agreement showing their willingness to connect to a surface water system; such agreement can even be backed by a security deposit as manifested by farming investors in a stakeholder workshop held in October 2004 in Cairo, involving over 150 growers representing almost 60 percent of the cultivated land.

- There are also robust indications that farmers in the WDP could be willing to pay the full cost of surface infrastructure investments plus its related O&M costs; according to the EWP survey, farmers in the WDP area are paying from LE 1000 to a maximum value of LE 12000 with an average of LE 1768 per feddan per year for O&M of groundwater.

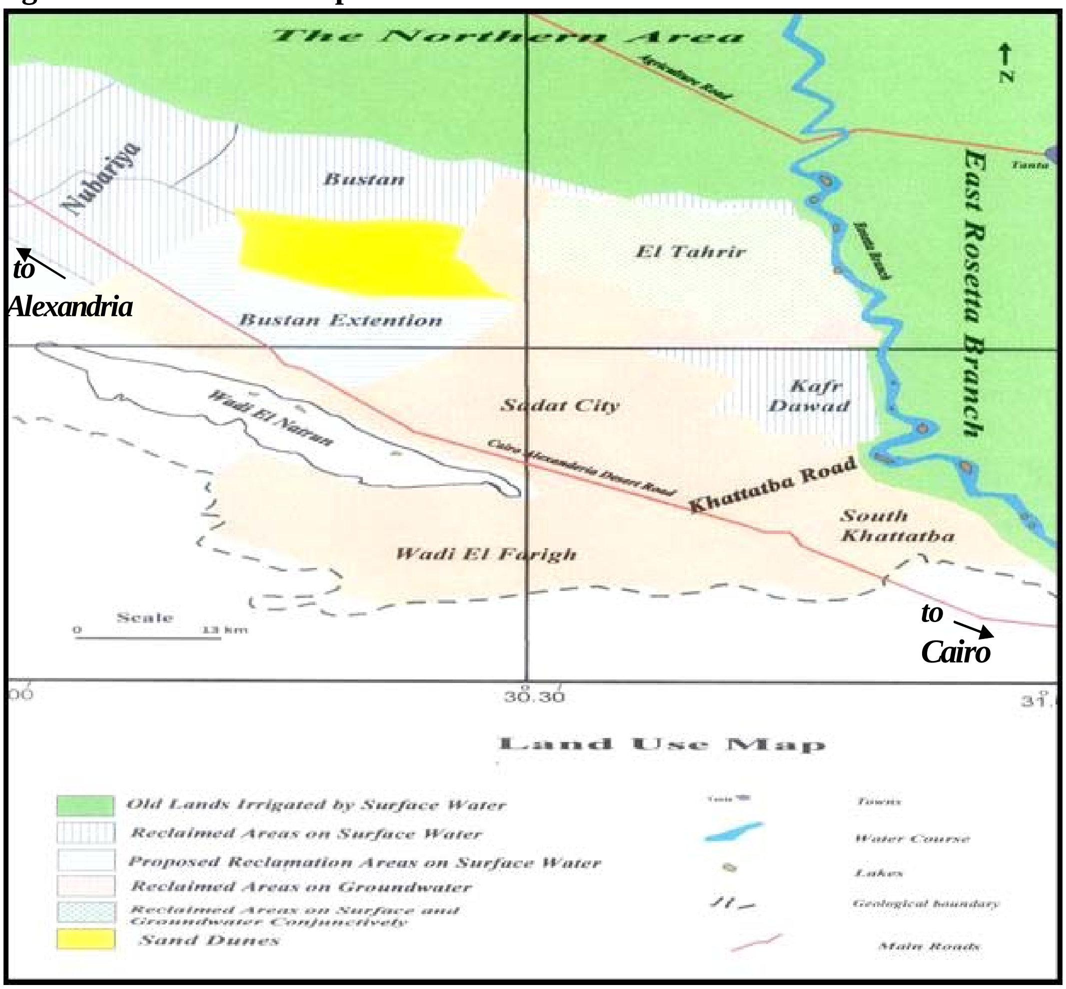
- Preferred mode of organization for managing and operating the new surface water for irrigation system is that of a Water User Association; second option is a government organization, and the private sector comes only as a third option.

- When fully developed, the West Delta will require 1.6 billion m3 annually at present consumption rates,1.06 Bm3 of which will be needed during the six month peak season between April-September. However, as volumetric pricing is implemented with the new surface water system, its also presumed that greater conservation measures will be adopted ultimately lowering the effective demand for water during peak.

3. Groundwater Assessment

Desert reclamation with groundwater, started in 1985 but was mainly confined to the area south and east of Wadi El Natrun; a development implemented largely by the private sector. In 1990, the groundwater extraction was calculated as 640 million m3/year to irrigate 70,000 feddans. At present, the groundwater extraction may be about 874 million m3/year with a total irrigated area of approximately 130,000 feddans. The new reclamation areas are distributed in Kafr Dawod, Birigat along Desert road, Khatatba, Dina Farm, Sadat City and Wadi Farigh, all of them under the West Delta area.

Figure 3.1: Land Use Map



3.1 Groundwater Extraction

Table 3.1 shows the change in groundwater extraction in sub areas of the West Delta between 1990 and 2000. Information in this table can lead to the following observations:

- Groundwater extraction has increased throughout the entire study area but in some areas more than others. Overall the increase has been approximately 36.2% or an average 3.6% annually during the 10-year period.

- The increase in extraction has been very rapid in sub-areas using groundwater irrigation -- up to twenty times more than the extraction levels of 1990. This phenomenon is clear in South Khattatba, Khattatba road, Wadi El Natrun, and Wadi El Farigh.

- In areas with limited agricultural development or those that had already achieved high development in 1990 (e.g., Dina Farms), groundwater extraction increased more gradually.

Table 3.1: Groundwater Extraction in the Study Area (millions of m3/year)

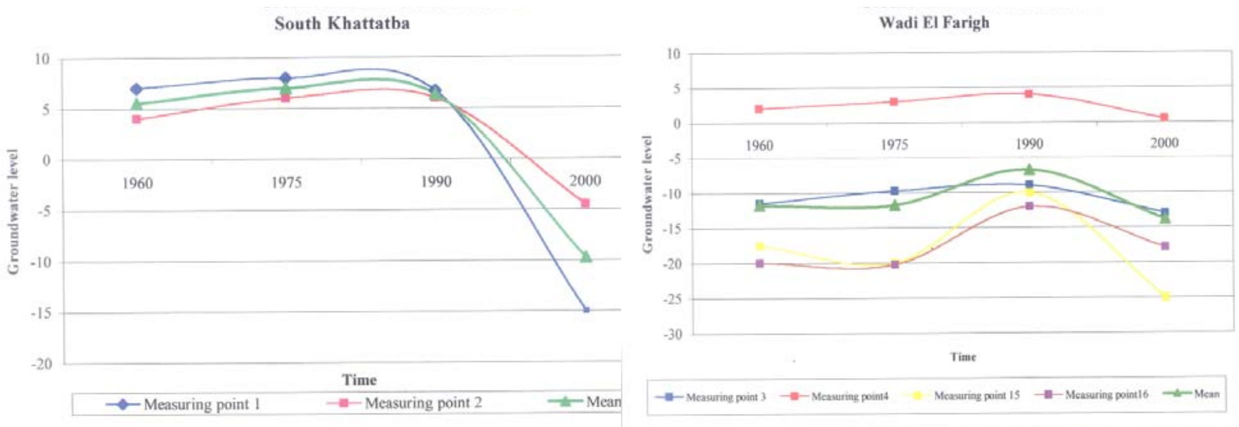
Sub Area of WD	1990	2000	Total Increase
Sadat City	19.99	20.50	3%
Kafr Dawod	164.74	172.98	5%
Birigate	80.32	86.74	8%
Desert Road	115.66	126.50	9%
Tahrir	128.99	141.89	10%
Dina	18.47	20.31	10%
Bustan Extension	19.54	23.45	20%
Bustan	31.52	47.77	52%
South Khattatba	31.05	64.21	107%
Khattatba Road	22.80	60.00	163%
Wadi El Natrun	6.00	49.35	723%
Wadi El Farigh	2.64	60.38	2192%
Total Study Area	**641.72**	**874.08**	**36.2%**
Cultivated Area	**70,000 feddans**	**130,000 feddans**	**85.7%**

3.2 Review of the Regional Variation in Hydrological and Hydro-Chemical Conditions

Hydrological Conditions

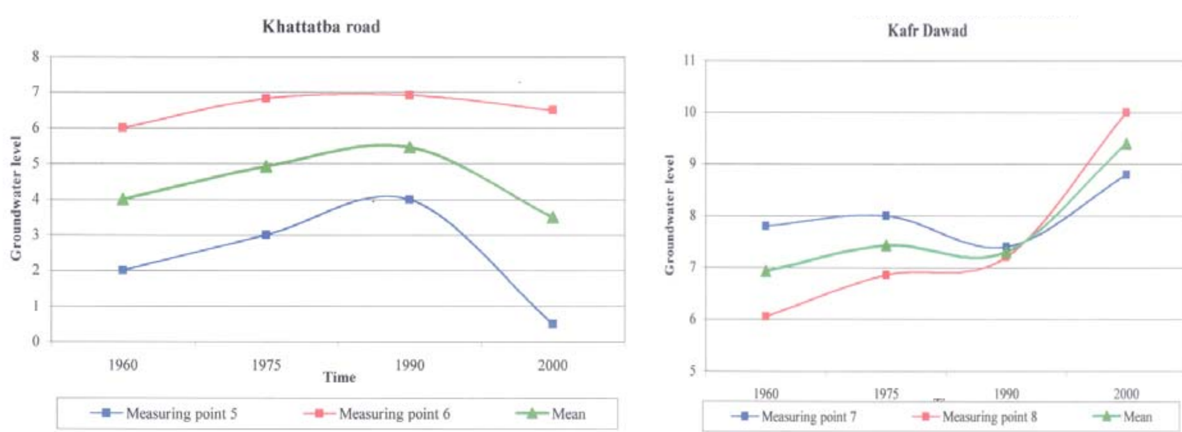
South Khattatba – This area lies south of West Delta between Desert road and Rosetta branch. The changes in hydrological conditions (water table level) were observed by two measuring points. The observed variation in levels is presented in Figure 3.2 (left), along with the average level. Note the increases in water table level up to about 1985. However, due to good groundwater quality many factories for mineral drinking water and agriculture projects were established during 1990-2000 in this area. The effect of these developments was that the groundwater levels decreased at a high rate, reaching an average level of -10 masl, a decline of about 1.73 m/year. This rate was the highest rate of decline recorded within the study area. This reduction in groundwater levels could lead to depletion, as the recharge rate of the aquifers is not able to keep up with the rate of extraction.

Figure 3.2: Groundwater Level Fluctuations, Shouth Khattatba and Wadi El Farigh



Wadi El Farigh - This area lies west of Wadi El Natrun and extends to the south. The changes in hydrological conditions were observed by 4 measuring points. The results are presented in Figure 3.2 (right), along with the average (note the increases in water table level up to 1990). However, during the period 1990-2000, agricultural development based on groundwater increased. As a consequence, the mean groundwater level decreased and reached -13 masl with a rate of decline of 0.65 m/year. Also in this case the trend of recharge during the years 1960 and 1990 seems to be lower than the current extraction rates.

