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Ministry of Water Resources and Irrigation

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

# Assessment of Year 2 Information System Activities

***Report No. 28***

**October 2006**

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# Acronyms and Abbreviations

| | |
|---|---|
| AAU | Agricultural Administrative Unit |
| AED | Academy for Educational Development (a US-based entity providing USAID-funded assistance regarding environmental education and awareness) |
| APRP | Agricultural Policy Reform Program |
| BCWUA | Branch Canal Water User Association |
| CAD | Computer aided design |
| CD | Central Directorate |
| CDA | Community Development Association |
| CTO | Cognizant Technical Officer (the USAID person responsible for supervising a technical assistance contractor) |
| CY | Calendar Year |
| DAI | Development Alternatives, Inc. (a Washington DC-based consulting firm working with IRG to implement the project) |
| EEAA | Egyptian Environmental Affairs Agency |
| EEPP | Egyptian Environmental Policy Program (a USAID-funded program aimed at achieving environmental policy reform) |
| EPADP | (MWRI) Egyptian Public Authority for Drainage Projects |
| EPIQ | Environmental Policy and Institutional Strengthening Indefinite Quantity Contract |
| ET | Evapotranspiration |
| GB | Gigabyte |
| GIS | Geographic Information System |
| GOE | Government of Egypt |
| GPS | Global Positioning System |
| GW | Groundwater |
| GWS | Groundwater Sector |
| HD | (Aswan) High Dam |
| IAS | Irrigation Advisory Service |
| IBRD | International Bank for Reconstruction and Development or World Bank |
| ID | Irrigation Department |
| IDS | Irrigation and drainage system |
| IIIMP | Integrated Irrigation Improvement and Management Project |
| IIP | Irrigation Improvement Project |
| 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 |
| IRU | MWRI Institutional Reform Unit |
| IS | Information Systems |
| IT | Information Technology |
| IWMD | Integrated Water Management District |
| IWMU | Integrated Water Management Unit (A unit of MWRI) |
| IWRM | Integrated Water Resources Management |
| IWRMP | Integrated Water Resource Management Project |
| jpg, jpeg | Joint Photographic Expert Group (computing) |
| KB | Kilobyte |
| LAN | Local Area Network |
| LIFE | Livelihood and Income from the Environment (project) |
| LOE | Level of Effort |
| M&E | Monitoring and Evaluation |
| MALR | Ministry of Agriculture and Land Reclamation |
| MED | MWRI Mechanical & Electrical Department |
| MIC | MWRI Ministry Information Center |
| MISD | Matching Irrigation Supply and Demand |
| MOE | Ministry of Education |
| MOH | Ministry of Housing |
| MOU | Memorandum of Understanding |
| MSEA | Ministry of Sate for Environmental Affairs |
| MWH | Montgomery Watson Harza |
| MWRI | Ministry of Water Resources and Irrigation |
| NASA | (United States) National Aeronautics and Space Administration |
| NGO | Non governmental Organization |
| NSCE | North South Consultants Exchange |
| NWRC | (MWRI) National Water Research Center |
| O&M | Operation and Maintenance |
| OJT | On-the-Job Training |
| PC | Personal Computer |
| PM&E | Performance Monitoring and Evaluation |
| RSC/WP | Red Sea Coastal/Water Project, short name for USAID Red Sea Coastal and |

| | |
|---|---|
| | Improved Water Resource Management Project |
| RWS | Relative Water Supply |
| SIRs | Sub-Intermediate Results |
| SOs | Strategic Objectives |
| STTA | Short-term Technical Assistance |
| TA | Technical assistance |
| TOR | Terms of Reference |
| TRG | Training Resources Group |
| UPS | Uninterruptible Power Supply Device |
| USB | Universal Serial Bus (computing) |
| USAID | United States Agency for International Development |
| WCU | MWRI Water Communication Unit |
| WDC | MWRI Central Water Distribution Center |
| WPRP | Water Resources Results Package |
| WQU | MWRI Water Quality Unit |

# 1. Introduction

## *1.1 Authorization*

Under the USAID/Egypt-funded Livelihood and Income from the Environment (LIFE) Integrated Water Resources Management (IWRM) Project (Contract No. EPP-I-802-03-00013-00 Task Order 802), International Resources Group (IRG) in association with the Academy for Educational Development (AED), Development Alternatives, Inc. (DAI), ECODIT, Environmental Quality International, Inc. (EQII), Montgomery Watson Harza (MWH), and Training Resources Group, Inc. (TRG), is responsible for assisting the Government of Egypt (GOE) to promote integrated water resources management. The period of performance for the contract is October 1, 2004–September 30, 2008.

