REPUBLIC OF YEMEN

MINISTRY OF AGRICULTURE AND IRRIGATION

IRRIGATION IMPROVEMENT PROJECT

(IDA Credit No. 3412 – YEM)

Main Technical Assistance Package for IIP

WORKING PAPER NO 30

FINAL REPORT MIS-GIS

February 2005

ARCADIS EUROCONSULT

IN ASSOCIATION WITH

Halcrow

YEMENI ENGINEERING GROUP

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List of Abbreviations

CWR	Crop water requirement
MIS	Management Information System
DEM	Digital Elevation Model
FAO	Food and Agricultural Organization (United Nations)
EIS	Executive Information System
ID	Irrigation Department (Ministry of Agriculture)
IIP	Irrigation Improvement Project
IT	Information Technology
GIS	Geographic Information System
GOY	Government of Yemen
GW	Groundwater
PIU	Project Implementation Unit
PMU	Project Management Unit
PI	Performance Indicator
NWRA	National Water Resources Administration
M&E	Monitoring and Evaluation
O&M	Operation and Maintenance
SMM	Spate management Model
TDA	Tihama Development Authority
TOR	Terms of Reference
UTM	Universal Transverse Mercator
USD	United States Dollar
VBA	Visual Basic for Applications
WUA	Water User Association
WUG	Water User Group

SUMMARY

This report presents only the conceptual design factors for the MIS and GIS systems provided. It is supplemented by a series of training/user manuals for each sub-system.

It was originally estimated that it would cost the PMU approximately USD 65,000.00 to set up the MIS in the PMU and the two (2) PIU's. The PMU have procured the necessary systems and software. They are installed and operational. The ongoing costs after the Project is completed are likely to be approximately USD 35,000. - to USD 40,000. - per year.

The MIS has been implemented using MS Access 2000. The GIS has been implemented using ARCVIEW 8.x and ARCVIEW 3.x.

The MIS has not been set to run in a Client/Server environment because of the lack of a network administrator, and insufficient funds for a server. Any networking of computers has been done using a peer-to- peer protocol. This is suitable for file transfer and Intranet/email access.

The MIS/GIS has been integrated with the SMM.

Up to completion of the Project, or such other time that may be deemed appropriate, the PMU and the two (2) PIU's will be responsible for maintenance of the MIS/GIS. All agencies may use it to request or view reports and data. During the project implementation, the Consultant and the PMU-PIU will operate the MIS jointly. During the remaining implementation period the PMU/PIU will particularly be involved in further populating the MIS with relevant data. Any updates from The Consultant's side will be regularly forwarded to the PMU/PIUs during the remainder of the project implementation period.

For future reference purposes: the following Consultant specialist/experts have been involved in the development and preparation of the MIS-GIS and its databases:

- Dr. T.R.E. Chidley - MIS/GIS Specialist;
- Mr. Mohammed A.A. Hodish - MIS/GIS expert;
- Mr. Abdulrahman Mujahed - GIS expert;
- Mr. Yehyah A. Al Ahdal - PIM database Zabid;
- Mrs. Bilqis Abdo Sherabi - PIM Database Tuban

1. INTRODUCTION

This report is concerned with the overall concepts used in designing and implementing the MIS-GIS for the Project. Details of the sub-systems are provided in User training manuals, in the databases themselves, and in the Hydrology report.

The manuals referred to concern:

- MIS Manual on Hydrology Database;
- MIS Manual on O&M Equipment Database;
- MIS Manual on Tuban PIM Database;
- MIS Manual on Zabid PIM Database
- MIS Manual on Irrigation Assets Database;
- MIS Manual on PIU-WUA Assets Database;
- GIS Data manual;
- GIS Manual on Image Mapping.

The World Bank Terms of Reference (TOR) specified a Management Information System (MIS), which contained the following basic features:

- A medium for storing all basic information pertaining to the irrigation system infrastructure;
- Identifying the users of the information and reports, and specification of the frequency of such reports based on the need for the information;
- Generating the information needs of the different levels of management for successful operation of the irrigation system. Focus on the reports relating to monitoring irrigation operation, maintenance and control of facilities and equipment, water charge billing and collection support services, and overall operating and financial performance;
- Provision of the information required by the Irrigation Department or Tihama Development Authority for supervising and monitoring the performance of the WUAs.

