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The Rwanda Metadata Portal: A Web Catalogue Service*

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Abstract

The creation of a National Spatial Data Infrastructure (NSDI) is of growing interest in Rwanda. The importance of NSDI in facilitating access to and use of geospatial data to support decision-making is recognised. Numerous government ministries and institutions in Rwanda produce geospatial datasets of different themes. It is challenging to know what datasets exist and how to access them. Since geospatial data is costly to produce, it is expedient to reuse data in different applications. Realizing that geospatial metadata are needed to properly manage and maximize data use, a metadata portal was developed. The aim is to ease the discovery of existing geospatial datasets on Rwanda. This paper describes the procedure utilised in compiling and creating metadata, presents an overview of the portal and discusses challenges faced in its development. The information will be particularly useful for those wanting to establish or already working on metadata in similar less economically developed context as ours.

Keywords: Metadata, Web catalogue service, Geoportal, Geospatial data, Rwanda Metadata Portal, National spatial data infrastructure, GeoNetwork

1 INTRODUCTION

The amount of geospatial data in Rwanda increased exponentially since the beginning of the 21st century. Numerous government ministries and institutions are producing data of different themes as the awareness of the value of geospatial data is currently high. The Government of Rwanda (GoR) recognised

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that geographic data and information are essential to social and economic planning and development (Schilling et al. 2006).

Once created, geospatial data can be reused by different applications, which significantly reduces cost (Fonseca et al. 2000). For facilitating geospatial data use/reuse, additional information describing the data is provided called metadata. Metadata can be thematic (e.g. data acquisition method), spatial (e.g. spatial reference system used) or temporal (e.g. the time of data acquisition). The purpose of metadata is to facilitate the interpretation of data (Sboui et al. 2009). According to the GSDI cookbook (p.24 2004 http://www.gsdi.org/docs2004/Cookbook/cookbookV2.0.pdf), developing and making metadata available ensures that users are aware of the existence of datasets; helps to avoid duplication of effort as all available geospatial and associated data relevant to an area of interest can be easily located; collection of metadata builds upon and enhances the data management procedures of the geospatial community and the reporting of descriptive metadata promotes the availability of geospatial data beyond the traditional geospatial community.

Although numerous geospatial datasets on Rwanda exist, there has never been an inventory of what is available. It is still a challenge to know what datasets exist, where they are and how to access them. It is to ease the discovery of geospatial data that the Rwanda Metadata Portal (RMP) was recently developed. This is a web catalogue service that enables users to access metadata. It is recognised that the lack of information about existing datasets is a major barrier to many geospatial applications. Although the value of geospatial data is recognised by both government and society, its effective use is inhibited by poor knowledge of the existence of data, poorly documented information about the datasets and data inconsistencies. Given the dynamic nature of geospatial data in a networked environment, metadata is therefore an essential requirement for locating and evaluating available data (GSDI 2004, Masser 2005).

A geospatial metadata catalogue is essential for maximising the value of database searches and ensuring that users find datasets that are potentially able to satisfy their specific requirements (Berry et al. 2010). Examples are the Spanish IDEE (Infraestructura de Datos Espaciales de España) catalogue portal (www.idee.es/show.do?to=pideep_catalogoIDEE.EN),Canadian GeoConnections discovery portal (http://geodiscover.cgdi.ca/web/guest/home), Norwegian geoNorge (http://www.geonorge.no), The Netherlands Nationaal Register (http://www.nationaalgeoregister.nl) and the metadata tool for land use change in the region of Victoria, Australia (see William et al. 2009). In East Africa there are two operational metadata registries, that is, the Food and Agriculture Organisation (FAO) Somali Water and Land Information Management (SWALIM) project (http://www.faoswalim.org) and the SDI-East Africa (SDI-EA) http://dewa03.unep.org/sdi-ea). There is no service registry or example of

reusable data-sharing agreements in the region (Wilson et al. 2009). Maguire and Longley (2005) traced the origins and growth of geoportals alongside SDI and discussed their importance in simplifying access to geospatial information and services.

Prior to creating the RMP, the state of metadata in Rwanda has not been examined. Consequently, it became necessary to undertake an inventory of existing spatial datasets on Rwanda but for a start limiting it to the data holdings at the Centre for GIS and Remote Sensing (CGIS) of the National University of Rwanda (NUR). The centre is supporting key national institutions in producing various spatial datasets. This paper describes the inventory of geospatial data; the metadata compilation procedure used and gives an overview of the RMP. Challenges faced in developing the RMP and lessons learnt are also discussed.

