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BANGLADESH FLOOD ACTION PLAN

GIS INSTITUTIONAL ISSUES

GEOGRAPHIC INFORMATION SYSTEM (FAP 19)

Prepared for

The Flood Plan Coordination Organization (FPCO)
of the
Ministry of Irrigation Water Development and Flood Control

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ISPAN
IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST
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IRRIGATION SUPPORT PROJECT FOR ASIA
AND THE NEAR EAST

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ACRONYMS

ADB	Asian Development Bank
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Centre for Advanced Studies
BRAC	Bangladesh Rural Advancement Committee
BWDB	Bangladesh Water Development Board
CIDA	Canadian International Development Agency
EC	European Community
EWI	Eastern Waters Initiative
FAO	Food and Agriculture Organization
FAP	Flood Action Plan
FPCO	Flood Plan Coordinating Organization
GIS	Geographic Information System
ICDDR,B	International Center for Diarrhoeal Disease Research, Bangladesh
IFDC	International Fertilizer Development Center
ILO	International Labor Organization
ISPAN	Irrigation Support Project for Asia and the Near East
LGED	Local Government Engineering Department
MIWDFC	Ministry of Irrigation, Water Development and Flood Control
ODA	Overseas Development Administration (British)
SPARRSO	Space Research and Remote Sensing Organization
TAPP	Technical Assistance Project Proforma
UNDP	United Nations Development Programme
UNEP	United Nation Environmental Programme
USAID	United States Agency for International Development
WARPO	Water Resources Planning Organization
WHO	World Health Organization

EXECUTIVE SUMMARY

In 1991 ISPAN initiated a program to carry out a series of pilot studies and application projects using geographic information systems (GIS) to support the Flood Action Plan (FAP). The success of this program, which is supported by the US Agency for International Development (USAID) under the Eastern Waters Initiative (EWI), is recognized by the government of Bangladesh and the development community. FAP 19 has developed new processing techniques, conducted spatial analyses, created a number of databases, and produced information products that are important for project planning and environmental monitoring in Bangladesh. During its short life, FAP 19 has become a "center of excellence" in the use of GIS and related information technologies and is supporting its development in both the public and the private sectors.

This report identifies issues concerning the transfer of the FAP 19 GIS to a local organization. It describes examples of geographic information needs in the water resources, agriculture, fisheries, environment, and disaster preparedness sectors. It defines an ideal model for the institutionalization of the FAP 19 GIS and examines the options currently available for that purpose. The report also identifies possible funding sources for the institutionalized GIS.

The report concludes that there is no local organization ready to assume effective operation of the FAP 19 GIS. In retrospect, it was perhaps too optimistic to expect that such a sophisticated technology could be designed, set up, established, demonstrated, and also institutionalized in Bangladesh in just two years.

The chief recommendation of the report is that USAID should consider supporting FAP 19 within the Flood Action Plan for another two years. This extended period would allow FAP 19 to conduct additional applications projects and would allow time for the orderly selection and transfer of the project's GIS to an appropriate local institution. During this period, FAP 19 could continue to provide GIS technical support to other FAP activities and could provide support to other organizations such as CARE-Bangladesh, the International Fertilizer Development Center (IFDC), and the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR,B).

FAP 19 should conduct additional GIS training programs and convene a small committee consisting of representatives from government, commerce, academia, and donor agencies, to advise on GIS institutionalization and to recommend a new host organization by the end of 1994.

In early 1995 the FAP 19 GIS should be transferred to the organization that can continue its GIS leadership role in Bangladesh. The transfer should occur approximately six months before the end of the project to allow time to provide technical assistance to the new host.

The possible consequences of not extending FAP 19 are:

- Failure to institutionalize the FAP 19 GIS.
- A loss of successful GIS experience, national leadership, and data acquired over the past two years.
- A loss of opportunities for creating public and private sector links for using GIS to promote sound development planning in Bangladesh.

This study was carried out by a team of three under the direction of the FAP 19 Team Leader, Mr. Timothy Martin, and the ISPAN Chief of Party, Dr. Keith Pitman. The team consisted of: Mr. Thomas W. Wagner, senior GIS specialist, Environmental Research Institute of Michigan, Ann Arbor; Dr. Thomas Chidley, consultant and former professor of civil engineering, University of Aston, U.K.; and Dr. Anwar Hossain, consultant and former chairman, Bangladesh Space Research and Remote Sensing Organization (SPARRSO), Dhaka.

Chapter 1

INTRODUCTION

The Inception Report for FAP 19 states that one output of the project is: "a PC-based GIS [geographic information system] initially housed at ISPAN offices and later transferred to a location to be determined" (FAP 19, 1991). The FAP 19 GIS now has been fully operational since October 1991 and has proved its usefulness to the Flood Action Plan (FAP) by providing image maps, digital databases, and thematic maps to other FAP studies. FAP 19, according to its terms of reference, is scheduled to end in October 1993, despite the fact that various studies under the Flood Action Plan will continue until 1995. Moreover, a suitable location for the FAP 19 GIS has yet to be found. The Flood Plan Coordination Organization (FPCO), therefore, has requested the extension of FAP 19 beyond October 1993 so that the project can continue to serve the geographic data needs of the FAP and complete the transfer of technology. This report addresses the latter issue and provides a set of recommendations to the government of Bangladesh and USAID for the orderly achievement of that goal.

While transferring the FAP 19 GIS to local control would be useful to future development planning in Bangladesh, transfer alone is not enough. Rather, what is required is that the technology be institutionalized. That is, GIS maintenance and use in day-to-day decision-making must become routine, ongoing activities within a single specified organization, whether it be in the public sector, the private sector, or some combination of the two. This institutionalization requires the creation of an operating environment, a new setting, in which the GIS technology can survive, flourish, and eventually become self-supporting. In short, it must be put in a location that will enable the technology to become sustainable.

1.1 Report Objectives

The objectives of this report are to:

- Describe the potential development planning uses for GIS in Bangladesh.
- Describe the ideal model for institutionalizing GIS technology.
- Survey currently available options for the institutionalization of GIS.
- Identify possible funding sources for the institutionalized GIS.
- Recommend specific actions that can be taken to transfer the FAP 19 GIS to a new organization and start the institutionalization process.

1.2 FAP 19

Like all FAP studies, FAP 19 is coordinated by the FPCO. The project's Technical Assistance Project Proforma was approved by the Bangladesh government in December 1990. USAID/Dhaka has committed additional funds and a time extension: total funding of about $2.7 million will support the project through October 1993.

1.2.1 Project Objectives

FAP 19's objectives are to:

- Provide a GIS facility to assist in planning and managing geographic information for the FAP.
- Assist FPCO in establishing a GIS network to serve FAP users.
- Promote and establish standardized data protocols and database formats for FAP GISs.
- Provide on-the-job GIS technology training to FPCO and other government and nongovernment personnel in support of FAP objectives.
- Promote unrestricted access to water resources management and planning information for legitimate users.