## *1.2 Purpose of Report*

The purpose of this report is to present an assessment of the IS activities carried out under Tasks 2, 3, and M&E in Year 2 (October 2005 –September 2006). Furthermore, the report covers recommendations for Year 3 information systems program.

## *1.3 Project Objectives*

**Figure 1 Project Location Map**


The GOE is implementing an aggressive irrigated agricultural area expansion program, which will reduce the supply of water per feddan. In addition, the high cost of operating and maintaining the water delivery infrastructure is a serious strain on the national budget because farmers pay a low portion of the actual costs. This is further compounded by decreasing water quality as the water conveyance system is increasingly used for waste disposal.

The objective of LIFE/IWRM is to provide technical assistance, training, commodities, and small grants in support of the decentralization of water management decision-making and increased participation of all rural inhabitants in such decision-making in two priority geographical areas and five Irrigation Directorates: Zifta and West Sharkiya in the Middle Delta; and West Qena, East Qena and Aswan in Upper Egypt, as shown on the right. With decentralization and participation, USAID expects greater civic responsibility in maintaining the water conveyance infrastructure and improvements in the quality of local water resources through better management of locally generated liquid and solid wastes.

The objectives of the project are expected to be achieved through the formation and development of functional and sustainable Branch Canal Water User Associations (BCWUAs) and Integrated Water Management Districts (IWMDs), and by developing the capacity of stakeholders to manage solid and liquid wastes in the targeted directorates.

Sub-OBJECTIVE 1. Rural inhabitants accrue immediate and long-term economic benefits from participating in water-management decision-making and governance of the water conveyance infrastructure.

SUB-OBJECTIVE 2. Local communities and private associations participate in water resources decision-making, accept responsibility for maintaining the water conveyance infrastructure, and adopt improved management practices for solid and liquid wastes.

Seven tasks under three performance requirement categories are to be implemented under the LIFE/IWRM Program:

A.1 Performance Requirement I: Decentralized Management of Water Resources

1. Formation of Integrated Water Management Districts
2. Formation of Branch Canal Water Users' Associations
3. Equitable Allocation of Water Resources

A.2 Performance Requirement II: Stakeholder Engagement in Water Resources Management

4. Improved Maintenance and Upgrading of Water Management Equipment
5. Environmental Services for Improving Water Quality Management
6. Improved Wastewater Reuse Practices

A.3 Performance Requirement III: Capacity Building of MWRI staff

7. Graduate Degree Training for MWRI staff

There are also a number of cross-cutting issues that are common to all seven tasks, including: commodity purchases; workshops and training; monitoring and evaluation; donor coordination; public awareness, information, education, and communications; and gender considerations.

The LIFE/IWRM has worked closely with the MWRI Integrated Water Management Unit, five Directorate Undersecretaries and General Directors, 27 IWMDs, and other key stakeholders in the past 24 months. To facilitate project implementation, to provide technical coordination at higher levels, and to resolve any inter-sectoral issues, a Steering Committee was appointed by the Minister of the MWRI. Members of the steering committee include:

- Eng. Gamil Mahmoud, Chairman (MWRI Special Consultant to H.E. Minister)
- Head of Irrigation Department
- Egyptian Public Authority for Drainage Projects
- Chairman of M & E Department
- Head of Sector - Minister's Office
- Head of Institutional Reform Unit
- Head of National Water Boards Project
- USAID representative
- LIFE/IWRM representative