Although not a specific requirement of the TOR, the MIS for irrigation system infrastructure and irrigation performance monitoring is GIS based. This represents a great advance over a traditional MIS. In addition the proposed Spate Management Model (SMM) is linked to the MIS/GIS. The linkage will enable system operators to see which command areas have received water in the current year and with what frequency.

In order to provide this improved level of MIS, resources have been transferred from more traditional MIS.

The proposed MIS is not a replacement for existing systems. Where there are existing systems they will not be duplicated. The MIS developed covers IIP needs only. It is capable of being transferred to other Wadis.

1.1. Users of the MIS and its application

'**….Identifying the users…**' - in the long term, the main users of the MIS are expected to be:

- The PMU;
- The two PIU's;
- TDA;
- The Regional Irrigation Department at Lahej;
- Possibly the Ministry of Agriculture & Irrigation; and
- Possibly the World Bank.

In the short term it will be the Consultant, the PMU and the PIUs who will use the system mostly.

In the long term, the PMU and the two (2) PIU's (or its successors) will be responsible for maintenance of the MIS/GIS. All agencies could use it to view reports and data if required.

It is intended to involve the PIU as much as possible on day-to-day operations of data entry and report preparation in order to promote sustainability. The Client should be aware of the financial and institutional consequences of taking over any MIS after completion of the Project.

It should be noted that the operational life of equipment and software for an MIS is typically 4 to 5 years, at which time hardware replacements and software upgrades are necessary to keep the system fully operational.

The application of a MIS in these circumstances might take into account the users interests as described in Table 1-1. The proposed MIS will only address the interests of the direct stakeholders, though this may coincide with the interests of indirect stakeholders.

Table 1.1: Irrigation system stakeholders

Direct Stake holders	Potential Key Interests
TDA/Irrigation Department as infrastructure 'owner'	Preserve and increase value of infrastructure
Water User/Farmer	Right to define the service and ensure performance standards
Payer (water user/farmer)	Low cost, cost efficiency, commensurate benefits
Service provider (WUA/PMU/PIU)	Protect work opportunity, cost recovery, minimize complaints
Indirect Stakeholder	Potential Key Interests
Regulator (Ministry of Agriculture & Irrigation)	Policy compliance, containment of conflicts, prevention of resource depletion, and environmental degradation
Agribusiness	Business opportunities, income, capture markets
Consumer	Low Crop Prices, availability of produce
Competing Users of resources	Protect water, land, forests, preserve quality and quantity of resources

A Project MIS can be used for monitoring the progress and the performance of the Project. Performance indicators, however, need to be defined. It is proposed that performance of the irrigation system is limited to attempting to monitor the allocation of water by spatial extent and frequency of application, and the cropping pattern. No attempt has been made to attribute success in the form of increased productivity of agriculture, or increased satisfaction of users (other than the survey of 30 farmers being carried out), since this requires much more detailed M&E survey data. In addition progress on design and implementation of rehabilitation works is included, together with major costs of O&M and cost recovery. The performance of the WUA's/WUG's can also be monitored.

1.2 The MIS

The makeup of a Management Information System (MIS) developed for the PMU and the WUA can be categorized according to the need to keep records on the following:

- Irrigation assets, including a description of the basic irrigation system features *'…medium for storing information pertaining to irrigation system infrastructure …..'* ;
- Rehabilitation works contract support;
- Monitoring of irrigation system operations, application of water, cropping pattern *'…generating information needs of different levels of management for successful operation of the irrigation system……';*

- Performance of WUA's, including O&M activities, and cost recovery of water service charge *'…..provision of information to Irrigation Department/Tihama Development Authority for supervising and monitoring the performance of the WUAs…..'*
- Certain summaries of financial transactions at PIU and WUA level.

The basic system features include information on the service area, irrigation infrastructure, organization, and equipment.

Monitoring of system operations also includes all paper forms and systems needed for keeping track of day-to-day activities relating to the irrigation operation and maintenance including selected key financial and administrative aspects.

Reporting activities have been aimed at satisfying the information requirements for internal PMU/PIU and WUA management of system operations, as well as for the Irrigation Department and TDA in their supervisory role for overseeing system operations in the spate irrigation areas.

2. FUNCTIONAL REQUIREMENTS

2.1 General guidelines

As emphasized in the ToR, the MIS will need to evolve as user requirements and expectations become clearer. Initial user requirements have been identified during the formulation of the MIS and were ranked according to the ease of providing the information and the overall benefit. As increasing volumes of data are added to the database and the various end users start to receive reports, requests for modified presentation and additional information can be expected to arise.