FAP 19 is meeting these objectives. The FAP 19 Interim Report (1992) describes its achievements with respect to each of these objectives and the products that have been created to date. It also presents plans for additional activities and products that will be developed before the end of October 1993.

1.2.2 The FAP 19 GIS

FAP 19 employs a group of well-trained and experienced scientists and engineers who understand how to apply GIS, and how to create and maintain GIS databases. This kind of knowledge base is essential to GIS operations as are good analytical skills, teamwork, and the ability to conceptualize spatial (geographical) relationships. A large part of the FAP 19 GIS investment has involved hiring local people who are proficient computer users and training them to use GIS systems. This training has been provided by regional organizations, the FAP 19 team leader, and short-term experts.

After training, however, the largest GIS investment is in creating digital databases. Database development usually represents a considerable portion of the work of a GIS facility, and, in fact, FAP 19 has constructed, and continues to construct, numerous national, regional, and subregional databases to support various applications. For example, digital elevation models (DEMs) based on topographic data give FAP 19 the ability to map the extent and effects of flooding under various scenarios.

The GIS hardware and software, although perhaps the most visible components of a GIS, are the parts that can most easily be replaced or replicated. FAP 19's hardware consists of several 486 and 386 computers, image processors, pen plotters, inkjet printers, large digitizing tablets, dot-matrix printers, and a nine-track tape drive. This hardware supports installation of pcARC/INFO, ERDAS, IDRISI, and several surface-modelling software and other peripheral programs. FAP 19 has arranged for the import of spare parts, most of which are not locally available, via ISPAN/TSC in Arlington, Virginia. It has also negotiated computer maintenance with local and foreign vendors.

1.2.3 Project Results

The results of FAP 19, described in its Interim Report and periodic special application reports, were achieved through the efforts of FAP 19 staff and with the support of FPCO. The range of the pilot and application projects undertaken by FAP 19 illustrates the various uses for GIS technology in supporting water resources sector information needs, both as individual FAP 19 activities and as input to other FAP studies.

The FAP 19 GIS application projects and their current status are shown in Table 1.

These projects involve interfacing with hydrologic models through digital terrain modelling, mapping and analysis to assess environmental impact, landscape change monitoring to characterize fluvial

processes and river morphology, mapping and analysis for the design and management of flood compartments, and creating a database for national and regional planning and management.

There are a number of GIS installations in Bangladesh (see Chapter 4), and in 1991, FAP 19 convened an informal GIS users group to bring together individuals and organizations with a common interest in the technology. Since its founding, the users group has had regular meetings, and approximately 90 people from government, private industry, NGOs, and donor agencies have attended each time.

Table 1

FAP 19 GIS Application Projects

Application Project	Status
Compartmentalization Design and Management (FAP 20)	*Complete*
Jamuna River Morphology and Char History (FAP 1)	*Complete*
Environmental Impact Assessment (FAP 16, FAP 20, FAP 4)	*Complete*
Digital Elevation and Spatial Interface for Hydrologic/Hydraulic Models (FAP 24/25, FAP 21/22)	*Ongoing*
National Overviews and Planning	*Ongoing*
Disaster Management and Relief (FAP 10/11)	*Started*
Monsoon Season Satellite Radar	*Started*

FAP 19 has taken the initiative to develop and propose several technical standards and protocols for database development and data sharing among the different institutions using GIS in Bangladesh. Broad guidelines for data documentation and quality standards are being prepared, as is a series of technical notes that address specific issues related to data standards. Data needs and format were determined after discussions and meetings between FAP 19 and other GIS users.

FAP 19 has assumed a leadership role in promoting changes in the local information environment that, in the long term, will make all GISs more effective. These changes involve development of data standards, information sharing, and guidance in the design of new GISs for other organizations and agencies.

1.3 Advantages of GIS

Good geographic information is paramount to sound planning and implementing of development projects, not only in the FAP but also in almost all physical and environmental resource development activities. In times of flood, topography determines how water moves over the landscape and whether flood control will be successful. Transportation and communications planning requires data on the precise locations of towns and villages. Knowledge of river and coastline movements is used to assess and anticipate the effects of those movements on the populations along their shores. Accurate administrative and political boundaries are necessary for compiling good economic and social statistics and for displaying them in comprehensible forms.

Accurate, readily available geographic information also stimulates development and environmental monitoring. It promotes informed decision-making and allows communication of important economic, social, and physical relationships, not only within an economic sector but also between sectors. Since maps and images can be understood even by illiterate people they can also help integrate local people into the planning process.

Recent advances in digital computer technologies

have led to the development of powerful, low-cost information systems for capturing maps and other geographic data, and for creating new maps or other types of information products. A geographic information system, or GIS, is a computer-based technology for recording, manipulating, analyzing, and displaying data such as maps, satellite images, or other information having geographical references e.g., latitude and longitude or grid references. In simple terms, GISs are to maps and images what spreadsheets are to tables of numbers and word processors are to text. They are more, however, than just image processors; they are maps plus databases. Since they can bring data together from a wide variety of sources, they can act as consolidators of widely dispersed information. They provide a powerful means for manipulating geographic information and for creating information products that can be tailored to serve particular decision requirements.

GISs are being adopted by governments and planning agencies in countries around the world to fulfill a variety of project planning and implementation requirements. USAID in Washington, for example, has recently installed a powerful GIS for tracking its development projects around the world. In South and Southeast Asia, Sri Lanka, Singapore, Thailand, Malaysia, the Philippines, and Indonesia all have instituted planning procedures based on GIS technology.

1.4 Summary

FAP 19, by providing accurate and detailed geographic data to the Flood Action Plan, has demonstrated a more general need for improving the quality, quantity, and accessibility of geographic information in Bangladesh. Therefore, by fulfilling the project's mandate to transfer GIS technology to local control, and helping it to become institutionalized, FAP 19 can make a permanent contribution toward that desirable end.

GISs work best where reliable geo-referenced data is available and where there is a clear requirement for spatial information products. The FAP 19 success is due, in part, to the relatively open information environment of the FAP that supports the flow of information to and among the different FAP studies and the FPCO. It is also successful because of numerous, useful applications of the technology within the FAP.

The FAP 19 GIS, while not the only geographic system in Bangladesh (Chapter 4), is certainly among the most flexible, and the most developed, of its kind. Furthermore, FAP 19 has developed a technical staff that, under careful management and with the necessary resources, can ensure its continuation. The leadership role FAP 19 has taken, through setting standards and establishing the GIS users group, would help ensure the success of the institutionalization of the technology.

A workable, central GIS that is capable of brokering geographic data collection and dissemination is an essential tool for future development planning and monitoring in Bangladesh. Indeed, a need for accurate geographic data already exists and the market for it is growing at a rapid pace. While each development sector may have its own informational needs, most geographic data cuts across many sectors. Therefore, a central GIS would help eliminate costly duplications of effort and increase cross-sectoral communications and decision-making.

