

**Ministry of
Water Resources and Irrigation**

**US Agency
for International Development**



**LIFE Integrated Water Resources Management
Task Order No. 802
EPIQ II: Contract No. EPP-T-802-03-00013-00**

Monitoring and Evaluation Plan

*Report No. 3
Rev 01*

February 2005

IRG International Resources Group

**In association with
Academy for Educational Development (AED)
Development Alternatives, Inc. (DAI)
ECODIT
Environmental Quality International (EQI)
Montgomery Watson Harza (MWH)
Training Resources Group, Inc. (TRG)**

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**Prepared by:
Dr Mark Svendsen and Dr Ibrahim El Assiouty**

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Acronyms and Terms

AAU	Agricultural Administrative Unit
BCWUA	Branch Canal Water User Association
CD	Central Directorate
CY	Calendar Year
CY	calendar year
DAI	Development Alternatives, Inc. (a Washington DC-based consulting firm working with IRG to implement the project)
ET	evapotranspiration
GIS	Geographic Information System
GOE	Government of Egypt
GPS	Global Positioning System
IAS	Irrigation Advisory Service
ID	Irrigation Department
IDS	Irrigation and drainage system
IRG	International Resources Group (a Washington DC-based consulting firm that is prime contractor for the IWRMP)
IRMU	Integrated Water Management Unit
IRs	Intermediate Results
IWMD	Integrated Water Management District
IWMU	Integrated Water Management Unit (A unit of MWRI)
IWRMP	Integrated Water Resource Management Project
LIFE	Livelihood and Income from the Environment (project)
M&E	Monitoring and Evaluation
MISD	Matching Irrigation Supply and Demand
MWRI	Ministry of Water Resources and Irrigation
NGO	Non-governmental organization
RWP	Relative Water Supply
SIRs	Sub-Intermediate Results
SOs	Strategic Objectives
TOR	Terms of Reference
USAID	United States Agency for International Development

1. Background

IWRM Project

The Integrated Water Resource Management Project (IWRMP) is being implemented by the Ministry of Water Resources and Irrigation (MWRI) to increase water use efficiency and productivity in Egypt. The project is supported by the United States Agency for International Development (USAID). International Resources Group (IRG), as prime contractor, and the Integrated Water Management Unit (IRMU), the MWRI counterpart, lead and coordinate the project. The project commenced in October 2004 and completes in September 2008.

It comprises seven principal tasks, which are shown in the box at right. Tasks 1, 2, and 3 aim to have a direct impact on water efficiency and productivity and the environment, while Tasks 4, 5, 6, and 7 are pilot and supporting activities with longer-term indirect impacts. This M&E plan relates only to the first three tasks. Other tasks will be monitored separately.

IWRM Project Tasks

1. Formation of Integrated Water Management Districts
2. Formation of Branch Canal Water User Associations
3. Equitable Allocation of Water Resources
4. Improved Maintenance and Upgrading of Water Management Equipment
5. Environmental Services for Improving Water Quality Management
6. Improved Wastewater Reuse Practices
7. Graduate Degree Training for MWRI Staff

M&E Plan

Purposes

This Monitoring and Evaluation (M&E) Plan is intended (a) to guide the implementation of the project and (b) to assess its outcomes and impacts. It is a deliverable called for in the contract between USAID and the prime contractor.¹ In addition to these two primary functions, the practices of setting objectives, defining indicators, and collecting data as required by the M&E activity can be readily adapted, following project completion, to serve as a performance benchmarking activity for the Ministry. Performance benchmarking is an important management tool which can be used to compare the relative performance of different organizational units (for example, Integrated Water Management Districts) and improve overall system and organizational performance.

This activity is based on earlier M&E work carried out under the “Bridging Activity” which preceded the LIFE IWRM project. Indicators and data collection activities developed under this project are described in the publication *A Performance Monitoring and Evaluation System for Integrated Water Management Districts*.²

¹ The contract language mandating the M&E Plan is contained in Annex 1.

² Svendsen, M. and I. Ellassiouty. 2004. Integrated Water Management Unit, Ministry of Water Resources and Irrigation, Cairo.

Components

Monitoring and Evaluation (M&E) is a learning process intended to help leaders and implementers make wise and well-informed choices related to progress toward chosen objectives. It is not simply collecting and analyzing data and it is pointless unless it is integrated directly with program implementation and decision-making. The overview that follows is drawn primarily from a draft *Participatory Monitoring and Evaluation Participants Workbook* prepared by Dr. Dian Svendsen.³

Effective M&E begins with specification of goals and objectives. The remainder of the M&E process then makes judgments about the program's success in achieving those goals and objectives.

A goal is a broad statement of what a program would like to accomplish. It portrays a positive future condition.

Objectives are specific, measurable, appropriate, realistic, and time-bound statements describing what the project hopes to accomplish. Objectives say what is to be achieved. They do not say how it is to be achieved. The project implementation plan must do that. Moreover, it is not enough to have clear objectives. Project objectives must have “buy-in” from key project stakeholders. They must be developed through a consultative process that recognizes that different groups of stakeholders; e.g. farmers and engineers, men and women; are likely to have somewhat different interests which need to be brought together in the set of objectives specified.

Once goals and objectives are established, indicators are formulated to measure progress and change relative to project objectives. **Indicators** are objectively measurable gauges of progress toward achieving an objective or measuring the impact of a specific intervention. Indicators are neutral. That is they do not have value judgments built into them. An indicator of “yield” therefore is simply the measure of output per unit area. The indicator itself does not imply that a particular value of yield, say 3 tons/feddan for example, is good or bad.

An objective can have more than one indicator connected with it. However, it is better to have a limited number of indicators that everyone understands than many complex ones. Indicators can be based on both quantitative and qualitative information.

Specifying values of indicators to be achieved is the job of targets. The indicators themselves, remember, are neutral. **Targets** are specific values of indicators that the program wishes to achieve through its actions.

In order to measure changes resulting from program implementation, it is necessary to know what conditions existed before implementation began. **A baseline** provides a starting point from which to measure progress. It establishes the pre-program values of the chosen indicators. Without baseline information, it may be impossible to determine what has changed, when and by how much.

After a baseline is established, the monitoring program will continue to collect data at suitable intervals that can be used to compute or portray the indicators selected. These will be the same indicators, of course, for which baseline data was collected. Periodically the monitoring data collected will be processed to create a new set of values for the indicators and the new values compared with previous values and the

³ Dian S. Svendsen. 2004. *Participatory Monitoring and Evaluation Participants' Workbook*. HasNa, Washington, DC.

baseline values so that judgments about program effectiveness and impacts can be made.

