Nigeria's National Geo-spatial Data Infrastructure: Problems and Prospects

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Key words: Geospatial Information, National Planning, Fundamental Datasets, Thematic Datasets, Metadata, Portability, Interoperability, Maintainability, Environmental Management.

SUMMARY

Virtually all the information required for planning and national development are spatial in nature. That is they are referenced to a giving geographic location on the earth. For easy accessibility, such information must be produced in coordinated and consistent manner and distributed harmoniously to all who need them. Geographic information system provides the platform for handling spatially referenced information and allows for integration of datasets from different sources. When such spatial information are available even in organised form, a suitable framework or technology is needed to facilitate data sharing among various users and producers.

Geospatial Data Infrastructure (GDI) provides the framework and technology to accomplish this. A national Geospatial Data Infrastructure is therefore necessary to facilitate harmonious production, usage and dissemination of geographic data in a country. Nigeria has started the process of developing her National Geospatial Data Infrastructure (NGDI).

This paper looks at the structure and implementation strategy of Nigeria's National Geospatial Data Infrastructure, the problems inherent in its implementation and prospects it holds for our developing economy.

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1. INTRODUCTION

1.1 What is Geospatial Data Infrastructure ?

Geospatial Information is needed for social, political, economic and physical development and for environmental and natural resources management. Production, usage and distribution of Geospatial information must be properly organised, standardized and structured to benefit all users and producers (Igbokwe, 2002). Geospatial Data Infrastructure provides the framework and technology to achieve this goal. Geospatial Data Infrastructure is therefore a collection of Policies and standards for data acquisition, integration and sharing. It includes also the relevant technologies and procedures for harmonious and efficient management and dissemination of geospatial data, the institutional arrangements and producers and users who interrelate within the framework. Benefits of such an infrastructure are enormous and include

- Standardized methods for acquisition, processing and management of spatial data
- Structured and organised access to data and data sharing
- Creation of vital digital datasets for different areas of national development
- Elimination of duplication of efforts in data acquisition and management
- Cost saving in data acquisition and management.

1. 2 Components of GDI

The components of GDI are universally acknowledged and they include

- The spatial Datasets (Fundamental, Thematic and Framework Datasets)
- Data Distribution Network (Data Resources, Metadata System, equipment and Infrastructure – technologies)
- Policies and standards (policies, laws, standards that govern data acquisition, sharing and usage)
- Institutional Framework (needed for easy coordination among various producers and users of spatial data
- Providers (Producers) and users of spatial data.

Nigeria has commenced the implementation of a National Geospatial Data Infrastructure (NGDI) as a way of harmonizing the production, usage and sharing of GI in the country. As at now the Draft National Policy on NGDI is ready. The apex coordinating organization has been selected, Contractors for the NGDI project appointed and various national committees are now being put in place. We will now examine the structure of our NGDI and its implementation strategy, problems encountered or will be encountered as well as the prospects it holds for our developing economy.

2. NIGERIA'S NATIONAL GEOSPATIAL DATA INFRASTRUCTURE

Nigeria has adopted as the terminology for geospatial data infrastructure – National Geospatial Data Infrastructure (NGDI). This incorporates the National Geographic Information System (NAGIS) and National Geographic Information Infrastructure (NAGII) started a few years ago under the auspices of the Federal Survey Department. Also the National Space Research and Development Agency (NSRDA) , a parastatal under the Federal Ministry of Science and Technology has been selected as the coordinating agency. The current efforts to implement the NGDI in the country is being done under the auspices of NASRDA. The organizational framework as envisaged by the national draft policy on NGDI is shown on figure 1.

2. 1 National NGDI Policy Framework

To ensure optimal use of geospatial information, Nigeria has prepared a draft policy document for the development and implementation of NGDI. The policy document has as its vision statement

i. To facilitate cooperation and collaboration among stakeholders in generating geospatial databases which are vital for development at the national state and local levels in Nigeria
ii. To eliminate duplication in the acquisition and maintenance of geospatial data
iii. To establish institutional legal, technical and administrative frameworks for
    - a consistent and harmonized mechanism for geospatial data distribution
    - easy access to vital geospatial datasets and their efficient sharing and exchange
    - integration of datasets through the application of common standards
iv. To promote investments in the production of geospatial databases
v. To promote research, training, education and capacity building related to geospatial data production, management and usage.