Chapter 2

THE MARKET FOR GIS SERVICES IN BANGLADESH

There is great potential for using GISs in development planning and for managing sector activities in Bangladesh at local, regional, and national levels. Valuable applications for GIS can be identified in many development sectors, including:

- Natural Resources: environment, water, land, agriculture, fisheries, minerals, energy.
- Social Welfare: health, education, local government planning, demographics.
- Infrastructure: transportation, urban planning.
- Disaster and Relief Management.

It is evident from the nature of these applications, and confirmed by a FAP 19 survey of current and planned GIS implementations in Bangladesh, that the information requirements of these sectors form overlapping data sets. Although there will always be a need for specialized databases for individual sectors, a central organization that is capable of gathering and disseminating data that cuts across sectors can help reduce duplication of efforts. Such an organization could be used to identify and examine the environmental sustainability issues involved in new projects. It could also be used to assess the extra-sectoral impact of a certain project or plan, thereby helping reduce conflicts between sectors.

This chapter broadly explores applications in which GIS technology may contribute to the development of Bangladesh and presents specific examples. Such potential applications may play a role in determining the new home of the FAP 19 GIS.

2.1 Water Resources

Water development projects are characterized by numerous large and small engineering works that are constructed and maintained to direct and control water distribution in channels and on the land. These structures include embankments, dams, bunds, canals, ponds, culverts, tubewells, and regulators. All of these can have significant, and sometimes unforeseen, effects on the availability and distribution of water, which, in turn, affect agriculture, fisheries, transportation, and the local environment.

GIS technology can be an important tool for water resource planning. As more water management structures are built in Bangladesh, GIS technology may be combined with other technologies, e.g., satellite Global Positioning Systems (GPS), to obtain and display more accurate information about the location of those structures. Managers in the Bangladesh Water Development Board (BWDB) and the Ministry of Irrigation, Water Development and Flood Control (MIWDFC) need such information about the structures under their control. Many water control structures have been built over the past 20 years, but because of incomplete records, their locations and operational status are often unknown. GIS technology can be used to

compile a database that includes not only location information but also information on the factors that affect the hydrology of a given catchment or watershed unit. Such a database can be used in planning and predicting the effects of new structures.

2.2 Agriculture and Fisheries

Agriculture and fisheries dominate the Bangladesh economy. These sectors together employ some 60 million people and contribute more than half the nation's gross national product. Agricultural practices and fisheries in Bangladesh are land- and water-intensive and vary with season and topography. GISs may be used to record and display the cropping systems and seasonal water body variability and thereby contribute to better planning and marketing of sector products and services.

For example, the complex network of rivers and small and medium-size water bodies support a vital but seasonally variable fresh water capture fishery. The physical connections of water bodies, both to each other and to major rivers, affect the success of fish spawning and fish distribution and, therefore, the availability of this important protein source. In the past, the Department of Fisheries conducted incomplete inventories of water bodies that quickly became outdated due to modifications made to the land by man and nature. A GIS, coupled with contemporary remote sensing data, could be used to map the seasonal inundation of the floodplains and provide current information on the status of the water bodies.

Water quality may be linked to such factors as fertilizer and pesticide use. In the United States, it is estimated that agriculture is responsible for 50 to 60 percent of the controllable damage to water resources and significantly threatens groundwater quality (OTA 1990). As Bangladesh increases application of agricultural inputs, their use could be monitored and mapped using GIS.

A series of agro-ecological zone (AEZ) maps, originally prepared by the Food and Agricultural Organization (FAO), provides a basis for conducting land capability studies, helps identify areas most suitable for new crops or new cultivators, and can be used to specify agricultural inputs. Soils, topography, ground water, climate, and crop information can be combined in a GIS for prioritizing locations most suitable for diversifying crops.

Land capability databases that integrate road network information with market locations might be used for assessing distribution requirements for agricultural commodities such as seeds, fertilizers, and pesticides. For example, the IFDC's Agribusiness and Technology Development Project, concerned with providing market information to private sector distributors, could use a GIS to provide maps containing useful agronomic and market information. The GIS could compile and update local market intelligence for developing crop storage and sales and product delivery strategies.

2.3 Environment

The growing population of Bangladesh is threatened by episodic and cumulative environmental hazards. These hazards, many of them preventable, can affect productivity, land capability, biological diversity, air and water quality, and human health. A GIS is a useful tool in predicting the effects of development decisions on the local environment.

For example, each year, CARE, an international NGO, reviews plans for the construction or improvement of some 3,000 miles of rural feeder roads and other local construction under its Integrated Food For Work program. While this program provides seasonally important employment for thousands of workers, the roads, bridges, embankments, and ponds that it builds sometimes

adversely affect the environment. CARE recognizes the need for EIAs and is incorporating environmental review processes in its revised Integrated Food For Work program (CARE 1991). CARE and other organizations concerned with local development, e.g., the Local Government Engineering Department (LGED), intend to use GIS for planning engineering works and assessing environmental impacts.

Increasingly maps are seen not just as analytical tools for planning but as media for stimulating discussion and conveying information. Often maps and images are comprehensible to nonprofessionals as well as professionals, and therefore help to bring people with less formal training into the planning process.

2.4 Disaster Preparedness

Bangladesh's unique combination of geography and demographic circumstances makes it one of the most disaster-prone countries in the world. Its position on the delta of two of the world's largest rivers and at the apex of the cyclone-spawning Bay of Bengal concentrates the results of such climatic processes as floods from heavy monsoon rains and severe storms and cyclones during the inter-monsoonal seasons. High population densities and low topography virtually ensures disastrous consequences when these natural events occur. The cyclone of April 1991, for instance, resulted in an estimated 139,000 fatalities, but even during so-called normal years thousands of people lose their lives to natural disasters in Bangladesh (CARE 1991).

The recent United States publication, "Reducing the Impact of Natural Hazards" (USOSTP May 1992) identifies GIS as an important technology in both preparing for and assessing the effects of disasters, each of which can have unique spatial components. GISs can be designed to provide information needed for short-term relief, medium-term mitigation, long-term rehabilitation, and for determining measures that may reduce the effects of future disasters. The information needed for short-term relief includes the location of shelters and routes to deliver food and medicine. Medium-term information may include crop or infrastructure damage assessment as a means of developing and coordinating relief measures. Long-term disaster preparedness and rehabilitation includes developing complex programs that can both anticipate and respond to disasters at local, regional, and national levels.

2.5 Summary

The market for GIS services in Bangladesh is not limited to a single development sector. FAP 19 has found substantial and growing need for those services in a variety of areas. Neither is it limited to the public, private, or NGO sectors. While each of them may have some need for proprietary databases and GIS systems (Chapter 4), they also need access to a wider range of geographic knowledge than they can justify funding for themselves. A central GIS organization would be more cost effective than widely distributed databases that duplicate some information, and it would be an authority to which any sector could refer for the information it requires.

Chapter 3

THE CENTRAL GIS: AN INSTITUTIONAL MODEL

Before defining the ideal model for institutionalizing the FAP 19 GIS, it is important first to understand that certain conditions must exist to ensure successful institutionalization. Unless these preconditions can be met, the likelihood that any attempt to sustain GIS technology in Bangladesh could succeed would be questionable.

