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An Assessment of the Current State of Spatial Data Sharing in Rwanda*

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Abstract

Geographic information is becoming more important everyday at all levels of society. It has a central role in supporting economies, improving business effectiveness in the private sector, enabling more efficient decision-making and increasing citizens' involvement in governance. The need to share becomes apparent when individuals and organisations cannot produce all datasets they need. Identifying current data sharing arrangements is pivotal to understanding the kind of sharing mechanism required. An assessment of data sharing in Rwanda was made by surveying organisations producing and/or using spatial datasets in their daily activities. Key areas covered include organisational approaches used and inhibitions to spatial data sharing. The main spatial data producers were identified as they exert enormous influence on the data sharing process. Results reveal that the main datasets shared are administrative boundaries, topographic maps and orthophotos. Most spatial data are exchanged as printed maps, implying that the data management system is predominantly paper-based. Furthermore, findings show that majority of data users in Rwanda are decision-makers. Data producers and users perceive the absence of a national policy on data access and sharing as the main impediment to sharing in Rwanda. Consequently, sharing modalities are very informal, with friendship, goodwill and organisation's propensity to share identified as major considerations influencing decision to share data. Based on survey findings, different data sharing policy options were proposed. This assessment of the state of data sharing in Rwanda helps to identify current arrangements of spatial data exchange.

Keywords: Data access, Public sector information, Spatial data sharing, Rwanda

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1. INTRODUCTION

Geographic information plays a significant role in supporting economies, creating business opportunities and improving business effectiveness in the private sector, delivering more efficient and effective government services and enabling citizens' informed decision-making that increases quality of life (Elwood, 2007, 2008; Paschou et al, 2010). Much of the information needed for decision-making are spatial in nature and are usually presented as maps. About 80% of information used at all levels of development planning and decision-making is spatial (Østensen, 2001, Kolte et al, 2009).

The huge potential of information, particularly public sector information (PSI) as an enabler of socio-economic development is recently being recognised (Eckardt, 2008). PSI in a broad sense includes information and data produced by the public sector as well as materials that result from publicly funded cultural, educational and scientific activities. It can include policy documents and reports of government departments, public registers, legislation and regulations, meteorological information, scientific research databases, statistical compilations and datasets, maps and geospatial information and numerous other data and information products produced by government for public purposes (Fitzgerald, 2010). Spatial data forms a substantial component of PSI because most decisions on public service provision are spatial in nature. The need to share becomes apparent when individuals or organisations depend on others to derive the full suite of data needed to carry on their activities. According to Rajabifard et al. (2005), the capacity to meet user needs and to deliver services and tools within the spatial information community has gone far beyond the ability of single organisations, especially when more value-added and integrated spatial data is required for more complex analysis. Hence, organisations move toward the sharing of spatial datasets, collecting and integrating spatial data from different sources.

Data sharing is a process that provides transactions to obtain access to data and services from other stakeholders under certain terms and conditions. These transactions may or may not include financial payment. In reality, data sharing is far easier to advocate than to practice (see Azad and Wiggins, 1995). Benefits of data sharing include 1) avoiding duplication of effort in data collection, 2) enabling re-use of existing datasets, 3) curtailing waste of resources (time, financial and human), and 4) reducing data collection and maintenance costs (de Montalvo, 2000; Omran, 2007). Data ought to be produced once and used by different users, given that no single agency can satisfy all its data needs (Dale and McLaughlin, 1999). Ideally, agencies should spend 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).

To facilitate access to spatial data, Rwanda collaborates within regional and global initiatives. Examples are the African Monitoring of the Environment for Sustainable Development (AMESD) programme and the Mapping Africa for Africa initiative (MAfA). AMESD is a partnership pan-African programme between African Union Commission (AUC) and European Union (EU) http://www.amesd.org. An AMESD satellite receiving station was deployed in November 2010 at the Rwanda Environment Management Authority (AMESD 2010). The aim is to give full access to remote sensing and environmental data and products for environmental monitoring applications. It proposes the creation of an African Information System on environment to improve national and regional decision-making. Rwanda contributes to Information and Communication Technology related efforts of the UN Economic Commission for Africa (UNECA). It participated in defining fundamental geospatial datasets for Africa undertaken as part of MAfA which aims to enhance capacity building and knowledge sharing among African countries.