Figure 3.3: Groundwater Level Fluctuations, Khattatba Road and Kafr Dawad

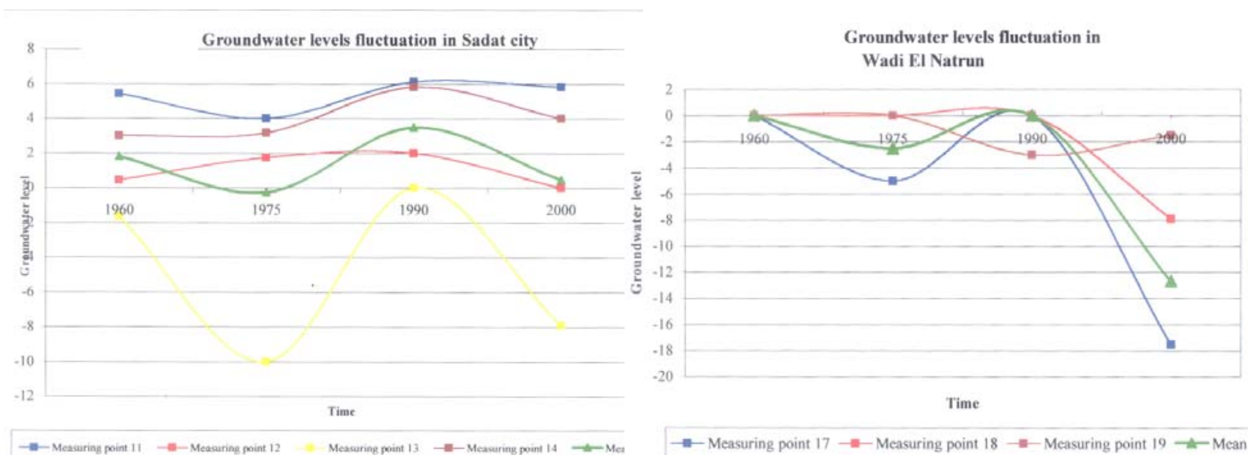


Khattatba Road - This area lies between Khattatba City and Cairo – Alexandria desert road. Two measuring points were used to observe the changes in hydrological conditions as shown in Fig. 3.3 (left figure). During the 1975-1990 period an increase of groundwater level was observed equaling 0.4 m/year. However, from 1990-2000 groundwater levels dropped to 3.5 masl, or 0.2 meters/year. The current extraction rates could lead to eventual depletion of the aquifers (see rates of extraction in Table 3.1).

Kafr Dawod **-** This area lies between Tahrir province in the north and south Khattatba area in the south and Sadat City in the west. At present, the area is supplied by surface water. Two measuring points recorded the changes in hydrological conditions, (Fig. 3.3 right). Prior to 1990, the mean water level dropped to 7.3 masl, without recharge because no agricultural activities were observed at that time. However, after 1990, groundwater levels increased sharply by the year 2000 with the mean groundwater level reaching 9.35 masl, or 0.20 m/year. This increase reflects the effect of Tahrir mound on groundwater levels, especially from irrigated areas with surface water close to the Nile River.

Sadat City **-** This area lies along the Cairo-Alexandria Desert Road. The Tahrir area lies on the Northeast of Sadat City and Wadi El Natrun in the west. The change in hydrological conditions was observed by 4 measuring points, (Fig. 3.4 left). The groundwater flow direction is from east to west. Prior to 1990, the mean groundwater level reached about 3.8 masl with a rate of increase of 0.26 meters per year. This rise was due to the presence of Tahrir mound during this period while the agricultural development did not consume the excess irrigation water infiltrated from the Tahrir area passing through Sadat City into Wadi El Natrun. However, after 1990 an increased in agriculture activities occurred in this area and reduced groundwater to the sea level. The rate of decrease was equal to 0.38 meters per year. Groundwater levels are expected to drop further in the coming years due to extension of agricultural projects in this area.

Figure 3.4: Groundwater Level Fluctuations, Sadat City and Wadi El Natrun



Wadi El Natrun – The Wadi El Natrun depression is considered as one of two main discharging areas. The changes in hydrological conditions were observed by 3 measuring points, (Fig. 3.4 right). From 1975-1990, this area was affected by the Nubariya mound from surface irrigation infiltrations, and the mean of groundwater level increased and became equal to the mean sea level with a rate of increment during this period equal to 0.16 m/year. During this period, the extension of agricultural activities consumed quantities of groundwater less than the quantity of water that recharged the aquifer from Nubariya in the north. However, from 1990-2000, many agriculture projects were constructed by private investors and the groundwater extraction for newly reclaimed areas increased rapidly (see rates of extraction in Table 3.1). Rates of extraction were higher than rates of recharge, and as a consequence, the mean groundwater level went down to -9.3 masl, a decline of 0.93 m/year

Hydro chemical Changes in Some Developed Areas

Salinity as a result of over extraction and return flows – Main cause of salinity in the area is the return flow groundwater accompanied with ionic-exchange between Calcium and Sodium that leads to increase in Sodium and decrease in Calcium; this was the case in South Khatattba, Khatattba Road, Wadi El Farigh, and Sadat City, during 1990-2000 period.

Salinity as a result of low quality surface water infiltration – During the period 1990-2000, a salinity took place accompanied with the increase of groundwater levels as a result of the mound that has been formed in the Tahrir area that affected Kafr Dawod area. The same happened during 1990-2000 period in Wadi El Natrum, with increase of groundwater levels as result of invading low quality groundwater coming from leaching surface water used in irrigation of the soil in Nubariya.

Increase of Chloride and Sulfate – This might be the result of applying fertilizers or continuous leaching of soil salts or up-coning of low quality groundwater, as was the case in Khatattba Road.

3.3 Conclusions

Aquifers in the project area are rechargeable, but extraction rates are well above recharge rates which lead to the decline of groundwater levels imposing higher costs of pumping and eventually leading to depletion of groundwater resources. Decline of ground water levels is compounded by increased levels of salinity due to over extraction, which took place especially in the areas east and west of the Cairo-Alexandria Desert Road such as in South Khattaba, Khatattba Road, Wadi El Farigh, and Wadi El Natrum. Groundwater salinity doubled several times due to the return flow process.

In addition, planning for using groundwater and surface water must take in consideration the relationships between some adjoining areas such as (i) Nubariya, Bustan, and North Wadi El Farigh; (ii) Tahrir, Kafr Dawod, and Sadat City; and (iii) South Khattatba, Khattatba Road and South Wadi El Farigh. All these areas are hydrologically related and affect each other.

4. Technology Options for Comprehensive Development of Study Area

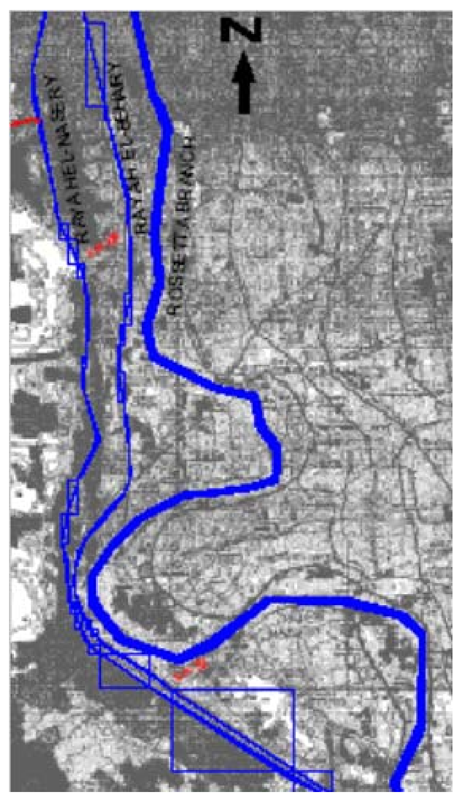
This section summarizes the technical options – along with cost estimates – to bring surface water for irrigation to the study area. The full technical report is presented in Annex 3.

The technical options presented in this section were based on a number of design criteria involving both technical considerations as well as the farmers' needs and a service they would be willing to pay for. The consultant team extensively involved farmer representatives and MWRI counterparts in the various technical options. This approach yielded: (i) the most feasible conceptual plan for open canal irrigation networks that covers the whole project area; (ii) cost estimates for each proposed open canal network and determination of the minimum cost option; and (iii) an improved closed conduit network configuration. Technical parameters of the most feasible conceptual plan were then used by the financial assessment work in order to derive the total revenue requirements and tariffs to meet the Government's objectives for cost recovery.

4.1 Surface Water for Irrigation Sources and Planning Criteria

Source of Surface water – Fully developed and according to current water for irrigation demand patterns, the proposed surface water system will require approximately 1.6 Bm3 annually which will be drawn from three main existing water channels:

Figure 4.1: Sources of surface water



(i) ***Rosetta Nile Branch***, bifurcates from the Nile River north of Cairo and discharges in the Mediterranean Sea, with maximum annual capacity of 12 Bm3;

(ii) ***Rayah El Behary***, an 82 km diversion canal that conveys water from the Nile River to the Nubaria, El Nasr, and El-Bustan main canals. Its daily discharge is about 27 Mm3, with a maximum capacity of 28.6 Mm3 that will result from rehabilitation work. The additional 1.6 Mm3, will be conveyed to the Rayah El Nasery through a culvert at km 38 to substitute the abstracted water for the project area.

(iii) ***Rayah El Nasery***, an 82 km diversion canal with a discharge capacity of 14 Mm3/day equivalent to 162.0 m3/sec. The Rayah el Nasery receives an extra 1.6 Mm3 per day at km 38 through the culvert from the Rayah El Behairy. The Raya el Nasery has two cross regulators to control water flow. The first cross regulator is at km 70.9, the second one is at km 81.5.

Characteristics of the Proposed Planning Options

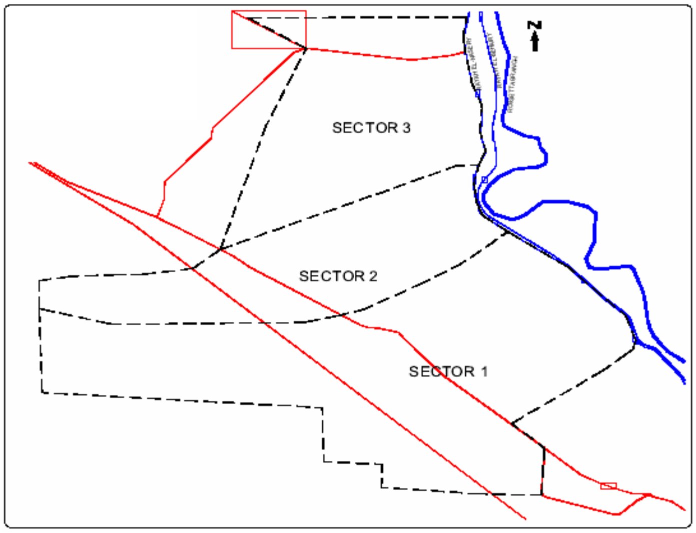
The study considered three main planning and design options to develop the entire project area. Table 4.1 summarizes the technical characteristics of each.