2 BACKGROUND

In Rwanda, development priorities are based on numerous strategies such as the Vision 2020, the EDPRS (Economic Development and Poverty Reduction Strategies) and the UN-MDGs (United Nations Millennium Development Goals). The Vision 2020 is a long term development road map for 20 years that started in year 2000 with the objectives of raising the Rwandan population out of poverty and transforming the country into a middle-income, knowledge based economy (see Table 1).

Table 1: Components of the Vision 2020

	Pillars	**Cross-cutting areas**
1	Good governance and a capable state	• Gender equality • Protection of environment and sustainable natural resource management • Science and technology, including ICT
2	Human resource development and a knowledge based economy	
3	A private sector-led economy	
4	Infrastructure development	
5	Productive and market oriented agriculture	
6	Regional and international economic integration	

Table 1 shows the six pillars upon which the Rwanda Vision 2020 is built and three cross-cutting areas of focus. According to the Ministry of Finance and Economic Planning (MINECOFIN 2000, 2002), this vision requires that by year 2020, an annual per capita income of US$ 900, a poverty rate of 30% and an average life expectancy of 55 years be achieved. Over the years, the performance of these indicators has improved. During the period 2000 to 2010, annual per capita income rose from US$ 200 to US$ 272 in year 2006 and is

projected to rise to US$ 400 in year 2010; poverty rate declined from 64% to 56.9% in year 2006 and the projection for year 2010 is 40%; average life expectancy increased from 49 years to 51 years in year 2006. MINECOFIN (2007) compares the progress achieved within the Vision 2020 to the MDG targets. There is the EDPRS, which is a mechanism for implementing Vision 2020 in the medium term and has in addition its own targets (see MINECOFIN 2009).

To plan and manage these development strategies successfully, the need for geospatial information is evident. Studies have shown that much of the information needed for decision making are spatial in nature and are usually presented as maps (see Ezigbalike 2002). About 80% of geographic information is used in all forms of development planning and decision making at local, regional, national, continental and global levels (Goodwin and Wright 1991, Longhorn and Blakemore 2008). In the context of the National Information and Communications Infrastructure (NICI) plans, the GoR believes that geographic data and information are much a part of the nation's information infrastructure as the other elements of the infrastructure and should be accorded the same level of support (GoR 2006, see http://www.uneca.org/aisi/nici/Rwanda/rwanda.htm). This idea of geospatial data and information being an infrastructure is the impetus for SDI development. It should not be strange to think of geospatial information as an infrastructure anymore than we think of highways, telecommunications, health care, air traffic control, and policing as infrastructures that we depend on and use daily (Canadian Geospatial Data Infrastructure - CGDI 2001).

3 THE NEED FOR NSDI IN RWANDA

The importance of National Spatial Data Infrastructure (NSDI) in facilitating access to and use of geospatial data in support of decision-making is known. Although there is no NSDI yet, series of SDI related events have occurred in Rwanda at various times. The first is the national workshop in 2006 with the aim of kick-starting the NSDI process. It was organized by the CGIS-NUR in collaboration with the National Institute of Statistics of Rwanda (NISR), the President office and the Human Resources and Institutional Capacity Development Agency (HIDA). This initial effort actually has helped to raise awareness as regards the need for NSDI in Rwanda and to initiate the process of implementation.

The latest SDI related initiative is the Rwanda Metadata Portal (RMP) project implemented by the CGIS-NUR. The main goals of the project were to improve the metadata status of existing geospatial datasets on Rwanda, raise awareness about the benefits of web-based metadata catalogues and to lay the foundation

for the establishment of a local, sub-national SDI node at NUR. At the close of the RMP project in June 2009, a workshop was organized titled: Spatial data inventory and metadata management: showcasing the metadata search facility. The high point of the workshop was the presentation of the RMP as a geospatial metadata catalogue service.

There is an increasing demand for use of geospatial information in Rwanda as in other parts of the world. As a result, an efficient way of accessing data is required. Take the issue of spatial data availability in Rwanda for instance. Access to available data is very poor due to the absence of a spatial data and sharing policy. It will be incorrect to say that data sharing is not happening at all in Rwanda, the fact remains that the modality of exchange is highly informal. Data is mostly exchange via CDs and USB flash drives. Establishing the NSDI to maximize access to and use of geospatial data is more important for the public good than just boosting ministries' ego for possessing the data. This will help forestall the situation where efforts in geospatial data collection are duplicated and will curtail the consequent waste of scarce resources. Ideally, agencies should spend their time on adding value to existing data, instead of wasting resources in cleaning up and producing yet more agency specific versions of the same base datasets (Wilson et al. 2009). Dale and McLaughlin (1999) noted that data ought to be produced once and used by all users, given that no single agency can satisfy its data needs on its own. Since geospatial data is an expensive resource, it is important to foster efficient production, use and management by means of SDI (Simbizi 2007).