On the global scene are initiatives that require data sharing such as the Global Earth Observing System of Systems (GEOSS), and the UN Millennium Development Goals (MDGs). The GEOSS aims at promoting the sharing of earth observation data. According to the implementation guidelines, full and open exchange of data, metadata, and products are advocated (GEO 2009). The goal is to have data accessed with minimal time delay and with as few restrictions as possible, on a non-discriminatory basis, at minimum cost for no more than the cost of reproduction and distribution. Focus is on these areas of societal benefit: disasters, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity. The Global Ecosystems data for Sub-Saharan-Africa released in 2009 includes isobioclimate, lithology, hydrology, land use/land cover, Digital Elevation Model, etc. (http://rmgsc.cr.usgs.gov/ecosystems/geoss_task.shtml). GEOSS stresses the facilitation of access to data, engagement of users and assistance for developing countries. The MDG is not a geospatial data initiative but needs spatial data for measuring achievement on series of targets ranging from eradicating extreme poverty and hunger to sustainable access to safe drinking water and basic sanitation (http://mdgs.un.org/unsd/mdg/Default.aspx).

Data sharing is no longer limited to public sector or intra-government initiatives. Of potential significance are data from crowd-sourcing (CS) and volunteered geographic information (VGI) such as OpenStreetMap, Google Map Maker, and Tracks4Africa. VGI describes any type of content that has a geographic element that has been voluntarily collected (Goodchild, 2007; Castelein et al, 2010; Ho and Rajabifard, 2010). Although their impact is still not well felt in Rwanda, it is obvious that these initiatives have the potential to change attitudes and approaches to data sharing. Data sharing mechanisms appropriate to the context in which sharing is to take place are needed. Spatial data sharing policies need to account for different information communities' conceptual abstractions,

classification schemes, data models, processing approaches and recording methods and the sources of data from CS and VGI developments. The issues are complicated and apply to law enforcement, civil protection and emergency response, hydrology, agriculture or the consumption of location services (Jackson et al, 2009a). There is no doubt that the lack of effective mechanism to exchange information among government, private sector and grassroots groups remains a significant impediment to more effective and efficient use of geospatial products and services (Pinto and Onsrud, 1995, Elwood, 2007).

Access to and use of existing spatial data to support planning and decision-making is imperative in Rwanda. To develop a suitable sharing mechanism requires an investigation of the current state of data sharing. Consequently, an assessment was made to identify the current arrangements. This paper emanates from the survey conducted in June 2010 to examine organisations' willingness to share data. The major goals were to assess the preparedness of organisations in Rwanda to share spatial data, to ascertain existing policies at organisational level and identify existing barriers to data sharing.

2. BACKGROUND TO GEOGRAPHIC INFORMATION IN RWANDA

There is an increasing demand for geographic information in Rwanda. This increase is due in part to the current drive by the Government of Rwanda (GOR) to promote evidence-based decision-making within the context of an information rich, knowledge-based economy (see African iParliaments, 2009). Evidence-based decision-making requires the use of accurate data in the scientific analysis of a given situation in order to derive results that could feed into government policies. The role of spatial data in national development, social and economic planning is recognized in Rwanda.

> The GOR recognized that geographic data and information are essential to social and economic planning and development. It believes that they 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. In this context, Information and Communication Technology (ICT) policies and strategies, including National Information and Communications Infrastructure, will take into account the geoinformation component (GOR 2000).

Increasing demand for geospatial data in Rwanda is due to the recognition that there is a spatial dimension[1] to problem solving in health, poverty reduction and addressing complex national development issues. Consequently, most institutions are aspiring to use Geographic Information Technologies (GITs) in their day-to-day activities, producing geographic data of different themes and presenting results as maps in reports.

The awareness of the importance of geographic information in Rwanda was raised by the first national SDI conference in 2006. Although there is no NSDI yet, awareness is currently high and the need for users to access existing data is evident. It is a challenge to know what datasets exist, where they are and how to access them. Recognising the lack of information about available datasets as a major barrier to implementing applications, an inventory of existing spatial datasets on Rwanda was undertaking in 2009. This led to the creation of the Rwanda Metadata Portal (RMP), a web catalogue service. It enables users to access metadata to identify datasets for their needs. This improved the status of metadata, eased the discovery of geospatial data on Rwanda and raised awareness about benefits of web-based metadata catalogues (see Akinyemi and Kagoyire 2010).