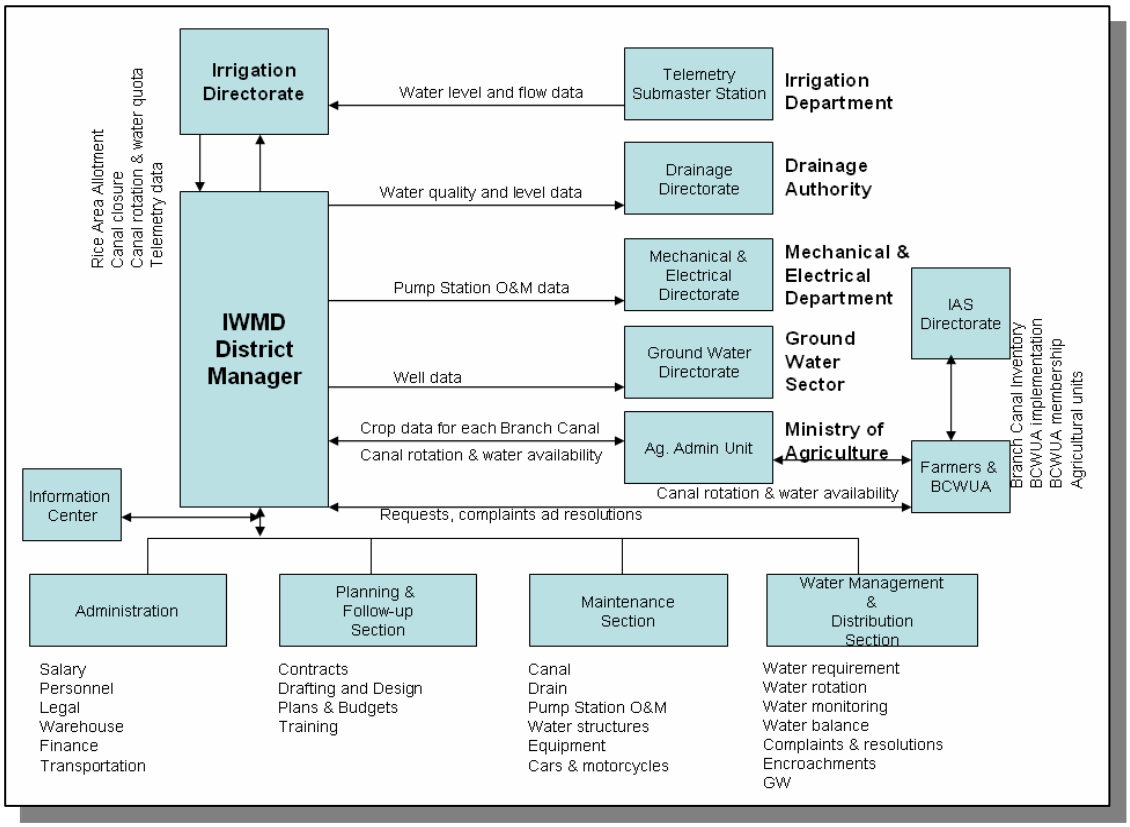
# 2. Information Systems Component

## *2.1 Data Flow*

In general, data flows from the districts to their respective directorates. The directorates then review, aggregate, and summarize the data before forwarding the information to the general directorates. The general directorates carry out similar data management activities as the directorates, and forward the data/information to the central level for planning, operation, and analysis.

Once decisions are made at the central level, specific information such as 10-day water allocation and seasonal rice area allotments flow downward to the directorates. The directorates then inform the districts and the districts inform the BCWUAs and/or the Agricultural Administrative Units. In turn, the BCWUA and/or agriculture extension officers share the information with the farmers in the districts so they can manage their pumping operation at the mesqa level. When farmers have issues with water delivery, they file complaints with the districts. The district mangers consult with the respective directorate staff and resolve the problems locally.

**Figure 2 IWMD Data Flow**




IWMDs currently receive crop data from the Agricultural Administrative Units. Water requirements are prepared fortnightly as a part of the MISD (matching water supply to demand) and the information is submitted to the respective directorates. Unfortunately, the directorates and regional water distribution offices are not yet responding to the IWMD's water demand and are still prescribing water by level and annual directorate quotes.

### *2.2 Concept*

With the integrated water management approach, the main objectives are to:

Integrate all water management functions so the IWMD can manage all water supplies (i.e., Nile water, groundwater, and drainage water) within each district; and

Decentralize water management so the district staff can match water supplies with water demands from all sources (agricultural, municipal, and industrial requirements) within each of the districts fortnightly.