Relationship to Objectives

An M&E plan can be only as good as the objectives which drive it. Considerable attention has thus been paid to framing operational objectives which capture the intent and spirit of the project. These operational objectives draw directly and explicitly on the objectives contained in official project documents but they have been reformulated and reorganized slightly to be more operationally useful. Reformulated objectives fall into three categories – Decentralization, Participation, and Performance. Considerable effort has also gone into securing a broad consensus among project stakeholders around the objectives and the indicators that measure them, involving numerous reviews and meetings. Objectives are discussed in greater detail below.

Relationship to Project Tasks

The three main objectives drawn from the technical assistance contract relate to the project as a whole and not to individual project activities. There is, therefore, not always a direct correspondence between an objective and one of the three tasks covered by this plan. The results framework presented here has thus been organized in such a way that each of the operational objectives in it can be associated explicitly with one of the main USAID results categories (decentralization, participation, performance) and with USAID Strategic Objectives, and, alternatively, with one or more of the seven project tasks (see box above). This allows the framework to be used to examine the project as a whole, or for individual task managers to look only at the objectives and indicators that relate to their particular set of activities.

Reporting

The results of the M&E activity will be compiled quarterly and annually and will feed into the quarterly, annual, and final reports to USAID on the project, as required by the contract. They will also be used internally to help managers guide project implementation.

2. Objectives

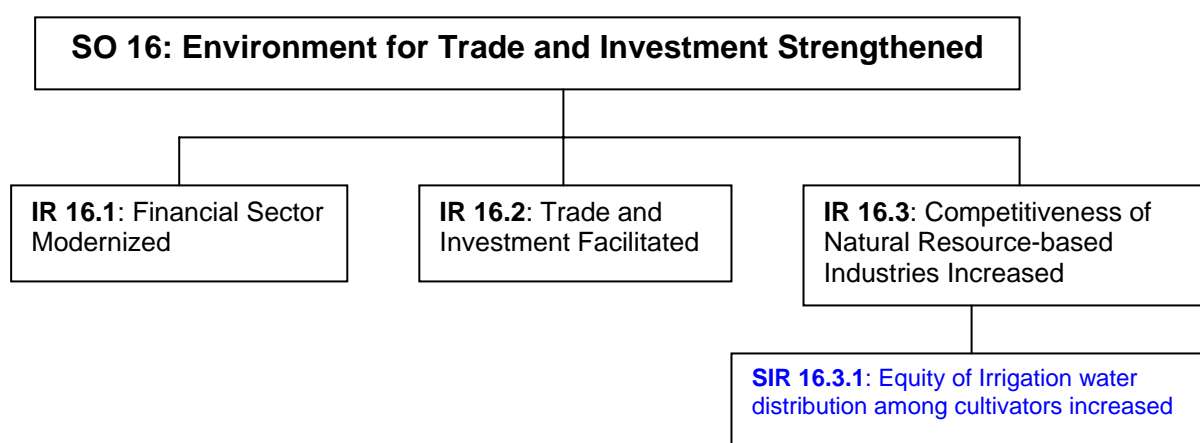
USAID Results Framework

SO Hierarchy

USAID organizes its projects under Strategic Objectives (SOs) for management purposes. The LIFE IWRM project falls under *SO 16: Environment for Trade and Investment Strengthened*.⁴ In this framework, under each SO are Intermediate Results (IRs) and under these are Sub-Intermediate Results (SIRs). These three levels act as a nested hierarchy of objectives guiding the project. SO 16 has three IRs. One of these, *IR 16.3: Competitiveness of Natural Resource Based Industries Increased*, is the working objective for the project.

IR 16.3 aims, among other things, to increase the competitiveness of sectors with high potential to raise incomes of average Egyptians. Competitiveness is enhanced through sustainable development of the human and natural resources on which productive activities are based. Strengthening local NGOs and communities to participate in decision making that affects resource use will also contribute to improved democracy and governance. Efforts under this SO will promote improved environmental management in water conservation (for agricultural productivity). As SIRs have not yet been adopted under IR 16.3. The SIR shown in Figure 1 is proposed to guide performance monitoring of IWRM. USAID/Egypt's SO framework and the IWRM project objectives have been explicitly incorporated into this results framework.

Figure 1. USAID Strategic Objective hierarchy



Rationale for SIR 16.3.1

Agricultural water management in Egypt has reached a performance plateau under current organizational structures and operating practices. To step up to a new level, some fundamental modifications are needed. Under the LIFE project, the MWRI is beginning to make these modifications. Changes include integrating responsibility for

⁴ Originally, the LIFE project fell under USAID *Strategic Objective (SO) 19: Improved Management of the Environment and Natural Resources of Targeted Areas*. This SO, together with SO 22, was subsequently merged with SO 16 to form a new economic growth objective.

drainage, irrigation, and other public water-related services at the field level into Integrated Water Management Districts (IWMDs) and devolving greater authority to them, forming Water User Associations at the Branch Canal level (BCWUAs), and employing revised system operating practices involving data-based management systems and closer cooperation between public water managers and farmer-users of irrigation and drainage services.

The impacts stemming from these changes will necessarily take some time to emerge on the ground. Ultimately they can be expected to increase rural incomes, increase agricultural exports, generate new employment, and increase agricultural sector output. However to be measurable and significant on a national scale will require time and the expansion of the program over larger areas of the country.

Over the shorter run, intermediate outcomes and impacts can be observed. The degree of success achieved in putting in place the new structures and procedures can be readily observed and documented. In addition, a powerful predictor of future economic impacts is increased equity in the distribution of water to farmers within the project area. This objective has the advantage of being clearly within the manageable interest of the project actors and stakeholders. By contrast, higher level indicators such as yields and agricultural export levels are also functions of exogenous factors such as domestic and world market prices for inputs and outputs, export infrastructure, pest and disease incidence, and so on.

One of the principal constraints to rising production, income, and exports is the uneven distribution of water deliveries to farms. Agriculture in Egypt is almost completely dependent on irrigation, and an adequate water supply is a critical determinant of output. Head-end farms generally have considerably better access to water than tail-end farms. Although not universal across the country, this generalization often applies at all levels – main canal, branch canal, and *mesqa*, which is a smaller canal taking water from the branch canal to the farms. Thus while yield and output in favoured locations can be extremely high, averages are brought down by low yields and output in areas experiencing water shortages and drainage problems. By making the distribution of water more equitable across the various system levels, average yields rise and other positive change follow. An increase in equity of water distribution is thus an important predictor of positive future economic growth outcomes, as well as being an important “equitizer” of rural welfare in its own right.

Project Objectives

Supplementing the information on project objectives contained in the SO framework, guidance for framing project objectives and indicators for assessing project performance is provided by the contract between USAID and the prime contractor. For the following discussion, objectives have been extracted from the text passages in which they are presented in the contract and then organized and listed in a standard format. From that exercise two primary objectives and several secondary ones can be distinguished. The primary objectives are the following.

1. Water management decision making is **decentralized**
2. Stakeholders **participate** more in water management decision making.

The secondary objectives extracted from the contract are these.