Increased availability of public participation platforms such as Web 2.0 technologies, web-based mapping applications with free APIs such as from Google, Microsoft and Yahoo and online availability of spatial data have revolutionised and democratised mapping. These technologies opened up digital mapping to mainstream internet users and encouraged citizens to produce content, maps, ideas on the internet (Jackson et al, 2009b; McDougall, 2009). Their impact is still minimal in Rwanda, but things will definitely change over time as internet connectivity improves. Necessary changes must occur in the existing structure to be responsive to the current high demand for spatial data. At present, spatial data is predominantly provided by government institutions. Private sector's role in capturing spatial data and developing products and services is very limited. Occasionally, the collection of spatial data is commissioned in the telecommunication sector by a private service provider. As neither a national spatial policy nor data sharing mechanism are in place, access to existing data is still not straightforward.

To ease access to information, a revised draft bill on Access to Information (ATI) is about to be enacted in Rwanda. Its set standards include a strong public interest test, 5 working days for government bodies to respond to information requests and extensive oversight powers to the Ombudsman (Article 19 2011).

[1] The spatial dimension implies that the value of a phenomenon varies from one geographic location to another.

With about 90 countries having or are about to enact such laws worldwide, examples in Africa are South Africa (enacted 2 February 2000) and Nigeria (enacted 1 June 2011). Some countries with draft ATI laws are Botswana, Senegal, Cameroon, Uganda, and Ghana. Right to access information held by public authorities is a fundamental human right recognised in the African Charter on Human and Peoples' Rights (OAU-Organisation of African Unity, 1982).

The ATI bill will definitely have impact on access to publicly held data and creates a significant opportunity for the development of SDI in Rwanda. SDI facilitates access to and use of geospatial data. Yawson et al. (2010) noted that SDI is an integral part of the technical infrastructure used particularly for spatial information discovery and distribution in many nations that have enacted freedom of information laws. Therefore, a logical sequel to the enactment of the law is to create appropriate policy and institutional frameworks and to build the NSDI as part of the technical infrastructure required to give life to the law. The technical infrastructure serves as the physical vehicle that makes the information accessible. However, like most African countries, Rwanda faces challenges that hamper establishing the NSDI. Requisite requirements for implementation are policies, appropriate institutional arrangement, strong partnership within and between institutions, human resources, datasets and custodianship, standards and technology.

3. STUDY OBJECTIVES AND METHODOLOGY

3.1. Objectives

This study seeks to understand the process of sharing spatial data in Rwanda. Ultimately, this would facilitate the development of a national spatial data policy to particularly address spatial data production, provision and data sharing issues. The study objectives are:

- Assessing the need for spatial data sharing
- Identifying the current means of sharing spatial data
- Identifying the rationale for engaging in sharing data and inhibitions
- Identifying available spatial data sharing policies

The study seeks to investigate why spatial data is shared in Rwanda. What necessitates the sharing? In which format is data exchanged, what are the types of media in use for sharing data? What are the reasons for individuals or organisations to engage in spatial data sharing? Are there some factors inhibiting sharing? If yes, what are they? What is the data sharing policy situation like at both organisational and national levels? These are salient questions that this study seeks to investigate, for better appreciation of spatial data sharing in Rwanda.

3.2. Sampling Method and Data

Given the fact that the geospatial industry in Rwanda is just developing, organisations producing and/or using geographic data or information are not many when compared to many other countries. In this regard, purposive sampling was done using the definition of a sample based on judgment. Only organisations using geospatial technologies, which are likely to have the required information to achieve the survey objectives, are targeted. Having that in mind, the following categories of institutions and organisations were targeted for survey. These are public, semi-public, private/consulting firms, non-governmental organisations and academic/research institutions. Predominantly, the sample covered both the public and private sectors as broad categories. In all, thirty-five organisations using geospatial technologies were surveyed, specifically targeting staff in charge of spatial data in these organisations. Organisations surveyed are government institutions (66%), consulting firms (20%), academia (11%) and NGOs (3%). All organisations targeted consented to being surveyed except three organisations, which did not refuse per se but had very long approval procedure that led to their eventual exclusion from the survey. The coverage of the survey is representative and the results give substantive insights into the contexts and practices of data sharing in Rwanda.

In drawing-up the survey instrument, questions covered are under two broad sections, namely Part I - identification and Part II - specific questions. Questions in the part II are focused on types of spatial data exchanged, users, means of sharing spatial data and rationale for sharing amongst others (for further details and the questionnaire see http://memberservices.gsdi.org/files/?artifact_id=809). As the organizations in the geographic information field are few, there was no point in making the questionnaires anonymous, i.e. personal name, company name and status were requested. This was not a limitation in filling questionnaires or granting interviews as the survey was conducted face-to-face in their organizations. Respondents identified the problems faced when existing spatial data is not shared and freely gave information as regards finding suitable solutions to facilitate data sharing. As they all indicated their interest in receiving the survey results, all participating organisations received the summary report via email. The results of the survey are widely circulated (see survey summary at these links UN Spider and Servir blog http://www.un-spider.org/news-en/3893/2010-11-26t170400/survey-spatial-data-sharing-rwanda, http://www.servir.net/africa/index.php?option=com_mamblog&Itemid=54&task=show&action=view&id=791&Itemid=54