2.1.1 Policy Issues on NGDI Components

2.1.1.1 Geospatial Datasets

a.) Fundamental Datasets

The fundamental datasets refer to datasets with national coverage needed consistently by more than one users. The following data were identified as fundamental datasets for Nigeria

- Geodetic Control database
- Topographic database/DEM (at scales 1:25,000 – 1: 50,000)
- Administrative boundaries data
- Cadastral databases
- Transportation data
- Hydrographic data
- Landuse / Landcover data
- Geological databases

- Demographic databases

b.) Thematic Datasets

Two categories of thematic datasets were identified
- thematic datasets that can be produced only by legally mandated agencies, e.g. oil pipeline corridor maps, various kinds of utility maps and gazetteer of place names
- thematic datasets that can be freely produced according to specific use requirements, e.g. tourist map, soil map, meteorological datasets and agricultural map.

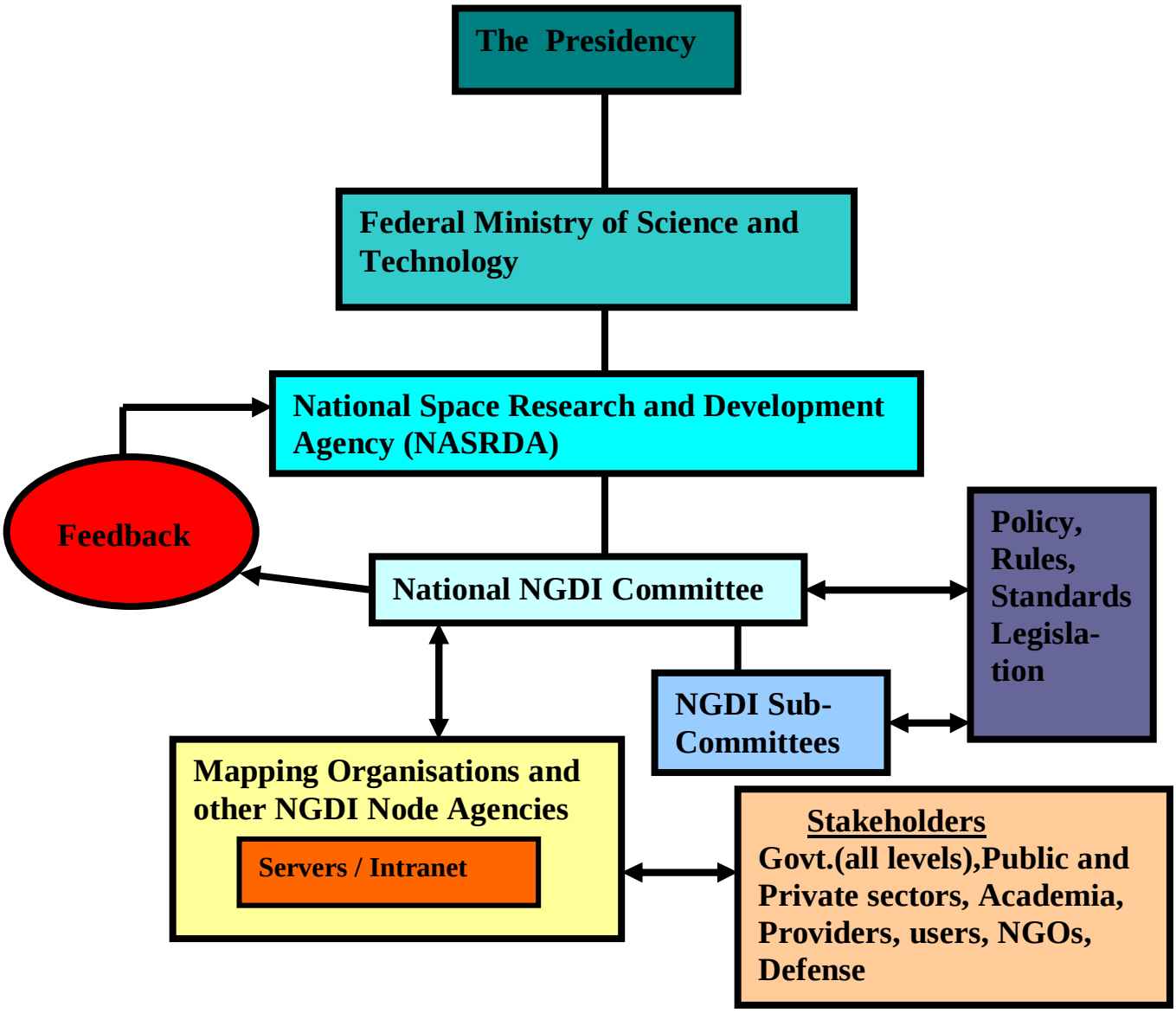

Fig. 1. Organisational Framework for Nigeria's NGDI

2.1.1.2 Standards

The aspects of standardization that are of importance to our NGDI include data acquisition standards, data presentation and transfer / exchange standards and hardware and software standards. The Policy draft further adopted the universally acknowledged standards for GI users reflected primarily in

- **Portability:** ability to use and move data, software and custom applications Among multiple computers and operating system environments
- **Interoperability and Information Access:** ability of computers and network users to connect and retrieve information from multiple systems
- **Maintainability:** use of standards to promote long – term and efficient up – dating up-grading and the effective use of computer systems and databases

2.1.1.3 Metadata

Metadata helps people who use geospatial data to find the data they need and determine how best to use the data. It also benefits the data producing agencies as well, because as personnel changes in an organisation, undocumented data may lose their value due to little understanding of the contents and uses by new staff (NASRDA, 2003)

The Nigeria's NGDI policy statement states that every geospatial data producer shall provide Metadata for each of its data holdings which must contain at minimum