3.1 Preconditions for Institutionalizing GIS

The institutionalization of GIS in Bangladesh cannot be fully realized until there is a change in attitude about information access. This is already beginning to happen in the upper levels of government, and it needs to be encouraged. Appropriate information must first become available in a conventional form (reports, tables, maps, etc.) that can be converted to digital data.

Assuming the information is made available and is digitized, standards must be in place for information interchange and for setting quality assurance levels for data acquisition. Once these conditions are met, the accuracy of any set of information offered can be guaranteed. In such a climate, private and public sector organizations can compete in providing information.

Finally, users of information services will need to expect to pay for data. It is essential that the fees for providing those information services cover GIS operating costs and the cost of acquiring information that is not required for routine management. At present, information users in Bangladesh have very little experience with paying for data. Agreements with consultants and government contractors usually include clauses specifying that the government make all information freely available. The Surface Water Modelling Centre (SWMC) has been among the first to introduce fees for the output of its model runs and for other services. In order for this idea to develop further, the government of Bangladesh will need to amend the terms of its agreements with consultants and contractors to allow the buying and selling of data. It will also, of course, require that donors be able to budget for the purchase of necessary data or agree with the government of Bangladesh to make a counterpart data contribution. Clearly, too, if data is bought and sold in this manner, questions of ownership and copyright will have to be addressed at the institutional and governmental level.

It will take some time to reach these conditions. Once they are met, however, private or public sector organizations can set up enterprises that access networked databases and service users' requirements for GIS applications. If it is done in a proper manner, the development of a central GIS service organization can ameliorate the current situation, which has development planners running from pillar to post to gather the information they need to do their jobs (see the box on the next page). In the meantime, it is important to keep FAP 19 operating so that progress continues toward setting standards and so that GIS applications development can continue under the project.

THE IDEAL GIS FACILITY

In an ideal world all the factors affecting a project should be taken into account during the planning process. Under present circumstances this is nearly impossible. In order to do a thorough investigation, a planner now might have to visit the BSS to collect a database of population statistics, the BWDB for whatever maps are available, the Ministry of Agriculture for details of cropping patterns, and then he or she might have to begin making the rounds of NGOs, donor agencies, and other government ministies and agencies that have sponsored studies relevant to the project at hand. At many of these stops the planner would likely find that the information they want is unavailable or no longer exists for any of a number of reasons. Assuming the planner's search for information is successful, he or she might then be faced with doing further work to determine the quality of the information collected.

The model GIS and Information Center would enable planners to streamline project preparation by using data collated and verified by the center. At the beginning of a project, the design team would go to the center with their list of objectives. The first level of inquiry would be the National Data Base. Utilizing one work station, the team could call up the geographic area in question on the video monitor. The display would list a menu giving the layers of information available.

The first choice may be to look at the proposed project in the context of administrative and hydrological units. A stylus could be used to draw the project boundary on the screen and this GIS map and associated statistics (names of units, areas, populations, market and town centers, rivers, canals, roads, power supplies, etc.) could be printed out within a few minutes.

The team may then wish to determine what exiting or planned projects will affect the proposed project area. Taking a hydrologic example, the team may call up a map showing hydrologic catchments and drainage area, and ask the GIS to show all projects upstream and downstream of the proposed project. An associated data file could list all relevant reports and investigations, as well as their locations. Similarly, data from roads and highways, the power authority, and BIWTA could be displayed. Thus, the likely environmental impacts of the project could be provisionally determined, which would help in the design of the EIA program. Another layer of information would show wetlands and sites of special scientific interest. From a social perspective, the general population structure in the area could be integrated, showing social classes and land ownership patterns, number of landless people, etc. Other maps and files could show land use, soil associations, available cropping and yield data, and meterological information.

The team may have further special needs that are not part of the GIS data base. In this case, the GIS would be used to create a whole new set of information. Following discussion with the GIS managers, for example, a contract could be specified to estimate the cost of earthworks for, say, an embankment or road. The GIS center would then work with the SWSMC to determine design flood depths in local rivers and drains and, integrating this data with a digital elevation model of the proposed project area and a standard road earthworks (cut and fill) design program, give provisional costs of the embankment/road. The special application would also include the volume of earth works so that the labor requirements, and hence temporary local employment, can be determined.

Finally, the appraisal team may wish to make a presentation of their findings to a ministry, donor organization, or even Parliament. The GIS Center would have facilities to produce videos (including animations of the potential impact of the project), slides, and overhead presentation material.

3.2 The Model for Institutionalization

Assuming the preconditions outlined above are met, the model organization for the institutionalization of the FAP 19 GIS should meet certain criteria. While it may not be possible for any single organization in Bangladesh to meet these criteria at present, they are outlined here to serve as an ideal against which current and future options can be compared.

Ideally, the GIS center should be centrally located and actively involved in helping set GIS standards for Bangladesh. The center would be engaged in creating an information network drawing upon the distributed databases of the public, private, and NGO sectors. In this role it would serve as a data broker, assisting not only in the gathering of data but also in its dissemination. To achieve this, the center would have to be impartial, outside the influence of the needs of a single economic sector; it should be a cross-sectoral endeavor.

The GIS, in order to be permanent, should have long-term funding. Its funding should not be tied to any single project. The long-term goal of the GIS funding should be to make the technology self-supporting through the sale of products and services. To do so, of course, it also must be cost-effective.

Maintenance of the databases and physical equipment that constitute the GIS are paramount to successful institutionalization. This will require sufficient foreign exchange to procure replacement equipment and to meet any future software needs. It is also essential that the organization be able to respond to system failures immediately and keep the GIS fully operational.

In the long term, GIS management should be able to pass from foreign experts to a well-trained national staff. The center will also need a staff of GIS technologists and scientists that can develop appropriate models. It will also require policy and interpretation specialists who can advise the center and the government on GIS information needs and uses and who can act as consultants for outside contracts.

The capabilities of the central GIS should be able to grow over time. By starting on a small scale, providing only products and services that are widely usable, the cost of on-the-job training is minimized and the cost and risk of failure is limited.

If all of these ideals are met, GIS technology can be fully institutionalized in development decision-making in Bangladesh. Unfortunately, as the next chapter reports, there are few options at hand that come close to the ideal.

Chapter 4

OPTIONS FOR FAP 19 INSTITUTIONALIZATION

GIS development in Bangladesh primarily depends upon public agencies because government ministries exercise control over such information as maps, aerial imagery, and renewable natural resource and meteorological data. Government institutions, the prime mobilizers of national resources for economic development, are the legitimate end-users of the information that can be supplied by a GIS and would therefore benefit by its institutionalization.

