THE PROJECT FOR STRENGTHENING SURVEY OF KENYA FOR GIS PROMOTION IN THE REPUBLIC OF KENYA

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ABSTRACT:

The Republic of Kenya has started to build National Spatial Data Infrastructure (NSDI) since 2002, in cooperation with several stakeholders in the country, including Survey of Kenya (SoK) that is the National Surveying and Mapping Organization. In a review in 2006, concrete or tangible results were yet to be realized in the implementation of NSDI, because the situation was attributed to inadequate capacity in the application of geographical information in SoK. That is why the Government of Kenya requested the Government of Japan for technical assistance in carrying out a project aimed at strengthening the department's capacity in the related fields. Finally, Japan acceded to the request through Japan International Cooperation Agency (JICA) to start 2-year-project since October 2006. Our major activities about this project are following three fields: 1) Development of NSDI standards in Kenya, 2) Enhancement of competence in map digitization, and 3) Developing resources for GIS dissemination. In consequence of the activities during one and half year, a lot of useful outputs have been gained, such as several drafts for geographical data standard based on ISO and KSISO, manuals for map digitizing, KNSDI (Kenyan NSDI) website and clearing house, etc. This project will be finished in September 2008; however, for the broad objective of promotion of GIS in Kenya and the establishment of KNSDI to be achieved, there is more need to look into lowering the cost of accessing internet, passing of NSDI Policy in Kenya, and so on.

1. INTRODUCTION

1.1 Purpose of this Paper

In Kenya, paper maps have been in existence since 1900. They cover the country in various scales and accuracies. These maps form a rich base of geographical information although their static state makes them difficult to manipulate and combine content. Modern technology has however transformed the handling capabilities to ensure that information from disparate sources can be integrated to support decision making and sound economic planning in the country. In 2002, National Spatial Data Infrastructure (NSDI) was initiated in order to facilitate the capture, storage, conveyance and display of geographical information. NSDI also served to further UN Agenda 21 WSSD and the Habitat II Global Plan of Action in Kenya. Survey of Kenya (SoK), the National Surveying and Mapping Organization in Kenya, was thereafter nominated by the stakeholders as the implementing agency of NSDI. In 2006, a review of NSDI achievements reviewed that there was a lot of achievement in terms of sensitization on NSDI but concrete or tangible results were yet to be realized in the implementation of NSDI. The situation was attributed to inadequate capacity in the application of geographical information in SoK. This necessitated the Government of Kenya to request the Government of Japan for assistance to build capacity to strengthen SoK for promotion of NSDI.

The purpose of this paper is to introduce our activities implemented with glorious cooperation between Kenya and Japan. We already introduced our activities in other places (e.g. Mathenge *et al*, 2007), but we are now in the final stage of the project in the first phase which is for a period of two years and ends in September 2008. Here our achievement should be introduced and discussed.

1.2 Kenya Geographic Location

Kenya lies across the equator on the Eastern part of the Africa continent (Figure 1.). It is within 4º North and 4º South and longitude of 34º East and 41º West. Kenya borders Ethiopia and Sudan to the North, Somalia to the East, Tanzania to the South and Uganda to the West. It covers an area of 582,246 square kilometres with heights varying from sea-leave at the Indian Ocean in the East raising to 5,199 metres above sea level at the peak of the snow-capped Mount Kenya in Central Kenya. In Kenya, arable land is only 20% (approx.) while 80% (approx.) is arid and semi arid land.

1.3 For Development of NSDI

In 2001, SoK started the development of NSDI by carrying out an inventory survey of Geographical information demand within the country (Survey of Kenya, 2002). The survey showed that,

- there is a variation in demand for various data sets
- that some organization data needs came form multiple sources, and
- that data management is distributed among many users

Evidently, there was a felt need to create an enabling framework to enable users find what geographical information exist, where it exist, how to get access to it and how to use it (Ottichilo, 2006; Mulaku, 2006).