Table 4.1 Characteristics and Subdivisions of Alternative Planning Options

Contour & Topology	***High Areas Potential***	***Market & Demand***
Based on previous work. Three Intakes along the Rayah El Nassery	Based on exploiting high areas as points of water release so it can flow by gravity. Two Intakes along the Rayah el Nassery	Based on technical and market considerations. Three Intakes along the Rayah El Nassery
Southern Area = 130,000 feddans Average Level = 90.00 m High Level = 120.00 m Flow = 26 m^3/sec Main System Length = 52 km Branch Canals Length = 63 km	**Southern & Central** Area = 190,000 feddans Average Level = 85.00 m High Level = 120.00 m Flow = 38 m^3/sec Main System Length = 51 km Branch Canals Length = 117	**Southern** Area = 48,400 fed Average Level = 110.00 m High Level = 120.00 m Flow = 10 m^3/sec Main System Length = 42 km Branch Canals Length = 12 km
Central Area = 60,000 feddan Average Level = 80.00 m High Level = 90.00 m Flow = 12 m^3/sec Main System Length= 41 km Branch Canals Length = 24 km	**Northern** Area = 65,000 feddan Average Level = 45.00 m High Level = 60.00 m Flow = 13 m^3/sec Main System Length = 16 km Branch Canals Length = 37km	**Central** Area = 141,600 feddan Average Level = 85.00 m High Level = 100.00 m Flow = 28 m^3/sec Main System Length= 41 km Branch Canals Length = 65 km
Northern Area = 65,000 feddan Average Level = 45.00 m High Level = 60.00 m Flow = 13 m^3/sec Main System Length = 16 km Branch Canals Length = 37km		**Northern** Area = 65,000 feddan Average Level = 45.00 m High Level = 60.00 m Flow = 13 m^3/sec Main System Length = 16 km Branch Canals Length = 37km

The main differences among options are: (i) the location of border between the southern, central and northern sectors; (ii) the extension of each sector; and (iii) the capacity of the intakes and main canals. Note that in three technical design options the northern sector has the same technical features. The three options cover the entire project area according to original boundaries and their further descriptions follows.

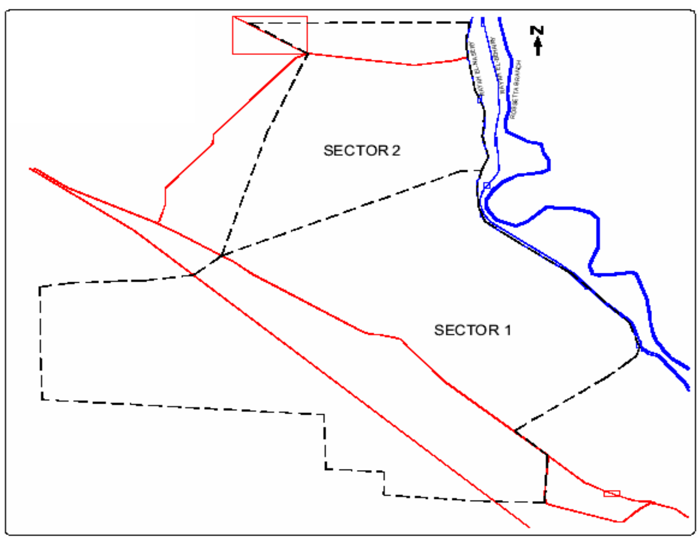
Figure 4.2: Partition According to Contour and Topology Parameters



1. ***Contour and Topology Parameters (CTP)*** – This option was developed based on the topology and contour lines of the area and was drawn largely from previous work that had been commissioned by MWRI[6] in a pre-feasibility technical study of the area. The design respects the main ridges and depressions of the area and sub-divides the area into three sectors, corresponding to three terraces, the highest of which is located in the south, and the north being the lowest. A separate intake is planned for each sector with a main branch canal serving growers within each of those boundaries. In this option, Sector 1 (Southern Sector) with an altitude ranging from 90 to 120 masl covers 130,000 feddans; Sector 2 (Central Sector) with 60 to 90 masl covers 60,000 feddans; and Sector 3 (Northern Sector) with 40 to 60 masl covers 65,000 feddans, Boundaries of each sector in this case are shown in Figure 4.2.

2. ***High Areas Potential (HAP)*** A second alternative to develop the entire area was developed by the study team in consultation with the focus group of private growers. This design was premised on planning criteria to make maximum use of the potential energy in high areas of south to serve most of the entire area by gravity. By contrast to the first option, this HAP design envisions two sectors each having a corresponding intake. The first intake would be placed in the most southern area and with main and subsidiary branches serving approximately 190,000 feddans. The other one will serve 65,000 in the northern sector. The irrigation system is planned and designed for each sector reaching the optimum in the sector itself, where the topographic criteria are considered locally in each sector. See Figure 4.3.

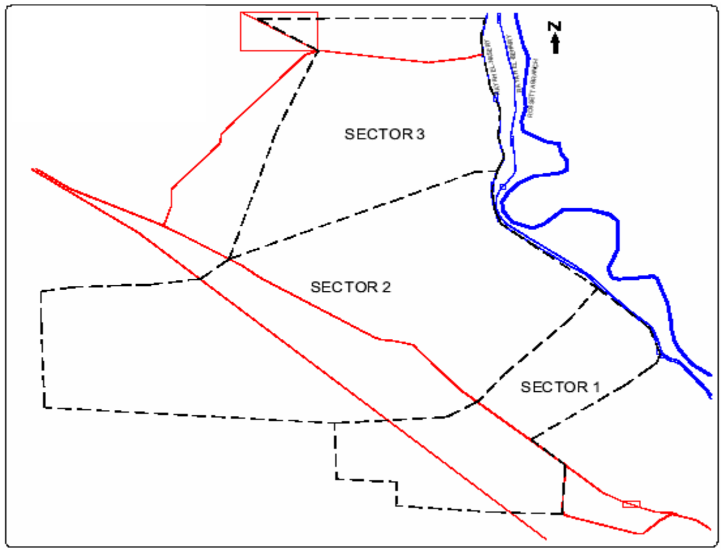
Figure 4.3: Partition According to High Areas Potential Parameters



[6] Pre-Feasibility study prepared by Eng. Farouk Shaheem and Magdi Khalifa, PhD.

3. Market and Demand Parameters (MDP) **–**This last alternative complements the elements of the Contour and Topology Options with market information about the existing concentration of farmer groups in the area. In particular, the market survey undertaken revealed: (i) that 61 percent of the original southern area was currently not cultivated; and (ii) some of the large farms were located in both the original boundaries of the central and southern sectors, meaning that they would require the implementation of both sectors in order for these farms to be served. In consequence the MDP alternative was developed to also include the findings from the market survey. The sector boundaries were re-drawn to increase the size of the central area to be able to include the farms already under cultivation and to reduce the southern sector to mostly uncultivated lands at the highest and most costly terrace of the project area. The product of this exercise yielded a project area which is divided into three separate sectors that better reflect the current market and demand conditions; i.e., 48,400 feddans in the southern zone (Sector 1); 141,600 in the central zone (Sector 2), and 65,000 feddans in the northern zone (Sector 3); see Figure 4.4.

Figure 4.4: Partition According to Market and Demand Parameters



4.2 Cost Estimates for Each Planning and Design Options: Open Channel System

Preliminary cost estimates have been prepared for an open channel system; see Table 4.2. The main assumptions for the cost estimates are as follows:

System capacity – System Capacity is estimated based on an average water demand of 15.53 m3 per feddan/day, equivalent to 5,668 m3 per feddan/year. A 10% evaporation loss is used to estimate a gross demand of water for irrigation of 6,299 m3 per feddan/year. Therefore System Capacity to supply such demand is estimated at 1.6 billion m3/year. This capacity is consistent with current average demand in the project area, which according to the groundwater study is 6,723 m3 per feddan/year. The system design did not specifically address changes in agricultural patterns which may result from a more abundant and reliable flow of surface water. The average monthly consumption of 118 Mm3 would be higher than current patterns in off-peak months. However, it is assumed that by the time the system is fully developed to serve the entire 255,000 feddan area, cropping patterns will have in fact shifted in a number of ways. More study will be needed to further confirm actual trends in usage.

***Planning assumptions* –** The system consists of pump stations, conveyance canals, main canals or primary distribution networks, branch canals, and secondary distribution networks. Pump stations, conveyance canals, main canals, and branch canals are considered public investments, while secondary distribution networks are considered to be property of farmers, or farmer associations. Therefore, estimates are done separately for public infrastructure investments and for on-farm infrastructure investments. The related cost of these investments were thus estimated, but would be offered to farmers as an optional feature which would be amortized in the tariff over the life of the loan (see section 5 on the cost of tariff structure).

Design assumptions – Trapezoidal open channels lined with concrete and PVC sheets. The conveyance efficiency is 90%. The manning coefficient is 0.0167. The intakes of the branch canals have automatic control gates. Main canals and branches have two asphalt roads on both sides of the channel. Secondary canals have two earth roads at each bank. Design parameters of open channels' cross sections are listed in Table A 2.1, in Annex 3.

General cost assumptions – Inflation contingency of 7% is applied; no taxes are included; no illegal costs are included; 365 days of work per year; security personnel, 3 shifts/day; each farm has a separate gauging system; all stakeholders participate in the project; all the project area is covered by the project and the whole amount of water will be consumed. Costs are based on 2004 prices.

Table 4.2 Total and Per Feddan Costs for the Three Planning Options

	Contour and Topology	**High Areas Potential**	**Market and Demand**
Overall costs per planning option			
Total Investment cost (Million LE)	**2,876**	**2,845**	**2,748**
Annual Per feddan Plus O&M (LE)	**1,561**	**1,624**	**1,525**
Cost per Sector			
Southern			
Total Capital Cost (Millions LE)	**1,593**	**2,273**	**607**
Annual Per feddan Costs (LE)			
Capital cost per year	681	665	697
O&M per year	1,071	1,136	1,150
Total per year	**1,752**	**1,801**	**1,846**
Central			
Total Capital Cost (Millions LE)	**711**		**1,570**
Annual Per feddan Costs (LE)			
Capital cost per year	658		616
O&M per year	980		991
Total per year	**1,639**		**1,607**
Northern			
Total Capital Cost (Millions LE)	**572**	**572**	**571**
Annual Per feddan Costs (LE)			
Capital cost per year	489	489	488
O&M per year	619	619	619
Total per year	**1,108**	**1,108**	**1,107**

- Cost estimates do not include interest during construction
- Per feddan capital costs are estimated considering a repayment term of 18 years. O&M per feddan is estimated by simple average of total O&M cost over the total number of feddans per sector.

Overall cost estimates – Cost estimates are presented in Table 4.2 and correspond to the three planning criteria discussed in section 4.1. As shown, the Market and Demand Parameters option presents the least cost option; i.e., LE 2,748 million, compared with LE 2,876 million for the Contour and Topology option and LE 2,845 million for the High Areas Potential option. In terms of per feddan costs, including O&M cost, the Market and Demand Parameters option is also the least expensive; i.e., LE 1,525 per feddan compared to LE 1,561 for the Contour and Topology option and LE 1,624 for the High Areas Potential Option.

Cost estimates per sector: the northern sector – The cost estimates for the Northern sector are fundamentally the same for the three options, as there was no variation in its size or boundaries and system network. In a sector-by-sector comparison, the investment and O&M costs are the lowest. This is quite fortuitous because the northern sector included the largest group of smaller and less productive landholders. Therefore, the farmers in this sector would be charged the lowest tariff with no need for cross-subsidies.

Cost estimates per sector: the tradeoffs between alternative partitions of the central and southern sectors – The High Areas Potential option pulls together into a single system the central and southern sectors with the intent to obtain economies of scale from investments and lower O&M costs. Investment costs for the HAP option are in fact lower than the Contour and Topology Parameter option; i.e., the investment cost for the southern sector (LE 2,273 million) is lower than the combined investment cost of the central and southern sectors of the contour and topology option (LE 2,304 millions). However, O&M costs of the High Areas Potential are higher than those of the combined southern and central sectors in the Contour and Topology option (See Table 4.2). Considering the combined investment and O&M cost, the Contour and Topology option is less expensive than the High Areas Potential option.