Like many other African countries, Rwanda is still faced with challenges that need to be addressed to allow it establish an operational NSDI. Requisite requirements for implementation are policies, appropriate institutional arrangement, strong partnership within and between institutions, human resources, fundamental datasets and custodianship, standards and technology. The CGIS-NUR through the various SDI related work it is spearheading is providing leadership in the aspects of technology, standards and policies. The issue related to producing fundamental datasets and custodianship is being solved with the creation of the National Land Centre (NLC) under the Ministry of Lands and Environment (MINELA). It has in its mandate the production of major fundamental datasets such as topographic maps, and digital orthophotos for the entire country. Other issues to address urgently relate to finding a workable institutional arrangement, improving institutional partnership and establishing the legal and policy framework for the NSDI. CGIS-NUR is represented on the NLC technical committee for SDI and it increasingly plays the role of a national think tank for spatial matters, helping in human capacity building. As the only Centre with geospatial expertise in Rwanda and in the immediate region, it is playing a key role in raising awareness and facilitating the uptake of geospatial technologies in various fields.

4 THE RWANDA METADATA PORTAL PROJECT

The main objectives of the RMP project are as follows:

- inventory of geospatial datasets and metadata
- metadata compilation when missing
- metadata creation and publication

4.1 Data Inventory

The range of existing datasets can be easily deciphered by the different ministries and institutions producing them (see Table 2). Table 2 shows selected geospatial datasets produced by different ministries and institutions.

In conducting the inventory, datasets were broadly categorized into three types for convenience. These are images, thematic maps/data and topographic maps/data. Data was sourced from CDs, server, project coordinators to individual researchers in the CGIS-NUR research units. Most of the satellite images found on CDs had metadata. Most images derived from spatial analysis and image processing (e.g. hillshading output, digital elevation model and land cover analysis) had no metadata at all.

Knowing what data resources are available and allowing the larger geospatial community access to them can result in cost savings to the data producer as well as the user community. Access to geospatial data can allow for effective and coordinated response to incidents such as natural and human induced disasters as well as new emerging diseases. These events often extend beyond physical or political boundaries. The need to effectively and efficiently access and share data requires proper documentation and the means to access the documentation and the spatial data itself (see Moellering et al. 2006).

4.2 Metadata Inventory and Creation

What is metadata? The term metadata is defined as structured information that describes, explains, locates or otherwise makes it easier to retrieve, use or manage an information resource (NISO 2004). A common definition is information about data. For example, metadata documents where a data is stored, the attributes, purpose why it was created, ownership, etc. Sometimes, it may include descriptive information about the context, quality and condition or characteristics of the data (Foldoc 1997). In its most elemental form, geospatial metadata is information about geospatial data, usually housed within the database. As such it has been realized that in order to efficiently use and manage all kinds of spatial databases, sets of metadata pertaining to the data in question are needed (Ezigbalike 2004). According to Moellering et al. (2006), the

primary rationale for geospatial metadata lies in inventorying internal geospatial resources, the condition of the inventory and the quality of the data.

Table 2: Selected spatial datasets on Rwanda

Date	Custodian	Dataset	Attribute
2001	Ministry of Public Works, Transport and Communication (now Ministry of Infrastructure) & CGIS-NUR	Administrative map of Rwanda	Scale 1/250000
1988 2008	Ministry of Infrastructure - Electrogaz, CGIS-NUR	Power lines	Existing and planned electricity power lines
2007	Ministry of Natural Resources (now Ministry of Forest and Mines).	Forest cover mapping	Forest cover at National, province, district levels
		Depository of the FAO AFRICOVER data for Rwanda	
2009, 2010	National Land Centre	Aerial photographs, digital orthophotos, national land use, depository of the 1988 topographic maps	Scale 25m
2007	Ministry of Commerce, Industry, Investment Promotion, Tourism and Cooperatives (MINICOM)	Rwanda trade map	- Trading centres/ zones - days of operation - Major products and services available - Existing channels of distribution - Existing trading opportunities - Categories of traders (Wholesalers, Retailers) - Storage facilities
2002, 2008	MINEDUC (Ministry of Education)	Primary and Secondary schools	GPS points of schools location
1992, 2000/ 2006	MINAGRI (Ministry of Agriculture and Livestock), Vendoodt and Van Ranst, (2006)	Soil map, digital soil database	Scale 1/250000, 1/50000
Many years	National Institute of Statistics - NISR (former National Census Bureau)	Spatial sampling survey frame, administrative boundaries to the 5th level, social and cultural datasets	Population census data, household living conditions survey, Demographic household survey