The IWMDs now have the authority to make district-level management decisions. In order to make well-informed decisions, district managers require information, not just data. They also need to be able to understand the information as opposed just being handed a report; managers need this support to be put in context and it must be received in a timely manner. To support the district manger's information requirements, it is necessary to digitize and store district water, agricultural, and spatial data in computerized information systems which can be structurally organized, systematically maintained, freely accessed, and fully analyzed by staff members within each district.

The information systems component under the project consists of two major technologies: database management and digital mapping systems. While the database management and mapping systems evolved independently, both are integrating, analytical, and strategic technologies that are complementary to each other. The convergence of both technologies offers extraordinary opportunities for producing information management tools that connect disparate, but indispensable, threads of spatial and non-spatial data across different information systems and management units. These tools create broader knowledge and understanding for decision makers at the district, directorate, and central levels.

### *2.3 Objectives*

Under the integrated water management approach, the specific IS objectives are to:

- Establish databases to support the measurement-based water management practices and data/information-based decision making at the district and directorate levels;
- Provide specific information systems to support the MISD approach matching water supply to demand from all sources (agricultural, municipal, and industrial requirements) within each of the districts;
- Establish five directorate digital mapping systems to prepare and provide geo-referenced district maps with canal and drain networks for each of the districts; and
- Use satellite imagery (free NASA Landsat 7 ETM+) and GPS data to verify and/or calculate IWMD boundaries, canal and drain alignments, water structure locations, branch canal command areas, and actual cropped areas to improve water management practices.

### *2.4 Approach*

The IS development approach of the project consists of three phases. The specific IS activities under each of the three phases are listed below.

Phase I activities:

1. Install computer hardware and software at the districts and directorates;

2. Install five databases (MISD, Water Level, Complaint, Groundwater and Water Quality) at all 27 IWMDs;
3. Train selected staff from the districts and directorates on computer basics, hardware maintenance, database operation, and general GPS use.

Phase II activities:

4. Establish five functioning databases at the districts;
5. Support district implementation of MISD water management practices with the MISD database;
6. Support district water monitoring activities with the Water Level database;
7. Build capacity for digital mapping at the districts and directorates;
8. Produce geo-referenced district maps including water objects such as canals, drains, water monitoring sites, structures, pump stations, and wells;
9. Support inventories of water objects (i.e., wells, water structures, and waterways) and conduct a survey of branch canal command areas at each district using GPS receivers;
10. Introduce and support the district M&E program with data from the databases;
11. Aggregate the IWMD's water and agricultural data at each directorate using MS-Excel worksheets and/or MS-Access databases.
12. Carry out corresponding training events such as digital mapping using GPS and AutoCAD Map, ArcGIS, and MISD, Water Quality, and Groundwater databases operation and maintenance.

Phase III activities:

13. Link the tabular database data to the georeferenced IWMD maps to provide additional integrating and analytical functionalities;
14. Establish an Intranet framework to connect the tabular and mapping information systems across the district's LAN system to create broader knowledge and understanding to support decentralized and integrated water management.
15. Carry out corresponding training events.

The project has successfully completed the IS activities under Phases I and II during the last 24 months, except Activities 9 and 11. The two activities (9 and 10) plus Phase III activities will be carried out in Years 3 and 4.

# 3. Review of IS Activities

### *3.1 Computer Hardware and Software*

Over the last 12 months, most of the project hardware and software encountered occasional minor problems. With the support of the project, most of the computer problems such as failure of the power supply unit, virus infection, and overheating have been resolved. Computer virus infection is still a common problem among the IWMDs due to browsing the Internet and downloading files without: (1) the most updated antivirus definitions and (2) performing frequent virus scans of the hard disk. A refresher course on computer maintenance is recommended. As a part of the course, instructions should be provided to protect the IWMD's computer from viruses and other security risks while on the Internet.

A summary of computer hardware and software provided by the project is presented below.

