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National Spatial Data Infrastructure in Botswana – An Overview

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Abstract

The spatial data plays a vital role in any developmental activities whether it is natural resource management or socio-economic development. Most land-related government departments in Botswana have over the years since independence in 1966 developed systems to support their principal areas of operations as regards to spatial data. The adequacy and currency of spatial data in government operations improved leading to a need for integrated systems. This has progressively led to issues of building a National Spatial Data Infrastructure (NSDI) and an initiative modeled around Federal Geographic Data Committee (FGDC) has been established. Several facilitative committees were set and several meetings held in attempt to develop the idea to a realizable level and integrate it into the greater workings of the national economy. This noble idea has stalled for some time now and it is the intention of this paper to report on how the idea was initiated in Botswana and look at the probable causes for its stalling. The paper will then go ahead and suggest what could be done to revitalize the idea by relating it to what is considered the best practices in Spatial Data Infrastructure (SDI) programmes globally.

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INTRODUCTION

Republic of Botswana, a Southern African country, has made a smooth transition from one of the least developed nations in 1966 when it became independent from British colonial rules to a developing nation with one of the fast growing economy. This has been possible due to prudent adoption of a systematic developmental planning through National Development Plans (NDPs). In order to have an effective planning the Government of Botswana has given sufficient attention for collection of geo-spatial data, the conventional source of which is surveying and mapping. Thrust has been given on modern technologies of Aerial photogrammetry, Global Positioning System and Remote Sensing for this purpose. The conceptualization of Botswana National Spatial Data Infrastructure (BNSDI) was during NDP 8 (2003-09) and initiated within the frameworks of an ongoing project called National Geographic Information System (NGIS) coordinated by the Department of Information Technology (DIT) and the Department of Surveys and Mapping (DSM). When this initiative was started a website, http://www.ngis.gov.bw/ was established for its activities. The primary objectives of BNSDI were:

- To provide geospatial/geographic data of the whole country on a single platform with currency and adequacy of content needed for planning
- To reduce duplication of efforts among organizations needing geospatial data
- Disseminate the data to user community with an affordable price
- To make geographic data more accessible and
- To increase the benefits of using the available data

When this initiative was kick started an over seeing committee called National Geographic Committee was

established with its members derived from its main stakeholders. NGCC then went on to establish what it called Work Groups (WG) in 2003 in order for them to focus on what was believed to be the major aspects of the envisaged BNSDI and these groups were;

- Work Group (WG) 1: Fundamental Data
- Work Group (WG) 2: Geographic Information Standards
- Work Group (WG) 3: Metadata
- Work Group (WG) 4: Architecture and Infrastructure
- Work Group (WG) 5: Institutional and Organizational Framework
- Work Group (WG) 6: Education and Human Resources

The members of these groups were also derived from various organizations which utilize spatial information in their operations. According to the documents available on the BNSDI site the last meeting to be held by the steering committee was on the 4th of May 2004 and some other workgroups seems to have functioned until 2007 i.e. the Meta Data, Fundamental Data Sets and Standards Workgroups ended with a clear signal that shows a poor attendance of the groups meetings. The month of December 2005 seems to have brought a slow down on the activities of the initiative at least in terms of the activities of the workgroups and the reporting on the website. Some traceable activities running from October 2003 to November 2007 can also be noted in the National Geographic Information System (NGIS) Website news portal. Despite all these efforts, the question that remains is what could have prevented a tangible BNSDI product to this day? What cannot be denied is that the stated benefits of BNSDI still remain relevant even today. As reported in Warnest, Rajabifard and Williamson (2003), a number of nations in the world have started recognizing geo-spatial data as an infrastructure and with it has come the movement of devolving it from National Mapping Agencies to all stakeholders. Spatial data is now realized as an important asset in supporting major government, business and private decision-making (Lipej, 2010; Mueller, 2010). In that light Botswana needs to review the pitfalls and carry on with the BNSDI program