1. Stakeholders take more responsibility for maintaining water conveyance infrastructure

2. Quality of local water resources is improved
3. Water management is improved, raising rural incomes
4. Local communities adopt improved management practices for solid and liquid waste
5. More private sector jobs are available in the water sector.

These objectives can be conveniently grouped into three overall categories:

- **Decentralization**
- **Participation**
- **Performance.**

The five “secondary objectives” shown above comprise the performance category. These objectives have been used as a base to create the set of operational objectives described below.

The resulting six operational objectives are shown in Table 1. The first three objectives generally refer to the process of project implementation. The last three objectives are the “impact” objectives, which assess the impact the project has on the local population and the environment

Table 1 Project Objectives

1	IWMDs created and functioning to cover completely the 4 project directorates
2	Measurement-based management practices established and functioning in all IWMDs
3	BCWUAs participate in the management system in all IWMDs
4	Quality of irrigation service to farmers improved in all IWMDs
5	Equity of water distribution among and within all IWMDs improved
6	Real gross value of agricultural output in all IWMDs increased

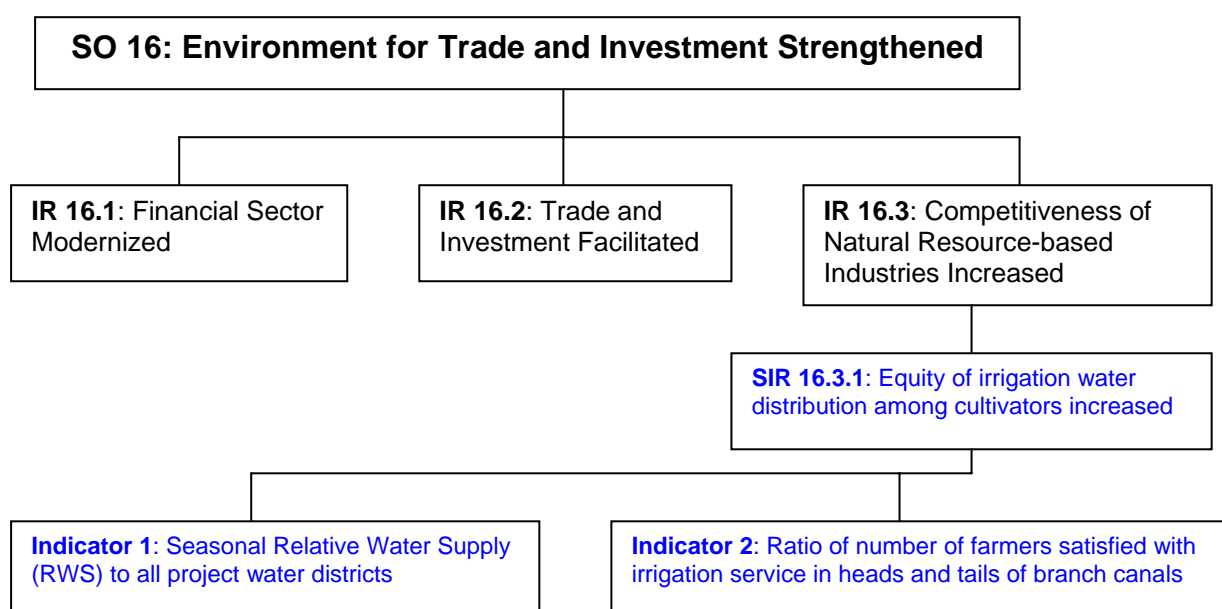
Each objective requires one or more indicators to measure results related to the objective.

3. Indicators

USAID SO Indicators

Two indicators are singled out for use in assessing SIR 16.3.1 as proposed under Objectives, above. The first measures equity of distribution among Integrated Districts within a Directorate. The second indicator measures equity of water distribution among Branch Canals within Districts. This indicator responds to the actions of the District staff, working in conjunction with the new local BCWUAs. These two indicators are shown in Figure 2 and described later in this section.

Figure 2 USAID Results Framework Structure



LIFE IWRMP M&E Objectives and Indicators

Indicators to be used are shown in Table 2, together with the objectives they relate to, the units of measurement, the contract objective category, and annual targets (see below). The indicators shown here are closely related to and subsume the illustrative indicators contained in the contract document. Objectives and indicators are sorted by project task and presented for each task separately in Annex 2.

Table 2 Target Values for Implementation Indicators

LIFE IWMP M&E Objectives and Indicators

Objective	Indicator	Units	Contract Objective	Targets					
				Baseline	Year 1	Year 2	Year 3	Year 4	
1	IWMDs created and functioning to cover completely the 4 project directorates	Area served by functioning IWMDs	Feddans	Decentralization	0	0	229,476	688,427	1,239,169
1.1		Number of IWMDs established by signed Ministerial decree	Number	Decentralization	4	27	27	27	27
1.2		Number of districts with geo-referenced maps showing district boundaries and canal layouts	Number	Decentralization	4	27	27	27	27
1.3		Number of IWMDs with completed integrated maintenance plans	Number	Decentralization	4	27	27	27	27
1.4		Number of IWMDs fully-staffed senior positions according to new staffing plan	Number	Decentralization	0	27	27	27	27
1.5		Number of IWMDs with local computer networks installed and operational	Number	Decentralization	4	16	27	27	27
1.6		Number of IWMDs awarding maintenance contracts directly	Number	Decentralization	0	0	5	15	27
2	Measurement-based management practices established and functioning in all IWMDs	Area served by IWMDs with functioning measurement-based water management systems	Feddans	Decentralization	0	0	413,056	826,113	1,239,169
2.1		Number of IWMDs with calibrations for all authorized inflow and outflow structures into and out from the District	Number	Decentralization	1	15	27	27	27
2.2		Number of IWMDs providing 15-daily reports of measured water inflows to the District Manager for one complete season	Number	Decentralization	0	0	15	27	27
2.3		Number of IWMDs with a completed water resource inventory in approved standard format	Number	Decentralization	0	9	18	27	27
2.4		Number of IWMDs with a completed water resource management plan in approved standard format (includes MISD)	Number	Decentralization	0	0	9	18	27
3	BCWUAs participate in the management system in all IWMDs			Participation					
3.1		Area covered by BCWUAs with signed MOUs with MWRI	Feddans	Participation	166,500	550,742	917,903	1,101,484	1,239,169
3.2		Area covered by BCWUAs with internal regulations approved by the respective RA	Feddans	Participation	0	91,790	160,633	252,423	619,585
3.3		Number of IWMDs holding Branch Canal-level meeting with representatives of at least 75% of BCWUAs at least once in the previous 6 months to discuss BC issues	Number	Participation	0	4	12	20	27
3.4		Number of BCWUAs providing written maintenance priorities to IWMD	Number	Participation	0	0	50	100	250
3.5		Number of IWMDs holding district-level group meetings with representatives of all BCWUAs at least once per season	Number	Participation	0	0	4	8	15