To date, attempts to establish public GIS organizations in Bangladesh have been fraught with difficulties. One reason for this is the government's inability to retain highly skilled and trained management and technical staff beyond the donor-funded project completion date. Another reason is inadequate funding of operation and maintenance and access to foreign exchange. In many cases, the information gathered to assist in the functioning and management of the public organization falls into disuse. This is because inadequate training of the end-users results in no demand for the information that is available. Moreover, the government policy of frequent staff rotation in line agencies makes it impossible to establish a lasting "institutional memory," that is, a core of people with comprehensive knowledge of the information that is available. Without demand for the information there is no incentive to support system maintenance, and eventually the system collapses.

The NGO and private sectors can overcome some of the constraints that hinder public organizations and, in the long term, may offer a more sustainable home for the FAP 19 GIS. Private organizations and NGOs play an increasingly important role in economic and social development and in creating an open information environment that leads to public participation and effective use of new information. New government policies for decentralization and privatization will empower the private sector and NGOs to a degree, but restrictions on access to data will continue to wield the public sector control for some time.

4.1 The Public, NGO, and Private Sector Models

Several organizations and agencies were asked to suggest options for transferring the FAP 19 GIS to the NGO and private sector (see Appendix). In some cases the organization was already using GIS technology and had specific experience in dealing with the issues that confront GIS applications in Bangladesh. In other cases, candidate homes for FAP 19 were suggested. The suggestions were of two types: some advocated retaining the GIS in the public sector, others suggested transferring it to the NGO sector.

4.1.1 Public Sector Model

In the public sector model, line ministries and organizations are viewed as the means for implementing government economic and social development policies. Government decision-makers and policy-makers within these agencies seek primary access to information that affects those policies and decisions, including geographic information. Most donor-supported GISs are intended to support and improve the information flowing to decision makers within the government of Bangladesh. The institutionalization team focused its attention on the government agencies as a potential home for the FAP 19 GIS.

Within the water sector, FPCO was the most obvious candidate. FPCO has been supportive of FAP 19 from the beginning and has an interest in the technology. FAP 19 contributes to FPCO's central role in coordinating and compiling information from the different FAP studies. However, the temporary nature of FPCO, which is scheduled to complete its task in late 1995, and the agency's current space, funding, and technical resources make it an unlikely new home. Indeed, FPCO officials have stated that the FAP 19 GIS should be transferred to a permanent organization.

The Water Resources Planning Organization (WARPO) has a permanent mandate to be a data gathering, planning, and mapping body, and GIS could make a useful contribution to the agency. As the successor to the defunct Master Plan Organization, WARPO has primary responsibility for developing and updating Bangladesh's national water plan. A number of factors, however, limit the attractiveness of WARPO including its newness, lack of resources, absence of GIS interest and experience, and restrictive data policies. Only if one or more donors were to take a strong supporting interest in WARPO would the FAP 19 GIS survive there.

The BWDB plays a major role in developing and using the water resources of Bangladesh. Under UNDP funding, two GISs are being provided to the BWDB and several people are being trained to use this technology. However, visits to these projects indicated that the GISs have not been institutionalized yet within the agency and future use is somewhat uncertain. Thus, at this stage, BWDB could not be recommended as a home of the FAP 19 GIS.

SPARRSO, an autonomous research organization under the Ministry of Defence, is another candidate considered for the FAP 19 GIS (Wagner 1992). SPARRSO was originally created under the Science and Technology Division of the Ministry of Education, and there is a possibility of its return there. SPARRSO has the most image processing/GIS experience of any government agency and has a well-trained staff; it also has provided valuable assistance to FAP 19 under its terms of reference. SPARRSO has four installations, the latest of which is under a UNDP project. The SPARRSO facilities are currently underutilized because, although the staff is generally well-trained, many are often absent for long-term training and there is little incentive to complete project tasks in a timely manner. Also, dissemination of study results, especially to FAP studies, has been slow. SPARRSO has not yet proved that it could maintain effective operation of the FAP 19 GIS.

The BBS's emphasis on completing publication of its 1991 Population Census resulted in its GIS program being given a low priority. With the publication of the census in late 1993, the BBS may again turn its attention to GIS applications under the technical support of several donors. The technical management, staff resources, and commitment to GIS are all indeterminate, so at this time BBS cannot be recommended.

BARC already has plans to upgrade its existing land resources database to use GIS technology. This database includes large quantities of information supplied by various government ministries. The upgrade plan includes a means of building an information network of information gatherers and users at the department and district levels. Since its database is limited to the agriculture sector, however, is not a suitable location for a centralized GIS. If successful, the BARC network could be linked to the FAP 19 GIS (as its soil database presently is).

The institutionalization team was impressed with LGED's efforts to compile map data from different sources and create a new 1:50,000 scale base and thematic map series for each of the 460 thanas. LGED has plans to digitize the base maps for each of the thanas, and, when complete, these

data will be a valuable resource for the GIS community. LGED already has plans for developing GIS capabilities with a long-term objective of assisting thana-level development planning.

Of the public sector choices for the FAP 19 GIS facility, LGED would probably utilize the GIS most efficiently in terms of building databases and possibly, in the longer term, for planning purposes. However, like other government institutions discussed above, LGED is not oriented toward developing new analytical procedures or providing broad support services across ministries, neither is the department in a position to provide a broad leadership role.

While there is considerable potential for institutionalizing the FAP 19 GIS in the public sector, such a move has drawbacks when compared to the ideal outlined in Chapter 3. Among them is the lack of foreign exchange, which would be required to maintain the system. Couple that with the generally slow reaction time of government bureaucracy and reliance on external service contracts, and in time, the GIS likely would fall into disuse. Additionally, line ministries and public organizations, because they generally focus on a single sector or only a few sectors, lack the impartiality required for smooth operation; in such a situation, there is a potential for operational interference due to inter-ministerial or inter-organizational conflicts. Finally, in the public sector, funding for the institutionalized GIS is likely to be project-specific and linked to projects with a short time scale.

4.1.2 NGO Model

Currently there are no NGOs with functioning GISs in Bangladesh, but CARE, IFDC, BRAC, and others have indicated interest primarily as potential users of GIS information rather than as GIS implementers.

CARE-Bangladesh has a requirement for developing and reviewing EIAs for its 3,000 miles of annual road construction and other union- and thana-level engineering projects. To test the technology, CARE plans to develop a limited in-house GIS capability after conducting an information needs assessment to determine what GIS capabilities it needs. CARE has specific requirements for GIS technology and services but is not interested in adopting a leadership role and has no capacity to do so under its current policy.

IFDC, headquartered in the United States, is an international center involved in agricultural input delivery to Bangladeshi farmers for the private sector (IFDC 1992). IFDC is interested in developing GIS capabilities to provide better marketing information to its thousands of suppliers. FAP 19 could contribute to IFDC's local development of GIS capabilities, but IFDC would not be a suitable home for the FAP 19 GIS facility because of its specialized interests and scope.

Neither CARE nor IFDC are in a position to use the full capabilities of the FAP 19 GIS, but together they and other NGOs may provide a local demand for GIS products and services that could be served by a central, institutionalized GIS.