- Data scale and date of acquisition
- Data quality (positional accuracy, attribute accuracy, temporal accuracy, lineage, completeness and logical consistency)
- Geospatial data organisation and spatial referencing
- Identification information (names of data, custodian of data, geographic coverage, etc)
- Entity / attribute information
- Distribution information

The Metadata produced is expected to conform to national and international standards.

2.1.1.4 Legal Issues

The National NGDI Committee is expected to provide advice to government on legal issues regarding the production, management and sharing of geospatial information to ensure that GI are produced, maintained and delivered in consistent way. The legal issues cover

- Ownership / Custodianship of data
- Copyright / Intellectual property
- Confidentiality, Privacy and Liability

2.1.1.5 Data Access and Data Security

The NGDI policy statement provides for two types of data access, namely

- Restricted Access (Data that relate to national security)
- Community Access (Data that can be accessed freely without restriction)

2.1.1.6 Institutional Arrangement

The institutional arrangement envisages that data management should be done as close as possible to source and should not be threatening to the mandate of stakeholders. The current institutional arrangement comprises of

- An Apex Clearinghouse which is the National Space Research and Development Agency (NASRDA) , under the Federal Ministry of Science and Technology
- A national NGDI Committee established under NASRDA. There are Sub-Committees for various aspects of NGDI
- Each Contributing Agency is a Node in NGDI.

2. 2 Implementation Strategy (The journey so far.)

A National NGDI Committee has long been constituted and has started work. The committee membership was drawn from stakeholders (GI producers and users). Various sub- committees for various aspects of NGDI are being put in place. The actual implementation of the NGDI project has started with GML Projects LTD as the main contractor. IT is working in technical association with Infoterra Global, Image Africa and Raytheon Technologies. Fig 2 presents a brief schetch of the implementation strategy.