- **Each of the 23 new IWMDs:**
    - 3 desktop computers with Windows XP, Office 2003, and Antivirus software (2 standard and 1 database models)
    - 5 project supported databases
    - 3 UPS'
    - 3 voltage stabilizers
    - 1 A3 color printer
    - 1 black and white LaserJet printer
    - 1 LAN
    - 2 GPS receivers and 2 PC interface cables
    - 2 computer tables and 2 task chairs
    - 1 USB 2.0 memory stick (256 KB)
    - 1 dial-up Internet connection (25 of 27 districts)
    - 1 data logger with Falcon Tango GSM/GPSR modem (Quesna only)
    - 1 Falcon Samba GSM/GPSR modem (Quesna)

- **Each of the five directorates:**
    - 3 desktop computers Windows XP, Office 2003, and Antivirus software (1 standard, 1 database, and 1 GIS models)
    - 1 laptop (Aswan and West Sharkiya only)
    - 1 ArcView 9.2
    - 2-3 UPS'
    - 2-3 voltage stabilizers
    - 1 A0 plotter (3 of 5 directorates)
    - 1 A3 color printer

- 1 black and white LaserJet printer
- 1 A4 scanner
- 1 LAN
- 1 GPS receiver and 1 PC interface cable
- 2 USB mobile hard drives (60 GB)
- 3 computer tables and 3 task chairs
- 1 DSL Internet connection ( 3 of 5 Directorates)

- **IAS:**
  - 3 desktop computers (standard model)
  - 2 A3 color printers
  - 3 black and white LaserJet printers
  - 1 GPS receiver and 1 PC interface cable
  - 2 computer tables and 2 task chairs

- **IWMU:**
  - 5 desktop computers with Windows XP (3 standard and 2 GIS models)
  - 1 ArcView 9.1
  - 5 laptop computers
  - 2 Falcon Samba GSM/GPSR modems
  - 5 UPS'
  - 1 A3 color inkjet plotter
  - 2 black and white LaserJet printers
  - 6 GPS receivers and 6 PC cables
  - 1 A0 plotter
  - 1 A0 scanner
  - 1 A3 color scanner
  - 1 LAN system
  - 5 USB mobile hard drives (60GB)
  - 5 USB memory sticks (256 MB)
  - 1 DSL Internet connection

- **Special Items:**
  - 2 desktop computers Windows XP, Office 2003, and Antivirus software (Aswan Directorate training room)

- 6 desktop computers Windows XP, Office 2003, and Antivirus software (Esna IWMD training room)
- 1 Datashow (Aswan only)
- 1 Falcon Samba GSM/GPSR modem (New Zifta only)

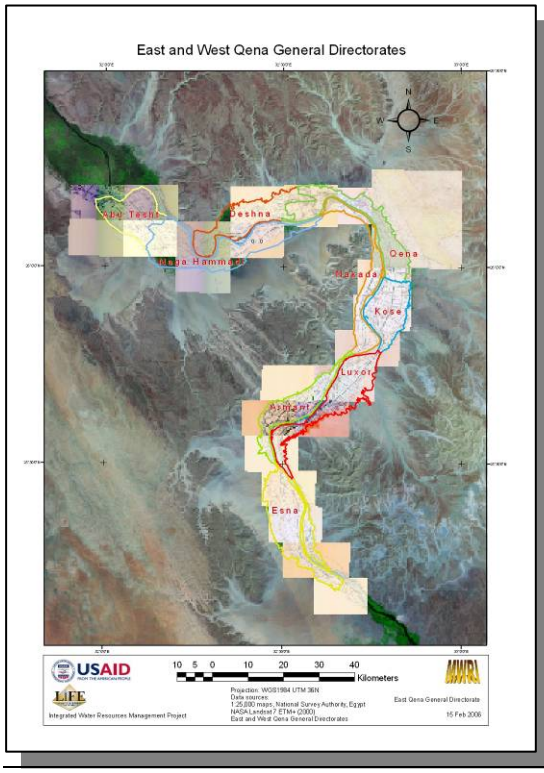
All the hardware and software are functioning properly, except occasionally when a computer is infected by a virus, Trojan horse, or worms.

### *3.2 IWMD Databases*

The overall system development approach used by the project was to implement the databases that were tested and used by the MWRI. These included:

- Water Level Database originally prepared by MIC under the Red Sea Sustainable Development and Improved Water Resources Management Project and updated in mid-2005.
- Complaint Database originally prepared by MIC under the Red Sea Sustainable Development and Improved Water Resources Management Project and updated in mid-2005.
- MISD database originally developed under the Water Policy Reform Program with the user's manual and database translated from English to Arabic in August 2005.
- Water Quality Database developed and used by the Water Quality Management Unit.
- Groundwater Database developed and used by the Groundwater Sector.
- All five databases are installed and used by a majority of the IWMDs to organize and maintain their seasonal water and agricultural data sets.