As an alternative, the formation of a new scientific organization, called, for example, the Bangladesh Environmental Monitoring and Information Center, could provide GIS leadership. If it were semi-autonomous and donor-guided, such a center could be an asset to the growing GIS community in Bangladesh and could help introduce additional technologies, such as remote sensing and global positioning systems. The center could conduct studies and publish a variety of environmental mapping and monitoring reports, including EIAs, flood risk analysis, and other studies that incorporate the use of these technologies. Establishing a new institution is a big undertaking, and it is unlikely to be achieved within the life span of an extended FAP 19 activity, but this is an option that should be explored for the long-term future of

GIS in Bangladesh.

The Science and Technology Division of the Ministry of Education, at the suggestion of the Third World Academy of Sciences, is considering sponsoring an "International Center for Science, Technology, and Environment for Densely Populated Regions." While it is too early to say whether such a center could provide a home for the FAP 19 GIS, its progress and mandate should be watched by those concerned with the future of FAP 19.

Establishing a new institution to house the FAP 19 between now and October 1993 is impossible, but if the existing project were extended under FAP, the creation of a new center to provide GIS leadership, perhaps in cooperation with an existing national or international institution, may be feasible.

The NGO model fares well in comparison with the ideal model except on several crucial issues. First, funding in the NGO sector is usually project-specific, and while some of those projects may have very long time scales, they are none the less subject to specific project goals within the organization. Additionally, while all of those interviewed for this report supported GIS in principle, NGOs, like government ministries, often focus on a limited number of sectors and are, therefore, unlikely to take on the broader responsibility of brokering information for many different sectors and a variety of needs that do not fit with their own agendas. Perhaps the best choice would be the formation of a new scientific organization, but this is fraught with complications that would require the mobilization of a massive effort within the scientific and technological communities of Bangladesh.

4.1.3 Private Sector Model

The institutionalization team's discussions with private sector organizations were positive and indicated that they may fulfil several roles, including supplying qualified technical people, supporting database development, and conducting user-specified studies and applications.

BCAS, a consulting firm that conducts applied social science studies and publishes reports and public interest papers, for example, plans to acquire a GIS to help support the geographical components of its studies. BCAS has expressed an interest in the FAP 19 GIS and has proposed to publish a newsletter for the Bangladesh GIS community. The BCAS policy, staffing, and management strength would need to be verified before making a recommendation regarding its suitability to house the FAP 19 GIS facility. BCAS could, however, undertake project studies on subcontract.

Donor-supported projects are hiring local companies and individuals to supply and maintain equipment, provide technical staff, build databases, and carry out GIS applications. There is even one GIS software representative in Dhaka. The value of this market, largely fueled by donor-supported projects, is thought to be growing at about 30 percent per year. Any easing of government restrictions on available maps and images will result in a sharp increase in private sector demand for GIS products and services.

A private sector organization, in the long term, is probably the best hope for the institutionalization of GIS in Bangladesh. The principle challenge of such an organization would be to maintain strong links with the public and NGO sector organizations that can both deliver the data necessary and be the users of the GIS products it produces. At this time, it is does not appear that there is a private sector organization with this capability nor even with adequately trained personnel and a management structure capable of taking on the FAP 19 GIS. There is not sufficient time to build up this capability and work out the necessary transfer arrangements before October 1993.

4.2 Public-NGO-Private Sector Linkages

Cooperative linkages between such organizations as LGED, CARE, and a private sector firm like BCAS, or perhaps the Ministry of Agriculture and IFDC may provide an opportunity for institutionalizing the FAP 19 GIS. Granting the GIS to CARE or IFDC and operating it by a private local contractor may provide the best of both worlds, development orientation and private sector efficiency, but it would not ensure wider leadership in GIS. While SPARRSO, BARC, LGED, BBS, the Ministry of Agriculture, and other public institutions have plans for their own GISs, information linkages that allow data sharing among them have been notably unsuccessful.

An alternative model, described in Chapter 5, would be to provide a private sector organization with an operational GIS under a grant or loan with the expectation that the value of the facilities could be charged against work performed for USAID or other donor-supported projects.

4.3 Marketing GIS Products and Services

Regardless of the model that is ultimately selected, marketing will be essential to the institutionalization of GIS. The marketing of any product can take two forms: concept marketing and selling. Before the actual selling can occur, the need and uses for a product or service must be apparent to the potential market; that is the goal of concept marketing. FAP 19, by demonstrating applications for GIS and by discussing with members of the development community their need for GIS services, can be said to have been involved in concept marketing. Through this process, FAP 19 has found that there is a substantial and growing market for GIS services, which could, in time, support a private sector organization.

The potential market for GIS services, as touched on in Chapter 2, consists of local and international NGOs; NGOs and consultants funded by multinational and bilateral agencies; research institutes; academic institutes; ministries of the government of Bangladesh; other government agencies; local and district planning authorities; and international agencies such as the World Bank, UNEP, FAO, WHO, and ILO. A commercially operated GIS information broker could expect to provide information and GIS products and services to many of these.

The commercial GIS could offer such products as image maps, digital databases, and thematic maps, and services that might include advice on setting up systems and applications, data processing, application development, and training.

The value of the market for GIS products and services is, admittedly, unknown. Most of its potential lies in the developmental benefits that can be reaped from projects using the higher quality and wider distribution of geographic knowledge.

Many government organization have vast databases and are planning to convert parts of them to GIS formats. To realize the value of that data outside the department responsible for it and to reduce the costs associated with excessive duplication of effort requires a means for networking and sharing information. One means of doing this in a private sector organization would be to create a Value Added Network (VAN) enterprise.

A VAN is an operation that acquires information from authenticated sources and adds value to it by providing services to clients, such as finding the information required and processing it or combining in novel ways. There are several activities in Bangladesh that are potential beneficiaries of a VAN. Take, for example, the databases developed by FAP 4. The project has, and will create, several GIS-based data sets of environmental information that can be used for regional and local planning. Dissemination of that data, which will

include important information on the effects of agricultural chemicals on ground water, is not one of the activities of the project, yet the data would be useful to, among others, the proposed World Bank/EC National Minor Irrigation Development Project (NMIDP).

In this context, a broker of information, contacted by NMIDP, would find out what the client's information needs are and direct it to the source. In this simple transaction between the user of the data (NMIDP) and its owner (in this case, the Ministry of Agriculture), the broker receives a fee for administrative costs and arranges for the payment to the owner. The broker organization can also generate income by combining data in ways that are specific to the client's needs. For example, in the Brahmaputra-Jamuna charland study carried out by FAP 19 for FAP 16, FAP 19 obtained satellite imagery from SPARRSO and other international data suppliers, population statistics from BBS, and base maps from SOB. All of this was combined with information obtained by FAP 16 surveys to produce maps showing the age of charlands and their distribution, along with important spatially oriented socioeconomic data. This database can now be used to assess the impact of flood control structures on adjacent river banks and flood proofing measures.