Source: Akinyemi's compilation

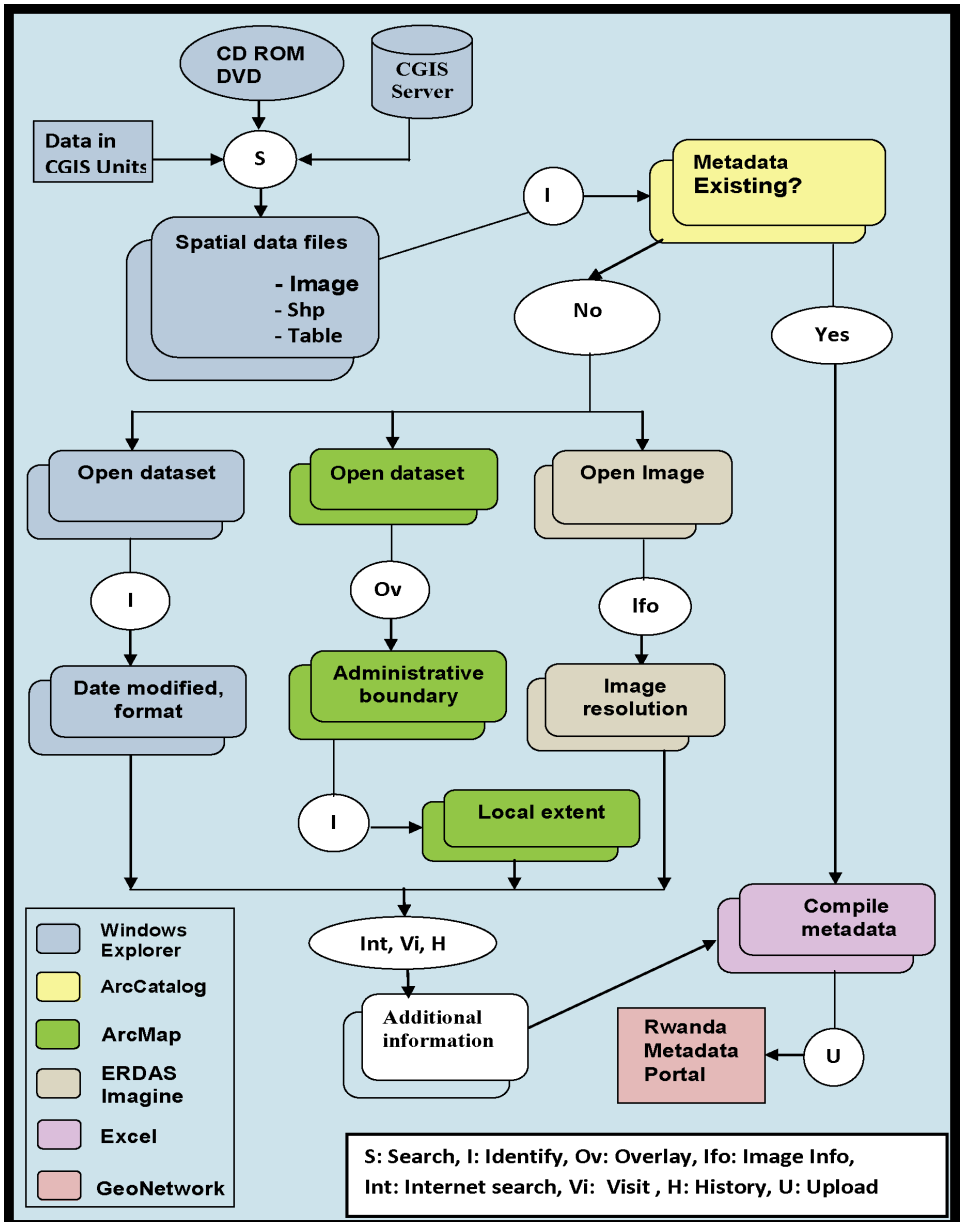
Although the application of a variety of standards provides commonality underpinning a reliable SDI, it is the metadata content within the system that delivers the contextual intelligence required to support the diversity of data and applications utilizing the infrastructure (GSDI 2001). Standardised metadata support users in effectively and efficiently accessing data by using a common set of terminology and metadata elements that allow for a quick means of data discovery and retrieval from metadata clearinghouses. The metadata based on standards ensure information consistency and quality and avoid that important parts of data knowledge are lost (OSGeo 2009). The establishment of a metadata dissemination portal is a yardstick used in measuring SDI success in any country or region (Tang and Selwood 2005 cited in Masser 2005).