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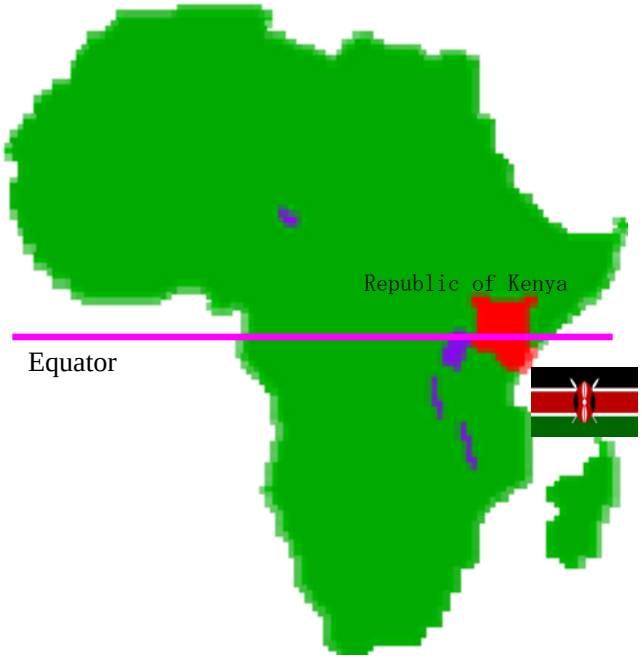

Figure 1. Kenya in relation to Africa

Consequently, five stakeholders' workshops were held between 2002 and 2006 with the following objectives:

- To emphasis the importance of geographical data in decision making
- To impress upon the stakeholders to recognize geographical data infrastructure as any other important infrastructure such as road network, telecommunication and give it the attention and allocate it the resources it deserves.
- To reinforce the understanding that no one organization is capable of satisfying user requirements for geographical data therein exemplifying the need for stakeholders to 'pool resources.'
- To emphasize the need for partnerships through cooperation, collaboration, coordination and consistency of NSDI in order to reduce redundancies and promote data sharing.
- To create a structure of NSDI with committees and working groups with clearly defined rules and responsibilities.
- To create an inventory of available spatial data in Kenya.

The broad objective of NSDI was to create awareness and eventually a 'one-stop' access for geographical data. The attainment of these objectives depended to a large extent on political good will and administrative support from the Government. The commitment by Government of Kenya in the construction of NSDI was captured in the 2002-2008 National Development Plan. Further, the achievement of an information – based society was cited as one of the main priorities towards realization of Vision 2030, the Kenya's blue print for economic development. The successful implementation of the Millennium Development Goals of the United Nations also depend to large extend on the availability of geographical information.

Despite the political goodwill, administrative support and the stakeholders' readiness to implement NSDI, no tangible results had been achieved five years after its inception. SoK having been nominated by the stakeholders as the lead organization in achievement of NSDI was put under scrutiny. It became apparent that SoK's capacity in NSDI needed to be enhanced if the implementation and promotion of geographical information was to be realized. In 2005 therefore, Kenyan Government requested the Government of Japan for technical assistance in strengthening SoK's capability in the application of GIS in order to realize the mandate bestowed on it by the stakeholders.

1.4 Project Launched

After careful evaluation and bilateral discussions, the Government of Japan through the Japan International Cooperation Agency (JICA) agreed to offer technical assistance in the implementation of NSDI programme. The two parties agreed that implementation of the programme would be done in three phases;

- Phase I: objective would be to build capacity of SoK, the implementing agency.
- Phase II: would aim at promoting and propagating the use and application of GIS technology in the Republic of Kenya.
- Phase III: would be the construction of the KNSDI (Kenyan NSDI).

Subsequent discussions on phase I culminated in '*the project for strengthening of Survey of Kenya for GIS Promotion in the Republic of Kenya.*'

The project started in October 2006 and is expected to be concluded in September 2008. The expected outcome of this project is:

- formulation of standards for KNSDI
- the enhancement of SoK's competence in map digitization, and
- the development of resources for GIS dissemination in Kenya.

A Joint Coordinating Committee (JCC) was formed to monitor the overall progress of the project and to ensure that it is managed effectively and efficiently. JCC, whose membership is drawn from Ministry of Finance, JICA representatives and the main stakeholders and include KEBS (Kenya Bureau of Standards), National Bureau of Statistics, Department of Resource Surveys and Remote Sensing (DRSRS), SoK and Kenya Institute of Surveying and Mapping (KISM), ensures that there is close collaboration with the stakeholders. Regional Centre for Mapping of Resource for Development is also invited as an observer.

2. PROJECT ACTIVITIES IN DETAIL

Our major activities about this project are following three fields: 1) Development of NSDI standards in Kenya, 2) Enhancement of competence in map digitization, and 3) Developing resources for GIS dissemination.

2.1 Development of KNSDI Standards

The development of KNSDI Standards was started with a stakeholders seminar referred to as KNSDI Standard Seminar I held on 29th November 2006. It was attended by 55 persons from 18 organizations. The aim of the seminar was to sensitize the stakeholder on the need to formulate KNSDI standards. This was followed by a feasibility survey on user needs to determine standardization requirements.