Spatial Data Infrastructure Concept

Spatial Data Infrastructure (SDI) has largely come to be acknowledged to have been so named following the work of United States of America National Research Committee (NSC) in 1993. This concept has been given several scopes by different scholars and commentators. For instance, Crompvoets *et al.* (2008) have advanced the view that SDI is an ambiguous adventure and Onsrud (2007) summed it as complex while Budhathoki and Nedovic-Budic (2007) has alluded to lack of SDI research concept grounded on theory and continuity of past experiences, but then Budhathoki, Bruce and Nedovic-Budic (2008) have since advanced a hybrid SDI model that captures aspirations of government and any other users. Earlier on Maser (1999) had alluded to promotion of economic development, stimulating better government and fostering of environmental sustainability as the basis of developing a SDI. In recognition of all these, it has now become universally accepted that SDI is a framework upon which institutions, technologies and policies interact to foster geospatial data collection, consumption, sharing and exchange (ESRI, 2010) and it can exist at three main levels being locally, regionally and globally. This accepted view of SDI seems to have played a fundamental role when the idea of BNSDI was considered.

Scholars such as Ryttersgaard (2001) have adopted some SDI views such as the one by the Global Spatial Data Infrastructure (GSDI) which views it as "the policies, organizational remits, data, technologies, standards, delivery mechanisms and financial and human resources necessary to ensure that those working on the global and regional scale are not impeded in meeting their objectives." This view promotes continuity and resource availability in the establishment of an SDI in a regional or global environment and it is viewed as applicable in the case of Botswana. In simple terms spatial data is likened to a real infrastructure such as roads and utilities so as to emphasize the need for its reliability in different operational, tactical and strategic functions of government, private organizations and stakeholders at large. Crompvoets *et al.* (2004) simplified SDI by referring to it as being "about the facilitation and coordination of the exchange and sharing of spatial data between stakeholders in the spatial data community". This particular version of defining SDI has been highly informative and instructive to the SDI initiative in Botswana especially if we look at the work groups that were formed.

Land Tenure in Botswana

In Botswana Tribal Land occupies 71% of the 582,000 km^2 of land, whereas State Land occupies around 23% and Free Hold Land about 5% (Tembo, Manisa & Maphale, 2001). This categorization of tenure in Botswana dates as far back as 1885 owing to the criteria instituted by the British Colonial government (Mothibi, Malatsi & Finnström, 2008). History of Botswana data acquisition reveals that spatial data collection in the tribal land has been at a bare minimum most of the time until in late 20th century when it started progressing forward when land pressures in these areas were generally getting higher. In some areas squatting was found to be a problem and it hindered a lot of planned developments. The country still faces these challenges to date and the need for land management systems which are fit for purpose have been on the rise and understandably the call for the establishment of the National Spatial Data Infrastructure have intensified. State Land which constitute of cities, towns, game reserves and national parks on the other

hand seems to have been better managed and accounted for systematic planning, surveying and land management. Freehold land is the residual of farm lands which were owned by white settlers and good land management was also generally associated with them. According to Nkambwe (2002), it has over the years been a mammoth task in compiling records and developing management systems for these three tenure systems.

Spatial Data Acquisition in Botswana

Spatial data has been collected by a range of methods in Botswana which include conventional land survey methods, photogrammetric, remote sensing and global positioning survey methods. Conventional Land Surveying methods in particular have largely contributed to the trigonometric stations network throughout the country. These stations were used principally to support cadastral surveying and mapping in general. The cadastral survey and topographic mapping work was done by the Department of Surveys which was first establish in 1962 and later reformed in 1971 to include Lands and 1993 reformed again to exclude Lands and include Mapping hence Department of Surveys and Mapping (Das, Morebodi, & Habana, 2008). Regardless of what it was called over the various periods it has remained principally responsible for surveying and mapping activities in the country. The Department of Surveys and Mapping has also remained the main custodians of the land surveying instruments in Botswana, in particular the Land Survey Act.