Robustness and reliability must be key features of the MIS, and priority has been given to meeting these rather than satisfying every user requirement for analysis and reporting. A single MIS model was prepared that can be used, subject to the data entry, for each scheme. The MIS was structured so that software upgrades and enhancements can be applied without affecting the underlying database. The MIS includes an integrated Geographic Information System (GIS) interface to appropriate data. The MIS for the PMU includes the two systems for Tuban and Zabid, plus the Hydrology Database.

The quality of output of all MISs depends on the adequacy and quality of the input data. Checks for data validity have been included at the data entry and analysis stages and a set of standard data entry codes developed.

The main database has been implemented in English, however wherever possible data entry forms the reporting systems are bi-lingual, Arabic and English. This has been achieved by use of aliases and lookup tables, and alternative interfaces.

All relevant data in the MIS/GIS has been geo-referenced to the UTM zone 38 North Projection with the WGS 84 spheroid. The standard set by the Yemen Survey Authority is under review. Currently it is believed to be UTM zone 38 North Projection with the GRS80 spheroid. In practice, for X-Y locations there is very little difference between the two systems.

2.2 Irrigation management assets

The functional requirements of the asset management system have been designed to provide the PIU, PMU and other concerned agencies information on the utilization of the assets, and progress on rehabilitation and O&M. To this end it has the capacity to record:

- The location, description and status of each kind of irrigation assets, excluding water wells and pipe distribution systems;
- The spatial extent of command areas at the secondary level (if feasible details of tertiary and field/plot boundaries will be held);
- Every spate irrigation event, at least at the command area (WUG/canal) level.

To achieve this, an inventory of the major irrigation assets has been be made primarily using satellite images, and existing drawings and plans; and any new plans (imported from AUTOCAD). In addition Global Positioning System (GPS) technology has been used to fill in details of major irrigation system assets not visible on the satellite images. The major spate irrigation assets identified include:

- Canals/conveyance systems;
- Headworks and major diversion structures;
- Water distribution structures (Gates Database);
- Major equipment and mechanical/electrical plant items (other than office equipment).

This inventory provides the basis for monitoring:

- The rehabilitation work progress (to include capacity to add new assets);
- Maintenance of the assets;
- Operation of the assets (in conjunction with the Spate Management Model (SMM).

2.3 Spate management model

The MIS/GIS and accompanying Spate Management Model (SMM) supports the water management study and modelling functions. The components include:

- Land and water resources;
- Water rights and establishment of priorities for water use at the wadi level;
- Water right contradiction with existing irrigation canals or off-takes;
- Water retention capacity of the soils;
- Cropping pattern and CWR;
- Irrigation system and operational protocols;
- Irrigation efficiencies.

Several items of these data are found in the irrigation asset GIS. Operational data will have to be provided by WUA's.

2.4 Main fixed agricultural/natural resources

The purpose of this component is, potentially, to enable the performance of the agricultural production to be monitored. This requires that the activity on the land, defined at least at the secondary command area level, be recorded (WUG/Canal). This is taken to mean the number of times and timing of each spate irrigation that water is received, and the cropping pattern in the command area for the given year. The information used is land extent (down to command area/field/plot boundaries), volumes of water entering the area as a flood at the two input points, human resources, soil resources, climate resources.

2.4.1 Land extent

There are two possibilities for dealing with land extent:

- To work at the individual field/plot level;
- Or use the tertiary command area level.

The main resources entered into the MIS are details of both the field/plot boundaries/locations, and the tertiary command areas of the land. The plot/field boundaries and the tertiary command areas have been digitized using the 0.62 meter resolution satellite images, supplemented by examination of existing plans, field checking, and generation from field observations using GIS modelling techniques.

Each identifiable field/plot and tertiary command area has been given a unique numeric identification code and the user/farmer code working the land and, where possible, it's owner; or the tertiary command area code. In the case of Zabid a further level had to be introduced to allow for more detailed owner/user identification, namely a point or address was introduced to locate a parcel of land within the framework of observed field or plot boundaries.

2.4.2 Water

The main output from the hydrological studies is two time series of inflow data, one for Tuban and one for Zabid. Microsoft Access databases have been used to store the data. They contain daily rainfall, daily flow series and monthly summaries. The reason for including these data is to provide and integrated information system linking the SMM with the MIS and to provide information for future development.

In addition a capability or entering details of any rainfall and climate data recorded on the catchment, and on flows at the entrance to the Irrigation scheme has been provided.