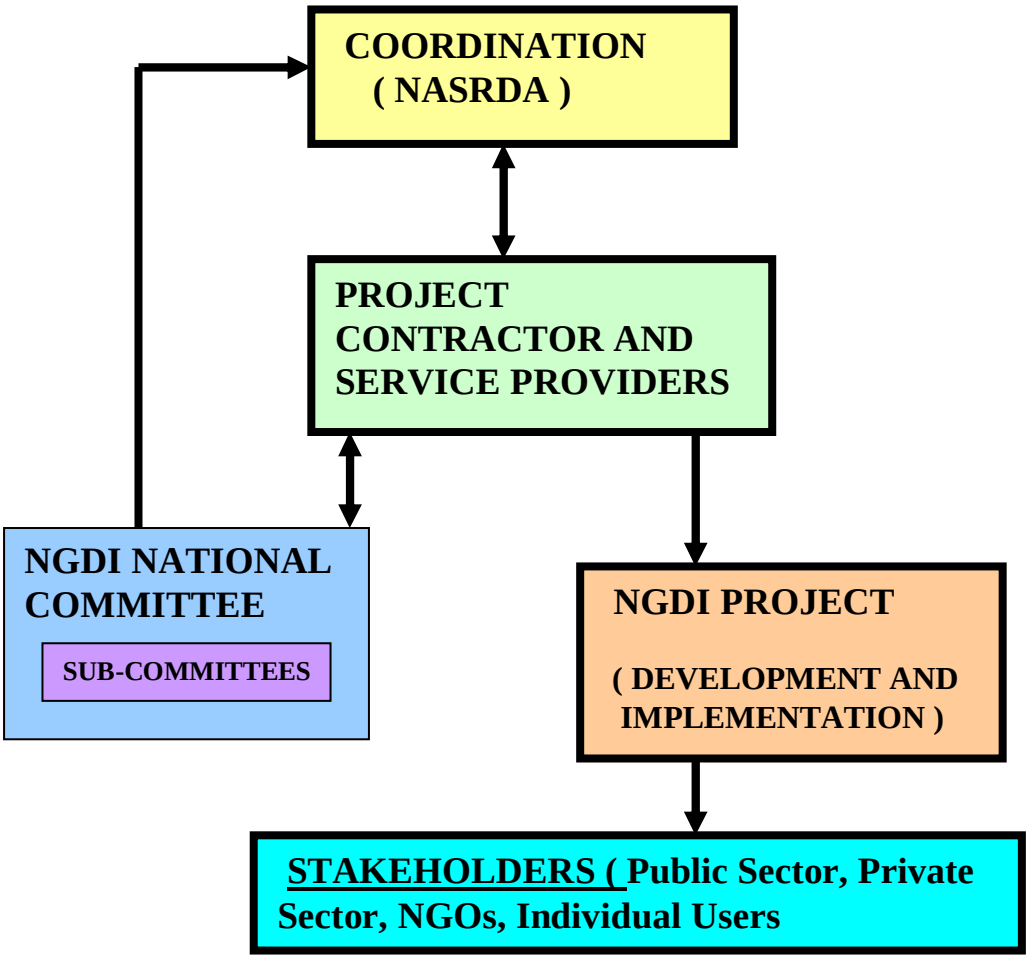

Fig. 2 Implementation Strategy (Adapted from NASRDA Report, 2005)

Currently an inventory of GI producers and users are going on in the country. The inventory is been handled directly by NASRDA. When completed it is expected to provide comprehensive data on available fundamental and thematic datasets in the country and their quality, the actual producers and users of GI.
At the same time, various training workshops on various aspects of NGDI are being organized to familiarize stakeholders on the NGDI project and its importance to the economy.

3. PROBLEMS AND PROSPECTS

3.1 Problems

Implementation of NGDI project in Nigeria has been facing numerous problems. Some of these problems are highlighted here.

3.1.1 Availability of Digital Datasets in the Country

Most of the fundamental and thematic datasets in the country are still in analogue form. Few of them are current but most are grossly outdated. So implementation of NGDI project will inevitably run concurrently with coordinated revision of the existing datasets and conversion of them to digital form. This is a serious handicap to NGDI project. The Federal Survey Department commenced the conversion of existing analogue maps to digital a few years ago and the building of national topographic database, which will eventually be integrated into the NGDI spatial datasets. However the exercise is not progressing at the expected speed and generally the impact is not being felt.