**Figure 3 Digital Map of Qena Governorate**

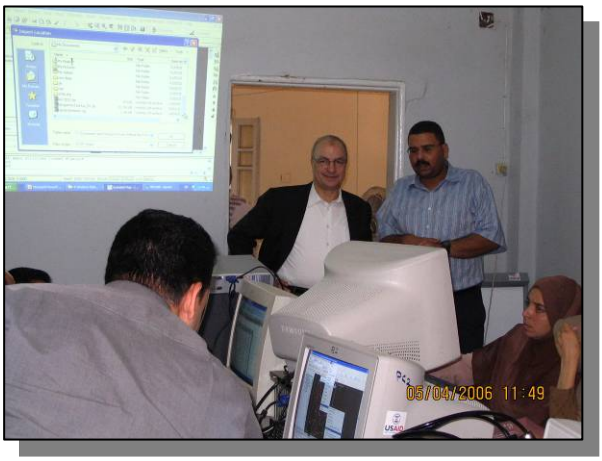



### *3.3 Digital Maps*

The project purchased 180 sheets (3 sets) of 1:25,000 and 90 sheets (3 sets) of 1:50,000 topographic maps from EGSA in Year 1. With the assistance of the IWMU staff, the 1:25,000 paper topographic maps were scanned and geo-referenced. Two sets of paper maps (1:50,000 and 1:25,000), plus the digital version of 1:25,000 maps in jpg format and Landsat 7 ETM+ imagery, were distributed to the directorates and districts via the two project regional offices in Upper and Lower Egypt. MIC staff members geo-referenced and edge matched all the scanned maps (1:25,000) covering New Zifta and West Sharkiya Directorates. The mapping staff members from the East Qena Directorate geo-referenced and edge matched all the scanned maps (1:25,000) for the Qena and Aswan directorates. As of

September 30, 2006, all 27 IWMD maps are complete with boundaries, canals, drains, water monitoring points, and water quality sampling sites. All IWMDs are using AutoCAD Map and/or ArcGIS software for their digital mapping work.

**Figure 4 Digital Map Training in Lower Egypt**




### *3.4 Training*

A comprehensive training program was designed by project staff. In Year 2, seven courses were carried out by the IWMU, MIC, WQ Management Unit, and GW Sector staff members and a local service provider. Six courses were conducted at multiple locations in Upper and Lower Egypt from May to September 2006. Only one course, Map Production and Data Integration using ArcGIS, was conducted twice at the local provider's office in Cairo. A summary of the Year 2 training program is presented below.

**Table 1 Year 2 Training Program Summary**

| General Directorate | As of September 30, 2006 | | | | | | | | | | | | | | Total Number of Participants |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MISD Database | | Water Level Database | | Complaint Database | | Mapping using GPS and AutoCAD Map | | Map Production and Data Integration using ArcGIS | | Water Quality Database | | GW Database | | |
| | No. | Participants | No. | Participants | No. | Participants | No. | Participants | No. | Participants | No. | Participants | No. | Participants | |
| New Zifta | 1 | 17 | 1 | 15 | 1 | 15 | 1 | 22 | | 2 | 1 | 14 | 1 | 14 | **99** |
| West Sharkiya | 1 | 15 | 1 | 15 | 1 | 14 | 1 | 22 | | 2 | 1 | 14 | 1 | 14 | **96** |
| West Qena | 1 | 17 | 1 | 17 | 0 | 0 | 1 | 23 | | 2 | 1 | 23 | 1 | 23 | **105** |
| East Qena | 1 | 14 | 1 | 14 | 0 | 0 | 1 | 18 | | 2 | 1 | 19 | 1 | 19 | **86** |
| Aswan | 2 | 26 | 2 | 26 | 0 | 0 | 2 | 26 | | 2 | 2 | 32 | 2 | 32 | **144** |
| **Grand Total** | **6** | **89** | **6** | **87** | **3** | **29** | **6** | **111** | **2** | **10** | **6** | **102** | **6** | **102** | **530** |

The general feedback for the training program from the participants was very positive. Trained staff members are using the project supported databases and newly acquired digital mapping skills to build their IWMD maps using mapping software programs and GPS units.