2.4.3 Human

A digital record inventory has been made of the users/farmers of land in each WUA. The inventory provides the name of the farmer, some form of address data, and the identification codes for all the fields/plots currently worked, or the total land holding worked. The WUG to which the farmer belongs is being derived by GIS analysis. A separate table holds details of the WUG's in each WUA. This database contains several thousand records.

2.4.4 Soil

It has not been possible to obtain in digital formats details of the soil for each field/plot or tertiary command area.

2.4.5 Climate

A database of climate records has been prepared for the SMM. The FAO CROPWAT system and database have been used to provide this function.

2.5 Groundwater monitoring

ITDA and NWRA have a GW monitoring program that covers the whole coastal plain and it would be a waste of time for the Project to duplicate this effort. It has not therefore been intended to have any GW data entered into the MIS by the Project. Any data needed will be obtained from NWRA of TDA. Unfortunately, it was not possible to obtain any digital GW data from any source even though strenuous efforts were made to achieve this. This is a serious deficiency of the system and should be remedied by the GOY as soon as possible.

2.6 Characteristics of catchment areas

Though not directly in the TOR for the Consultant to cover this topic, information on the characteristics of the W. Zabid, W. Tuban catchments forms a part of the MIS. This takes the form of::

- Satellite image maps at scales 1:100,000 and 1:50,000 (Land sat TM); and 1:50,000 (SPOT Image);
- Other data in GIS formats at scales ranging from 1:250,000 to 1:1,000,000, including place names, population density, and drainage;
- 1 km. DEM tuned for hydrological use;
- A 90-meter resolution DEM from the US shuttle radar.

2.7 WUA performance monitoring

A WUA performance monitoring capability has been provided in the PIM databases for Tuban and Zabid.

2.8 Operation and maintenance of equipment assets

A sub-system has been provided for provision of an inventory of large items of O&M equipment to be purchased/hired by the Project. This has been incorporated into a database for recording the usage of this equipment.

2.9 Operation and maintenance of roads

Activity on roads maintenance is recorded in the O&M database for Equipment.

2.10 Budget accounts

It is understood that the PMU have acquired software from the World Bank that meets financial and project management reporting requirements. The Consultant made no proposals to replace or duplicate this system.

2.11 Monitoring and evaluation

Other than the M &E relating to water distribution, cropping pattern and WUA performance, it is not proposed to provide an irrigation scheme M & E system for the Project.

3 MIS REPORTING ACTIVITIES

The aims of the reporting capacity of the MIS were that in the long term:

1. It should at least meet the requirements of the PMU (and through it the TDA and the Irrigation Department, and indirectly the World Bank);
2. It should support the administrative functions of the PIU and the WUA, and
3. Possibly support the operation of the irrigation schemes, but this is more likely to come from the SMM.

In the short term reporting will be concerned with monitoring the progress of the Project in implementing rehabilitation, change in land use and productivity.

Visits were made to main administrative stakeholders (except for the WUAs, who are presently not in a situation to deal with a MIS and the Irrigation Department at Lahej, who were not available) in order to determine reporting requirements. Details of monthly, quarterly, semi-annual and annual reports were obtained. These were analyzed to determine what data is required to be entered on a regular basis.

4. MIS IMPLEMENTATION

In implementing any information system the physical and human environment available for implementation has to be taken into account. For instance it is known that electricity supply at the PIU level is not completely reliable and any operational system requiring real-time of near real time capacity must be ruled out. Telephone communications also are not guaranteed unless mobile telephony is used, where reliability can be acceptable, it is expensive.

The MIS will not be set to run in a Client/Server environment because of the lack of experienced network administrators, and insufficient funds for a server, and associated server level software. Any networking of computers will be done using a peer-to-peer protocol. This is suitable for file transfer and Intranet/email access. The most constraining element is the availability of trained human resources. Unless the PIU's are to recruit highly experienced IT personnel then they will have to rely on training their current staff (many on secondment from TDA and ID). All of these factors make it a preference to have a hybrid paper/electronic MIS that does not rely on 100% availability of computers.