Chapter 5

FUNDING THE FAP 19 GIS

Donor-assisted projects, as Chapter 4 notes, have already installed GISs in a half-dozen government departments and organizations, and an equal number of GISs are being used in support of specific projects, including FAP 19. More GISs are planned for the near future, both within projects and as part of technical assistance to the government. As a result there is a developing market for GIS technology, products, and services, but the market is not yet large enough to support the FAP 19 GIS entirely on the basis of its products and services.

Without funding, of course, the FAP 19 GIS will not be sustainable. This chapter discusses possible sources of funding for the institutionalized GIS. Factors that may affect this funding include the levels of continuing donor support, the rate at which the government eases its restrictions on maps and other data, and the way in which private and non-government sectors respond to demands for GIS technology and services.

5.1 FAP 19 GIS Costs

About $800,000 per year is needed to maintain the current activities of FAP 19. This amount, which is currently paid by USAID, can be broken down into fixed and variable costs. The fixed costs consist of building rental, equipment, basic supplies, expatriate management, local staff, materials, and administration. The variable costs are those associated with conducting GIS applications projects and include the cost of data acquisition, database development, and short-term specialists. If the FAP 19 GIS is institutionalized under local management, it would cost about $400,000 per year to sustain operations. These costs could be recovered from fees and information charges levied on the GIS users.

The FAP 19 institutionalization team has met with several donors to discuss their interest in GIS and assess the possibility of their financial support for institutionalizing the technology. The following organizations are likely to participate in the GIS market for products and services:

- World Bank
- Food and Agriculture Organization (FAO)
- Asian Development Bank (ADB)
- United Nations Development Programme (UNDP)
- USAID
- Danish International Development Agency (DANIDA)
- Canadian International Development Agency (CIDA)
- Space Research and Remote Sensing Organisation (SPARRSO)
- Bangladesh Agriculture Research Council (BARC)
- Bangladesh University of Engineering and Technology (BUET)
- Jahangirnagar University
- Bangladesh Centre for Advanced Studies (BCAS)

- Bangladesh Water Development Board (BWDB)
- Bangladesh Bureau of Statistics (BBS)
- Flood Plan Coordination Organization (FPCO)
- Local Government Engineering Department (LGED)
- United Nations Environment Programme (UNEP)
- World Health Organization (WHO)
- CARE
- International Fertilizer Development Center (IFDC)

5.2 Bilateral Donors

USAID, an early supporter of GIS technology in Bangladesh, has funded four separate GIS installations in the country, including FAP 19, and additional GISs are being proposed by CARE and IFDC. Together, these projects represent a significant USAID investment in improving the management, quality, and use of information resources. Also, USAID's population office recently has expressed interest in developing GIS applications for health and population programs through ICDDR,B.

CIDA is assisting the Ministry of Agriculture by employing GIS technology in its Agriculture Sector Team and Crop Diversification Project. The British Overseas Development Administration (ODA) has an interest in information systems and has indicated they may look to FAP 19 for technical support and guidance concerning GIS and remote sensing applications for its fisheries studies (FAP 17).

DANIDA, in concert with ODA and the governments of France and the Netherlands, is supporting the FAP 25 flood management model that integrates GIS systems with floodplain modelling. FAP 19 provided this project with technical advice, digital elevation models (DEMs), and other GIS data. The government of France has made additional contributions to GIS development in Bangladesh by supplying a series of SPOT satellite images through FAP 18 and FAP 24. Also, the government of Finland is preparing new topographic maps that eventually will make it possible to create new DEMs and other up-to-date terrain information.

5.3 Multilateral Donors

The World Bank, European Commission, ADB, and UNDP are aware of FAP 19's work and have expressed an interest in seeing it continue. Each is projecting an increase in its GIS-supported activities and recognizes the need for coordination among the GIS users in Bangladesh.

The World Bank supports developing countries by lending money and assisting the design and implementation of large projects, among them, the FAP. Since these projects are engineering-oriented, the bank supports and encourages other donors to support GISs.

UNDP is providing two GISs for BWDB, two for the Ministry of Works, and one each for SPARRSO, LGED, BBS, and BUET. Further, UNDP, which supports the Flood Action Plan, has proposed a distributed GIS for the agricultural research and extension community under BARC. UNDP also has expressed an interest in supporting projects that contain elements of institutional development and training, and may be a funding source for FAP 19's institutionalization. In fact, UNDP has money available to fund a GIS database development for the proposed Integrated Coastal Zone Management Strategy (Clark 1993), but the project designer has indicated it would be better to fund FAP 19 to do the work rather than developing a new facility for that purpose.

The ADB has funded several projects using GIS, including FAP 4, and plans to use GIS in new

projects including an irrigation command area project and a small-scale water resources development project. The European Commission currently is funding four projects in which GIS plays a significant part and has indicated that funds may become available for developing applications of radar satellite data.

5.4 Private Sector

Currently, private sector investment in GIS capability and end-user products and services are limited. Still, a digitizing contract recently offered by FAP 19 drew 11 responses, three of which were made by qualified local bidders, indicating some private sector interest in providing GIS services and products.

Development Design Consultants, Ltd. recently has installed a GIS as an addition to its successful computer-aided design (CAD) capability. BCAS, a private organization, also has plans to install GIS capability. There is expectation that this capability might grow over the next few years, stimulated by funding from donor projects that are promoting enterprises for computer-based activities, including computer-aided design (CAD) and automated cartography.

GIS services currently available in Bangladesh are mainly in equipment supply and servicing and in digitizing. None of the local providers are capable yet, nor are they expected to be in the near future, of offering the type of information brokering required for GIS applications. Therefore, the private sector is seen as a potential supplier of equipment and support rather than of information and GIS applications development services.

Chapter 6

RECOMMENDATIONS

6.1 Recommendations

After considering the issues presented in Chapters 2-4 and consulting with many individuals both inside and outside the government (see Appendix), FAP 19 has made the following recommendations for institutionalizing the GIS.

- The activities of FAP 19 GIS should continue under the FAP for at least two years beyond the current project completion date of October 1993.
- The US government should be requested to provide the core support for continuing the FAP 19 activities for the additional two-years.
- FAP 19 should, in that two-year period, develop a mechanism to charge users for the costs of requested products or services that are not part of funded core activities.
- FAP 19 should continue to develop and conduct pilot studies and GIS applications projects, and should continue in its GIS leadership role.
- Other USAID-supported projects should use FAP 19's experience when seeking to employ new GIS technologies in Bangladesh.
- FAP 19 should broaden its training and outreach activities to include local workshops and seminars for both high-level officials and local development project managers. Training should include long-term, on-the-job GIS management training for selected individuals from concerned organizations in Bangladesh.
- FAP 19 should convene a small advisory committee comprising senior people from government, commerce, academia, and donor agencies to help guide the institutionalization process. This committee should recommend a new home for the GIS to USAID and the government of Bangladesh by December 31, 1994.
- The GIS organization should be encouraged to retain the services of the current well-trained staff members. The FAP 19 staff should be informed and consulted about the selection of a new home for the GIS.
- Institutionalization of GISs in Bangladesh should involve building links between the private and NGO sector and the public sector.
- FAP 19 should aid in the physical transfer of its GIS facilities and personnel to its new home at least six months prior to project completion date.