Cost estimates per sectors: the tradeoffs between Contour and Topology and Market and Demand Parameters options – The main difference between the two is that in the Market and Demand Parameters option, farmers covering 81,600 feddans are moved from the southern sector to the central sector and served by the one intake and system. The central sector irrigation system would thus serve 141,600 feddans in total, versus 60,000 in the Contour and Typology option. The effects on costs by the reconfiguration of sectors are as follows: (i) farmers that were moved from the southern sector to the central sector will reduce their per feddan capital and O&M costs LE 145 from LE 1,752 to LE 1,607; and, (ii) those farmers that were already in the central zones, covering 60,000 feddans, will reduce their per feddan investment and O&M costs in LE 32, from LE 1,639 to LE 1607. However, farmers that remain in the southern zone covering 48,400 feddans will see a slight increase in their per feddan/year investment and O&M costs by LE 94, from LE 1752 to LE 1846. However, as indicated earlier the most southern farms were heavily cross sub-subsidized in the Contour and Topology Option and with the re-configuration there is an overall cost reduction by LE 9.2 million per year. Moreover, the farms the remains in the southern sector in the MDP are still largely uncultivated. As such, the MDP option appears to be the more equitable design insofar as allocating cost by sector.

Per feddan costs and farmers' ability to pay for the investment and O&M costs – The capital and O&M cost derived based on an 18-year amortization, excluding the interest charges, come to be in the range of LE 0.19/m3 (US$ 0.032/m3) in the northern sector, and LE 0.33 /m3 (US$ 0.053/m3) for the southern sector. These estimates are substantially below the cost of service of similar size and scope; e.g., in the Guerdane Project in Morocco, the cost was estimated at US$ 0.14/m3. The estimates are also close and even below to what farmers are currently paying for pumping groundwater. It is also worth noting that the costs are also very competitive, particularly when considering that these per m3 costs also includes the optional on-farm investment which comprises almost 40% of the estimated capital costs.

4.3 Main Comparative Features among Various Planning Options

Table 4.3 compares each technical option along cost and other criteria.

Table 4.3 Main Comparative Features for Various Technical Options

Features	Contour and Topology	High Areas Potential	Market and Demand
Annual Investment costs per feddan/year (LE)	627	620	599
Annual O&M costs per feddan/year (LE)	934	1,004	926
Responsiveness to market characteristics/needs	Higher	Lowest	Highest
Flexibility for structuring equitable tariffs	Higher	Lowest	Highest
Flexibility for phased implementation as demand grows; by sequencing implementation by sectors	High	Lowest	High

Investment costs – In terms of investment and O&M costs the Market and Demand Parameters option is the least expensive of the three options, LE 599 per feddan/year and LE 926 respectively.

Responsiveness to existing market characteristics/needs – The Contour and the Market and Demand Parameters options responds more effectively to the various groups of customers compared to the High Areas Potential option. The High Areas Potential option is deprived from being responsive to market needs as it groups southern and central sector in one single group and heavily cross subsidizes the most expensive area in the southern sector.

Flexibility for providing room for equitable tariff structures – The Market and Demand Parameters option has the highest flexibility for more equitable tariff structures; i.e., if systems in each sector are implemented independently, the tariff in each sector will reflect more accurately the capital and O&M costs of each sector, with limited scope for cross subsidies. The overall saving per year of this option is estimated to be LE 9.2 million.

Flexibility for phased infrastructure implementation – The High Areas Potential option is regarded as the least flexible to allow phased infrastructure implementation as it has to deploy most of the system in the southern sector to serve customers in both the central and the southern sector. By contrast the Contour and Topology and the Market and Demand Parameter options offer greater flexibility, as implementation of the southern and central sectors can proceed independently.

Taking into account all comparative features the Market and Demand Parameters option seems to be the best option – The best two options are clearly the Contour and Topology and the Market and Demand Parameters options; however, the Market and Demand Parameters option is the preferred option for the reasons noted and was the option chosen by the Advisory Group and the option advanced further.

4.4 Closed Conduit Technical Options

Closed conduit option – The study team also considered the design and costing of a fully closed conduit system. The exercise was deemed important because a closed conduit system would offer additional benefits vis-à-vis the open channel system, most notably the greater opportunity for phased implementation in order to meet actual connections. Cost estimates for the closed conduit system, for the Market and Demand Parameter planning option are presented in Table 4.4. For comparison purposes, the corresponding cost estimates for the MDP open channel option are also shown in the last row of this Table.

Table 4.4 Per Feddan Investment Cost Over a Period of 18 Years (LE per year)

MDP, closed conduit option	Southern Sector	Central Sector	Northern Sector	Overall
Investment cost, LE million	876	2,143	831	3,850
Annual Investment cost per feddan per year	1,005	841	710	839
O&M per year per feddan	1,202	983	637	936
Total Investment and O&M per year	2,207	1,823	1,347	1,775
US$ per feddan per year	362	299	221	291
Equivalent US$ per m3	0.064	0.053	0.039	0.051
Ref. US$/m3 for open channel	0.052	0.046	0.032	0.044

No financial costs are included in the cost estimates. 18 year amortization term is assumed for capital investments.

Closed conduit capital cost is 41% more expensive than the open channel option – From the tables above we can see that the closed conduit option is about 41% more costly than the open channel option. In absolute terms, the closed conduit option would cost a total of LE 3.8 billion or approximately LE 1.1 billion more than the open channel option.

Advantages of closed conduit systems – Despite the added cost, the closed conduit option has a number of advantages, including: (i) pipes can be installed beside roads, thus minimizing land acquisition, resettlements, and right-of-way issues; (ii) the closed conduit system maintains the pressure increasing the efficiency of the distribution system; (iii) the closed conduit system has minimum water losses, pollution and contamination thus reducing total water requirements for the area; (iv) maintenance of the closed conduit system is minimal compared to open channels system; (v) implementation of the closed conduit system in the project site requires a shorter time period compared with the open channels system; and, (vi) the closed conduit system can be controlled and managed better than the open channel system. Other comparative advantages of the closed conduit are presented in Table 4.5.

Table 4.5 Comparative Features of Open Channel and Closed Conduit

Features	Open Channel	Closed Conduit
Flexibility for phased implementation as demand grows; by sequencing implementation by sectors	High	Higher
Technical system losses	10%	2%
Potential for non-technical system losses	High	Low
System management upon demand using modern telemetry and information systems	No	Yes
Flexibility for introducing demand management through volumetric billing	Low	High
Potential for fully continuous service	Low	High

Flexibility for phased infrastructure implementation – Closed conduits offer the greatest opportunity for phased implementation as pipes can be laid to meet almost exact consumption needs without necessarily overbuilding the system. Additional work would need to be undertaken to further assess or simulate a connection program to better determine whether a closed system may actually be less costly to actual consumers. It is premised that the more time it would take to convert demand to actual connections and consumption, the more cost competitive the closed conduit becomes. The determination for choosing a closed conduit instead of an open channel system would however have to be made by the party that effectively assumes the demand risk in a likely PPP transaction.

System losses – In terms of technical system losses due to evaporation, the closed conduit is more efficient as it only loses 2% compared with 10% for open channel. In terms of non-technical losses, basically due to the likelihood of water theft and other commercial reasons, closed conduits present lower system losses than the open channels.

Supply upon demand using modern telemetry and information systems – Closed conduits offer full flexibility to introduce modern telemetry and information systems to optimize supply/demand management. This is so because the hydraulics of the closed conduit system offer more potential to increase/reduce flows upon demand, and can offer more flexibility to attend peak demand during summer.

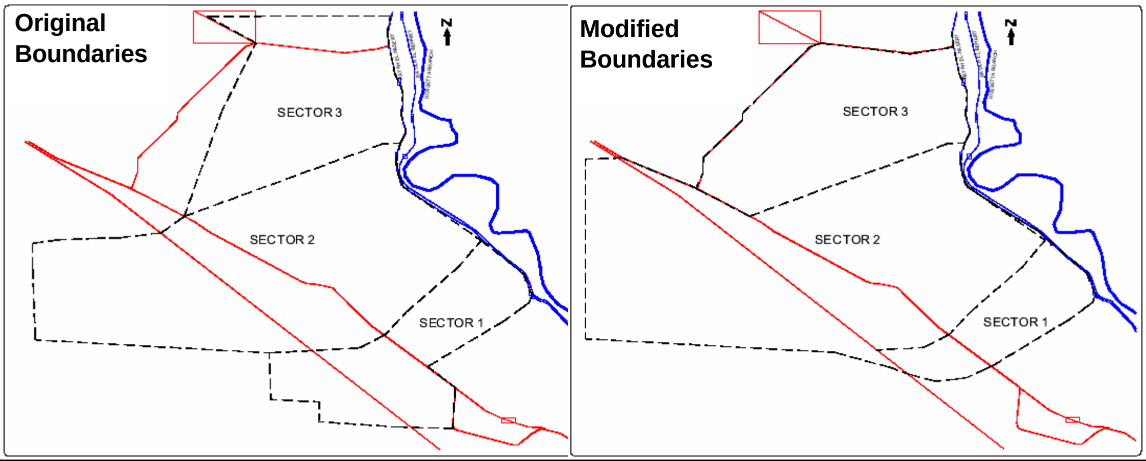
Potential for demand management through volumetric billing – Although tariffs can be constant over time, the fact that billing is done based on volumetric consumption will have an impact in water usage efficiency, eventually making farmers use less water. Full potential for volumetric billings is offered by the closed conduit technical option, the other options offer less room for volumetric billing.

Potential for fully continuous service – Uninterrupted water for irrigation service is difficult to achieve in open channels. It is hard to conceive that the proposed open channel system can materially change this trend. In contrast, a closed conduit system increases the likelihood of fully continuous service by making use of pressure, telemetry and managing demand through volumetric charges.

4.5 Modifying Boundaries to Reduce Investment and O&M Costs

Exclude marginal areas that present obstacles to be served – Searching to further cost reduction, the stakeholders requested the technical consultant to prepare another variation to the original options which would re-draw the original boundaries to exclude areas in the extreme north and south that are exposed to physical obstacles; i.e., separated from the main areas by existing roads that in order to be served would require to have culverts built. See Figure 4.5.

Figure 4.5: Proposed Modification of Boundaries to Reduce Costs



Original boundaries	**Sector 1**	**Sector 2**	**Sector 3**	**Modified boundaries**	Sector 1	Sector 2	Sector 3
Areas per sector	48,400	141,600	65,000	**Areas per sector**	27,000	166,270	61,730
				Changes to original	-21,400	+24,670	-3,270

Proposed modification of boundaries – In the revised boundaries the northern sector boundaries were re-drawn to exclude the more northern areas beyond the Agricultural Road, thus reducing the total feddans by 3,270 from 65,000 to 61,730. The proposed boundary for the southern sector excluded land west of the Cairo-Alexandria Desert Road and recreation activities land located at the highest altitudes with an overall reduction of 21,400 feddans from 48,400 to 27,000 feddans. The Central sector was extended to the west into the dessert to compensate for the reductions in the northern and southern areas; total increase in area in the central sector is 24,670 feddans, from 141,600 to 166,270 feddans.

Reduction of costs – With these changes in boundaries, a total cost reduction of about LE 144 millions was achieved from the MDP option under the original boundaries. In per feddan terms, the overall reduction cost is LE 80 per feddan/year, from LE 1,525 to LE 1,445.