4	Quality of irrigation service to farmers improved in all IWMDs			Performance					
4.1	Number of complaints filed by farmers with the IWMD	Number		Performance					
4.2	Ratio of total seasonal IWMD canal inflows to target allocation for season	Dimensionless		Performance					
4.3	Share of number of 15-daily periods for which supply matched target within 10%	Percent		Performance					
4.4	Percent of farmers in each IWMD satisfied with quality of irrigation service	Percent		Performance					
4.5	Ratio of average duration of a rotation to planned duration	Dimensionless		Performance					
4.6	Ratio of average interval between rotations to planned interval	Dimensionless		Performance					
5	Equity of water distribution among and within all IWMDs improved			Performance					
5.1	Fraction of seasonal IWMD RWS values falling within ±10% of allocation target	Dimensionless		Performance					
5.2	Ratio of satisfied farmers in head and tail reaches of Main Canals within the District	Dimensionless		Performance					
5.3	Ratio of satisfied farmers in heads and tails of Branch Canals within the District	Dimensionless		Performance					
6	Real gross value of agricultural output in all IWMDs increased			Performance					
6.1	Real gross value of agricultural output per feddan in IWMD	LE/feddan		Performance					
6.2	Real gross value of agricultural output per 1000 m ³ of water in IWMD	LE/m ³ of water		Performance					

See Discussion

BCWUA, Branch Canal Water Users Association; IWMD, Integrated Water Management District; RWS, Relative Water Supply

Note: Performance indicators 4 through 6 will be reported by District and then aggregated to Directorate and Project levels.

Task 1: Formation of IWMDs

Task 2: Establishment of BCWUAs

Task 3: Equitable allocation of water resources

Relative Water Supply

Relative Water Supply (RWS) is a well-established measure of the amount of water supplied to an area. It consists of the measured volume of water supplied to a defined area divided by the crop-specific water demand arising from that area (its ET or evapotranspiration). RWS thus measures water supply to an area, standardized for the area to be covered, the mix of crops to be grown, and the climate conditions of the locale. A RWS value of 1.0 would be exactly enough water to meet the evapotranspiration needs of the crops when delivered to their roots. A value of 2.0 would indicate a supply of twice as much water as the crops need. Because of unavoidable losses in delivery and management, desired values of RWS are generally more than 1.0 and less than 1.5.

The project will measure the RWS separately for each season (summer and winter) for each of the 27 IWMDs in the project area. After baseline RWS values are measured for each of the 27 districts, a project-wide band of standard desired RWS values will be set for each season. The Directorates working with the districts will then attempt to provide measured volumes of water to each district that just meet the calculated water requirement. In subsequent years, measured RWS values from each district will be compared with this band and the fraction of districts whose RWS falls within the band will be counted. Annual targets would then consist of the number of districts with RWS values that fall within the desired range.

An example might be as shown in table 3, which shows hypothetical baseline and targets and assuming that the desired band for summer deliveries was defined as RWS between 1.00 and 1.25.

Table 3 Number of Districts Receiving Desired Quantity of Water

	Baseline	Year 2	Year 3	Year 4
Target (hypothetical)	5	10	20	27
Actual				

Thus during the baseline year (before the project) five of our hypothetical districts received a water supply that fell into the desired range. This means that the 22 other districts received either more or less water than desired. The project would aim to increase the number of districts falling in the acceptable band in subsequent years until all districts were receiving a supply that fell within the desired range. If these targets were achieved, among-district equity would thus clearly be greater than it was under baseline conditions.

An alternative way to process and target values of the RWS indicator would be to compute a statistical measure such as a standard deviation or a coefficient of variation of the values measured for all of the districts. This would be simpler, but its meaning would be less intuitive.

Farmer Satisfaction

Since water is difficult to measure economically below the district level under Egyptian conditions, reported values of farmer satisfaction with irrigation service would be used to indicate the evenness of water distribution among the 30 to

50 Branch Canals within each district. The percentage of farmers reporting satisfaction with irrigation service for a particular season would be measured through a field survey and the percentage of satisfied farmers drawing water from Branch Canals in the head reach of a main canal in a district divided by the percentage of satisfied farmers along Branch Canals in tail reach of the main canal in the district to obtain a dimensionless ratio. Its value would be 1.0 under conditions of perfect equity and very large where the distribution was highly inequitable.

Table 4 shows an example. Target values are not ones being proposed and are presented only for illustration purposes.

Table 4 Ratio of Head/Tail Farmer Satisfaction with Irrigation Service

	Baseline	Year 2	Year 3	Year 4
Target (hypothetical)	3.0	2.5	2.0	1.5
Actual				

Project Indicators

There are 28 project indicators in the Plan. Seventeen the indicators are related to the progress of project implementation, while the remaining 11 indicate the impact that the project is having on productive agriculture in the target area. Two of the indicators in the latter group feed into the USAID SO framework.

Targets

Each indicator also has target values associated with it. Target values have been established for the four years of the project for the implementation indicators, together with a set of baseline values that represent pre-project conditions. Targets will be adjusted as the project progresses, if needed. Quarterly targets may be established for some indicators for the year immediately ahead if needed. Target values for the three implementation objectives are shown in Table 2. Target values for the impact indicators will be set once baseline data is available to establish initial conditions.

4. Data Collection

Data for the M&E activity will come from three principal sources. Data for most of the implementation indicators are simply indications of whether or not individual IWMDs have completed a particular step in the implementation process. Leaders for Task Teams 1, 2, and 3 will be responsible for seeing that these data are collected on forms developed for this purpose. Draft forms are shown in Annex 3.

Data for the impact indicators will come from two sources. The first is the data acquisition system being set up in each of the 27 IWMDs under Task 3 of the project. These data include information of water deliveries to the IWMDs, cropping patterns, and complaints filed with the IWMD by farmers. The only addition to the system being set up for this data will be a way of channelling the subset of the data required for the M&E activity to a central computer in the IWMU in Cairo. This will be done as a regular part of the implementation of Task 3.

The second source of impact data is a sample survey planned for each of the 4 years of the project. The survey, while covering a substantial number of farmers, will be extremely short, and will focus exclusively on assessing farmer perceptions of the quality of their irrigation and drainage services. The first round of the survey will establish a baseline in each IWMD, while subsequent rounds will assess changes as the project progresses.

A third, more minor, source of data for the impact indicators will be records kept by existing BCWUAs recording the timing of water deliveries to their branch canals throughout the cropping year. A draft form for this is shown in Annex 4. A data collection plan covering all of these data sources is shown in Annex 5.

The sample survey is an important source of information on the impacts the project is having on the quality and equity of irrigation service delivery. The survey will employ a stratified design with strata defined (a) at the IWMD level, (b) at the level of head, middle, and tail end branch canals within each IWMD, and (c) at the level of head, middle, and tail of the branch canals themselves. This will allow satisfaction to be assessed and compared at all of these levels. Changes over time can also then be assessed at each of these levels.