Despite the responsibilities bestowed by the Botswana Land Survey Act on the Department of Surveys and Mapping, other players have prominently started collection of spatial data in Botswana in order to support their own work and important decision-making process. These players include Botswana Water, Power and Telephone Utility companies, Ministry of Water Affairs and Mineral Resources, Tribal Land Boards, Ministry of Wildlife and Environment, Department of Tourism just to name a few. In the process duplication of data collection, lack of standards, problem in data sharing and exchange to support sustainable decision-making has been reported. This gave impetus to the development of a National Spatial Infrastructure in Botswana taking into consideration of some other existing/ongoing systems such as Integrated Geographical Information System (IGIS), State Land Information Management System (SLIMS), Tribal Land Information Management System (TLIMS) and Botswana National Geographic Information System (BNGIS).

Integrated Geographical Information System (IGIS)

This system was developed by the Department of Surveys and Mapping (DSM) in pursuit of its core mandate and harnessing of the associated technologies. The fact that this system was established by DSM in pursuit of its own interest as revealed by the features of the system which includes Geodetic Database, Topographic Database and Cadastral Database. As confirmed by Morebodi (2001), this systems forms the base upon which all the land related activities and associated information can be made in order to improve decision-making process at various levels.

State Land Information Management System (SLIMS)

This is an evolved system which started in the early 1990s as Botswana Integrated Land System (BLIS) with the aim to improve land allocation management and the upkeep of land application and waiting lists thereof (International Records Management Trust (IRMT), 2008). BLIS was initiated based on Oracle Database configuration and it captured the core activities of the Department of Lands. The intention was to interface this system with other systems from other department such as those from Department of Surveys and Mapping, primarily to access spatial data, but this phase proved futile. The BLIS system was then evolved in 2002 to establish what is now called the State Land Management System (SLIMS). The major duty of the evolved systems was to continue the functions of BLIS and further make direct links with systems at Department of Surveys and mapping, Deeds Registry, Botswana Housing Corporation and Department of Town and Regional planning (IRMT, 2008).

Tribal Land Information Management System (TLIMS)

This system was started by the Botswana Department of Lands under the Ministry of Lands and Housing in 2002. Its main beneficiary was the various Tribal Land Boards which are in control of 71% of Botswana land. It was to help them in their applications, waiting lists, allocations and their various other process to mange tribal land better. According to (IRMT, 2008) “Part of its aim was to facilitate data sharing between the various land boards and sub land boards as well as other government departments”. This statement is loaded with the reality of various players in spatial data issues, further justifying the need for a more inclusive system such as the Spatial Data Infrastructure. This system once more did not take off as expected and this have been acknowledged by IRMT (2008), where they specifically alluded to two pilot projects conducted for two selected Land Boards: Ngwato Land Board and Mogoditshane Sub Land Board. Great challenges are still abound in this system and its usability is very minimal.

Botswana National Geographic Information System (BNGIS)

An acknowledgement of what is termed inter-organizational-GIS has been made in Sebake and Cotzee (2011) to show the profitability of a GIS where most stakeholders contribute their GIS products in a sharing and exchange environment. The Government of Botswana has

been using GIS applications for a number of years but using various systems, which were not compatible with each other and this has posed a great challenge to the SDI concept. The BNGIS project was instituted with the mandate of inter-organizational-GIS in mind so as to get rid of duplication of effort in geospatial data activities and making it more accessible to all stakeholders in Botswana. According to the BNSDI web site, the principals in this project are noted to have been the following Botswana agencies;

- Department of Information technology
- Line Departments Within the Ministry of Lands and Housing
- Central Statistics Office
- Line Departments Within the Ministry of Water Affairs and Mineral Resources
- Line Departments Within Ministry of Transport and Communication
- Some Line Departments from Ministry of Wildlife and Environment
- Department of Crop Production and Forestry
- Botswana Telecommunications
- Botswana Power Corporation
- Botswana Water Utilities Corporation
- The University of Botswana

The BNGIS was to be carried out in two phases. The achievements of the 1st phase were;