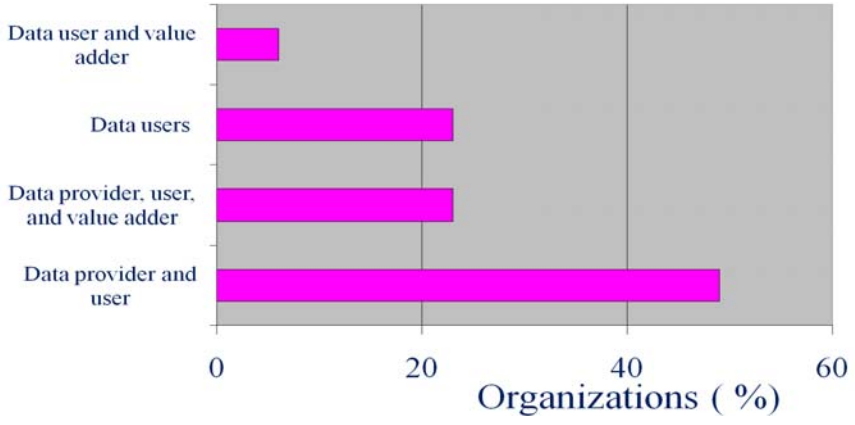
4. RESULTS

4.1. Spatial Data Producers, Providers and Users

Institutions were categorised into four classes, namely: spatial data provider, spatial data user, spatial data provider and user, spatial data *value-adder*[2]. The notion of spatial data producer and user are very broad terms. According to Cetl and Ivić (2009), spatial data producers include primary producers and those that derive new data and products from performing different analyses. Their study was restricted to primary producers, i.e. geodetic firms. However, as this study focuses on assessing spatial data sharing, we included all organisations dealing with spatial technologies and products. Primary producers were differentiated from value-adders to capture how organisations perceive themselves as regards spatial data production and usage. This is probably more realistic than how we may have categorised them because their understanding of the category they belong in come from what they do.

The spatial data user category comprises individuals or institutions that use spatial data. Sometimes spatial data producers are also users when they require datasets produced by other institutions for their activities. The four categories in the question presented to the respondents were slightly modified based on the answers received. These answers better reflect how these organisations perceive themselves (see Figure 1). More than 40% of the organisations describe themselves as spatial data providers and users, over 20% see themselves as spatial data providers, users and value adders, others are simply spatial data users (over 20%), and the minority (5%) are spatial data users and value adders.

Figure 1: Categories of Organisations relating to Spatial Data



[2] Value adder refers to those organisations that derive other products and services from datasets produced by others based on further work done, e.g. application of spatial analysis.

4.2. Need for Spatial Data Sharing

The need to share is evident as all respondents reported using spatial data produced by others (100%). As spatial data users are a formidable and diverse group, we sought to know who the users are (see Table 1, multiple choice answers). Results reveal that majority of spatial data users in Rwanda are decision makers (16%), 16% of organisations only produce data for internal uses, 13% are consultants, 11% are Academics, Donor agencies (10%) and grassroots groups (9%). Grassroots groups (e.g. NGOs, local level non-profit agencies, voluntary associations) are beginning to use spatial data and technologies in local planning, problem solving and service delivery. Until recently, they were not recognised by researchers or policy makers as participants in data sharing efforts. So little is known about the specific challenges they encounter in gaining access to data (Elwood, 2007).

Table 1: Types of Spatial Data Users

S/N	Data users	Frequency	%
1	Decisions makers	27	16
2	Other institutions producing spatial data	21	12
3	Value adders	10	6
4	Academic and research institutions	19	11
5	Grassroots groups	16	9
6	Consultants	22	13
7	Donors	17	10
8	The media	7	4
9	Own organisation	27	16
10	Our client	1	1
11	Investors	1	1
12	Telecommunication company	1	1
	Total	169	100