By the time the Project was starting, Kenya had already adopted 13 Standards (KSISO 19100) out of the 27 ISO 19100 Standards. However, not a single organization had even attempted to apply them due to their complexity. For the KNSDI project, 6 standards were adopted from the KSISO 19100. The decision of what standards to adopt was based on; compatibility of the standards with the Kenyan geospatial data, users' technical level and consistency with technical conditions of international standards. The six standards comprise:-

KSISO 19101.GI – Reference model
KSISO 19109 GI – Rules for schema
KSISO 19111 GI – Spatial referencing by coordinates
KSISO 19113 GI - Quality principal
KSISO 19114 GI - Quality evaluation procedures
KSISO 19115 GI – metadata

2.1.1 KPGIS: The six standards were compiled to constitute Kenya Profile for Geographical Information Standards (KPGIS). The profile which is a set of rules extracted from standards to form a document. The standards chosen were found necessary for the Kenyan situation and were also possible to apply given the technical capacity in SoK. It was emphasized to the stakeholders that it was possible to 'add' more standards to the profile should the need arise.

The KPGIS has two documents that have been produced by our activities; one is the main text of KPGIS and the other is the manual for products specification.

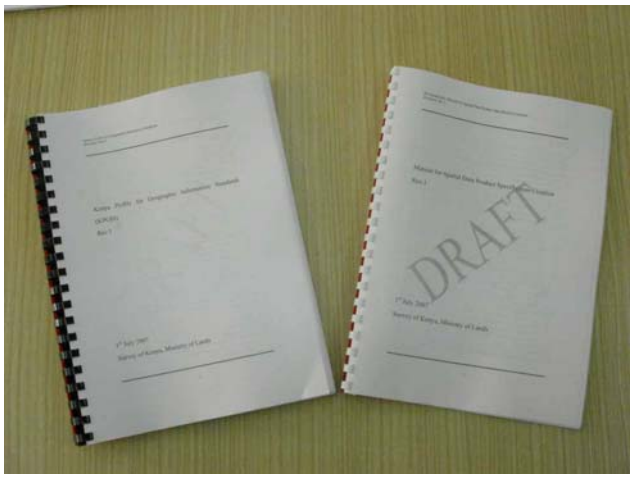

Figure 2. A KPGIS draft (left) and a manual for product specification (right)

2.1.2 Manual: Manual for preparation of "Spatial data products specification" provides instructions on information for a specific dataset. The manual provides basic standards for processing digital features of geographical information.

2.1.3 Specifications for Production: This is useful for creating a new product or when ordering someone to produce certain data. Products Specification are also useful when exchanging and utilizing data. The structure, type and quality of data as per the products specification can ensure smooth information exchange.

In a nutshell, the purpose of Specification for Production is:-

- Data production
- Quality evaluation of a third party or by the data producer
- Users get to know data contents in detail without accessing and analyzing the product.

The Specifications are unique for a particular product and in the case of NSDI Project products specifications were prepared for 1:50,000 scale topographical maps.

Data Quality is very important for geographical information or products,
Five elements of data quality used in the specifications are:

- Completeness
- Logical consistency
- Positional accuracy
- Temporal accuracy
- Thematic accuracy

Figure 3 shows the hierarchical structure of these elements.