The World Bank TOR refers to 'keeping track of day to day activities relating to irrigation operation and maintenance, including financial and administrative aspects'. "Keeping track of" does not necessarily imply that data is entered on a daily basis in electronic format, or that the information is to be used in day-to-day decision-making. Keeping track means that details of daily operations are simply just recorded. In order to enter data on a daily basis, in electronic format, of all transactions referred to and to use these data in day-to-day decision making is a major task, requiring the system to be connected over a Wide Area Network, to include plant and equipment operators, scheme gate keepers, PMU and PIU's. It could be an aspiration to achieve a fully real-time MIS, but its realization should be approached gradually, in keeping with the WB recommendation that the development is undertaken gradually, with good interaction with users.

To a large degree the PMU/PIUs will be required to become involved in the MIS operation. The Consultant provided the design and implement the design. Originally the Consultant's responsibility was to populate the database with sufficient data to prove the system function, however much more was done in this respect, particular with reference to the PIM, Hydrology and Gates databases. The PIUs and the PMU will have to populate (digitize and key punch) the system with further data. For this they have procured computer hardware and software, and trained staff. The PMU will have to possibly provide more basic training. The Consultant provided the on-the-job training in using the actual systems developed. The purpose here is to improve the chances of the system becoming sustainable after completion of the Project. In practice the PIU/PMU were not able to provide significant inputs to date.

Priority Components: it was expected that the MIS would develop according to needs over the life of the Project. Therefore priorities were established in developing the system. The Consultant originally proposed the following priorities, in order of importance:

- Irrigation asset system/inventory (canals and major structures to at least secondary level) - status almost complete i.e. gates-conveyance system;
- Land resources system (irrigation command areas and/or land plots, cropping patterns, extent of irrigation and frequency) - status essentially complete;
- WUA monitoring system (including membership lists, summary service charge cost recovery records) - status complete;
- O & M system for irrigation assets - under development;
- O & M system for equipment (propose to use the current system of PMU) - status implemented;
- Spate Management Model Integration - status essentially complete.

5 DATA GATHERING-DATA ENTRY

5.1 Irrigation asset management

The data entry of irrigation asset data was to have been carried out by Project and PIU staff. In practice the Consultant had to undertake these responsibilities in order to achieve anything.

The main irrigation assts are taken to include: the conveyance system, the major and secondary structures (drop structures/control structures), gates, selected irrigation access roads. An inventory of these assets has been prepared, although in Zabid minor structures will be added. This inventory is the basis for future O&M records. Until the O&M system is designed, an MIS for it cannot be provided. The O&M system can be designed around the GIS inventory.

Surveys include X, Y, and Z coordinates and thus can be represented in the GIS.

5.2 Spate management model

The information required for overall system management is far more detailed that that required by the SMM. However, the basic data has been the basis for generalizing the detailed data to bring it to a form usable by the SMM. The outputs from the SMM can thus be mapped back on the detailed data and linked ultimately to the monitoring of irrigation provided at the WUG level in the PIM.

5.3 Main fixed agricultural/natural resources

5.3.1 Field/plot boundaries

Project staff has digitized the field/plot boundaries. Unfortunately little or no assistance on this major task was provided by the PIUs, as originally intended. It provides a hard copy map at a suitable scale showing field boundaries (and, in the case of Zabid, plot locations) and field codes to the WUA; the Consultant together with its extension workers have been working with the WUGs to complete this laborious gathering of location and attribute data.

5.3.2 Tertiary command areas

The tertiary command areas (WUGs and canals) have been delineated and digitized.

5.3.3 Water

The Project Hydrologist has provided actual and synthetically generated time series data in MS Access format, and MS Access tables of original and 'cleaned data' data.

5.3.4 Soil

It has not been possible to obtain digital soil maps.

5.3.5 Climate

Climate data has been provided in FAO CROPWAT format; this can be directly linked to the MIS, if required. The CROPWAT format is a set of comma-delimited tables with information on monthly climates variables. These can be saved in structured of unstructured format in the MIS. The PIU staff can enter that data gathered from climate station records gathered by measurement staff.

A database has been provided for climate and water data.

5.4 WUA performance monitoring

A set of performance indicators has been provided in the PIM databases. These performance indicators were provided by the project PIM specialist.

5.5 Operation and maintenance equipment

A sub-system for provision of an inventory of O&M equipment has been provided by the Project. This can be used to monitor the usage and condition of such equipment.

5.6 Budget accounts

An elementary sub-system has been included in the O&M database for budget control. However, it is understood that the PMU are using software supplied by the World Bank for this activity.

5.7 Road maintenance

The O & M specialist will provide details during his following planned mission, but it is likely that PIU staff can gather any of this data and enter it into the MIS. The surveys carried out on the roads, include X, Y, and Z coordinates and thus can be represented in the GIS.