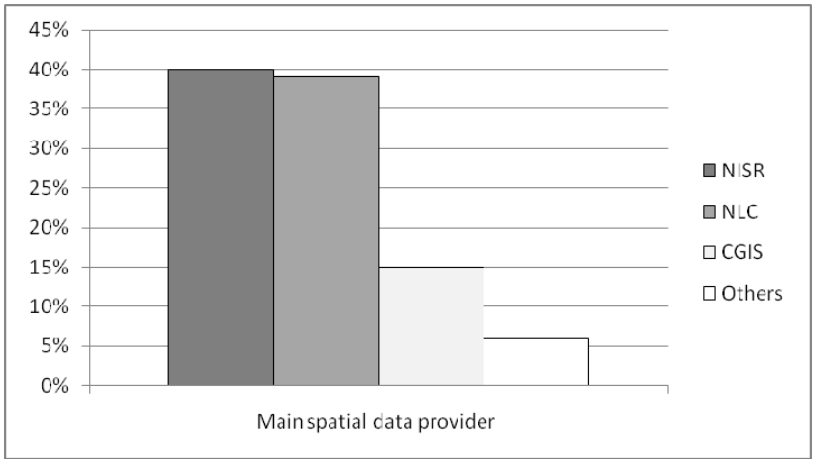
Regarding datasets exchanged, administrative boundaries (25%), topographic maps (15%) and orthophotos (14%) are most sought after (see Table 2).

Table 2: Types of Spatial Datasets Sourced from Other Organisations

No.	Types of datasets	Frequency	%
1	Administrative_boundaries	18	25
2	Topographic_maps	11	15
3	Protected area, forest and mining site	3	4
4	Trade map (markets)	2	3
6	Socio-demographic data	2	11
7	Orthophoto/Aerial photo	10	14
8	Roads	6	8
9	Land use	4	5
11	Accessibility to service	1	1
12	Meteorological data	1	1
13	Bathymetry of Lake KIVU	2	3
14	Soil maps	1	1
15	Satellite images	6	8
	Total	73	100

The types of datasets shared were related to the producers, enabling the identification of key players exerting influence on spatial data sharing in Rwanda (see Figure 2). The main spatial data producers identified by the respondents are National Institute of Statistics of Rwanda (NISR 40%), National Land Centre (NLC 39%), CGIS (Centre for GIS 15%). Other organisations combined supply 6% of all datasets shared. The implications of the foregoing are 1) the bulk of spatial datasets used in Rwanda come from these three organisations, consequently 2) spatial data exchange is controlled mainly by them, 3) if any data sharing mechanism is to succeed, it must take into cognizance these existing arrangements.

Figure 2: The Main Spatial Data Producers/providers in Rwanda



The system of spatial data production in Rwanda is mandate driven as organizations produce datasets relating to their domain (Akinyemi and Kagoyire, 2010). NISR produces socio-economic, demographic data and administrative boundaries. NLC produces most fundamental datasets such as orthophotos (0.25m) with about 97% national coverage, land parcel boundaries (scale 1:2,000 for rural and 1:1,000 for urban), national land use and development master plan (1:2500) and topographical maps. The digital soil database of Rwanda (1:50,000) was produced by the Ministry of Agriculture and Livestock Resources in 2000/2006. Ministry of Natural Resources in 2007 produced forest cover maps (1:40,000), Ministry of Trade and Industry produced trade datasets comprising of trading centres, days of operation, among others. Of the organisations surveyed, 81% (comprising mostly governmental or parastatal) finance the production of data through their budgetary allocation and/or external financial support, for example, from donors.

4.3. Means of Spatial Data Sharing

To assess the means of spatial data sharing, the spatial data management system, the format in which datasets are produced and the medium of data exchange were examined. The data management systems in use are paper-based, GIS-based or a combination of both (see Figure 3).

Most organisations combine paper and GIS based systems for data management (53%), whereas 35% and 12% are solely GIS or paper based respectively. Spatial datasets are stored as digital and/or paper maps. The data management system used has implications on data sharing. Because paper based systems diminish the potential use of spatial data in spatial analysis, GIS based systems

are preferred. Regarding the format in which spatial data is shared, most spatial datasets are shared as map printouts/hardcopies (47%), 32% are shared as shapefiles (.shp), 3% in portable document format (.pdf), and 8% are downloadable from the internet as non-dynamic maps. Despite possibilities with web map services, this option is largely unexplored in Rwanda (see Table 3).