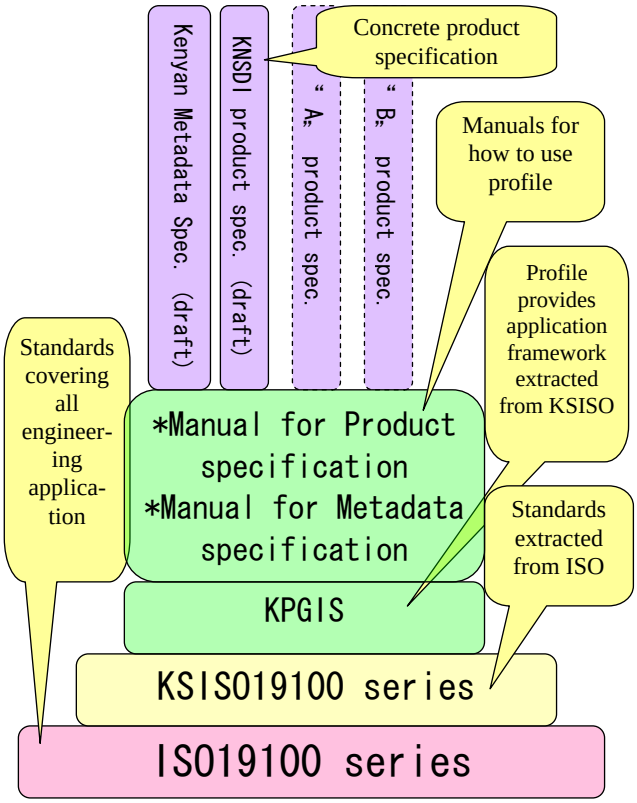

Figure 3. Hierarchical structure of the KNSDI draft standards

2.2 Enhancement of SoK Competence in Map Digitization

In Kenya**,** organizations wishing to digitize data have had to resort to own standards or a standard of the software in use. SoK uses unwritten standards which are passed from one officer to another verbally and in some cases on use screen tutorials. This has adversely affected data sharing and gone against the spirit of NSDI. Two ways of improving map digitization are:

-Application of standards in map digitization, and
-Production and application of digitization manual

The main purpose of this activity is to acquire the way of thinking and the actual method in digitizing maps from the viewpoint of the quality control.

2.2.1 Application of Standards and Manuals in Map Digitization: NSDI Standards are being applied in map digitization. The Standards clearly explains the steps to be taken when carrying out map digitization. The main objective is to improve map digitization.

- One way to achieve this is by creating digitizing manuals for use by all stake holders.
- These manuals have been created according to the specifications based on ISO and KPGIS Standards.

Two kinds of manuals have been prepared and are being applied in the digitization of fundamental datasets (Figure 4.). KNSDI stakeholders agreed on the following features as fundamental data sets for Kenya;

1. Geodetic control
2. Hydrology
3. Vegetation
4. Utilities
5. Geographic names
6. Elevation
7. Transportation
8. Administrative boundaries
9. Parcel boundaries
10. Digital imagery

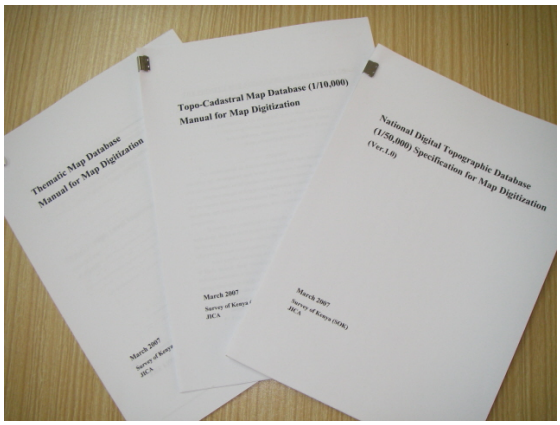

Figure 4. Manual for map digitization (left & centre) and specification for map digitization (right)

The list was by consensus and was not based on a formal user needs assessments. User needs approach to what constitute a 'fundamental dataset' promotes a broad consensus and encourages the systematic collection and maintenance of these data sets as part of the mapping programmes in various organizations.

2.2.2 Core Spatial Data: The following core spatial datasets are available in Kenya.

Topographical base maps include data on vegetation, geographical names and elevation.
Analogue Maps – 1:50.000 scale cover 63% of Kenya and the rest is covered by 1:100,000 scale. The whole country is also covered in 1:1 million scale and 1:250,000 scale
Digital (vector) Maps – The whole country is covered at 1:1 million, 1:250,000 scale cover 30% while 1:50,000 scale cover 10%. All the topographical maps covering the whole country have been scanned.

Cadastral Maps; these maps represents approximately 15% of the country.

Geodetic Control; Terrestrial geodetic control uses Cassini – Soldner (Clarke 1858 Ellipsoid) and UTM (Clark 1886 Ellipsoid). Geodetic control pillars are spread all over the country but unfortunately quite a number of them have been destroyed.
Precise levelling network uses datum at Kilindini harbour at the coast of Mombassa. The data is available in hard and soft form.

Utility data; include international, national, trunk and primary roads data, telecommunication lines, railway lines.

2.3 Developing Resources for GIS Dissemination

Mechanisms of disseminating geographic data to potential users need to be developed, if economical justification for investments in the collection, storage and management of data is to be attained. Embarking on collecting and storing data in whatever form is not good enough. The data need to be shared widely and made easily accessible to users. Resources for disseminating geographical data includes the high speed carrier capable of providing bandwidth on demand, the internet, computer hardware, relevant GIS software, geographical data, metadata, human capability, Clearing House or GIS Portals and servers, search and access protocols, policies and guidelines for data sharing.

2.3.1 Clearing House: A Clearing House is a distributed network of:

- Spatial Data Producers
- Spatial Data Users

The KNSDI Clearing House is to provide an enabling technological environment to enable the user's access the metadata and eventually the actual data. The Clearing House uses search and access protocols to search and retrieve the required data.