Table 4.6 per Feddan Cost for Market and Demand Parameters Modified Boundaries

	Southern sector	Central sector	Northern sector	Overall
Total Investment cost per feddan/year	790	574	451	567
O&M per year per feddan	1,080	947	605	878
Total Investment Plus O&M	1,870	1,521	1,056	1,445
Original Boundaries Total Investment Plus O&M	1,846	1607	1,107	1,525

No financial cost are included. Cost recovery is done over 18 years.

Cost savings and potential conflicts due to modification of boundaries – While the modified boundaries offer a lower cost, it presents problems to those farms in the extremes north and south that would be deprived from access to the surface water for irrigation services. As such this is essentially a policy decision for the Government, and one that could be pursued in the event effective demand in these extreme areas does not materialize.

5. Financial Aspects

5.1 Introduction

Focus of the financial study – The financial aspects of the study focused on: (i) determining the average tariff level that will recover all costs through the duration of the project; and (ii) the development of long term financial projections in order to assess financial sustainability of the project. The financial results would also provide useful elements for deriving a recommended transaction model through a better understanding of the potential attractiveness of the financial returns to private investors/operators. The presentation herein focuses on the least cost option for the original boundaries presented in section 4; i.e. Market and Demand Parameter Open Channel option.

Full financial projection model – A fully integrated financial projection model was developed to support the financial analysis and to assess the financial implications to the Project of the various policy options that are currently under consideration. The financial model was programmed to simulate the activity of a potential operator (public or private) which focuses essentially on constructing and operating a surface water conveyance system to supply irrigation water to its customer base in the West Delta. The operator is expected to carry out these activities on a full cost recovery basis while maintaining a positive cash flow. The full financial projections are presented in Annex 4 along with a description of the underlying assumptions and input variables. The model addresses the implications of the water tariff levels and structure, and the installation charges that are under consideration. Essentially, all important elements of the Project were incorporated in the model in order to assess the related financial implications and long-term viability and to assess the critical years where financing gaps may occur.

Assumptions to the projections – The financial projections were developed with the following critical assumptions with regard to scope of implementation and construction phasing. These are particularly important in understanding the approach taken for this initial study which may diverge from what would normally be presented as a base case scenario under a more traditional supply driven approach. Other important assumptions utilized in the financial projections are shown in Annex 4.

- This initial study intentionally considered a number of mutually exclusive technical alternatives for the comprehensive development of the entire area rather than just certain parts where the initial demand for surface water may be greater.

- Actual implementation may markedly differ from this comprehensive approach as: (i) not all growers in any one sector; and (ii) not all sectors may be connecting during the same time or within the defined construction period. More likely, the Project may be implemented in phases and in distinct financially viable modules within each sector. Follow-up on technical work will explore how the actual demand will develop (as expressed in the grower’s willingness to sign specific letters of intent and definitive contractual agreement). On this basis, prior to connection, a phasing plan will be designed to coincide with these firm expressions of interest and again a financial assessment would review the likely tariff under such scenarios.

- In project financing situations, longer grace periods are normally sought to meet the needs of the construction program. In this case the construction program is constrained to two years in order to make the tariffs affordable. It will be critical for the operator to take maximum advantage of the loan such that a tariff can be developed and based on a loan amortization of at least 18 years - the maximum allowable. The longer the operator takes in construction the less time they will have to amortize the capital cost and as such, the higher the tariff. While the entire program cannot be constructed over this period, it is assumed, as indicated earlier, that the system will actually be built in phases, that is, one sector at a time or in modules within a given sector. As such, it is more plausible that the project will be implemented under several loans in order to adhere to the need to keep construction schedules short and manageable. Once the operator is chosen, it is imperative that he will be off and running as any delay will have a severe impact on its ability to financially sustain operating costs and debt service. The strategy is to divide the project into several parts that can be discretely implemented in a maximum time frame of thirty-months in total (actual drawdown of loan for construction is constrained to 24 months). Again this will be determined in the next phase of this work.

- The approach provided the basis for establishing a base tariff for which growers would be able to express their willingness to connect to the new system and to pay for the irrigated water service.

5.2 Financing Plan

Estimated costs – The Project, assuming the completion of a system to cover the entire 255,000 feddan area, is estimated to cost approximately LE 2,924 billion, $468.6 million. Investment program costs include Interest During Construction (IDC) which is paid but capitalized to the fixed assets while the project becomes operational.

Sources of financing – The financing plan assumes that fifteen percent of the total investment cost would be financed through equity, leaving 85% financed by debt. The loan will have a 20-year maturity with a 2-year grace period on principal repayment. As such the principal amount will be amortized over 18 periods. In addition a small amount of funding (LE 49 million) would be sourced through internally generated funds, largely, security deposits obtained from growers willing to connect to the system. The amount of LE 49 million would still be a relatively small portion of the total funding requirements of the project.

Table 5.1 Financing Plan 2006-2007 (LE M)

Market and Demand Parameter, Original Boundaries, Open Channel	**Year 1**	**Year 2**
Capital Investment Requirements		
- Project Costs	1,331	1,417
- Interest During Construction	45	131
Total Investment Program	(1,376)	(1,548)
Funds From Loans & Grants		
- Equity Contributions	100	300
- Loans	1,275	1,200
- Internally Generated Funds	1	48
Funds From Loans	1,376	1,548

5.3 Tariff Level and Structure

Tariff calculated to cover all costs – The table below presents the estimated tariff level and proposed structure. Again the average tariff was calculated to cover all costs and set by the determining the revenue requirement (RR) based on the first full year of operation following the construction period and attainment of the desired coverage. Revenues must cover capital expenditures plus operating expenditures and debt service plus earn a fair return on equity during the life of the project. Based on these requirements, the average tariff came out to LE .38 per m3, assuming the recovery of all cost components, inclusive of on farm infrastructure which will be made optional to each consumer. On a per feddan basis this comes out to an average annual cost of LE 2,291.91. Tariffs by sector will of course vary widely, from LE 1,701.05 in the northern area having the lowest elevation, to LE 2,766.72 in the southern sector with the highest. The Central area converged to the average tariff level. Excluding the optional on-farm investment, the average tariff drops significantly, to about LE .32 m3 or LE 1,798 annually per feddan.

Average tariff will vary from one sector to another – Since each of the three sectors in the recommended technical design has different capital and operational cost characteristics, the average tariff will vary from one sector to another. As such possible cross subsidies and inequities between growers will be minimized. Moreover, a separate tariff regime allows for greater flexibility in implementation as one sector will not depend on the other for their financial sustainability. Each sector will be charged its cost recovery tariff (direct costs) plus a contribution margin to recover common costs (i.e. overhead items).

A three part tariff – As shown in the table below, each participating farmer will be subject to a three part tariff: (i) a minimum annual tariff to recover its relative share of the depreciation of public works; (ii) a volumetric charge to recover the variable O&M expenses based on actual usage; and (iii) an optional on-farm annual fixed charge to recover the cost of optional farm investment that would be made available to growers as an incentive to connect to the new system. The approach provided the basis for establishing a base tariff for which growers would be able to express their willingness to connect to the new system and to pay for the irrigated water service.

Table 5.2 Tariff Analysis

Market and Demand Parameter, Original Boundaries, Open Channel	**Southern**	**Central**	**Northern**	**Total/W.AV**
Tariff Structure				
Minimum Fixed Charge (LE	1,111.23	901.18	616.24	868.41
Optional Fixed Charge for On-Farm Works	483.95	501.53	483.48	493.59
Volumetric Charge	0.21	0.18	0.11	0.16
Tariff Structure Per 3m				
Minimum Fixed Charge	0.20	0.16	0.11	0.15
Optional Fixed Charge for On-Farm Works	0.09	0.09	0.09	0.09
Volumetric Charge	0.21	0.18	0.11	0.16
Total Tariff with on Farm Option	**0.49**	**0.42**	**0.30**	**0.40**
Total Estimated Tariff Per Feddan	2,766.72	2,400.88	1,701.05	2,291.91
Total Tariff without On-Farm Option	**0.40**	**0.34**	**0.21**	**0.32**
Total Tariff Per Feddan Without On Farm Option	2,282.77	1,899.34	1,217.57	1,798.32

5.4 Future Financial Performance

The table below summarizes the projected financial and operating performance for the Market-Demand Parameters, Open Channel option (MDP OC) assuming construction start up in 2006 and full operations commencing in 2008.

Table 5.3 Future Financial Performance

Market and Demand Parameter, Original Boundaries, Open Channel	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Operating Revenues (LE M)	550	550	550	550	550	550	550	550
Net Income (LE M)	7	16	26	36	45	55	65	74
Total Assets (LE M)	2,871	2,789	2,716	2,653	2,600	2,556	2,522	2,497
Debt/Equity Ratio (Times)[7]	5.15	4.65	4.10	3.54	3.00	2.50	2.05	1.66
Average Tariff (LE/m3)	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380
Water Losses	-2%	-2%	-2%	-2%	-2%	-2%	-2%	-2%
Debt Service Coverage (Times)	0.99	1.25	1.29	1.34	1.39	1.44	1.50	1.56
Operating Ratio	43%	43%	43%	43%	43%	43%	43%	43%
Return on Revenues	1.2%	3.0%	4.7%	6.5%	8.2%	10.0%	11.7%	13.5%
Return on Assets	0.2%	0.6%	1.0%	1.5%	2.0%	2.6%	3.3%	4.1%
Return on Equity	1.6%	3.7%	5.5%	7.1%	8.2%	9.1%	9.6%	10.0%

Rates of return **–** As shown, the tariffs will support a financially sustainable position which is expected to improve over time throughout the projection period. The financial Internal Rate of Return to total invested capital is estimated at 6.5% based on constant prices. More importantly, on the total return to equity basis, the Internal Rate of Return is estimated at 21%, making the project attractive to potential investors.

2008, a critical year **–** As shown by the table, the project is likely to experience a critical period in terms of its future finances in the year 2008. It is in this year that full operations are scheduled and the build up of coverage will be critical. As indicated, any delay in the completion of the project and in the connection program will have significant financial consequences as it is also the year that full debt service would commence. In 2008, debt service coverage is projected to be below 1.00, thus reinforcing this point. Revenue and cost would stabilize in subsequent years, allowing the financial situation to progressively improve over time.

Conditions for a favorable scenario **–** A favorable financial scenario as projected will therefore greatly depend on the project's ability to: (i) constrain to two years the construction program; (ii) realize estimates of grower's willingness to connect; and (iii) maintain adequate tariff levels.

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[7] A debt to Equity ratio of 1.0 times equates to a capital structure of 50% to 50% equity. Accordingly a capital structure of 75% Debt to 25% Equity equates to a Debt/Equity Ratio of 3 times.