# 4. Achievements

The project has successfully accomplished tasks that have the potential to permanently change how the IWMDs and the five directorates manage, use, and communicate their water resources data in the near future. The major achievements in Year 2 are:

- A total of 94 computer systems with Windows XP and Office were installed and functioning at the 27 districts and five directorates.
- Five project supported databases (Water Level, Complaint, MISD, Water Quality and Groundwater) have been installed and used by a majority of the IWMDs.
- A total of 35 training courses with 530 participants were successfully conducted in Upper and Lower Egypt.
- The trained IWMD staff members have developed additional computer applications and databases to better manage administrative and water objects data and information in the districts.
- A total of 27 digital district maps with canals, drains, water monitoring points, and water quality sampling sites have been produced by the IWMDs with the assistance of East Qena, MIC, and IWMU.
- An M&E database was designed, constructed, and used by the M&E team in the project office in Cairo. The district water and agricultural data from the 2004 and 2005 seasons has been compiled, organized, stored, reviewed, and analyzed.
- The project Website was updated to meet USAID requirements and is running with current information.
- One CSI CR 510 datalogger was installed and is providing hourly water level data via a low cost GSM/GPSR communication system.
- A digital mapping unit was established with GIS computer hardware and software and GPS receivers, plus the scanned maps (1:25,000) and Landsat images at each of the five directorates. The directorate in East Qena is in full operation and providing technical assistance to all IWMDs in Upper Egypt.

During the last 12 months, implementation of the five databases, mapping systems, and training programs was successfully carried out. Most of the trained district and directorate staff have populated the databases, built digital maps, computed fortnightly water demand values, and calculated actual water supplies to support their water management activities. The district and directorate staffs are eager to learn and do more with their computer systems.

# 5. Lessons Learned and Recommendations

Identification of lessons learned from any endeavour is extremely valuable, and in this instance, essential considering more advanced IS activities will be carried out over the next 12 months. The following lessons learned and recommendations are the result of an attempt to objectively identify items worthy of consideration when implementing and integrating information systems at the districts and directorates.

### *5.1 Databases*

The Water Level, Complaint, Water Quality and Groundwater databases are functioning properly. A new version or upgrade is unnecessary in FY 2007. However, the Water Level Database for Edfo East is incomplete with missing canals. The MIC staff should follow-up with the IWMD and correct this problem.

To enhance data management and results visualization, USAID suggested that the project build a BCWUA database with a map-based GUI so the user can click a BCWUA area or point (i.e., BC intake) on the map to bring up a table that contains the relevant WUA information from the database. It is recommended that a local service provider is hired to complete this work in consultation with IWMU staff members.

The fortnightly computed water demand values from the MISD Database were questioned for accuracy by the IWMD Mangers and the Directorate water distribution engineers. The majority of the IWMDs reported water demand values for summer 2005 that varied from the demand figures generated by the MISD Database. The MISD internal calculations should be validated and refined, if necessary, to ensure the database produces reasonable results.

With requests from IWMD managers, the project may want to standardize the employee, waterways, and license databases developed by the IWMDs in Lower Egypt for all 27 IWMDs.

### *5.2 Water Data*

The project installed one CSI CR510 datalogger with a Falcon Tango GSM/GPSR modem in the existing Telemetry's RTU box at the Meit Bera intake, Quesna. The data logger is functioning properly and recording both up- and down-stream water levels hourly. Additionally, three Falcon Samba GSM/GPSR modems and CSI LoggerNet software were installed on computers located in the New Zifta Directorate, Quesna IWMD, and on a laptop located in the Cairo project office. With this particular set up, the water level data can be downloaded from any location in Egypt.

The CR510 datalogger is a practical and inexpensive way to collect continuous flow data. Purchasing and installing more CR 510 dataloggers at the major inflow points to each of the five directorates, and perhaps to each of 27 IWMDs, is recommended if the Telemetry Department is willing to work with and support the directorates and IWMDs.