5. Analysis and Reporting

Implementation Indicators

Analysis of the Implementation Indicators (1.1 through 3.5) are simple and straightforward. Most are simply numbers of occurrences (e.g. “number of IWMDs with local computer networks installed and operational) which are summed across districts and reported against the target. Others are framed in terms of area served by a particular organizational entity meeting a certain criterion (e.g. area covered by BCWUAs with internal regulations approved by the respective Representative Assembly). For these the area associated with each unit (e.g. the BCWUA) meeting the criterion is summed and reported against the target.

Impact Indicators

Most of the Impact Indicators require some computation to create them. These are discussed individually below. Establishing targets for these indicators must be deferred until baseline data is available to permit realistic assessment of target values. For all indicators, gender effects will be disaggregated wherever possible and appropriate.

Complaints (4.1)

Number of complaints filed with the IWMD will be extracted from IWMD databases and reported on a seasonal basis. These will be summed and reported against targets. A decline in number of complaints is expected.

Seasonal IWMD Allocations (4.2)

Measured canal inflows to each IWMD will be summed for each season and divided by the seasonal target allocation for the IWMD obtained from the respective Directorate. These ratios can then be weighted and averaged to obtain a single value of the ratio for the project for each season. Values are expected to be above one, but the direction of expected change will depend on measured baseline values.

15-daily IWMD Allocations (4.3)

Measured canal inflows to each IWMD will be summed for each 15-day period and divided by the 15-daily target allocation for the IWMD obtained from the respective Directorate. The number of periods within each season (out of a total of 24) for which the ratio falls between 0.9 and 1.1 will be counted. The values obtained (e.g. 12, 15, or 20) for each IWMD will be averaged and reported for the project as a whole. Averages are expected to rise over the course of the project.

Service to Farmers at IWMD level (4.4)

Sample survey data for each season will be processed for each IWMD to produce a percentage of farmers who are satisfied with the irrigation service they received during the season. These values will be reported individually and averaged to obtain a value for the entire project. Values are expected to rise over the course of the project.

Precision of Rotation (4.5, 4.6)

BCWUAs, soon after each is formed, will be asked to record the time and date of the beginning of flow into their Branch Canal (BC) at the onset of a rotational turn and

the time and date of the cessation of flow into the canal. The difference between *on* and *off* times will be computed for each branch canal and then averaged for blocks of BCs which are receiving the same rotation. The average duration of the rotation will then be divided by the planned duration obtained from the IWMD to produce a ratio which can be less than or greater than one. The absolute values of the deviations from one will be averaged to create a single value for each IWMD for the season. These will be averaged across all IWMDs to create a single value for each season for the project. This value is expected to decline over the course of the project.⁵

A similar procedure will be followed for the intervals between rotations (*off to on* durations). This index is also expected to decline.

Allocational Equity among IWMDs (5.1)

Information on seasonal crop water requirements and water deliveries will be obtained from the “Match in Supply and Demand” (MISD) database in each IWMD and used to compute a seasonal Relative Water Supply (RWS) value. The number of RWS values for the 27 IWMDs falling into a band ranging from 0.9 to 1.1 will be counted and divided by the number of districts reporting to obtain a weighted average percentage value ranging between 0 and 100 percent. This value will be reported and compared to target values. The value is expected to rise over the course of the project. This value will feed into the USAID SO framework.

Allocational Equity among Branch Canals (5.2)

Sample survey data for each season will be analyzed for pre-defined groups of head and tail end BCs within each IWMD.⁶ Values representing satisfaction of farmers served by head-end canals within the IWMD will be divided by similar values for tail-end BCs to yield a ratio that will generally be greater than one. These values will be averaged for all IWMDs to obtain a project average value. This value is expected to decline toward 1 over the course of the project. This value will feed into the USAID SO framework.

Allocational Equity within Branch Canals (5.3)

A procedure similar to that described for Indicator 5.2 above will be followed using satisfaction data from pre-defined groups of farmers in the heads and tails of all of the BCs within an IWMD. These values will be aggregated as described above. The project average value is expected to decline toward 1 over the course of the project. (See also footnote 6.)

Output per Unit Land (6.1)

Crop area, yield, and price data from the IWMD database and used to compute a weighted average value of agricultural production per feddan from each IWMD for each season.⁷ A weighted average value of these values will be computed, in turn, to

⁵ The change is expected to result both from the IWMD using its new authority to adjust rotational patterns and from more careful management to achieve the scheduled rotation.

⁶ Data will be collected from 3 strata (head, middle, and tail) though only head and tail values will be used to compute the index. Data can be used for more extensive analysis of head, middle, and tail differences, however, if desired.

⁷ This data will be obtained from the local-level Agricultural Administration office and placed in the IWMD database.

produce a per feddan value of agricultural output for the project area for each season. This value is expected to rise over the course of the project.⁸

Output per Unit Water (6.2)

A procedure similar to that described for Indicator 6.1 above will be followed, substituting the total volume of water delivered to the IWMD for the season for cropped area to obtain a value of output per unit of water delivered. This value is also expected to rise over the course of the project (see also footnotes 7 and 8).

⁸ The causal connection with the project here though is not terribly strong, as many other factors influence value of output.

6. Plan Implementation

Implementation of the M&E plan is closely integrated into the implementation of the project itself. The M&E Team Leader will provide overall coordination and leadership for the activity, supported by 2 or 3 visits annually of the external M&E Specialist. Task Team Leaders for tasks 1, 2, and 3 will be responsible for data retrieval from the IWMD databases.

Annual sample surveys will be carried out under contract with an experienced outside survey group. An initial agreement to design and test a sampling plan for the survey and develop and test a draft questionnaire will be implemented with a local firm. A set of TORs for this activity are attached in Annex 6.

Timetable

1. M&E Plan completed in February 2005.
2. Calibration of IWMD inflow and outflow structures proceeds over the next 8 to 16 months to allow volumetric flow measurement and establishment of baseline conditions.
3. Preparation for carrying out sample survey takes place during the first half of CY 2005, with the first (baseline) survey round during the third quarter of CY 2005.
4. Database and data collection system development at the IWMD level proceeds over the first 3 years of the project. Districts begin reporting monitoring data as soon as they have completed one full season of data collection and storage.
5. Record keeping by the BCUWAs is implemented during the first half of calendar year (CY) 2005 in the 96 existing BCWUAs and in the others as they are established.
6. Reporting on Implementation Indicators by Task Team Leaders begins in the first quarter of CY 2005 for all IWMDs and continues throughout the project.
7. M&E Specialist works with M&E team members in September 2005 to prepare first annual M&E report.
8. In subsequent years, M&E data flow to a central point in the IWMU as per the data systems established. Sample surveys are conducted annually during the second quarter of each CY to cover both preceding agricultural seasons.
9. M&E Specialist works with M&E team annually in September to prepare annual report submissions and on other occasions as needed.