6 COMPUTER HARDWARE AND SOFTWARE

This section describes the equipment and software requirements for the PMU and PIU. Additional resources, presently in use by the Consultant to support the Consultant's activities, will be handed over to the PMU at completion of the Project.

The MIS consultant discussed the needs and specification of computer hardware and software for the PMU and PIUs.

6.1 Computer hardware

The PMU required a minimum of three (3) PC's/laptops. The PIU offices required a minimum of three (3) PC's/Laptops. The following equipment was agreed with the PMU:

- Three graphic workstations for GIS (19" monitor);
- Four PC workstations;
- Three laptop computer;
- Two B/W laser printers A3;
- One colour laser printer A3;
- Three colour inkjet printers, A2 (better investment is to get A3 or A1);
- One A0 colour inkjet plotter (with PostScript driver);
- One A0 colour scanner;
- Three standard size or A3 scanners;
- One APC smart 1000 VA, UPS;
- Seven APC back 650 VA, UPS;
- Eight Stac voltage stabilizers 1000 Watt;
- Three external modems.

6.2 Computer software

The recommended operating system was MS Windows 2000 (Arabic edition).

Each computer would be equipped with Microsoft Office 2000 Professional, Arabic/English editions, and/or include the Microsoft Office 2000 Multi-Language Pack. This includes MS Word, MS Excel, MS Access, MS Power point. The MIS would be implemented using MS Access and Excel. Consideration could be given to acquiring MS Project.

MIS/GIS attribute databases is implemented in Microsoft Access or as spreadsheet tables. MS Access 2000 is multi user and can be implemented on a network. If in the future a more powerful server based database on a wide area network is implemented it is a relatively straightforward operation to upgrade the system to MS SQL Server.

In order to facilitate the use of MS Access as the main MIS, and to lay the foundations for the Ministry to move on to using a fully integrated MIS/GIS system, it was proposed to use the ESRI ARCVIEW 8.x series GIS software for the GIS. Three licenses were purchased. By recommending ARCVIEW 8.x it lays the foundations for future expansion of GIS capability under ESRI's new flagship GIS – ARCGIS.

Arc Explorer, a free GIS data viewer, was used for any interested party to view the GIS/Image data.

One computer at PMU and each PIU required AUTOCAD software.

If groundwater monitoring is to become part of the MIS, a spatial interpolation program is required. This capability can be provide by purchasing either SURFER, IDRISI, ILWIS or ARCVIEW Spatial Analyst. Only on copy is required for the PMU. It is recommended that one copy of Surfer is obtained (cost USD 500. -) or ARCVIEW Spatial Analyst Extension (cost USD 2,500. -), if funds are available.

One copy of AUTOCAD 2000i was needed.

In addition utility software was required:

- Anti-virus software;
- CD writer software (usually included with CD writer);
- Adobe Distiller (not purchased);
- Lizardtech MrSid data compression software, desktop edition (not purchased).

Multi language fields were handled by a number of different methods, by converting table in English to queries in which the naming of the new field is made in Arabic. The value in the field was copied across (and converted to Arabic numerals or by having the data in one language, but the data entry forms and report forms in English and Arabic.

6.3 Computer security

All systems will have to be protected against computer viruses. This can be achieved by having up-to-date virus software, system backup and regular archiving using CD ROMs.

6.4 Computer training for MIS/GIS

PIU/PMU staff need basic training in MS Windows 2000, Access, and Excel. Additional selected staff will need training in ARCVIEW 8.x, and Visual Basic for Applications (VBA).

7. COST OF OPERATION OF MIS/GIS

The estimated cost of hardware and software for the initial setting up are of the order of USD 65,000 to USD 70,000.

The operational costs (which are on-going) should include:

- ISP connection, plus telephone charges (3) at USD 1000 per annum;
- Salaries and office overheads for 10 computer operators (estimated at USD 20,000 per annum);
- Salaries and overheads for 3 computer technicians/administrators (estimated at USD8, 000. - per annum);
- Cost of office space for 15 staff;
- Cost of electricity for air-conditioned offices for the 5 staff at each location (estimated at USD 350 per annum);
- Cost of consumables (paper and ink, CD's and diskettes), estimated at USD 500 per site;
- Cost of updating virus software (estimated at USD 150 per year);
- Replacement costs (annualized) estimated at USD 5,000 per year.

This represents a total of about USD 35,000 per annum excluding office rental costs.