### *5.3 Area Data*

A total of 16 of the 27 IWMDs have gross command areas that are different from the GIS area estimates calculated using the Year 2000 Landsat imagery. The comparison between the GIS and IWMD area estimates varied from 88% to 269%. There is a need to have a set of area figures produced using a standard set of rules and the latest land cover data available.

The project should devise a way to calculate/measure the total irrigable agricultural area in each IWMD (i.e., Green area and deduction methods with satellite imagery, 1:2,500 paper maps with a planimeter, and field survey with GPS units) and compare it with MALR and MWRI area figures.

### *5.4 Data Consolidation and Utilization*

Currently, the water and agricultural data are not systematically organized and consolidated at the directorates. In order to improve the directorate data management activities, the Groundwater, Water Quality, and Complaint databases can be installed and used by the directorates immediately. A simple database can be built to aggregate the IWMD water demand values by canal. The Water Level Database can be modified by removing the IWMD system schematic GUI and appending the canal, drain, and water level data from the IWMDs under each directorate.

The monitoring and evaluation process used by the project is now well established and can be institutionalized at the directorates so the mangers at IWMDs and directorates can fully appreciate why they are collecting the data, how they will use the data to evaluate system performance, and what they can do to better manage the available water resources to meet water requirements. It is recommended that the M&E Database be introduced and implemented at the five directorates.

### *5.5 Digital Mapping*

During the map verification process, it became apparent that not all IWMD map layers have the same map projection. The map projections varied from layer to layer and district to district. The three most commonly used projections by IWMDs are GEOGCS (lat and long), Egypt Red Belt, and UTM36N.

For ease of data integration at the directorates, it is necessary to re-project all the map layers using the same projection. A map projection of WGS 1984, UTM 36N is recommended because the re-projected map layers in UTM can be: (1) visually geo-referenced and verified using the available Landsat 7 imagery, which has the same map projection; and (2) used to perform complex vector-raster GIS analyses including but not limited to determination of irrigable areas for the 27 IWMDs.

To ensure high quality work, carrying out data quality assurance and quality control is recommended to show that (1) the shared boundaries among the IWMDs within a directorate are matched perfectly; (2) canals in the irrigation system network are linked by vertex; and (3) drains in the network are also linked by vertex. Additionally, the IWMD mapping staff will need to verify the location and alignment of each canal and drain with GPS points or tracks.

All IWMDs are planning to conduct inventories of wells, water structures, and waterways, along with a survey of branch canal command areas. The collected GPS points (lat and long) for each can be added as additional layers to the IWMD maps.

District maps are currently rare and generally not available. A majority of the 27 IWMDs have out-dated maps from the Egypt Survey Authority. As a part of the digital mapping effort, the mapping staff members in each directorate need to compile all the IWMD map layers under their directorate, and generate and print the IWMD and directorate maps with the pre-defined MWRI/USAID/LIFE map layout for the IWMDs. It is anticipated that these maps will have a minimum of nine layers including boundary, canals, drains, water monitoring points, water quality sampling points, wells, canal structure locations, BCWUA

locations, and branch canal command areas. It is recommended that the project hire a local service provider to assist the directorate mapping staff clean, build, and produce the multi-layer digital maps.

### *5.6 Website*

The Website has been a great tool for sharing project news, information, successes stories, and reports with the all the districts and directorates in Egypt. With the available digital IWMD maps and water data, adding downloads for the 27 IWMD maps (vector layers only, not the 1:25,000 scanned maps), Landsat 7 ETM+ images (Year 2000 for Egypt and the 90m DEM files for Egypt) and seasonal water data is recommended.

### *5.7 Training*

The IWMD staff have had limited exposure to MS-Access software and will need more training. This will help each IWMD improve the five project supported databases in the future by adding more reports, queries, and data export options to meet their own requirements, and to make them less dependent on MWRI staff members in Cairo.

Refresher courses for MS-Office, computer maintenance, and digital mapping are recommended. For Year 3, the project needs to invite more staff members from the directorates to strengthen the staff capacity at the five directorates.

AutoCAD Map, Total Station, and SAP are three other training courses requested by the IWMD Mangers in Upper Egypt. If schedule and resources permit, the project may want to consider them as well.