3.1.2 Policies and Standards

The National Draft Policy which formed the background to this paper has not yet been ratified by the Federal Executive Council and has not yet been presented to the National Assembly for the passage of necessary laws and Legislation that will govern data acquisition, management and sharing. So as it is now there are no common policies and standards on the production, usage and sharing of Geoinformation. This is obviously delaying the NGDI project in the country.

3.1.3 Inadequate Technology

The physical linkages which will be the major access to NGDI systems will be through a range of mechanisms, including telephone lines, Local Area Networks, Wide Area Networks and other Integrated Service networks (Adeoye et al, 2002). Our telecommunication facilities are still problematic and can cause problems to NGDI project. Hopefully, the introduction of wireless communication network is an asset to NGDI but the service in Nigeria still needs a lot of improvement. Closely connected to this is the electricity power needed to support all the activities of NGDI. Despite efforts by the present administration of President Olusegun

Obasanjo to improve this vital sector of our economy, electricity power supply has remained epileptic and in some places simply does not exist.

3.1.4 Problems in the Institutional Arrangement

The Institutional arrangement adopted for now has not clearly defined the roles of many public and private agencies producing and using GI. Conflicts of interests exist in so many areas and must be tackled to ensure successful implementation of the NGDI project. The organisational structure cannot guarantee cohesive framework for effective coordination of geospatial activities in the country. The Federal Ministry of Science and Technology and the Coordinating Agency - National Space Research and Development Agency (NSRDA) are however working hard to create a more flexible organisational framework that will eventually satisfy the needs of GI producers and users.

3.1.5 Availability of Trained Manpower

Despite the developments taking place in our Education and Capacity building, availability of properly trained personnel is still a problem in the implementation of the NGDI project. It is hoped however that training strategy adopted will eventually solve this problem.

3.2 Prospects of NGDI for the Country

Successful implementation of the NGDI project holds enormous prospects for the development of our country. It will generate the needed enthusiasm and support from political leadership which will eventually translate into more funding for Geoinformation activities in the country. We look at the following areas where the impact will be highly felt.

3.2.1 Development of Cadastral Database

NGDI project will lead to availability of Cadastral database for the whole country. Cadastral database is an essential component of the Fundamental Datasets of NGDI (Kufoniyi, 2002). As at now, this dataset is being produced by different data providers but NGDI will provide the frame work for coordination and integration of cadastral data from various sources into core dataset for the whole country. This will improve our often-chaotic land administration. Other benefits include

- Increase in revenue from property taxation
- Data for urban planning and development
- Data for urban landuse planning
- Infrastructure development and maintenance
- Data for Housing policy and housing development
- Data for crime monitoring and prevention
- Data for educational planning and institutional development
- National security.

Figure 3 illustrates some users of the cadastral information (Kufoniyi, 2002)