Figure 3: The Spatial Data Management Systems in Use in Rwanda

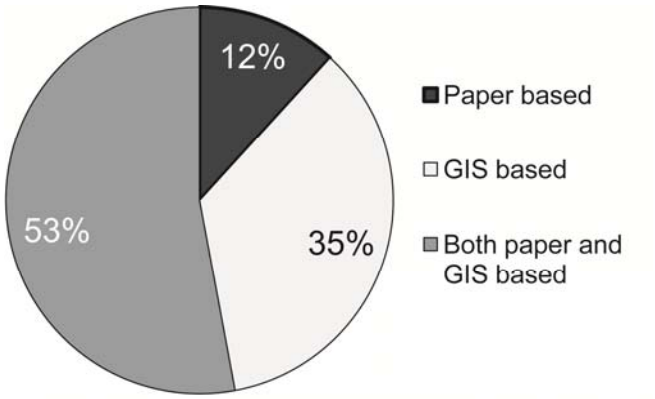


Table 3: Format in which Spatial Data are Shared

Format		Frequency	%
1	Map printouts/hardcopies	29	47
2	Web map services	0	0
3	Shapefiles	20	32
4	Non-dynamic online map	5	8
5	Reports	3	5
6	Pdf	2	3
7	Others	3	5
	Total	62	100

With 47% of data shared as hardcopy and zero web map services, the main technical barriers experienced are limited GIS web mapping skills and poor internet access. The media of data exchange were also examined (see Table 4).

Most datasets are exchanged using portable digital media e.g. CD-ROM, USB drives (34%), paper maps (33%), email attachments (22%), download from website (7%). These findings corroborate previous studies (see Simbizi, 2007; Akinyemi and Kagoyire, 2010). The implication is that data sharing is done mainly through digital means, which require a computerized system.

Table 4: Medium of Spatial Data Exchange

No.	Medium of exchange	Frequency	%
1	Paper maps	29	33
2	Portable digital media e.g. USB drives, CD-ROM	30	34
3	Email (attached file)	19	22
4	Download from website	6	7
5	Internet FTP - File transfer protocol site	2	2
6	Documents (hardcopy)	1	1
	Total	87	100

How then can this finding be reconciled with the earlier one that most spatial datasets are shared as hardcopy paper maps/printouts? We found that it is common practice to scan hardcopy paper maps and exchange them via email and other means. Such paper-based means of data sharing are inappropriate as they result in serious data capture, integration and data maintenance problems (Simbizi, 2007).

4.4. Rationale for Spatial Data Sharing

It is insightful to further examine what motivates organisations to engage in spatial data sharing. Omran (2007, p. 23) advocates that the determinants of organisations' willingness to share data with other organisations should be established empirically. From the results, goodwill, friendship and organisation's preference to share data are most relevant accounting for 24% of all responses respectively (see Table 5).

Table 5: Rationale for Engaging in Data Sharing

No.	Rationale	Frequency	%
1	Goodwill	11	24
2	Tradition	5	11
3	Organisation's preference to share	11	24
4	Individual initiative or Friendship	11	24
5	A written agreement (e.g. MoU)	5	11
6	National interest and researcher	3	7
	Total	46	100

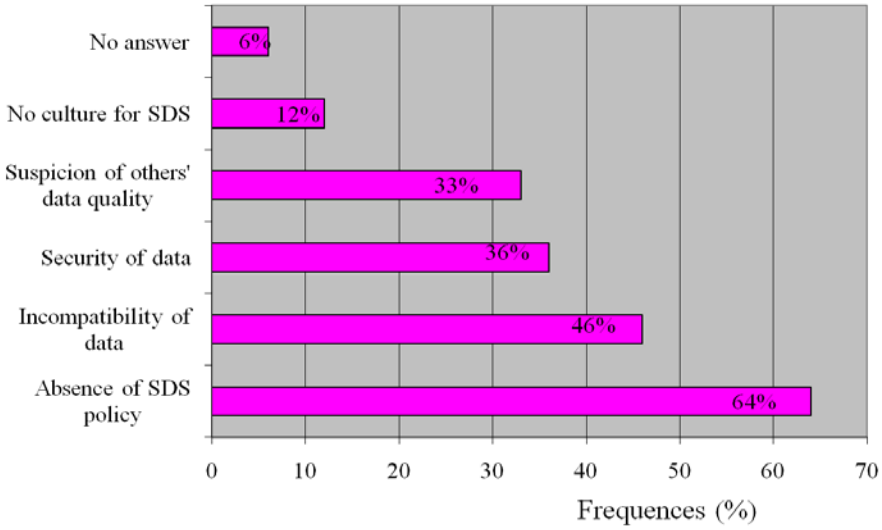
Others engage in spatial data sharing because it is in line with the organisation's tradition (11%), 11% have Memorandum of Understanding (MoU) with other organisations, 7% share data for national interest and research. Recent studies underscore trust as an important mutual feature of the sharing entities (see Harvey, 2003; Adobor, 2006; Omran 2007).