- **A Master Plan for the Establishment of a National GIS:** This Plan had been regarded as a dynamic document which should be updated regularly or when special achievements have been accomplished.
- **Establishment of a National GIS Coordination Committee (NGCC):** The NGCC consists of all major Geographical Information stakeholders in Government, Parastatals and the Academia. There are about twenty member organisations and the committee has been divided into six Working Groups.
- **Establishment of a GIS Coordination Unit:** A GIS Co-ordination Unit was established in October 2003 and has been in operation since then. The main functions of the Unit are: Administration of meetings, workshops and seminars; Administration of documents; Dissemination of information; Development and maintenance of both the metadata service and the website.
- **Development of a Metadata Service:** This was done after it was established that there was a need for information about the existing data. The whole idea was to; gather all metadata about geographic data in Botswana. The metadata was captured using MetaLite software which is based on the international standard, Federal (FGDC).
- **Review of existing standard for GIS software:** Recommended ESRI GIS Products as a standard.
- **Development of a Training Guideline for GIS training within Government organizations:** This strategy document for GIS training, aimed at determining the way forward towards a more coordinated and unified structure of staff involved in GIS and related issues within Government.
- **Development of a website for the NGIS:** The website has been developed; www.ngis.gov.bw, it was to be one of the major tools used to market the NSDI as it also hosted the metadata service.
- **Draft framework document on pricing policy for geographic data:** this document was prepared by the consultants and it has also been included on the Master Plan. The document was presented at the National Spatial Data Infrastructure (NSDI) seminar in May 2004.

GIS Projects Database: Initially, the database was developed in an Access database but it was felt that since there were not many records captured or submitted at this early stages, the database be changed into a Projects Register in MS Excel worksheet.

The NSDI vision statement: It was developed and presented to NGCC and the stakeholders, it reads as follows: "We will have a fully-fledged National Spatial Data Infrastructure for Botswana. It will be easy to find, access and integrate geographic data from different sources in order to improve efficiency and effectiveness of governance and provide new business opportunities."

It can be noted that this vision statement pronounced some important envisaged milestones in the committees' endeavors, but today the nation's SDI is still in the pipeline. Also from the organizations listed above the workgroups mentioned in the introduction were also established to carry the mandate forward. The second phase of the project was mainly to focus on the implementation with more emphasis on building technological infrastructure (hardware and software) and the development of NGCC working groups including formulation of a National SDI Policy – to guide implementation of the NSDI, Capacity building and awareness, Infrastructure – Procurement of Hard/Software, networks and Site License – Enterprise License Agreement, software maintenance and support. The activities of the second phase were not carried out due to lack of commitment by some organisations, and limited funding allocated to the project.

E-Governance and Spatial Data Infrastructure

The National Spatial Data Infrastructure (NSDI) was a good initiative, although it was stalled, the government has decided to resuscitate the initiative and link it to the e-government strategy. The aim of the e-governance

programme is to provide services through the use of Information and Communication Technology (ICT). As part of this programme 14 Clusters in the e-governance programme were identified. Ministry of Lands and housing was assigned to coordinate GIS cluster, which has now assumed the responsibility of reviewing the master plan of the NSDI. It has been realized that the NSDI vision statement is similar and relevant to the e-governance GIS Cluster mandate and has been adopted by the cluster. The cluster has established three working groups that they are currently working on i.e. Metadata, Standard and Communication and Marketing.

E-governance GIS Cluster emphasizes on spatial data analysis as a requirement to support high level decision making in government. Its initiative of a long term vision for Botswana (Vision 2016) is the aspiration of moving the nation towards prosperity for all, therefore increased effort at acquiring the country's spatial-information and creating infrastructure for optimal use needs to be developed.

Spatial Data Infrastructures in Other Regions

It has been largely endorsed in Sebake and Cotzee (2011) that inter-organizational GIS operates at lower level as compared to Spatial Data Infrastructure and this explains why countries continually strive to move up this ladder. Maser (1999) has made an evaluation of the SDIs in 11 countries who can be said to be the pace setters or first generation in the development of SDIs and shown that they are called by different names from one country to another as shown in the table below.