Various activities were carried out under metadata inventory (see Figure 1). Figure 1 shows the flowchart describing the steps taken in conducting metadata inventory and compilation within the project. To identify whether or not metadata existed for a particular dataset, the file is opened and examined in ESRI ArcCatalog. Where metadata is non-existing, it has to be compiled. Most crucial information needed is the geographic location to which the dataset pertains. If the dataset has a shapefile format, it is opened in ESRI ArcMap and the administrative boundary is overlaid to identify the actual geographic location. If the dataset is an image file, it is opened in ERDAS Imagine and information such as image resolution is retrieved from the image info. Other critical information such as date is retrieved by checking the date the file was created and when it was last modified in Microsoft Windows Explorer. Sometimes internet search was made for an organization's name when only an abbreviation appears on the map.

For accuracy checking and correction, some ministries were visited to verify the information and to identify contact persons. When none of the above methods of gathering metadata information worked, the only option would be to gather information verbally from CGIS-NUR staff. It is possible that they recall the use of such data, for example, in a particular project in the past. In the absence of catalogues containing general descriptions of archive contents, searches must too often rely on personal knowledge and personal contacts (Goodchild 2003).

The information retrieved about the datasets in this manner was used to compile the metadata. Metadata was compiled in the form of an Excel spreadsheet with numerous fields such as ID, Storage_ID, GeoNetwork File_ID, Title, Geo_extent, Area of Interest, Exact_location, Current_day location, Collection Date (Year), Initial Agency, Current Agency, Scale_resolution, Format, File_format, Projection System, Datum, Product type. A record was created for each dataset. While examining each dataset, it became necessary to add another field titled, metadata exist to which a Yes or No answer is appropriate. This aided the quick identification of datasets lacking metadata after the inventory was completed.

Figure 1: Flow chart for the creation of the Rwanda metadata portal



The metadata compiled in the spreadsheet was then used to create metadata records in GeoNetwork Opensource (see the next section 4.3 for details). Other auxiliary information such as title, abstract, purpose and a thumbnail of the dataset added.

Judging from our experience, metadata creation for existing data can be very tedious and expensive as the vast majority were created manually. It is time-consuming to go back and effectively tag legacy data, which may have existed long before metadata standards were implemented and long after its original purpose has been forgotten (see Green and Bossomaier 2002, Ma 2007, Bradford 2007).

4.3 GeoNetwork based architecture

As SDI related products gradually evolve in Rwanda, adherence to standards is essential for long term sustainability. The CGIS-NUR ensures that issues relating to standards were considered in the development of the RMP. For implementation, we opted for the GeoNetwork Opensource, which is a standard based, free and opensource web catalogue application (see GeoNetwork 2009, http://geonetwork-opensource.org/). It is a very versatile and low cost tool produced by the FAO with major support from World Food Programme (WFP) and UN Environmental Programme (UNEP). It has been developed for the purpose of connecting geospatial information communities and their data. It is easy to learn, the interface is easy to customize, which informed our decision to adopt it for implementing the RMP.

The GeoNetwork is built on the principles of a Free and Opensource Software and on International and Open Standards for services and protocols, like the ISO-TC211 and the Open Geospatial Consortium (OGC) specifications (see http://www.opengeospatial.org/standards/cat). GeoNetwork uses the Service Oriented Architecture (SOA), which provides methods for systems development and integration where systems package function as interoperable services. This infrastructure allows different applications to exchange data with one another (OSGeo 2009). The GeoNetwork architecture is also largely compatible with the OGC Portal Reference Architecture, that is, the OGC guide for implementing standardised geospatial portals.