4.5. Barriers to Spatial Data Sharing

Studies have identified some inhibitions to data access. For example, grassroots groups have limited financial resources, insufficient GIS expertise and poor network capacities to obtain data online (Niles and Hanson, 2003; Smith and Craglia, 2003). In Rwanda, 64% identified the absence of a national spatial data and sharing policy as the greatest barrier to data sharing. Other barriers are data incompatibility (46%), security of data implying misuse (36%), data quality (33%) and organisations not having a sharing culture (12%) (see Figure 4). Developing data sharing cultures is important to successfully implement geographic information technologies (Onsrud and Craglia, 2003).

These inhibitions to spatial data sharing are better handled when policies, common standards and data specifications are adopted and terms of data use are explicitly stated.

Figure 4: Barriers to Spatial Data Sharing in Rwanda



4.6. Data Access Options

Survey findings revealed that the types of data mostly exchanged are fundamental datasets. It also identified the main producers of spatial data that exert strong influence on the data sharing process in Rwanda. A major finding is that often spatial data are exchanged as printed, hardcopy maps. This implies that, irrespective of the data management system in use (whether paper based or GIS based), hardcopy maps are mostly shared. When softcopy maps are exchanged, these are produced in portable data format (.pdf). As this format restricts editing and spatial analysis, dissemination of spatial data in other formats should be encouraged. A digital spatial data management system that allows the use of data in a GIS environment is most desirable to facilitate the use and reuse of existing spatial datasets.

Studies have proposed different data sharing options. Some examples in several contexts are: Australia (see Fitzgerald, 2010), GEOSS (see Onsrud et al, 2010), Local government (see Harvey and Tulloch, 2006), United Nations System (see Wilson et al, 2009). Based on our findings, the following data access options for use in Rwanda are proposed:

1. accessing metadata only
2. serving data without actual features e.g. derived products, and
3. full access including every feature data.

In terms of fees, these different access levels can be further distinguished as:

A. free of any charge;
B. charging marginal cost, for example, to cover costs of media such as DVD/CD-ROM and postage; and
C. paid access where fees are charged

If we assume a simplified world of spatial data sharing, series of data access options can be derived by the *combinations* of these different access levels and fee options. As the study reveals, users of spatial data in Rwanda are varying. Consequently, spatial data access levels and fee options to be applied should be distinguished based on users' characteristics. Users can then in turn choose the access level appropriate to their circumstances.

The situation in the Rwandan context is no exception to the open versus paid data access scenarios. Some organizations already distinguish different users of their data and allow varying conditions of access. For example, some data producers give out data free of charge to all users, some producers give data free to only public entities, academic and research institutions but not to private entities, whereas some do not give data at all to external users, implying that data is created solely for use within the organization. As the debate is ongoing, it might be helpful to reconsider the value and costs of spatial data, services and products and to take into account the purpose of use to determine data access. Janssen et al. (2009) argue that while the debate on open access and cost recovery is important, it must be recognized that the arguments used in the debate are sometimes too generalized in nature as they fail to take into account the fact that different situations might call for different measures. Such a difference that is often disregarded lies in the purpose for which the data is used. For example, spatial data can be used by public bodies for performing their public tasks, by the private sector for creating commercial products, or by citizens for participating in their national democracy or holding their government accountable.

Initiatives such as Volunteered Geographic Information have the potential to change attitudes to sharing data in Rwanda. Their impacts are still limited due to the infancy of the geospatial industry and limited internet connectivity. The internet situation is bound to improve because the government of Rwanda 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 tele-centres (cyber cafes) in every district, ICT buses (mobile connectivity installed in buses) going to remote rural areas assisting local people to access facilities and services online. More GIS positions were also recently created in public institutions to help government institutions mainstream the use of geographic information in their operations (Bowman, 2009). These ongoing initiatives are aimed at bringing ICT applications closer to the people.

5. DISCUSSION

Accessing existing data is not straightforward because policies are often lacking. A look at the East African context shows that this situation is not peculiar to Rwanda. Uwayezu (2010) examined public organisations in Uganda and found that there are no established inter-organisational collaboration frameworks for spatial data sharing. Wilson et al. (2009) noted that there are no reusable spatial data-sharing agreements in East Africa. In the absence of sharing policies, informal cooperation is predominant in Rwanda, implying that sharing is based on individual staff contacts and relationships in organisations (Akinyemi and Kagoyire, 2010). Studies attest that informality is the predominant mechanism to sharing data across organisational boundaries. Formal relationships are established through inter-organisation agreements, memoranda of understanding (MoU) and data licensing, terms and conditions of data usage (Giordano et al, 1998; Nedović-Budić et al, 2004; Harvey and Tulloch, 2006). In Rwanda, some organisations have user request forms, MoU with other organisations to share spatial data for mutual benefits; others accept a formal request letter. In the latter situation, organisations simply rely on their judgement to grant or reject users' request. When a request for data is granted, some organisations issue a licence specifying the terms of usage of the data.