The Clearing House will ensure; maximum benefits of data sharing, minimum duplication of effort in data acquisition and provide 'one-stop' access for geospatial data information.

Figure 5. KNSDI Clearing House (212.49.76.177:8080/Portal)

The KNSDI Clearing House (Figure 5.) was developed using ESRI GIS Portal Toolkit, a software development kit for a GIS Portal (SDK), GIS Portal components and GIS Portal Building blocks. KNSDI GIS Portal used the following software; ESRI ArcGIS Desktop 9.2, ArcSDE 9.2, ArcIMS 9.2; for the Database, SQL Server 2000 was used; Web Server used is Apache 2.0.58; Sevlet Engine is Tomcat 5.5.17 and the development Kit is JavaSDK 1.5.0_06.

2.3.2 Metadata: Metadata is defined as a data about data. Metadata is necessary in order to locate appropriate data, evaluate whether the dataset meets the requirements, extract the relevant data and make use of the data (Ottichillo, 2006). Ideally metadata should go hand in hand with search facilities to enable the user to access the required datasets.

Survey of Kenya is producing metadata for the City of Nairobi maps using the Metadata Standards and has published some of it in web site and is available through the KNSDI Clearing House.

Current status

- Developing KNSDI Website - Completed (Figure 6.)
- Building a KNSDI Clearinghouse – On going
- Publishing Metadata (Nairobi) – On going (Figure 7.)

Figure 6. KNSDI website
(www.knsdi.go.ke)

2.3.3 Policies and guidelines on GIS Dissemination: The establishment of KNSDI and the formulation of NSDI Policy are going on concurrently. Once in place it is expected that they will address the many problem hindering data sharing like poor data quality, duplication of data production efforts, suppression of information markets and frustrated users (Kalende and Ondulo, 2006).

NSDI Policy will address data and metadata, software and hardware standards and governance arrangements of NSDI.
The policy is awaiting cabinet approval before being presented to Parliament in form of Bill for debate and approval. The policy will pave way for legal framework for data sharing.

The non-legal framework or Guidelines have been used successfully for disseminating data in other countries. The guidelines can address copyright issues, pricing of data, national and personal security. SoK with the help of JICA is in the process of producing and publishing its Guidelines for geographical data supply and sharing.

Figure 7. Metadata in the Clearing House

2.3.4 Training GIS users: The training course for GIS was designed to address the users' needs and to complement existing courses as opposed to duplicating them. The course was a result of survey carried out to find out the training needs of the GIS stakeholders. The survey revealed that:

- There were potential GIS users who had been trained in GIS had not got an opportunity to apply the knowledge gained due to lack of software and hardware.
- There were existing GIS users who had access to hard and software but were using less than 5% of the functionalities of the software.

Two types of courses were designed for these two categories. Potential users were introduced to QGIS and ILWIS Open Source software and basic GIS courses, while the existing users were taught how to optimize the functionalities of the software.

Eighty participants representative of all stakeholders were trained (Figure 8.). The course enjoyed 100% attendance. There are also follow up more advanced GIS course being offered by JICA through Video conferencing. These courses have greatly contributed to the development of human resource in GIS among the stakeholders. The courses are still on going.

Figure 8. GIS training course in October & November 2007

3. CONCLUSIONS

The project for strengthening SoK capacity for GIS promotion has successfully achieved the set objectives in the production of NSDI Standards, digitization manuals and Guidelines to facilitate data sharing. However, for the broad objective of promotion of GIS in Kenya to be achieved, there is the need to look into the following;

- Lowering the cost of accessing internet, GIS requires broad band whose cost in Kenya is prohibitive to majority stakeholders,
- Need for a clear communication strategy in order to reach more users and increase awareness and understanding of the benefits and concepts of NSDI. Kenyans are highly receptive to new technology as is evidence from the success of 'mpesa,' which is a way of money transfers in Kenya through mobile phones.
- Passing of NSDI Policy and subsequent legislation to legalize and institutionalize GIS dissemination.
- Need to ensure that NSDI is sustained by providing funds for maintenance of hard ware and software and for keeping abreast with emerging technology
- Need to recognise that spatial data is a national resource and 'wananchi' have a right to access it and build consensus on the mechanisms of disseminating it.

We irregularly provide newsletters that introduce our activities through KNSDI web site. Visit our web site (www.knsdi.go.ke/) and you can find back numbers. We ask all of you to continue to be interested in our challenge.

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