8   CONCLUSIONS AND RECOMMENDATIONS

8.1   Conclusions

(1)   The Role of IIMS in the Dakar Metropolitan Region

IIMS can make an important contribution to urban development in Dakar. The value of a consistent geographic and social database that is available to concerned agencies and that allows flexible and dedicated analysis based on the latest GIS technology should not be under-estimated.

a)   Planning

- In urban planning, GIS is particularly useful to agencies who implement utilities, services, or infrastructure and thus require line feature data managed by other agencies. Detailed design and construction requires integrated knowledge of various line data. In IIMS, the role of centralized GIS data is clear.
- In general planning which is not detailed design or construction, as undertaken by DUA, the IIMS provides an efficient mechanism for evaluating alternatives in addition to maintaining administrative-oriented planning procedures.

b)   Inventory Management

- The IIMS can be very useful in the management of urban infrastructure and services to individual line agencies in charge of the subject service, utility or infrastructure. The system provides an improved mechanism for information updates, information assembly, and information retrieval and presentation.
- However, in Dakar, many line agencies lack sufficient manpower and skill to establish and maintain such a detailed inventory database. It is therefore effective for the centrally managed IIMS to serve as common inventory database for sometime to come.

c)   Topographic Map Data

- The core of the IIMS database is the topographic map data. This is called the Spatial Data Infrastructure, which can be defined as a set of geographical data and their attributes based on a 1:5,000 scale. The spatial data infrastructure is managed centrally and used commonly by all agencies as standard.
- Establishment and recognition of such standard geographic data sets within the Spatial Data Infrastructure, are very important steps toward efficient management of urban development.

(2)   Immediate Applicability of IIMS

A survey of urban issues in the Dakar Metropolitan Region; the administrative situation to deal with them; and available data related to them, lead to the

identification of possible areas for immediate GIS application and eventually to the establishment of the IIMS with initial sets of geographic and other data. The following are the initial systems awaiting immediate application.

a)   Urban Sector Information Reference

-    Close to 120 items of urban features within the Region have been complied in the IIMS based on a scale of 1:5,000. Each one of them can be individually recalled with their geographic locations and their characteristic attributes to make thematic maps. They can be viewed individually or overlaid with each other in multiple layers. For each urban issue, related data can be referred and examined.

b)   Urban Development Control

-    The issuance of a Certificate of Urbanism (a set of building codes applicable to a site specified by an applicant) and the examination of Building Permit application can be streamlined by means of the system of retrieving pertinent codes at any specific site in the Plateau area.

c)   Urban Planning Support

-    Through the use of GIS data analysis, the selection of the most desirable site for an urban facility can be done quantitatively. Similarly, comparison of existing facilities in terms of geographic location can be undertaken.

d)   Residential Site Evaluation

-    A site in the Region can be evaluated against other sites in the Region on the basis of how suitable it is as a residential area utilizing a large number of criteria. Useful documents for planners can be prepared by this system.

(3)   Establishment of IIMS

A great deal of effort was made in this Study to assemble and re-arrange geographic and other data suitable for inclusion in IIMS. Various available hardware and software were evaluated against the actual environment in Dakar and the most suitable ones were selected.

a)   Hardware

-    Two almost identical sets of hardware were procured and installed in DTGC and in DUA by June 2000.

b) Software

- A GIS software ArcInfo was chosen for DTGC as the main software and GeoConcept for DUA.

c) Database

- Close to 120 urban features were made into data files with their geographic and other attributes.

d) Data Management

- Problems remain in the current practices of data preparation and management including confusion in geographic control points.

(4) IIMS Operation and Management

The Study Team found that both DTGC and DUA are capable of operating and maintaining the IIMS within their respective premises by the existing manpower. In fact, there is little prospect for strengthening manpower in either agencies due to a severe restriction on new recruitment in the government sector. However, in order for the IIMS to maintain its usefulness to other agencies and general public, it is essential for both agencies to update their respective database continuously.

8.2   Short Term Recommendations

(1)   System Management Organizational Structure

Recommended organizational structures for the operation of IIMS in both DTGC and DUA are quite similar. A system manager directly under the director would assume responsibilities for the operation and maintenance of hardware and software, external liaison, and training of staff. Under the current severe restriction on new recruit in all government agencies, there is little possibility to hire experienced GIS operators. Existing employees should operate the system under clearly defined responsibilities.