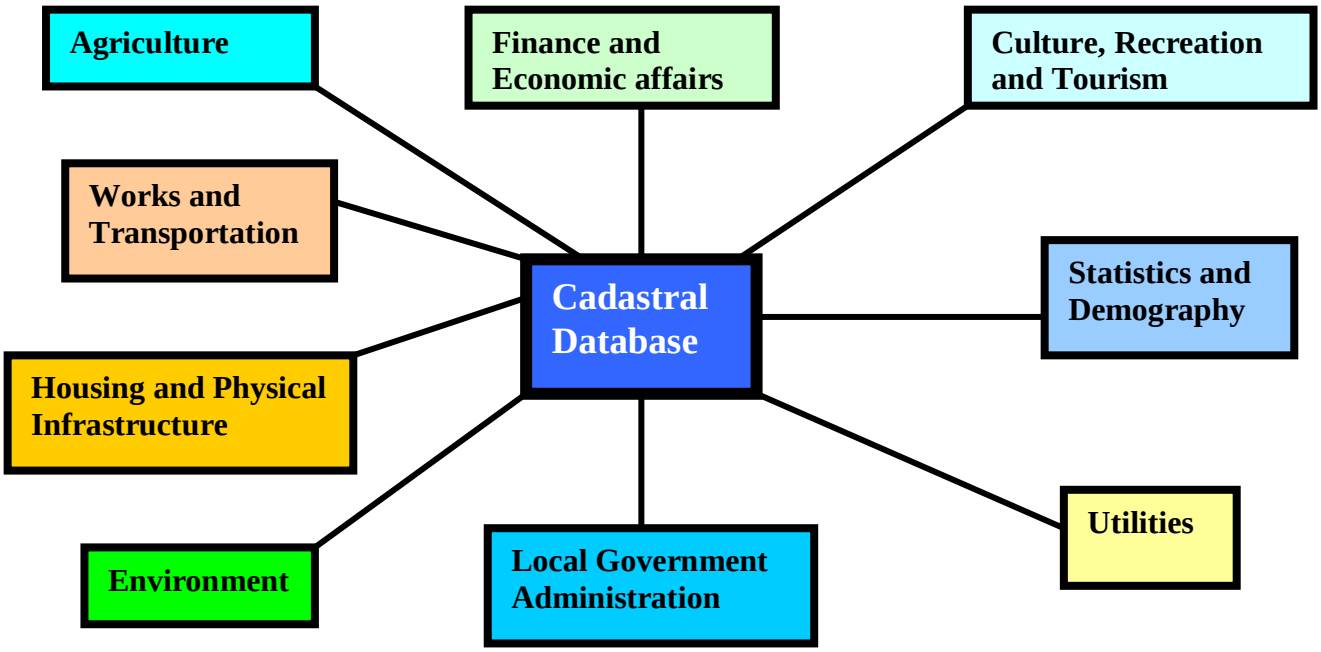

Fig. 3 Some Users of Cadastral Information
(Modified from Kufoniyi, 2002)

3.2.2 Creation of Large Pool of Digital Topographic and Thematic Databases

Topographic maps depict the inequalities of the land surface, as well as natural and man made features on the land. It essential data for many applications, ranging from engineering constructions, urban development to environmental monitoring and management. Like cadastral data, different data producers are involved in the production of topographic maps. The NGDI will bring harmony into this. Many topographic map sheets in the country are out dated. NGDI will provide a platform for massive revision of topographic maps in the country and the creation of large pool of topographic, DEM and thematic databases for the whole country.

3.2.3 Funding of GI Activities

NGDI project in Nigreia is generating the desired enthusiasm and interest among the political leadership. This is means more funding is likely to be introduced into the GI activities in the country. The government at various level are now willing to spend more money to fund production, usage and sharing of GI. This was due to awareness created by the NGDI project. International funding is also possible for the NGDI project. Many NGOs are willing to assist developing countries in this direction. The Economic Commission for Africa (ECA) has committed technical manpower and funds to help African Countries who embark on implementation of NGDI.

4. SUMMARY AND CONCLUSION

The Federal Government of Nigeria is seriously committed to implementation of NGDI or Nigeria. The Federal Ministry of Science and Technology as the supervising Ministry has been providing the necessary push to see that this project is realised. The coordinating Agency – National Space Research and Developemnt Agency (NASRDA) is currently presenting the benefits of NGDI to the Nation, carrying out survey of GI requirements, production and uses in the country. Various committees are now been set up in addition to the National NGDI Committee to begin work on the

- Designing of the architecture of NGDI
- Build up the necessary Infrastructure
- Identify reputable producers and users of GI in the Country
- Promote public awareness
- Harmonize data acquisition, usage and sharing in the country
- Develop capacity
- Define mandates and responsibilities of various producers and users
- Draw up technical programme and timetable for successful implementation of NGDI project.

We believe the needed political will emerge from the politicians to seed this project through. We are also counting on the continued support from international communities especially the various donor Agencies and NGOs.

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