Training Needs

Training for the sample survey enumeration will be carried out by the contractor implementing the surveys. Any other training needed beyond the training provided as a part of the regular implementation of Task 3 will be provided by appropriate Task Team, assisted by the M&E Specialist, on an *ad hoc* basis. Such needs are expected to be very limited.

Equipment Needs

No equipment beyond that otherwise provided for under the project is required.

Annex 1: Contract Language Mandating an M&E Plan

Monitoring and Evaluation

1. Within the first 90 days of the contract, the contractor shall review the then current applicable USAID SO results statements, identify new or refine existing and illustrative indicators to measure results, collect baseline data, and establish actual targets based on the collected baseline data. These targets will be updated during the course of project implementation, as appropriate.

2. Development of a comprehensive M&E Plan will be undertaken immediately following the completion of this initial data gathering effort and will involve all relevant partners in the sub-sector, i.e., MWRI counterparts, USAID, other donors, etc., and will be an interactive process of identifying monitoring parameters with clear indicators and benchmarks for determining progress against applicable SO results statements. A copy of the then current SO results statements will be provided to the contractor for use in this task. This exercise will propose indicators and performance targets for years 1, 2, 3, and 4 of the contract with clear responsibilities delineated for data collection against targets and reporting mechanisms. All proposed indicators and targets developed through this interactive process will be submitted for approval by the designated USAID CTO of the contract.

3. The contractor understands and agrees that achievement of tangible results is the essence of the contract and that USAID will judge the contractor's success in the contract based upon whether or not the tangible results are achieved. In the event that any one or more of the tangible results is (are) not achieved, or should the contractor at any time realize that they are not achievable, the contractor shall immediately advise USAID in writing, and in the next report, required as part of the existing "Reporting Requirements," shall provide a complete explanation related thereto.

Annex 2: Objectives and Indicators, by Task

LIFE IWMP M&E Objectives and Indicators - Task 1

Objective	Indicator	Units	Contract Objective	Task Teams		
				1	2	3
1 IWMDs created and functioning to cover completely the 4 project directorates	Area served by functioning IWMDs	Feddans	Decentralization	1		
1.1	Number of IWMDs established by signed Ministerial decree	Number	Decentralization	1		
1.2	Number of districts with geo-referenced maps showing district boundaries and canal layouts	Number	Decentralization	1		
1.3	Number of IWMDs with completed integrated maintenance plans	Number	Decentralization	1		
1.4	Number of IWMDs fully-staffed senior positions according to new staffing plan	Number	Decentralization	1		
1.5	Number of IWMDs with local computer networks installed and operational	Number	Decentralization	1		
1.6	Number of IWMDs awarding maintenance contracts directly	Number	Decentralization	1		
3 BCWUAs participate in the management system in all IWMDs			Participation	1	1	1
3.3	Number of IWMDs holding Branch Canal-level meeting with representatives of at least 75% of BCWUAs at least once in the previous 6 months to discuss BC issues	Number	Participation	1	1	
3.4	Number of BCWUAs providing written maintenance priorities to IWMD	Number	Participation	1	1	1
3.5	Number of IWMDs holding district-level group meetings with representatives of all BCWUAs at least once per season	Number	Participation	1	1	1
4 Quality of irrigation service to farmers improved in all IWMDs			Performance	1	1	1
4.1	Number of complaints filed by farmers with the IWMD	Number	Performance	1	1	1
4.2	Ratio of total seasonal IWMD canal inflows to target allocation for season	Dimensionless	Performance	1		1
4.3	Share of number of 15-daily periods for which supply matched target within 10%	Percent	Performance	1		1
4.4	Percent of farmers in each IWMD satisfied with quality of irrigation service	Percent	Performance	1	1	1
4.5	Ratio of average duration of a rotation to planned duration	Dimensionless	Performance	1	1	1
4.6	Ratio of average interval between rotations to planned interval	Dimensionless	Performance	1	1	1
5 Equity of water distribution among and within all IWMDs improved			Performance	1	1	1
5.1	Fraction of seasonal IWMD RWS values falling within ±10% of allocation target	Dimensionless	Performance	1	1	1
5.2	Ratio of satisfied farmers in head and tail reaches of Main Canals within the District	Dimensionless	Performance	1		1
5.3	Ratio of satisfied farmers in heads and tails of Branch Canals within the District	Dimensionless	Performance	1	1	1
6 Real gross value of agricultural output in all IWMDs increased			Performance	1	1	1
6.1	Real gross value of agricultural output per feddan in IWMD	LE/feddan	Performance	1	1	1
6.2	Real gross value of agricultural output per 1000 m³ of water in IWMD	LE/m³ of water	Performance	1	1	1

BCWUA, Branch Canal Water Users Association; IWMD, Integrated Water Management District; RWS, Relative Water Supply

Note: Performance indicators 4 through 6 will be reported by District and then aggregated to Directorate and Project levels.

Task 1: Formation of IWMDs
 Task 2: Establishment of BCWUAs
 Internal Resource Group

LIFE IWMP M&E Objectives and Indicators - Task 2

Objective	Indicator	Units	Contract Objective	Task Teams		
				1	2	3
2 Measurement-based management practices established and functioning in all IWMDs	Area served by IWMDs with functioning measurement-based water management systems	Feddans	Decentralization		1	1
2.4	Number of IWMDs with a completed water resource management plan in approved standard format (includes MISD)	Number	Decentralization		1	1
3 BCWUAs participate in the management system in all IWMDs			Participation	1	1	1
3.1	Area covered by BCWUAs with signed MOUs with MWRI	Feddans	Participation		1	
3.2	Area covered by BCWUAs with internal regulations approved by the respective RA	Feddans	Participation		1	
3.3	Number of IWMDs holding Branch Canal-level meeting with representatives of at least 75% of BCWUAs at least once in the previous 6 months to discuss BC issues	Number	Participation	1	1	
3.4	Number of BCWUAs providing written maintenance priorities to IWMD	Number	Participation	1	1	1
3.5	Number of IWMDs holding district-level group meetings with representatives of all BCWUAs at least once per season	Number	Participation	1	1	1
4 Quality of irrigation service to farmers improved in all IWMDs			Performance	1	1	1
4.1	Number of complaints filed by farmers with the IWMD	Number	Performance	1	1	1
4.4	Percent of farmers in each IWMD satisfied with quality of irrigation service	Percent	Performance	1	1	1
4.5	Ratio of average duration of a rotation to planned duration	Dimensionless	Performance	1	1	1
4.6	Ratio of average interval between rotations to planned interval	Dimensionless	Performance	1	1	1
5 Equity of water distribution among and within all IWMDs improved			Performance	1	1	1
5.1	Fraction of seasonal IWMD RWS values falling within ±10% of allocation target	Dimensionless	Performance	1	1	1
5.3	Ratio of satisfied farmers in heads and tails of Branch Canals within the District	Dimensionless	Performance	1	1	1
6 Real gross value of agricultural output in all IWMDs increased			Performance	1	1	1
6.1	Real gross value of agricultural output per feddan in IWMD	LE/feddan	Performance	1	1	1
6.2	Real gross value of agricultural output per 1000 m³ of water in IWMD	LE/m³ of water	Performance	1	1	1

BCWUA, Branch Canal Water Users Association; IWMD, Integrated Water Management District; RWS, Relative Water Supply

Note: Performance indicators 4 through 6 will be reported by District and then aggregated to Directorate and Project levels.