6.2 Considerations

The above recommendations have been made in light of the demonstrated success of FAP 19 to date. It is not intended that FAP 19 should continue indefinitely; likewise, it is not reasonable to expect that such a sophisticated technology could be designed, established, demonstrated, and

institutionalized in Bangladesh in just two years.

The institutionalization team was not specifically concerned with continuation of the FAP 19 facility; the concern was with continuing the functions it provides in terms of information and GIS community leadership. The orientation of this recommendation is toward improving and strengthening planning and decision-making with better geographic information, not toward any exclusive use of this technology by a particular organization.

The recommendation for continuing USAID support to FAP 19 for an additional two years coincides approximately with the remaining life of FPCO, which is scheduled to end in late 1995. There is little rationale for continuing the FAP 19 GIS study beyond that time. However, there are several FAP activities being extended, or just getting under way, to which FAP 19 could contribute over the next two years.

6.3 Donor Support

As stated in Chapter 5, approximately $800,000 per year is needed to fund FAP 19 in its current arrangement. Besides USAID, World Bank, ADB, UNDP, ODA, CIDA, and others have indicated strong support for continuing FAP 19, and have stated that FAP 19 is providing good service and GIS leadership. Several donors, specifically UNDP and ODA, are considering direct contributions to FAP 19 or supporting it through payment for services rendered. However, it is unlikely that such support could be put in place by October 1993, when FAP 19 is currently scheduled to end.

6.4 Government Support

The FPCO has indicated that continuing support for FAP 19 would be welcome. There is tacit recognition that neither FPCO nor any other institution within the water sector (BWDB or WARPO) is in a position to effectively use the FAP 19 GIS now.

6.5 Public-Private Sector Linkages

Cooperation between public and private sectors is important, and the process of institutionalization requires overt efforts to design and promote these linkages. The linkages can be of several types, assuming that physical transfer of the GIS technology is to a government agency or an NGO.

One possibility is that the host institution could employ local individuals and arrange for additional GIS staffing through a local consulting firm—similar to the arrangement now employed by ISPAN. The host institution also could contract with the private sector for the construction of large databases, such as the national digital elevation model (DEM) now being considered by ISPAN. If given sufficient time to gain appropriate expertise, a private company could handle all aspects of GIS.

Perhaps one of the most important steps toward GIS sustainability in Bangladesh is the ability to recover operational costs. Ultimately, the end-users or their donors must be willing to cover those costs, which must be competitive with other sources of similar data. Therefore, during the two-year extension, FAP 19 should look carefully at its product costs, including the amortization of the facilities and equipment, to determine a fair price for its products. FAP 19 should explore mechanisms to charge users for the services which currently are being provided at minimal cost.

6.6 Proposed Activities

Specific pilot project activities are not suggested at this stage. Pilot projects and applications can best be defined through continuation of dialogue between FAP 19 staff and user organizations. If the GIS project is extended for two years, some of the

current FAP 19 activities would be most logical to continue and up to three new projects could be initiated, possibly from among the examples cited in Chapter 2. While the main focus should remain on water sector applications, projects in other sectors—agriculture, environment, demography, or disaster preparedness—should be considered as well.

It is important to continue developing the use of low-cost software programs to display and reproduce GIS products on personal computers at FPCO, USAID, and other government and donor offices. Demonstrations could be developed through creating some GIS files, installing display software on the appropriate decision-maker's computer, and training the user in the GIS software. If this activity shows that GIS digital data products can be successfully transmitted and directly used by decision-makers, more and lower-cost access to this technology can be promoted within FAP and in Bangladesh in general.

In keeping with its terms of reference, FAP 19 could undertake an archiving role for geographic information generated by the FAP. FAP 19 could catalog the information so that reports could be retrieved by geographical reference. Systems for preparing hard copy from the scanned documents would be a part of the system. These also would be stored on CD-ROM and catalogued. To some extent FAP 19 is already doing this for selected areas.

6.7 Proposed Training Activities

Training should continue to receive priority by FAP 19 for the duration of its program. By its nature, GIS management requires a combination of special skills that is best acquired by on-the-job training within a GIS facility. Currently, these management skills are lacking in Bangladesh and there should be a concerted effort to develop them under the extended GIS program. Also, there is a need for higher-level administrators to become familiar with the nature and applications of GIS and spatial technology systems.

Recommendations for training include:

- GIS Sensitization Seminars: Aimed at administrators and policy makers, and oriented toward GIS applications in various sectors. To be conducted by local FAP 19 staff and expatriate consultants.
- Short-Term Workshops: Aimed at GIS analysts. FAP 19 staff members—and staff from other projects—should attend one to two weeks of technical training workshops on pcARC/INFO, ERDAS, IDRISI, or similar software.
- Long-Term On-the-Job Management Training: Aimed at potential GIS managers from public and private agencies with operational GISs, including candidates for the new home for FAP 19. This would be six months of on-the-job training at ISPAN, working on a day-to-day basis with the FAP 19 GIS manager. During this period the trainee(s) would become familiar with all aspects of GIS operation and management, including the technology, personnel management, accounting and documentation, user contacts and information requirements, and markets.
- Overseas Training: Aimed at government and private sector managers and technologists. The purpose of this training would be to demonstrate the design, mangement, and operation of GIS facilities for local, regional, and national planning. Typical training sites would be city planning departments, the U.S. Army Corps of Engineers, the Tennessee Valley Authority, environmental monitoring agencies, and the U.S. Bureau of Reclamation.

Any trainee nominated by a local organization or agency should meet the professional requirements

established by FAP 19. Also, the nominating agency or organization should commit to assigning the trainee to an operational GIS for a minimum of two years after the training.

6.8 Proposed Institutional Advisory Committee

A small informal committee should be created as soon as possible to help advise FAP 19 on its institutionalization process. Specifically, the committee should consist of senior government officials, representatives of the private or NGO sectors, and donor representatives. The ISPAN project manager should act as convener and executive secretary. The committee should recommend an organization to house the GIS before December 31, 1994.

6.9 Consequences of Not Extending FAP 19

The primary consequence of not extending FAP 19 for an additional two years is that the FAP 19 GIS will not be institutionalized and sustained locally. It will share the fate of a number of other USAID and other donor GIS projects in which the hardware and software have fallen into disuse, the well-trained personnel have found other employment, and the databases cease to be maintained and available.

The loss of local GIS experience and expertise is likely to be the most costly aspect to USAID and the donor community. It takes 18 to 24 months to develop a GIS capability for most donor-sponsored programs. As new projects come with GIS components, sources of reliable information concerning GIS databases, technologies, and applications will be limited. Many of these projects must start from the beginning to acquire the knowledge and information that FAP 19 took two years to obtain, and many difficulties associated with initiating this technology will be repeated.

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APPENDIX

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