5.5 Financial Data for Market and Demand Parameter, Modified Boundaries, Open Channel

Table 5.4 Financing Plan 2006-2007 (LE M)

Market and Demand Parameter, Modified Boundaries, Open Channel	Year 1	Year 2
Capital Investment Requirements		
- Project Costs	1,244	1,359
- Interest During Construction	41	123
Total Investment Program	(1,285)	(1,482)
Funds From Loans & Grants		
- Equity Contributions	100	300
- Loans	1,185	1,130
- Internally Generated Funds		52
Funds From Loans	1,285	1,482

Table 5.5 Tariff Analysis

Market and Demand Parameter, Modified Boundaries, Open Channel	Southern	Central	Northern	Total/W.AV
Tariff Structure				
Minimum Fixed Charge (LE)	1,010.84	858.87	530.26	795.41
Optional Fixed Charge for On-Farm Works	866.25	438.02	479.74	493.46
Volumetric Charge	0.20	0.17	0.10	0.16
Tariff Structure Per 3m				
Minimum Fixed Charge	0.18	0.15	0.09	0.14
Optional Fixed Charge for On-Farm Works	0.15	0.08	0.08	0.09
Volumetric Charge	0.20	0.17	0.10	0.16
Total Tariff with on Farm Option	**0.53**	**0.40**	**0.28**	**0.38**
Total Estimated Tariff Per Feddan	3,000.64	2,248.72	1,598.15	2,170.84
Total Tariff without On-Farm Option	**0.38**	**0.32**	**0.20**	**0.30**
Total Tariff Per Feddan Without On Farm Option	2,134.38	1,810.71	1,118.41	1,677.38

Table 5.6 Future Financial Performance

Market and Demand Parameter, Modified Boundaries, Open Channel	2008	2009	2010	2011	2012	2013	2014	2015
Operating Revenues (LE M)	518	518	518	518	518	518	518	518
Net Income (LE M)	6	15	24	33	42	51	60	69
Total Assets (LE M)	2,717	2,640	2,572	2,513	2,642	2,421	2,389	2,366
Debt/Equity Ratio (Times)[8]	4.81	4.36	3.87	3.35	2.86	2.40	1.98	1.61
Average Tariff (LE/m3)	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
Water Losses	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
Debt Service Coverage (Times)	0.99	1.26	1.30	1.35	1.39	1.45	1.50	1.56
Operating Ratio	43%	43%	43%	43%	43%	43%	43%	43%
Return on Revenues	1.1%	2.8%	4.6%	6.3%	8.0%	9.8%	11.5%	13.2%
Return on Assets	0.2%	0.6%	1.0%	1.5%	2.0%	2.5%	3.2%	4.0%
Return on Equity	1.3%	3.3%	5.1%	6.5%	7.7%	8.6%	9.2%	9.5%

[8] A debt to Equity ratio of 1.0 times equates to a capital structure of 50% to 50% equity. Accordingly a capital structure of 75% Debt to 25% Equity equates to a Debt/Equity Ratio of 3 times.

5.6 Financial Data for Market and Demand Parameter, Modified Boundaries, Closed Conduit

Table 5.7 Financing Plan 2006-2007 (LE M)

Market and Demand Parameter, Modified Boundaries, Closed Conduit	**Year 1**	**Year 2**
Capital Investment Requirements		
- Project Costs	1,716	1,549
- Interest During Construction	55	157
Total Investment Program	(1,771)	(1,706)
Funds From Loans & Grants		
- Equity Contributions	200	300
- Loans	1,570	1,355
- Internally Generated Funds	1	51
Funds From Loans	1,771	1,706

Table 5.8 Tariff Analysis

Market and Demand Parameter, Modified Boundaries, Closed Conduit	**Southern**	**Central**	**Northern**	**Total/W.AV**
Tariff Structure				
Minimum Fixed Charge (LE)	1,400.34	1,302.53	992.15	1,237.75
Optional Fixed Charge for On-Farm Works	687.51	332.99	380.87	382.11
Volumetric Charge	0.17	0.17	0.11	0.15
Tariff Structure Per 3m				
Minimum Fixed Charge	0.25	0.23	0.18	0.22
Optional Fixed Charge for On-Farm Works	0.12	0.06	0.07	0.07
Volumetric Charge	0.17	0.17	0.11	0.15
Total Tariff with on Farm Option	**0.54**	**0.46**	**0.35**	**0.44**
Total Estimated Tariff Per Feddan	3,071.15	2,579.59	1,974.22	2,485.08
Total Tariff without On-Farm Option	**0.42**	**0.40**	**0.28**	**0.37**
Total Tariff Per Feddan Without On Farm Option	2,383.64	2,246.60	1,593.36	2,102.97

Table 5.9 Future Financial Performance

Market and Demand Parameter, Modified Boundaries, Closed Conduit	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Operating Revenues (LE M)	590	590	590	590	590	590	590	590
Net Income (LE M)	7	18	30	41	52	64	75	87
Total Assets (LE M)	3,400	3,291	3,194	3,109	3,035	2,972	2,920	2,880
Debt/Equity Ratio (Times)[9]	4.90	4.44	3.93	3.41	2.90	2.43	2.00	1.63
Average Tariff (LE/m3)	0.408	0.408	0.408	0.408	0.408	0.408	0.408	0.408
Water Losses	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
Debt Service Coverage (Times)	0.99	1.21	1.25	1.29	1.34	1.39	1.44	1.50
Operating Ratio	37%	37%	37%	37%	37%	37%	37%	37%
Return on Revenues	1.2%	3.1%	5.0%	7.0%	8.9%	10.8%	12.8%	14.7%
Return on Assets	0.2%	0.6%	1.0%	1.5%	2.0%	2.6%	3.2%	4.0%
Return on Equity	1.3%	3.3%	5.1%	6.6%	7.8%	8.7%	9.3%	9.6%

[9] A debt to Equity ratio of 1.0 times equates to a capital structure of 50% to 50% equity. Accordingly a capital structure of 75% Debt to 25% Equity equates to a Debt/Equity Ratio of 3 times.

5.7 Financial Data for Market and Demand Parameter, Original Boundaries, Closed Conduit

Table 5.10 Financing Plan 2006-2007 (LE M)

Market and Demand Parameter, Original Boundaries, Closed Conduit	**Year 1**	**Year 2**
Capital Investment Requirements		
- Project Costs	1,783	2,066
- Interest During Construction	58	178
Total Investment Program	(1,841)	(2,244)
Funds From Loans & Grants		
- Equity Contributions	200	400
- Loans	1,640	1,793
- Internally Generated Funds	1	51
Funds From Loans	1,841	2,244

Table 5.11 Tariff Analysis

Market and Demand Parameter, Original Boundaries, Closed Conduit	**Southern**	**Central**	**Northern**	**Total/W.AV**
Tariff Structure				
Minimum Fixed Charge (LE)	1,673.88	1,285.91	978.18	1,281.10
Optional Fixed Charge for On-Farm Works	623.29	620.47	623.68	621.82
Volumetric Charge	0.22	0.17	0.11	0.17
Tariff Structure Per 3m				
Minimum Fixed Charge	0.30	0.23	0.17	0.23
Optional Fixed Charge for On-Farm Works	0.11	0.11	0.11	0.11
Volumetric Charge	0.22	0.17	0.11	0.17
Total Tariff with on Farm Option	**0.62**	**0.51**	**0.39**	**0.50**
Total Estimated Tariff Per Feddan	3,522.75	2,893.75	2,229.14	2,843.71
Total Tariff without On-Farm Option	**0.51**	**0.40**	**0.28**	**0.39**
Total Tariff Per Feddan Without On Farm Option	2,899.46	2,273.28	1,605.46	2,221.89

Table 5.12 Future Financial Performance

Market and Demand Parameter, Original Boundaries, Closed Conduit	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Operating Revenues (LE M)	674	674	674	674	674	674	674	674
Net Income (LE M)	8	21	35	48	61	75	88	101
Total Assets (LE M)	3,988	3,858	3,741	3,637	3,546	3,469	3,406	3,355
Debt/Equity Ratio (Times)[10]	4.82	4.37	3.87	3.36	2.86	2.40	1.98	1.61
Average Tariff (LE/m3)	0.466	0.466	0.466	0.466	0.466	0.466	0.466	0.466
Water Losses	2%	2%	2%	2%	2%	2%	2%	2%
Debt Service Coverage (Times)	0.99	1.20	1.24	1.28	1.33	1.38	1.43	1.49
Operating Ratio	36%	36%	36%	36%	36%	36%	36%	36%
Return on Revenues	1.2%	3.2%	5.2%	7.1%	9.1%	11.1%	13.1%	15.1%
Return on Assets	0.2%	0.6%	1.0%	1.5%	2.0%	2.6%	3.2%	4.0%
Return on Equity	1.3%	3.3%	5.1%	6.5%	7.7%	8.6%	9.2%	9.5%

[10] A debt to Equity ratio of 1.0 times equates to a capital structure of 50% to 50% equity. Accordingly a capital structure of 75% Debt to 25% Equity equates to a Debt/Equity Ratio of 3 times.

6. Involving Private Participation

Without a doubt, involving the private sector in the West Delta poses challenges. The proposed project imposes a number of significant risks to any party that assumes its planning, construction, financing and operation. Moreover, private participation in traditional infrastructure projects in power, telecommunication, transport and water supply have suffered serious declines over the past decades and as of 2003 the trends are still downward. Globally, newly released data for 2003 shows that investment in private projects dipped again to 1994 levels and investments in the water sector were the most affected.

The large dominant international operators of yesterday are playing a much lesser role, at least in direct financial placements. Their preferred choice of PPP options are those that transfer financing and demand risk to the public partner (as in management contracts, and leases); and it is not at all clear that with any changes in risk allocation these investors can be led back to assume project finance risks. In irrigation, private participation adds to the challenge given the relative void of successful transaction experience in this sector and the more severe obstacles that are perceived in running a private irrigation system on a commercial and cost recovery basis. To-date there are very few examples of successful irrigation projects of the magnitude being considered in the West Delta where the private sector has taken up a substantial share of the related risks of the undertaking.

A recent study[11] reviewed 21 cases of projects that involve some level of private sector participation, most of which was in the form of service contracts for O&M and of financing schemes for farmers to invest in on-farm pumping equipment. The closest project to the one proposed in the West Delta is the Guerdane Concession Project recently completed successfully in Morocco. However, after a number of failed bids this concession agreement could only be realized with substantial subsidies by Government to reduce the related risks of the private sponsors.

The West Delta Project in Egypt promises some significant challenges, given the limited history of successful private irrigation projects combined with the extremely low tariff levels in water supply and the past ideological resistance for farmers to pay for water.

On the other hand, as indicated in previous chapters, there are several factors which raise optimism on the feasibility of involving the private sector in the West Delta, most notably (i) the strong interest expressed by farmers to connect to a surface water systems and their willingness to pay the required tariff to sustain it financially; (ii) the fact that groundwater is depleting; and (iii) that farmers already have made substantial investments in the area that can only be sustained through surface water for irrigation. There is no doubt that in the long-term, the proposed surface water system would be financially sustainable as the water options decrease for the growers. The short-term however points to a number of risks where margin for errors are small and which could mean the difference between success and failure.

[11] PPP in the Irrigation and Drainage Sector: The Need for a Professional "Third Party Between Farmers and Governments, Henri Tardieu's French Team, 2004

There are different options or models available for involving the private sector which are largely determined by the way risks are allocated between the public and the private partners. Understanding the dimensions of such risks can aid in determining which of the options could be best suited for involving a private party in the West Delta.

6.1 Understanding the Project Related Risks

Irrespective of which public or private model is selected, the risks of the project have been identified as follows:

- **Demand Risk –** Demand risk, as expressed in terms of willingness to connect, purchase surface water and pay for the service is probably the most significant of the risks. The ability of demand to translate into effective consumption in the West Delta is aggravated by reality for conjunctive use of groundwater. As the use of groundwater cannot be effectively policed or regulated, the best way of dealing with demand risk is for the project to come up with a tariff that is competitive to the current cost of groundwater depletion.

- **System Design & Planning –** Realizing the impact of consumption on financial sustainability, it will be extremely important to plan the system to respond to its effective demand and not to create excess capacity through overbuilding. The tendency for any operator taking on the demand risk would then be to under-build the system to ensure full utilization. This may mean that a large number of potential consumers may not be effectively served if the operator is left unregulated. On the other hand, over dimensioning the project would jeopardize positive cash flows.

- **Operation & Commercial Risks –** Given the ideological resistance to pay for water, this area may pose significant risk to any operators. Efficient operation and management of activity may be prone to commercial losses through non payment and through high incidence of water theft.