Task 1: Formation of IWMDs

Task 2: Establishment of BCWUAs

Task 3: Equitable allocation of water resources

LIFE IWMP M&E Objectives and Indicators - Task 3

Objective	Indicator	Units	Contract Objective	Task Teams			
				1	2	3	
2	Measurement-based management practices established and functioning in all IWMDs	Area served by IWMDs with functioning measurement-based water management systems	Feddans	Decentralization		1	1
2.1	Number of IWMDs with calibrations for all authorized inflow and outflow structures into and out from the District	Number	Decentralization				1
2.2	Number of IWMDs providing 15-daily reports of measured water inflows to the District Manager for one complete season	Number	Decentralization				1
2.3	Number of IWMDs with a completed water resource inventory in approved standard format	Number	Decentralization				1
2.4	Number of IWMDs with a completed water resource management plan in approved standard format (includes MISD)	Number	Decentralization		1		1
3	BCWUAs participate in the management system in all IWMDs			Participation	1	1	1
3.4	Number of BCWUAs providing written maintenance priorities to IWMD	Number	Participation	1	1		1
3.5	Number of IWMDs holding district-level group meetings with representatives of all BCWUAs at least once per season	Number	Participation	1	1		1
4	Quality of irrigation service to farmers improved in all IWMDs			Performance	1	1	1
4.1	Number of complaints filed by farmers with the IWMD	Number	Performance	1	1		1
4.2	Ratio of total seasonal IWMD canal inflows to target allocation for season	Dimensionless	Performance	1			1
4.3	Share of number of 15-daily periods for which supply matched target within 10%	Percent	Performance	1			1
4.4	Percent of farmers in each IWMD satisfied with quality of irrigation service	Percent	Performance	1	1		1
4.5	Ratio of average duration of a rotation to planned duration	Dimensionless	Performance	1	1		1
4.6	Ratio of average interval between rotations to planned interval	Dimensionless	Performance	1	1		1
5	Equity of water distribution among and within all IWMDs improved			Performance	1	1	1
5.1	Fraction of seasonal IWMD RWS values falling within $\pm 10\%$ of allocation target	Dimensionless	Performance	1	1		1
5.2	Ratio of satisfied farmers in head and tail reaches of Main Canals within the District	Dimensionless	Performance	1			1
5.3	Ratio of satisfied farmers in heads and tails of Branch Canals within the District	Dimensionless	Performance	1	1		1
6	Real gross value of agricultural output in all IWMDs increased			Performance	1	1	1
6.1	Real gross value of agricultural output per feddan in IWMD	LE/feddan	Performance	1	1		1
6.2	Real gross value of agricultural output per 1000 m ³ of water in IWMD	LE/m ³ of water	Performance	1	1		1

BCWUA, Branch Canal Water Users Association; IWMD, Integrated Water Management District; RWS, Relative Water Supply

Note: Performance indicators 4 through 6 will be reported by District and then aggregated to Directorate and Project levels.

Task 1: Formation of IWMDs

Task 2: Establishment of BCWUAs

Task 3: Equitable allocation of water resources

Annex 3. Data Collection Forms for Objectives 1, 2, and 3

Data Collector: _____

Task 1 Data Collection Form

Date: _____

Indicator	Units	New Zifta					West Sharkiya					Qena					Aswan										
		North Zifta	El Santa	Quesna	Zifta	Birket el Sab'a	abu Kebeer	Kafr Sakr	Awlad Sakr	El Ibrajo,oa	El Zagazig	Esna	Armant	Luxor	Nakada	Gous	Qena	Deshna	Nagaa Hammadi	Abu Tesht	Aswan	El Tobsa	Wadi El Nokra	Kom Ombo	Eiselsa	East Edfu	West Edfu
1.1 IWMDs established by signed Ministerial decree	Number																										
1.2 Districts with GIS-based maps showing district boundaries and canal layouts	Number																										
1.3 IWMDs with completed integrated maintenance plans	Number																										
1.4 IWMDs with fully-staffed senior positions according to new staffing plan	Number																										
1.6 IWMDs awarding maintenance contracts directly	Number																										

Instructions: Place an "X" in the box for each IWMD (or directorate) which has satisfied a particular indicator

Data Collector: _____

Task 2 Data Collection Form

Date: _____

Indicator	Units	New Zifta					West Sharkiya					Qena					Aswan											
		North Zifta	El Santa	Quesna	Zifta	Birket el Sab'a	abu Kebeer	Kafr Sakr	Awlad Sakr	El Ibrajio,oa	El Zagazig	Esna	Armant	Luxor	Nakada	Qous	Qena	Deshna	Nagaa Hammadi	Abu Tesht	Aswan	El Tobsa	Wadi El Nokra	Kom Ombo	Eiselsla	East Edfu	West Edfu	Wadi El Saida
3.1	Area covered by BCWUAs with signed MOUs with MWRI	Feddans																										
3.2	Area covered by BCWUAs with internal regulations approved by the respective RA	Feddans																										
3.3	IWMDs holding Branch Canal-level meeting with representatives of at least 75% of BCWUAs at least once in the previous 6 months to discuss BC issues	Number																										
3.4	Number of BCWUAs providing maintenance priorities to IWMD	Number																										
3.5	Number of IWMDs holding group meetings with representatives of all BCWUAs at least once per season	Number																										

Instructions: Place an "X" in the box for each IWMD which has satisfied a particular indicator

Data Collector: _____

Task 3 Data Collection Form

Date: _____

Indicator	Units	New Zifta					West Sharkiya					Qena					Aswan											
		North Zifta	El Santa	Quesna	Zifta	Birket el Sab'a	abu Kebeer	Kafr Sakr	Awlad Sakr	El Ibrajo,oa	El Zagazig	Esna	Armant	Luxor	Nakada	Qous	Qena	Deshna	Nagaa Hammadi	Abu Tesht	Aswan	El Tobsa	Wadi El Nokra	Kom Ombo	Elseisla	East Edfu	West Edfu	Wadi El Saïda
1.5 IWMDs with local computer networks installed and operational	Number																											
2.1 IWMDs with calibrations for all authorized inflow and outflow structures into and out from the District	Number																											
2.2 IWMDs providing 15-daily reports of measured water inflows to the District Manager for one complete season	Number																											
2.3 IWMDs with a completed water resource inventory in approved standard format	Number																											
2.4 IWMDs with a completed water resource management plan in approved standard format (includes MISD)	Number																											