(2)   Data Management

a)   Spatial Data Infrastructure

Frequent revisions and updating are essential for artificial information such as that based on road and buildings and they should form a part of spatial data infrastructure. DTGC should continue collecting the most recent data and revising data files.

b)   Other GIS Data

Agencies responsible for urban facilities and services should report any changes in their subjects to DTGC and DUA. On such occasions, the data format of reported changes should conform with the IIMS system requirements.

c)   Strengthening of National Map Committee

The National Map Committee must be strengthened and held more frequently, such as once a month, in order to coordinate effectively among agencies so that the two requirements of a) and b) above could be implemented. The committee will play a central role in creating a system that facilitates sustainable data updates and/or system expansions in addition to ensuring that relevant organizations conform to it. The system will refer not only to technical issues including quality control of contents, standardization of data format and data update/exchange methodologies, but also to institutional coordination including role clarification.

d)   Standardization of Control Points

At present, the two geographic coordinates systems of ADINDAN and System 74 are utilized in parallel in Senegal. In the future, the coordinates should be standardized into the world standard system of WGS-84. The special data infrastructure compiled in this study will be easily converted into the new system.

(3)   Funding of Operating Costs

a)   DTGC

Following the last change in government, DTGC has been allowed to keep proceeds from own activities, such as the sale of maps. Operating costs of IIMS at DTGC is estimated at FCFA 20 million per year. It is recommended to fund the operating cost from the following sources:

Personnel	Ordinary budget of MET
Utility and communication	Ordinary budget of MET
Consumables	Proceeds from sales
Data input of large amount	Project budget by external agencies

b)   DUA

Operating costs of IIMS at DUA are estimated at FCFA 16 million. In principle, it must be paid out of the ordinary departmental budget as DUA does not have its own funding source. However, when DUA assists an external agency's project, the cost of operating IIMS for the project should be paid from the project budget. It is suggested to fund the operating cost from the following sources:

Personnel	Ordinary budget of MUH
Utility and communications	Ordinary budget of MUH
Consumables	Operating budget of DUA (including revenue from external projects)
Data input of large amount	Project budget of DUA (including revenue from the external projects)

(4)   New Activities and Own Funding Source

a)   DTGC should provide various map making services out of its map making capability as an asset. Various maps such as road maps and tourist maps, can be prepared and sold to the pubic. Proceeds from such sales can be made into its own funding source.

b)   It is also conceivable for DUA to collect fees for its services such as issuance of certificate of urbanism and building permit, the quality of which can be greatly enhanced by IIMS.

c)   DTGC and DUA should hold training sessions on GIS to officials of other agencies and the general public by utilizing equipment and manuals provided by this Study.

8.3   Long Term Recommendations

(1)   Networking

The initial IIMS is a stand-alone system at DTGC and at DUA. The Operating System used however is capable of networking. A national plan for developing an IT system in Senegal should be established in due course and an inter-agency information network should be gradually established following the national plan. Expansion of the IIMS should be carried out in line with such a direction. Nevertheless, the networking of the IIMS can be done in the following order:

    1 - between DTGC and DUA
    2 - between DUA headquarters and DUA branch offices
    3 - between DUA and the municipality of Dakar
    4 - between DUA and other municipalities
    5 - between DTGC and agencies which request such connection

An important issue is security. Access to files kept at DTGC and DUA must be limited to read-only for the foreseeable future. Otherwise accidental or intentional alteration of the files by outsiders may take place, which cannot be properly controlled. Changes or updates to the original data files deemed necessary should be dealt with by sending such a request to DTGC by non-direct means.

Initially, networking can be done by telephone connection dial-up. For heavily used connections an exclusive connection can be installed. A server for each of DTGC and DUA will be necessary before the networking.

(2)   Updating and Expansion of Spatial Data Infrastructure

Establishment of the Spatial Data Infrastructure within the IIMS has made it possible for any information within the Dakar Metropolitan Region containing location coordinates to be stored and recalled. The initial IIMS contains about 120 data items with some attributes in addition to location data. Agencies can strengthen Spatial Data Infrastructure by providing more attributes and more information items during the course of carrying out their projects utilizing the IIMS. In this respect, periodical updating of data is an important requirement of the system, though the required precision of data should be appropriately controlled.

Spatial Data Infrastructure has characteristics of common goods, i.e. its consumption by one does not reduce consumption by others. On the contrary, its strengthening associated with consumption benefits all. The National Map Committee should act as a mechanism to encourage its use and its strengthening. The area covered by the IIMS should also be expanded as the Dakar Metropolitan Area expands beyond the area covered by this Study.

(3)   Strengthening of GIS Data

GIS data, defined in this study as data not included in Spatial Data Infrastructure, was collected in this Study only from readily available sources, without carrying out fresh surveys. This data also awaits updating in the future. More accurate and up to date data should be collected by actual surveys. This will be a continuous effort by all concerned, particularly DTGC which will be on the receiving end of such updated data. DTGC should make it compulsory for agencies requesting its services and products to provide GIS data concerned with their activities.

(4)   Human Resource Development for West Africa

DTGC and DUA could become the center of human resource development in the field of GIS technology for Francophone countries in Africa. DTGC and DUA can train not only their own personnel, but also those who are external through seminars and training sessions open to the public. When the number of these trained persons reach a certain level, DTGC and DUA can organize seminars and workshops for the general benefit of whole of Francophone Africa.