With the pervasive use of spatial data in society, its creation and dissemination is no longer confined to government institutions. VGI presents an opportunity to facilitate citizen's participation in realizing SDI. Their impact on spatial data availability is enormous and opens up a means for effectively engaging society. Ho and Rajabifard (2010) noted that most SDIs typically only comprise those having traditional or commercial roles in producing spatial data (i.e. government, private organisations), leaving community groups or ordinary citizens with nominal roles (Williamson et al, 2005; Budhathoki et al, 2008). Government cannot continue to follow a path that is separate and discrete from the bottom-up revolution generating and using location-based data for mass consumer applications. Government's part in that revolution is supporting research, developing consensus and re-defining their role. Government's role must change from being a primary provider of authoritative spatial information to coordinating and managing geospatial data and facilitating partnerships (see Jackson et al, 2009b; Folger, 2009).

An emerging trend is towards open data access, especially for public sector information (PSI) as many countries enact freedom of information laws. In the spatial information and the wider information community, there is the growing use of open portals to collect and share both spatial and non-spatial information (McDougall 2009). Uwayezu (2010) analyzed fee and free spatial data sharing policies in the Ugandan public sector and found that there is a convergence towards free data access over time. With the provision of spatial data through

Volunteered Geographic Information (VGI), spatial data sharing goes beyond the sphere of the public sector. It is noteworthy that such novel initiatives designed to work for *the average person* could be so successful that, issues of relative accuracy notwithstanding, they might significantly alter government spatial data plans and programs.

Salient questions are: How can governments and industry effectively harness the possibilities of these bottom-up initiatives to improve their sharing and maintenance of spatial information? What if the quality and currency of VGI begin to exceed the quality and currency of government-provided data? For example, OpenStreetMap database grows and improves through the efforts of thousands of volunteers. Given the economic, organisational, legislative and political importance of NSDIs, what should be done to ensure that currently divergent *top-down* and *bottom-up* approaches to geoprocessing become mutually reinforcing? Unless these and other pressing issues are addressed, these multi-year initiatives on which millions of pounds/euros/dollars are expended might be superseded or marginalised by the time they reach fruition (see McDougall 2009; Jackson et al, 2009b).

To succeed in Rwanda, any mechanism for spatial data provision and sharing must adopt a multi-stakeholder approach as no single organisation produces all spatial datasets needed. The policy to be defined for data sharing must include the levels of data access and address issues relating to security, copyrights and intellectual property rights, cost sharing, standard protocol with the major goal of harmonizing access to PSI.

6. CONCLUSION

This study examined the approaches employed by organisations in spatial data sharing and usage in Rwanda. In order to better capture the local context of data sharing, any policy developed must take into cognizance the realities on ground. An assessment was made of the current state of data sharing, the types of spatial data sourced from other organisations, the motivation for engaging in data sharing, factors that inhibit data sharing and the current spatial data policy situation. In Rwanda, the lack of knowledge about what datasets are available, a lack of a sharing culture in some organizations, issues of quality and hostility to data sharing are factors limiting spatial data exchange. In addition, a national spatial data and sharing policy is needed to guide cooperation among government, private and other organisations. The absence of this policy is seen as the main impediment to sharing in Rwanda. This explains why goodwill, friendship and organisation's propensity to share are the main factors influencing data sharing. Thus, informal data exchange is predominant. The development of a formalised and enhanced spatial data sharing mechanism is imperative. This

should be suited to the technological and infrastructural needs of all stakeholders, considering that producers and users of spatial data are diverse.

Efforts at facilitating spatial data sharing must address issues relating to users' levels of data access. As a starting point, this study presented several data access and fee options based on its findings. Further research work is still required to confirm the presented results, which will assist in fine-tuning the data sharing policy options. To further stimulate the discussion and get stakeholders' input, we intend to meet and presenting these results to stakeholders in various planned meetings, especially the newly created Rwanda Natural Resources Authority (RNRA – the government institution in charge of Geo-ICT). Though this study focused on the sharing of spatial data, findings are applicable to other types of data and documents that need to be shared.

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