- **Devaluation/Currency Risks –** A major deterrent to any infrastructure operation where loans and operating costs are highly susceptible to currency movements. Guarding against impacts from major devaluations and macro instability has deterred many private operators from undertaking infrastructure projects despite contractual rate adjustment provisions.

- **Regulatory Risks** - Ensuring sufficient tariff levels and quality standards. Ensuring fairness and independence in the interpretation of contractual agreements and disputes.

- **Financing -** Securing required investment financing at reasonable cost and rate of return expectations. Capital markets in Egypt cannot currently provide long term domestic financing to render tariffs affordable.

- **Construction Risk –** Assurance of timely completion of construction according to design standards – Delays will increase costs and associated tariffs levels.

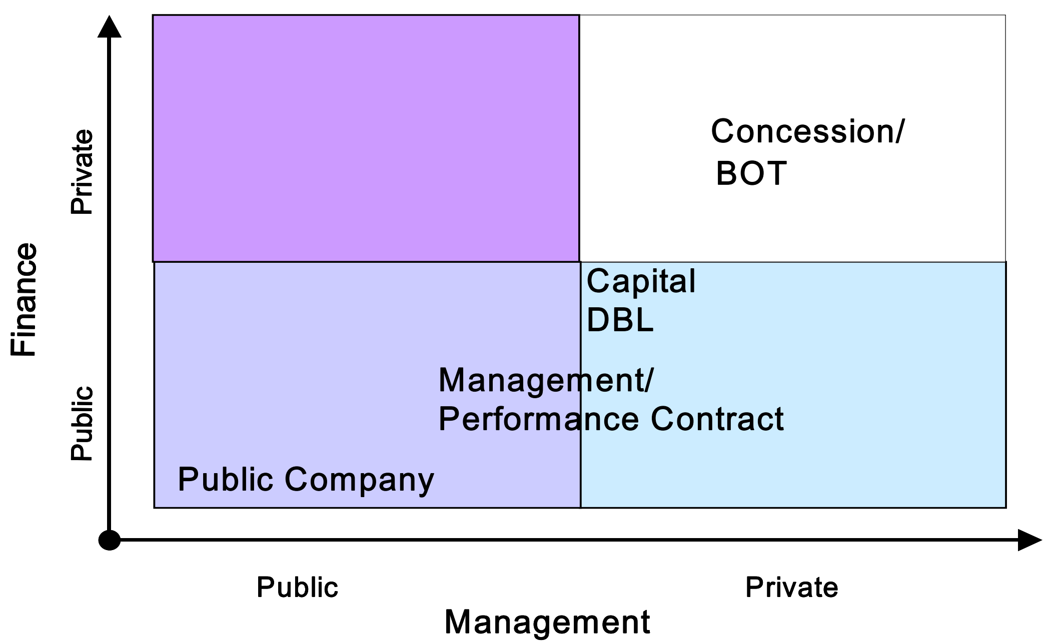
- **Credit Risks –** Ensuring timely debt servicing of loans.
- **Other Risks –** such as Political, Terrorism, Force Majeure

6.2 Public-Private Participation Options for Allocating Risks

While a wide variety of private-public models and variations of such models have been successfully transacted in infrastructure projects, the matrix below shows that essentially, the trade-offs are between which party retains the finance and management functions. With that determination the various risk are then generally allocated to the appropriate party who assume these functions. Ownership of the assets is also an important consideration but usually this is retained by the party that also bears the financing risks as the assets are often utilized and needed as security for mobilizing the financing.

The matrix below then shows a number of PPP modes falling under the various quadrants of finance and management, with the lower left quadrant offering a purely public sector option while the upper right hand quadrant the purely private option. The matrix thus provides for a useful framework for assessing the various options available for in the West Delta project.

Matrix 6.1: Different PPP Modes under the Quadrants of Finance and Management



Public Company Option – In the case of purely public option, a number of institutional alternatives could be developed with participation by both MWRI and other public entities such as the newly established Public Asset Holding Company. This particular option was considered only insofar as the Assets Holding Company which was set up under the public enterprise law would mimic a privately run operation. Besides that however, this particular option provides little other than the Government retaining all functions as well as the risks associated with the project.

Private Concession/BOT Option – By contrast, the upper right quadrant offers the private modality usually characterized by concession contracts and other such schemes as Build-Operate-Transfer and where most if not essentially all risks are taken up by the private party. As indicated, these options have fallen severely out of favor among private sponsors and financiers largely because of the significant losses experienced in these arrangements in the past. Today, private sponsors perceive that there are serious issues of equity among these modalities as the risks are often skewed to the private party.

Performance Management Contract Option – In search for a more equitable balance of risks, two basic forms of PPP contracts offer a sharing of risks, albeit in different degrees between the private and public party. The performance management contract for example, largely allocates risks to the public party with the exception that a private operator shares in gains achieved from performance improvements of the operation.

The downside, besides losing the contract, is limited however. Performance contracts are usually implemented through incentive schemes and usually tied to agreed performance targets such as, operational efficiency improvements, reducing water losses through metering or controlling thefts, improving collections or expanding coverage to increase revenue. This contracting mode differs from the traditional management contract in that it does place some pressures to a private manager besides performing duties on a straight fee-for-service basis. Beyond this, the performance contracts do not transfer risks from the public to the private party.

Design-Build-Lease Option – The Design-Build-Lease Option is the other PPP option that attempts to divide risks between the public and private parties, but more to an extent than the performance management contracts. The scheme essentially contracts a private operator to design, construct and assume the full responsibilities of operating the system including, the associated demand and commercial risks. The public sector party would in turn, assume the ownership of the assets and undertake the finance responsibilities and related risks including the currency risk which would arise from potential devaluation of the Egyptian Pound.

Upon completion of construction, the private operator leases the assets from the Government along with a concession to operate the system for the entire area for which it pays a lease fee through the life of the contract. In a variant of the DBL scheme, the private operator is requested to put up some capital as equity financing of the investment costs. This contribution is channeled through a special purpose company so as not to intermingle the funds of the various parties. The matrix below re-caps the risk taken up by the private sector under each contract arrangement.

Matrix 6.2: Risks Taken by the Private Sector in Each PPP Institutional Option

	Public Company (PC)	Performance/ Management Contract	Capital-Design-Build-Lease Contract	Concession/ BOT Contract
Demand Risk			●	●
Planning & Design Risk			●	●
Construction Risk	○	○	●	●
Operational and Commercial Risk		○	●	●
Foreign Currency Risk				●
Regulatory Risk			●	●
Financing Risk				●
Credit Risk				●

Legend: ● Total ◒ Partial ○ Limited

6.3 Implementing PPP Options through Institutional Players

The main institutional players for implementing the PPP options include:

- ***The Ministry of Water Resources and Irrigation (MWRI) –*** On behalf of the Government of Egypt the, MWRI would assume the lead role in the policy and sector planning aspects of the Project. In the implementation phases it could assume a number of additional roles depending on the contractual agreement that is eventually implemented. The objective however, would be for the Ministry to devolve most function that could be performed best by other parties (public or private), such as, direct construction and operation of the system, while retaining perhaps general oversight regulatory functions until such time that an independent regulator can be established in an effective manner.

- ***The West Delta Holding Company –*** The West Delta Holding Company[12] (HC) was recently established as a State Owned Public Corporation based on the Egyptian Public Sector Companies Law[13] under the Ministry of Water Resources and Irrigation. The law governs by commercial principles, and is subject to the Egyptian Stock Exchange Laws. While not yet operational the holding company can assume an important role as major implementing agency by executing contractual agreements with service companies for the design, construction, financing and operation of the system. The HC would set up its own management and corporate oversight structure and accounting and financial management systems and would run its business on a full cost recovery basis while assuming certain risks related to the project implementation. Again, the various risk it would assume depend largely on the PPP model chosen for implementation as will be described below.

- ***The Private Sector – The*** private sector can take on a number of different forms, again depending on the contractual arrangements. In its most simplest role, a private construction company could be contracted to construct the system and a separate service company to

[12] We refer here to the Holding Company for Land Development in the Southern Valley and Northern Coast and West Delta, created by Presidential Decree No. 25 for the year 2002.
[13] Law 203, for the year 1991, and its bylaws.

manage operate the system. In its most extensive role the private party would undertake all functions through a single concession agreement with the MWRI or its Holding Company. Its is also important to underscore that the form in which private parties establish themselves should be left to market forces rather than determined ex-ante. This however would be accomplished with obvious compliance of qualifying technical and financial criteria. In other words, the qualified private party may consist of either a single entity or consortium of companies including farmer groups that come together for the specific purpose requested. Farmer groups could equally organize themselves through user associations to undertake a number of services envisioned under the project.

Tables 6.1 and 6.2 below summarize the likely organization structure and respective roles and functions of each main party under each contractual arrangement.

Table 6.1 Public-Private Partnership Likely Organization Structures

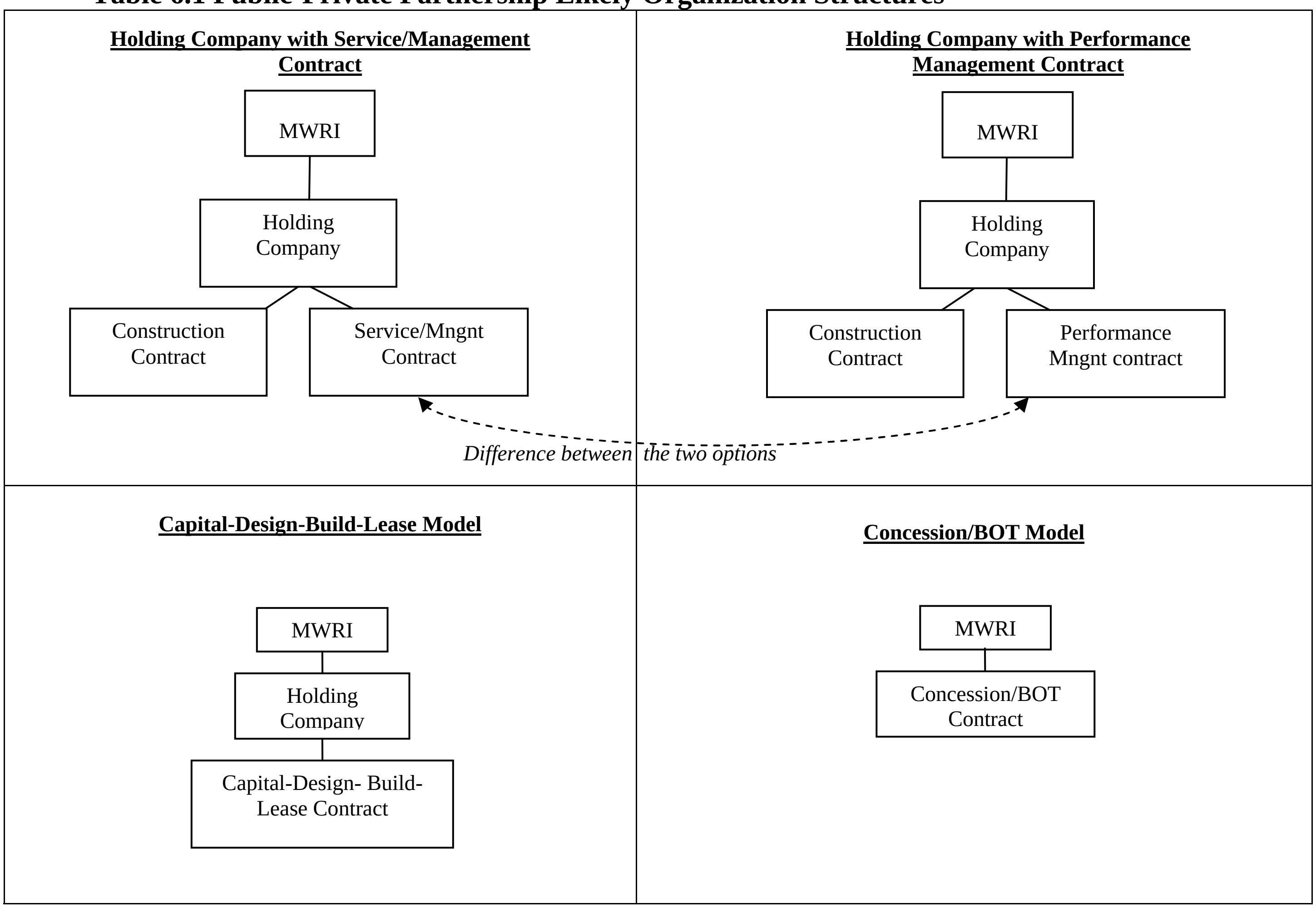


Table 6.2 Respective Roles and Functions of Each Main Party Under Each Contractual Arrangement