Table 1
The First Generation of National Spatial Data Infrastructures (Maser, 1999)

Country	Name of SDI
Australia	Australian Spatial Data Infrastructure
Canada	Canadian Geospatial Data Infrastructure
Indonesia	National Geographic Information Systems
Japan	National Spatial Data Infrastructure
Korea	National Geographic Information System
Malaysia	National Infrastructure for Land Information Systems
Netherlands	National Geographical Information Infrastructure
Portugal	National System for Geographic Information
Qatar	National Geographic Information System
United Kingdom	National Geospatial Data Framework
United States	National Spatial Data Infrastructure

In evaluating all these initiatives Maser (1999) concluded that they came in different sizes and shapes acknowledging that some were well off the ground and others just good intentions, but importantly Maser (1999) posed the following two questions about SDIs;

1. "What are the driving forces behind them?
2. What are their main features in terms of status, scope, access, approach to implementation and resources?"

These two questions remain relevant and applicable in case of countries which are only having a good intention on paper like Botswana. Botswana it now seems would have fallen in the second generation SDI development but as it stands, she is still struggling with its SDI movement. Therefore a brief will be presented to show how other countries and conglomerates have commenced in order to suggest that Botswana should learn from other countries approaches. The table below will tabulate selected SDIs across the globe and specifically mention how they were initiated, authorized, financed and the level at which they exist.

Table 2
Summary of Some Selected SDIs

SDI Name	Year of Inception	SDI Type	Initiative Instrument	Authority and Financed	Achievements
Infrastructure for Spatial Information in Europe (INSPIRE, 2007)	2007	Regional	Directive No. 2007/2/EC: A legal act	The Council of the European Union and the European Parliament. Data available from Website shows that it is well financed	●Directive entered into force on the 15th May 2007 ●Connection of 27 member states National Spatial Data Infrastructures. ●Addresses 34 spatial data themes ●Implementing Rules ●Spatial Data Specifications on various uses and applications ●Implementation Roadmap up to year 2020 ●Monitoring and Reporting started in 2010 ●INSPIRE Metadata Regulation ●INSPIRE Metadata implementing rules based on ENSO ISO 19115 and ENSO ISO 19119 ●INSPIRE Community Geoportal
Geospatial Network for South America (GEOSUR). From (ESRI, 2010)	2007	Regional	Integration of Regional Infrastructure in South America (IIRSA).	Andean Development Corporation. Well funded	Enables the access to available maps and geospatial data

To be continued

Continued

SDI Name	Year of Inception	SDI Type	Initiative Instrument	Authority and Financed	Achievements
National Spatial Information Framework: - South Africa SDI. Gavin (2001)	1997	National	A replacement of National Land Information System (NLIS). Supported by South African government and its Provinces	The National Department of Land Affairs. Well Funded	●Spatial Data Discovery Facility (SDDF) ●with around 3000 records ●Draft Spatial Information Bill
United States of America National Spatial Data Infrastructure (USANSDI)	1993	National	The Clinton **Executive Order 12906** of 1994. Legally supported from Executive Office of the President, Cabinet level and Independent Federal Agencies	Bestowed on the Federal Geographic Data Committee (FGDC). This is a well funded SDI at all levels of government	●Geospatial Platform ●Clearinghouse portal ●Metadata portal ●Geodata ●Standards ●Partnerships http://www.fgdc.gov/components

From the table, the INSPIRE and USANSDI websites are quite comprehensive on the activities that were envisaged for them and great lessons can be drawn from them. An important thing to take note of with these summaries is how they address well the questions posed by Maser (1999).