In terms of the four service classes, namely: Portal, Catalogue, Data and Portrayal services, the older version of GeoNetwork supported the first three. The fourth service class was not directly supported, but had to be provided through mapserver (Horáková et al. 2007). The new version embeds GeoServer as map server. Users can overlay OGC Web Map Services (WMS) available on the web, as well as create their own map services for other users to browse without having to download additional plugins (for detailed review of GeoNetwork architecture and updates, see Carboni 2006, Ožana and Horáková 2008, OSGeo 2009).

GeoNetwork metadata catalogue handles the latest ISO19115:2003 geographic metadata format based on the ISO19139:2007 schemas, as well as the older ISO19115 final draft format, FGDC (Federal Geographic Data Committee) and

Dublin Core. The metadata editor handles the majority of these complex standards, providing default, advanced and XML editing online tools (OSGeo 2009). The RMP was accomplished relatively easily as the ISO 19115 template used has all fields or questions well defined. The template was developed in 2003 by the ISO/TC211 Committee on Geographic Information/Geomatics, Spatial Metadata working group. In addition, GeoNetwork offers the possibility to harvest and synchronise metadata between distributed catalogues. It allows users to connect their server to other catalogues around the world. In the next stage of developing the RMP, we intend to expose these functionalities so other organizations could harvest metadata and publish it.

Examples of initiatives implemented using the GeoNetwork opensource application are the U.S. Geoscience Information Network metadata Catalog (http://catalog.usgin.org/geonetwork/srv/en/main.home), the CGIAR (Consultative Group for International Agriculture Research) network SINGER Project *(*http://geonetwork.singer.org/), and the CPWP *Project* (http://geonetwork.waterandfood.org/), the Western Australian iVEC MEST (Metadata Entry and Search Tool) index of marine data and projects (http://mest.ivec.org/geonetwork/srv/en/main.home), the UN SALB (Second Administrative Level Boundaries) project (see Ebener et al. 2006, http://www.unsalb.org*),* FAO GeoNetwork (http://www.fao.org/geonetwork) and the WFP VAM-SIE-GeoNetwork (http://vam.wfp.org/geonetwork). It is also used by the GEOSS (Global Earth Observation System of Systems) portal and in many other national SDIs in Africa and Asia-pacific.

4.4. Overview of the RMP

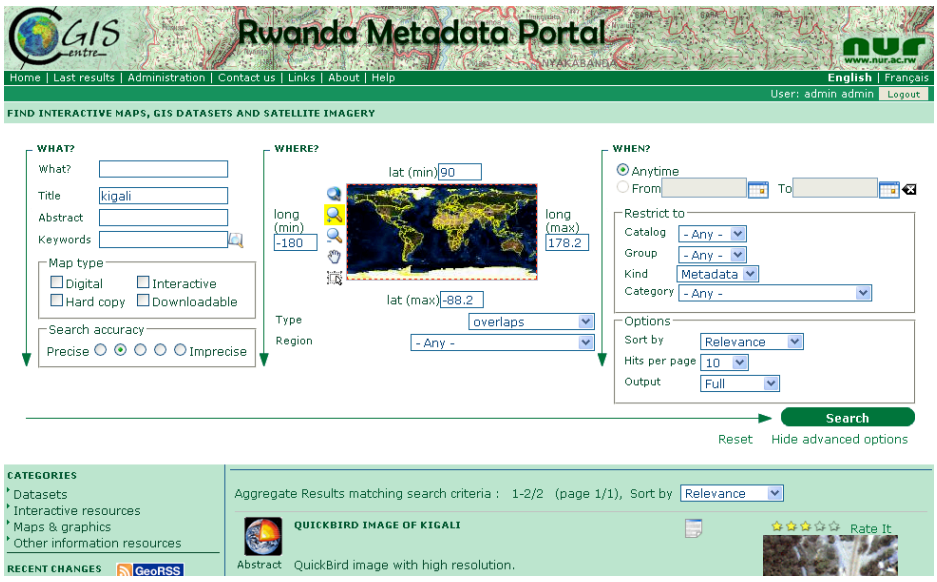
The general services included in a catalogue for geospatial data discovery are management, discovery and data access. The management functions include the ability to specify interfaces for creation, entry, update and deletion of metadata entries to a catalogue. The discovery functions include the ability to search for and retrieve metadata entries from a catalogue with embedded references within the formal metadata to online data access, where available. The access functions support extended access to or ordering of spatial data based on references established in the metadata (GSDI 2004). The RMP is conceptualised as a metadata catalogue service enabling users and producers to locate and evaluate geospatial data on Rwanda. Although the Geonetwork has data access function to enable users access or download data, the RMP as at present has this function deactivated. As soon as a data sharing mechanism is in place in Rwanda, this is the next step in the RMP's further development.