Instructions: Place an "X" in the box for each IWMD which has satisfied a particular indicator

Annex 4. Branch Canal Water Delivery Record

Branch Canal Water Supply Record

Month: _____ Year: _____ BC: _____
 District: _____

Day	Gate Position (open or closed)	Time gate opened	Time gate closed
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			

Person collecting data: _____

WUA Chairman: _____ (signed)

Date signed: _____

Annex 5. Impact Indicator Data Collection Plan

Impact Indicator Data Collection Plan

#	Variable	Unit	Time Step	Scope	Source	Frequency of Measurement	Contractor Responsibility	Partner Responsibility	Method of Collection
1	Crop yield	kg/feddan	season	crop/IWMD	Ag Admin	seasonal	Task 3 TL	IWMD	File transfer
2	Actual rotation duration (on)	days	rotation	sub-IWMD	BCWUAs	daily	Task 2 TL	IWMD	Report
3	Actual rotation interval (off)	days	rotation	sub-IWMD	BCWUAs	daily	Task 2 TL	IWMD	Report
4	Delivery target	m ³	15-days	IWMD	Directorate	annual	Task 3 TL	Directorate	File transfer
5	Delivery target	m ³	season	IWMD	Directorate	annual	Task 3 TL	Directorate	File transfer
6	Satisfied farmers	percent	season	Stratified	Farmers	annual	M&E TL	sub-contract	Survey
7	Inflow (surface)	m ³	15-days	IWMD	IWMD	daily	Task 3 TL	IWMD	File transfer
8	Inflow (surface)	m ³	season	IWMD	IWMD	daily	Task 3 TL	IWMD	File transfer
9	Outflow (surface)	m ³	15-days	IWMD	IWMD	daily	Task 3 TL	IWMD	File transfer
10	Outflow (surface)	m ³	season	IWMD	IWMD	daily	Task 3 TL	IWMD	File transfer
11	PET	m ³	season	crop/IWMD	IWMD	seasonal	Task 3 TL	IWMD	File transfer
12	Cropping pattern	feddans	season	crop/IWMD	IWMD	15-daily	Task 3 TL	IWMD	File transfer
13	Planned rotation duration (on)	days	rotation	sub-IWMD	IWMD	seasonal	Task 3 TL	IWMD	File transfer
14	Planned rotation interval (off)	days	rotation	sub-IWMD	IWMD	seasonal	Task 3 TL	IWMD	File transfer
15	Complaints	number	season	IWMD	IWMD	seasonal	Task 3 TL	IWMD	File transfer
16	Violations	number	season	IWMD	IWMD	seasonal	Task 3 TL	IWMD	File transfer
17	Crop prices	LE/1000 Kg	season	crop/directorate	Traders	seasonal	M&E TL	Directorate	Interview

Note: All data (except survey data) to be reported at the end of each crop season

Annex 6. TORs for Sampling Plan and Questionnaire Design

Development of Farmer-based Performance Monitoring Plan for Integrated Water Resource Management

SCOPE OF WORK

1. Description of Work

A. General

Under this purchase order, the vendor will assist the IWRM Component of the LIFE Project in developing a monitoring and evaluation (M&E) system to support the Performance Monitoring and Evaluation task. Note that only first stage is included in the work under this purchase order. The Monitoring and Evaluation (M&E) Plan is intended (a) to guide the implementation of the IWRM project and (b) to assess its outcomes and impacts.

B. Specific

Specifically, the vendor will carry out the following activities.

1. Design and field test a questionnaire to measure equity of water distribution based on farmer satisfaction with the irrigation service provided by the 27 Integrated Water Management Districts (IWMDs) in the project area.
2. Developing a methodology, procedures, and tools for collecting data on farmer-satisfaction with irrigation service.
3. Develop a statistically-valid sampling plan covering approximately 1.2 million feddans for collecting data that is stratified by:
 - a. IWMD
 - b. Head, middle, and tail of the main canal reach within each district
 - c. Head, middle, and tail of branch canals within each district
4. Apply and test the sampling plan developed in one of the project IWMDs in which the IAS has compiled a list of farmer names and modify the sampling plan as appropriate.
5. Design a training program plan for district management staff, enumerators and supervisors on the M&E program, data collection, quality control, and analysis.
6. Prepare an estimated budget and implementation schedule for implementing the survey. The budget should be broken out in three parts.
 - a. A survey in the 11 IWMD areas for which farmer names are available from IAS using traditional sampling methodology based on lists of names.
 - b. A survey in the remaining 16 IWMD areas using the sampling methodology employed in the KAP study in which names are collected from MOA *khoods* (agricultural base units) sampled randomly along branch canals.
 - c. As an alternative to (b), a sampling methodology for the 16 remaining IWMDs based on geo-referenced base maps to be supplied by the project and GPS units supplied by the contractor,

combined with the use of a MWRI *bahar* as an informant to identify farmers working particular fields.

7. Organize and participate in relevant meetings and coordination activities.
8. Coordinate with the expatriate M&E specialist, in person and via email, in carrying out the terms of this activity.

2. Work Schedule

The tentative schedule of work is shown below and will be finalized at the time the work is performed. The location is Cairo except as noted otherwise for field visits.

Date	Activity
March	Draft questionnaire and sampling plan
April	Field test questionnaire and test and refine sampling process in the field
7 May	Arrival of expatriate M&E Consultant
8-12 May	Review sampling process and questionnaire with Project and MWRI staff
15-19 May	Finalize deliverables and meet with Project and MWRI staff
20 May	Departure of expatriate M&E consultant

3. Deliverables

- A. A methodology for carrying out a sample survey exercise as described above, including a verified sampling plan, field methodology and procedures, a draft questionnaire and a data analysis plan.
- B. A sample implementation schedule and cost estimate for one survey round.
- C. A training plan for district management staff, enumerators and supervisors in data collection, quality control, and analysis. The plan will contain training materials and other practical how-to information on surveys, data collation and cleaning, data base management and analysis, including limits to confidence for various types of conclusions.

4. Costs

This is a fixed-price purchase order for the amount of LE _____ inclusive of all vendor costs, expenses and fees to supply products and/or services.

Travel, lodging and per diem for vendor staff to attend meetings and field visits outside Cairo, however, will be paid directly by the IWRM project for assigned vendor staff.

5. Terms of Payment

(Terms of payment will vary and are to be filled in individually for each scope of work.)

6. Assigned Staff

The vendor will assign Dr. Fatma El-Zanaty as the principle investigator, who will participate in all meetings and field visits. Requests for additional staff to participate in meetings and field visits must be made in writing in advance.

7. Supervisor

The supervisor for the work performed under this purchase order is Dr. Jeffrey Fredericks.