Evaluation of Botswana National Spatial Data Infrastructure

Botswana which had sort from the onset to emulate the FGDC SDI model, but seems to have deviated greatly from it can use the above evaluations to get back on track. The South American and South African experience can be useful for Botswana to evaluate and reshape ideas towards building spatial data infrastructure. Toth, Portele, Illert and Nunes de Lima (2012) acknowledged to the many dimensions an SDI can take and have specifically noted this by saying that "the establishment of an SDI requires the collaboration of many parties." In this it was explained that the collaboration can be voluntary, formally regulated or legally enforced with the ultimate goal to address the interest of the collaborating parties by delivering interoperability in geographic data sets of sorts. The BNSDI is now evaluated against the questions posed by Maser (1999) by specifically looking at its driving forces, status, scope, access, approach to implementation and resources

Driving Forces

The drivers of BNSDI can be derived from the organizations which started it and in here are surveys, lands, housing, information technology, minerals, water resources, transport, communication, environment, wildlife, crop production, forestry and power. The push for BNSDI can really be supported by what was suggested in Maser (1999) that the agencies in this case have largely acknowledged the growing importance of geographical information in our times and that they are better placed to come up with an integrative solution. The major problem that can be associated with these drivers is what is commonly known as "vested interest" which often creeps in some levels of uncertainties in the progress of a dynamic and ambiguous venture. Agencies tend to want things to be done in their favor and this often creates indifferences that directly affect interest in an initiative such as is the BNSDI. Driving forces are therefore considered to be a fundamental area where appropriate questions need to be asked and researched in order to know and understand if they could have lead to a near abandonment of the BNSDI initiative.

Status and Scope

Status and scope have been considered in Maser (1999) as key features in SDI development. In case of status Maser (1999) defined two broad categories of SDIs as "those which are the result of a formal mandate from government and those which have largely grown out of existing geographical information coordination activities". The Botswana SDI seems to have started off more as the latter whereby most user organizations wanted to move their geographical information coordination from operational level to a tactical level, and this was resulting from a project. Perusing through the initiative of the BNSDI, it has emerged quite clearly that the idea does not have much executive buy-in and this can be directly derived from the structure of the workgroups. Despite what is viewed by some as lack of commitment by the initiating organizations, the BNSDI has largely failed to have high-level instructive instrument, authority and dedicated finance for it to forge ahead and this largely speak for its stalling. The website of BNSDI reveals a voluntary system that started with a lot of excitement and a gradual degradation of commitment within the first five years, further explaining why it has stalled.

In case of SDI scope Maser (1999) also advanced two different views which are "the range of substantive geographical information interests which is represented in the different coordinating bodies and the extent to which the main stakeholders are directly involved in the process". When evaluating this stand points in the realm of BNSDI it emerges that the interests are quite varied as revealed by the drivers of this idea who ultimately

formed the National Geographic Coordinating Committee (NGCC). Despite these varied interest and stakeholders the BNSDI initiative has remained a voluntary exercise whereby members participated at will because there was no official instrument which forces them to attend the BNSDI activities. This has obviously posed great challenges and failures to the development of BNSDI. Another issue just as important in the scope is the standards that are associated with geographic information in Botswana, where various interests groups seems to have had their own data collection, processing and presentation standards.

Approach to Implementation

Spatial Data Infrastructures it has emerged that they always develop from existing Geographical Information Systems (GIS) efforts. Chan and Williamson (1999) did work on the GISs of Department of Natural Resources and Environment (DNRE) in Australia and came up with the following patterns *opportunistic*, *systematic*, *opportunistic-infrastructure* and *opportunistic-business process which* they consider underpin GIS development and approach towards a SDI. In this case opportunistic is defined to be uncoordinated GIS development and implementation where as systematic refers to a well planned GIS program. Management involvement in these patterns was highly emphasized as a critical success factor. Notwithstanding these the BNSDI can be characterized as opportunistic and there has been a strive to evolve it to a systematic approach but it seems it has not quite find a proper footing because it started off with a wider scope but seems to have reduced the scope under the current GIS clusters initiative, now driven by Ministry of Lands and Housing. As a lesson for BNSDI initiative Maser (1999) indentified critical success factors which are still considered relevant today with small variations. These factors are listed below;

- Be specific about the purpose of the clearinghouse under consideration. To be successful, there has to be a direct need to share data and services. When the context for implementation is missing, people will become frustrated to implement clearinghouses only out of fashion.
- Provide good communication channels for the community for sharing and using datasets instead of aiming only toward the linkage of available databases.
- Create stable funding. Stability of funding is needed to build a suitable framework that facilitates the management of information assets.
- Create trust and authority in the clearinghouse. Stability of funding could support this process.
- Create more user-friendly interfaces with less discipline-specific terminology.
- Introduce web services to clearinghouse. It is very likely that the software for web services will become cheaper in the future.
- Motivate data suppliers and web service providers to participate within the clearinghouse. The more data and web service providers, the more data and services are available. This improvement of the content will attract end-users.
- Motivate the clearinghouse managers to update their environment regularly.