The RMP is hosted at http://www.cgis.nur.ac.rw with varying levels of metadata record visibility (see Figure 2). Figure 2 shows the home page of the RMP. Its main feature is the search function for metadata discovery using keywords.

Figure 2: The CGIS-NUR Rwanda Metadata Portal

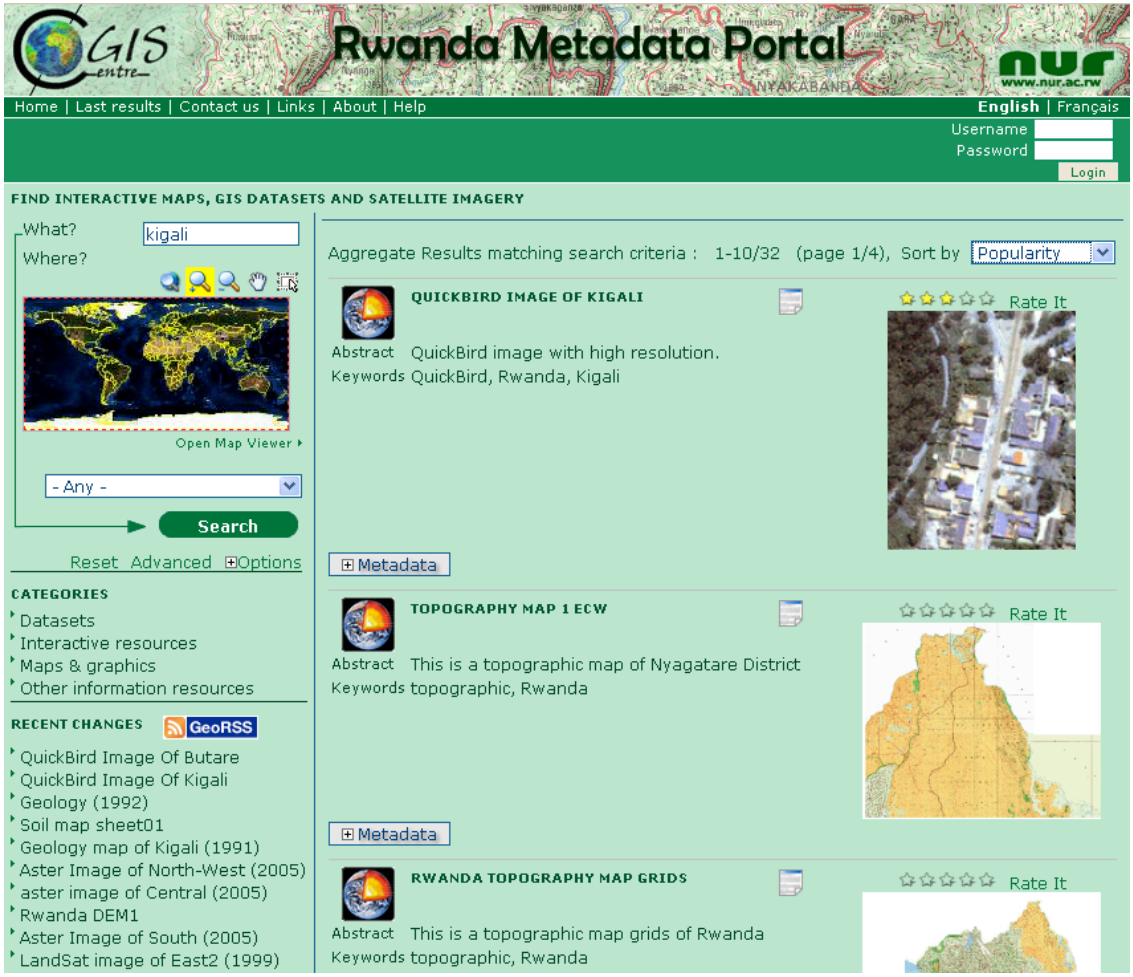
Another search option is the map viewer using geographic location with the possibility to use an advanced search (see Figure 3).

Figure 3: Advanced Metadata Search



The query result is displayed as a list of metadata records for datasets matching the keyword with a brief abstract and keywords (see Figure 4). Figure 4 shows the result of a search by keyword e.g. Kigali.