	Public Holding Company	**Performance Management Contract**	**Capital Design, Build and Lease Contract**	**Concession/BOT Contract**
Design & Planning	MWRI does system design and planning of needed infrastructure	MWRI does system design and planning of needed infrastructure	Upon wining DBL contract, by offering either least tariff or highest equity contribution, the Private Operator finalizes system design and planning of needed infrastructure as indicated in the BDL contract	MWRI does design and planning at the feasibility level. Upon wining Concession/BOT Contract, by offering either a least tariff or a highest Equity, the Private Operator does final system design and planning of needed infrastructure as indicated in the Concession/BOT Contract
Financing	MWRI finances investments with equity contribution from GOE/MWRI and Loans from IFI or Local Financial Institutions	MWRI finances investments with equity contribution from GOE/MWRI and Loans from IFI or Local Financial Institutions	MWRI finances investments with loans from IFI, GOE equity contributions, and Private Operator equity, As indicated of the DBL contract	Private Operator arranges the financing through equity and commercial loans
Construction	Private sector construct infrastructure upon wining tender handled by the MWRI;	Private sector construct infrastructure upon wining tender handled by the MWRI	Private Operator construct infrastructure as per system design and planning, in line with DBL contract	Private Operator construct infrastructure as part of Concession/BOT contract
Ownership	Allocated to the Asset Holding Company (Holding Company). The Company has separate balance sheet from MWRI and it holds the assets and debt of the project, it has administrative and finance independence	Allocated to the Asset Holding Company (Holding Company). The Company has separate balance sheet from MWRI and it holds the assets and debt of the project, it has administrative and finance independence	Allocated to the Asset Holding Company (Holding Company). The Company has separate balance sheet from MWRI and it holds the assets and debt of the project, it has administrative and finance independence**.** Project debt is paid back using Lease Fee revenues paid by Private Operator specified in DBL contract	Private company sets up special purpose company to hold assets and related debt of the project until they are reverted back to government at the end of the concession term (25-30 years);
Operation & Maintenance	The Holding Company enters into either a service or management contract to operate and maintain the system. Contracts are administered by a small operating arm of the Holding Company. Alternatively the Holding Company would need to staff up to take full control of the management and operation of the system	The Holding Company hires the private sector to manage, operate and maintain infrastructure through a management contract that includes performance targets. Performance targets are linked to financial rewards and penalties. Contract is administered by a small operating arm under the AHC.	Private company operates and maintains infrastructure as part of DBL contract taking on the demand and commercial risk and repaying the debt through an annual lease fee	Private Operator operates and maintains infrastructure according to the concession/BOT contract.

6.4 Recommended PPP Model

The choice of PPP model is largely governed by the following main considerations.

1. ***Allocation of Risks to Private Party.*** Transferring to the extent possible from public to private, the various risks associated with the project while at the same time maintaining a good probability for successful implementation. The pure public model for example would have a high probability for successful implementation but transfers few risks to the private sector. By comparison, the BOT/concession model proposes to transfer essentially all risks but would likely receive extremely low interest from prospective private parties in the absence of sizable subsidy support as recently seen in the Guerdane Concession in Morocco.

2. ***Cost Recovery.*** Realize the Government's objective for cost recovery and for the project to sustain itself financially throughout its project life. This effectively means the absence of capital or operating subsidies to stop any financing gap that would result in any given year. While all models could in theory be implemented on a cost recovery basis, in practice only the models that take on the demand and commercial risks can actually shield the Government's need to intervene in the event a funding gap arises. While governments have bailed out infrastructure projects in the past, this normally occurs only as last resort measures when the cost structure and dynamics of the projects materially change and following substantive negotiations with private sponsors and financiers. In the pure public and management contract options, government's financial support would be solicited in all occurrences where cash positions fail to meet ongoing expenses.

3. ***Favorable Financial Support.*** At the same time, the Government would assume some roles and related risks to achieve project development objectives for sustainability. As part of this, the ability to utilize its credit capacity to mobilize long-term donor financing can greatly support the objective of affordable tariffs which would not be feasible under more commercial financing terms and maturities. Moreover, the concern over conjunctive use requires that surface water tariff rates converge closely to the actual current cost of pumping groundwater any financing terms beyond what could be made available through international donor financing would substantially increase demand risk. This means that the pure private option that requires the private party to raise financing from commercial sources may substantially fall short on achieving affordable and competitive tariffs.

4. ***Linking Planning, Construction and Operating Risks.*** To ensure the maximum possible mitigation of demand risk, it will be essential to link the planning and construction scheduling to actual operation. Otherwise, there is great danger that the system will be over-built and largely non sustainable form its inception. As indicated, the actual implementation of the project would likely be carried out

through a modular construction approach where certain parts of the system would be extended to connect paying customers. In this regard, the utilization of a closed conduit may actually be the more feasible in the event only clusters of growers choose to connect to the system in the early period of project implementation. The pure concession and DBL agreements provide the sponsors to take full control of these aspects of project planning and implementation while the other modes would actually fraction the responsibility to a number of different entities.

5. ***Absolute Financial Commitments.*** Returns for a private party have to correspond not only to the level of risk being undertaken in the project, but also have to consider the absolute value of financial commitment that would be needed. In other words, at some level of financial commitment, there would be little or no interest for investors to buy-in, despite how high the expected returns may be. Moreover, lenders which are by profession risk averse would force equity sponsors to increase their financial commitment implicitly by requiring them to secure the loan portion of the project. Accordingly, the pure private model in this case would require a substantial financial commitment in the form of personal or corporate guarantees from private sponsors beyond what is typically requested by lenders under limited recourse financing.

Based on the foregoing considerations,

- The Design-Build-Lease Option proposes to be the more suitable model to pursue for the West Delta although its attractiveness to potential investors would still need to be confirmed. The following phases of this work would test the attractiveness of the recommendations with potential private investors.

- Like in the pure private option, the DBL transfers most risks to the private sector but requires a relatively lower level of financial commitment at the outset. Since the government would assume the role of raising debt funds, private sponsors would only need to secure to contractual agreement to pay a pre-determined lease fee for the duration of the lease tenure. The private party would be expected to raise the equity counterpart funds which are now estimated at 15% of total investment. Typically the equity contribution would be much greater in traditional private project finance schemes for BOTs and concessions. All this translates in lower costs and more affordable tariffs for the growers.

- At the same time, sourcing loan funds through the international donor assistance would allow for maximum maturities typically not available though commercial arrangements. This would then maintain tariffs to affordable levels, but without explicit capital or operational subsidies.

- The DBL approach also offers the private party to control the critical phases of planning and constructing the systems along with the need to connect actual paying customers to ensure financial sustainability at the outset. The bid agreements would however need to specify the minimum project size in order to ensure an adequate level of coverage at the outset.

- The DBL also allows private operators to earn a profit on the construction portion of the contract which can be utilized to meet its own counterpart financing requirements, thus lowering the initial cash outlays respectively.

- As commercial risk taker the operator of the DBL assumes the full upside benefits and would be able to expand coverage as in a straight concession to increase revenue.

6.5 Additional Measures that can be taken to Mitigate Risks (Elements of a Transaction Model)

As indicated the DBL scheme offers a number of incentives beyond the pure concession agreement. Despite this, further study would be needed to test the feasibility of the concept and potential attractiveness to private groups. Despite this several measures can additionally be taken to additionally mitigate certain risks or increase the incentives for a successful transaction. These are summarized here and include:

1. **Arrangements to Mitigate Demand Risks**

   - Bid would be based on percentage reduction of reference tariff rates for each sector.

   - The Execution of Definitive Connect Agreement with Farmers that specify responsibilities of each party (see Draft agreement in Annex)

   - A tariff structure such that the minimum tariff would be equal to the pro-rated capital cost of the user. This would be specified in the connect agreement.

   - The submission of a Security Deposit which can also be used by the DBL operator as an additional source of counterpart financing

   - The inclusion of connection incentives such as the ability of the project to finance on-farm investments as well the public works. Incentives for on-farm investments would be available to those committing to connect to the system during the initial period of project implementation.

   - Water allocation rights to convey with DBL agreement not to the farmers. This would give the water allocation control to the operator as an additional leverage for farmers to comply with terms and conditions of their agreements and to make the allocations as the demand prescribes.

- Moreover, as a cost recovery tariff is imposed, the likely trend will be for farmers to improve their practices for water conservation and efficiency, which would again mean an overall reduction in the water flow of the system given finite concession boundaries. This condition would again strain the demand risk associated with the project. Remedy for this could include the extension of the concession boundaries such that overtime the private operator can expand the system as water demand fall within the original boundaries.

- As indicated in the finance section the suggested tariff would be differentiated by sector as each would pay its own marginal cost of service. This scheme would then allow more flexibility for the construction of the system based on the actual connection program.

2. Arrangements to Mitigate Design and System Planning Risks

- Linking final design to actual connection program. Once the DBL operator is selected, the agreement would call for finalizing the design of the system, at which point they would be executing connect agreement from growers.

- Flexible construction scheduling.

- Direct Financial Accountability for Over-planning and Creating excess Capacity. The DBL inherently allows for the operator to benefit of suffer the consequences of his own planning. As there will be the inherent incentive to not over plan or construct, some minimum project size designation must be included in the Bid contract.

3. Arrangements to mitigate Operational and Commercial Risks

- Metered volumetric rates.

- Security Staff for guarding water theft in open channels.

- Disconnection and reconnection policy with potential withholding of future water allocations.

- Fines on past due accounts

- Price Adjustment mechanisms for cost increases.

4. Arrangement to Mitigate construction Risks

- Right-of-way access provided in bid document by Government through MWRI.

- Safeguard policies in place (i.e. arrangements for environmental and cultural heritage monitoring and evaluation and international water issues).

- Dispute resolution mechanisms.

5. Arrangements to Mitigate Foreign Exchange and Financing Risks

- With regard to foreign exchange Risks, the holding company would book the loan on its own accounts and charge an interest rate premium on the nominal interest rate to offset any possible losses due to fluctuations of the local currency.

- With regard to financing risks, the government would make full use of IFI lending program to source the lending portion of the financing. In addition, the bid documents would require a specified contribution of counterpart funding from the winning bidder.

6. Arrangements to Mitigate Regulatory Risks

IFI could make available a number of guarantee instruments to offset political, regulatory and breach of contract risks.

In addition regulatory functions and rules would be specified.