Though talking about clearing houses these factors can be fashioned to suit BNSDI, if they were to be taken individually and adapted to the initiative. What is now clear today is that the various fronts of Information Technology and Communications (ICT) have made considerable advancements, which makes it easy to tap in the potential raised by these factors. Particular success factors which stand the test of time are the ones on creating stable funding, trust and authority towards implementation of a SDI.

Resources

According to Ezigbalike, Selebalo, Faïz, and Zhou (2000) "SDI cannot be introduced in a vacuum. It depends on other technologies to work, notably information, communications and knowledge (ICK) technologies". This point is appreciated fully and a case is made here that an authoritative instrument and financial support are very important in feeling the vacuum. This is much so because most of the Botswana agencies do have considerable resources mentioned above but developing an SDI in the last ten years has proved a futile exercise. The resource need to be prioritized so as to allow for the implementation of spatial data infrastructure and here a controlling authority is envisaged as a viable option. The authority must be able to rally all the stakeholders of spatial data to a consensus table and give them directions on what has to be done in order to build a spatial data infrastructure. The authority has to be independent from the existing authorities that deal with spatial data so that it can act as a proper oversight agent in ensuring the systematic building of SDI. This gets rid of vested interest where some existing agencies might want to deviate the SDI development process into their favor which often results in other department losing interest in the initiative.

CONCLUSION

This paper has shown the growth and re-organization of spatial data in Botswana since independence leading to the early years of 2000 when initiatives to establish a NSDI in Botswana were kick started, but the problem is that up to date there is no working infrastructure to talk about. The table of the selected SDIs goes onto show that an SDI initiative is better off if it is supported by an initiative instrument, finance and responsible authority. The

instrument should be able to direct what is there to be done and the authority must ensure that financial and capacity are there to move the initiative forward and achieve results in a reasonable time. According to the experiences from the United States of America and the European Union top-level governmental support and sanctioning of an SDI often ensures that it takes shape and direction thereby setting realizable targets and goals. Modeling an SDI along established ones like that of the United States and Europe is welcome but this needs to be done along clear pronouncement of an initiative instrument, authority, and finance. Therefore it is proposed here that BNSDI should take the legal approach as opposed to the voluntary one, whereby the SDI Master Plan will be seriously ratified by government with clear objectives, implementation and outputs. Incidentally under the e-governance strategy it is evident that the Ministry of Lands and Housing has now assumed some kind of mandate to rekindle the nations SDI hopes, but the short fall might be the bias which will come with that. Warnest, Rajabifard and Williamson (2003) have noted this to be a stumbling block because though the land sector organizations do possess intimate knowledge about building spatial information, they usually have no or inadequate knowledge about the various purposes for which varying interest groups may require the information. The Ministry of Lands as a sector concerned with spatial data building is more on the supply side as opposed to being demand driven. On the other hand some commentators like Poplin (2010) views a successful SDI to be the one where the potential users and providers of geo-information get involved in order to reduce transaction cost for instance. That being the case the need for building spatial information on a dynamic framework capable of handling the involved interests well is emphasized. In that light a general rule that must be taken serious by all the stakeholders is that so long as the consumption of spatial information increases into the future, the higher the need to involve all the sectors of economy in its building. Lipej (2010) and Rajabifard (2008) have already alluded to the future power of spatial information by stating that "the development of spatial data infrastructures is an on-going process leading towards spatially enabled society and spatially enabled governments". Therefore as a beneficial on-going process it needs to be natured to maturity through approaches that are more focused, partner driven and effective, BNSDI needs this.

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