Figure 4: Result for Metadata Search by Keyword



A user who reads through this information and decides that the dataset is relevant clicks on the metadata tab to display detailed information (see Figure 5).

Figure 5: Display of Detailed Metadata

5 CHALLENGES AND LESSONS LEARNED

The challenges faced in developing the RMP are numerous. These can be classified as follows in four categories:

- pioneering work
- most geospatial datasets missing metadata
- changes and restructuring of government agencies
- very poor internet connectivity

5.1 Pioneering Work

The RMP, especially the metadata creation aspect was conducted as a pioneering work. There was no previous inventory of available geospatial data in Rwanda. This necessitated doing everything from scratch. There were no documentations or references to consult on the Rwandan spatial metadata situation.

5.2 Most Geospatial Datasets Missing Metadata

Many datasets were found to be duplicates and most had no metadata. Specifically missing were crucial information such as source and date of creation. For datasets that were copied and stored on another CD, the metadata was usually omitted. Probably the metadata was lost while copying from the original CD. We recommend that in the future, all datasets should be kept on their original CDs for reference purposes. Consequently, a metadata information gathering procedure was developed as the occasion demanded. In our circumstance, this proved to be a workable solution to recoup metadata information for the extant datasets.

Identifying the exact location of some datasets, especially images was difficult because they were not projected and so could not fit in within the administrative boundary that was overlaid. Reprojecting each dataset proved impossible as this would take up a great deal of time which was not the intention of the project. Consequently, these datasets had to be omitted from the inventory. Some datasets had several dates: the date of aerial photo capture, date of processing and the date of the edition (different editions were encountered) but there was no particular date of production. A good example is the soil map, *Carte pédologique du Rwanda*. The date of aerial photograph capture was adopted because it represented the phenomenon as it is at the time of data collection.

5.3 Changes and Restructuring of Government Agencies

Some agencies that produced geospatial datasets nolonger existed at the time of the inventory. Some were merged; several new agencies were created that inherited some existing datasets. Search for contact persons in the new agencies were made and both the name of the initial agency that produced the datasets and the name of the new agency that now has the custodianship were entered in the metadata. For datasets produced by foreign organizations, internet search was made and links to their websites were added.

5.4 Very Poor Internet Connectivity

Poor internet connectivity is a perennial problem at the CGIS-NUR. It really hampered the smooth execution of the project. We first collated all metadata information in an Excel spreadsheet and later entered each record in GeoNetwork. Initially, the metadata was created offline in GeoNetwork on a local computer and later uploaded when the connection was more reliable.

There is room for improvement of basic infrastructure - particularly the cost, availability, reliability of internet and electricity. Statistics show that only 3 per 100 inhabitants in Rwanda use the internet as against an African average of 4.2 (Morshid 2009). However, Rwanda is set to enjoy better internet connectivity in the nearest future as the GoR invested US$ 40 million on laying optical fibre and backbone transmission network for the entire country. In recent years, Rwanda has funded computers in schools, built telecenters and public post offices (Bowman 2009).

It is no longer the case that SDI technologies are simply beyond the capacity of the region and therefore frivolous luxuries. Rather, they are viable and will become increasingly so as basic infrastructure improves (Wilson et al. 2009).

6 CONCLUSION

Prior to developing the Rwanda Metadata Portal (RMP), there was no record of existing geospatial datasets in Rwanda. The portal was developed to ease geospatial data discovery. As more datasets are being produced, a web-based metadata catalogue system and data sharing mechanisms are needed.

In its development, a systematic inventory of existing geospatial data on Rwanda was conducted. The state of metadata was also examined and it was found that most of the existing datasets lacked metadata. This necessitated compiling metadata information for datasets through a simple but efficient procedure. Different methods of metadata compilation were employed such as internet search, institutional visit, administrative boundaries were overlaid on some datasets to identify the geographic location represented. Currently, the state of geospatial metadata in Rwanda is greatly enhanced. Several challenges were confronted in the process of metadata inventory, compilation and creation. The most formidable was the very poor internet connectivity.

The RMP is meant to raise awareness as regards the importance of metadata as a component of SDI in Rwanda. The RMP, similar to the SDI-East Africa described in Wilson et al. (2009) has demonstrated the technological feasibility of implementing open web catalogue services in East Africa. With the RMP in place

and accessible over the internet, there is the mounting concern of how to handle incoming request for data. Thus, the next critical task in the interim before the NSDI for Rwanda is in place would be to facilitate the development of a spatial data policy.

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