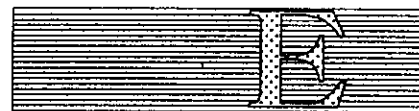


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**THE GEOINFORMATION INDUSTRY IN AFRICA:
PROSPECTS AND POTENTIALS**

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EXECUTIVE SUMMARY

1. INTRODUCTION

In looking at the geoinformation industry in Africa it is important to define what we mean by the term so that a more comprehensive exposé can be done on what are the prospects and potentials. For the purposes of this paper, geoinformation is used in the broadest sense and refers to all sectors of the industry. The industry are those public and private organizations that are involved in the collection, processing, management, retrieval, analysis and dissemination of geoinformation at a national, sub-regional and regional level. The provision of geoinformation software, human resource development (i.e. education, training and capacity building) and research and development are key components of the geoinformation industry.

For the geoinformation industry in Africa to develop, the provision of hardware (i.e. computers and peripherals) and information and communication technologies (ICT) (i.e. telecommunications, Internet) is critical. However, this paper will not focus on the hardware and ICT aspects of the industry, as it would require a paper on its own. The paper will, however, provide a general overview of the present situation within the geoinformation industry in Africa. This has been gleaned from the international literature and research conducted over several years in countries, sub-regions and the continent as a whole.

2. OVERVIEW OF GEOINFORMATION INDUSTRY IN AFRICA

Presently, many geoinformation initiatives are on the go in Africa and on an annual basis new ones are being added (National Research Council, 2002). Many of these initiatives are not well publicized and consequently, potential users on the African continent are not aware of their existence or what geoinformation is being collected (Estes and Kline, 2000). These initiatives provide some of the key geoinformation required for the implementation of development plans on the continent. For example, the AFRICOVER project of the Food and Agricultural Organization (FAO) has provided comprehensive layers of information for twelve countries in eastern and central Africa and the intention is to provide similar data sets for countries in other regions of Africa.

Many other initiatives provide comprehensive geoinformation for the whole continent, sub-regions and for specific countries. The geoinformation is provided at various scales and there are many different data types. Much of this information can be accessed via web portals such as the Africa Data Dissemination Service (ADDS) of USAID, the Southern African Humanitarian Information Management initiative (SAHIMS), the North African GeoNet, the GEO3 - Data Portal of the United Nations Environmental Programme (UNEP) and United Nations Economic Commission for Africa's (UNECA) GeoInfo Clearinghouse to mention but a few. Clearly, the issue is not about whether Africa has geoinformation but whether it has the right information to address all the problems facing the continent.

A project conducted by the Human Sciences Research Council of South Africa in collaboration with the SARDC of Zimbabwe has recently contributed to the geoinformation industry by collecting

much socio-economic data for all the member states of the Southern African Development Community (SADC) at a district level. Information was obtained from ministries within the countries and from regional initiatives. It also looked at what census data was available in each of the countries in a geoinformation format. Furthermore, it looked at the feasibility of capturing a country's census data into GIS. The project showed that there are extensive amounts of geoinformation available at the sub-national level. Lessons learnt from this project will be presented in a later section.

Consequently, when examining the many initiatives and looking at the geoinformation industry in Africa as a whole, the picture that one gets is that much has been done. However, much still needs to be done and many problems in the geoinformation industry have to be addressed. To ensure the future growth of the geoinformation industry and the efficient access to reliable and harmonized geoinformation, a needs driven approach is required (Groot, 1997). To reach its full potential the geoinformation industry also needs to be developed within an appropriate policy framework such as Agenda 21, the Poverty Reduction Strategy Papers (PRSP), the Millennium Development Goals (MDGs) or the New Partnership for Africa's Development (NEPAD) (National Research Council, 2002). Development strategies of regional economic communities and countries should also be considered in the development of geoinformation.

To bring about the effective development of the geoinformation industry over the long term also requires that it be developed within a Spatial Data Infrastructure (SDI) framework (Mtalo, 2003). The SDI framework identifies the need to conduct geoinformation inventories, implement data standards, catalogue data, maintain geoinformation on a regular basis and bring about its effective dissemination through a variety of means. Unfortunately, many factors are constraining the effective implementation of SDI's in Africa including a lack of policy, poor management, the absence of institutional capacity and financial resources and a limited access to appropriate technology.

Although there is quite an extensive geoinformation base in Africa, two of the main problems that need to be addressed are custodians not providing access to the geoinformation and it not being openly disseminated through various mediums. The open sharing of geoinformation between stakeholders at a national, sub-regional and regional level is also required to develop the industry. The role of the private sector must not be underplayed as they have historically played an important role throughout the world developing the geoinformation industry as a whole (Groot, 1997). It is known that the private sector is actively involved in all sectors of the industry in Africa, especially in the provision of software, training and the collection of geoinformation.

One of the main problems at the present moment is the lack of coordination in the geoinformation industry on the continent (Ezigabali, 2001). Without these coordination mechanisms being in place, information on initiatives such as AFRICOVER and ADDS as an example, are not being widely publicized. This has resulted in there being little knowledge of the extent and type of geoinformation that these initiatives can provide. Although these initiatives do make their information available across the World Wide Web (www), it generally requires an extensive search of the web before the information on these and the many other initiatives can be accessed. Nevertheless, the National Research Council (2002) in their book: "Down to earth: Geographic information for sustainable development in Africa", believes that these initiatives are contributing to the growth of the small geoinformation industry in Africa. To give some context to how small the industry is in Africa compared to the rest of the world, only 1.3% of all licensed users come from the continent (Zietsman, 2000).

To fully substantiate the extent of the geoinformation industry, one of the first activities that needs to be done is to develop an inventory of all the geoinformation and topocadastral maps available at a national, sub-regional and regional level (Brent Hall et al, 1998; Menneke and West, 2001). To prevent this becoming an unmanageable task, it again requires that this be done within appropriate policy frameworks (National Research Council, 2002). One of the initiatives that could well contribute to this activity is the Africa Environmental Information Network (AEIN) that is being planned by UNEP. The focus of this initiative is to "harness and enhance access to information and

knowledge to support the management of Africa's environmental resources". The initiative operates within the frameworks of Agenda 21, NEPAD and the African Ministers Conference on the Environment (AMCEN). What will have to be ensured in conducting an inventory of the African continent is that information is collected on all the key geoinformation data sets.

Access to geoinformation in Africa is mainly restricted by policies implemented at a national level and to a lesser extent by technology limitations. To overcome these restrictions, national governments need to be encouraged to develop policies that provide access to information either free or at a reasonable cost so that citizens and stakeholders are able to use it for decision-making purposes (Gavin, 2003). Through the SDI committees that have been established in many countries on the continent the need for the implementation of these types of policies are already receiving attention. In many countries on the continent there are already policies in place that guarantee free access to information and the coordination of national SDI.

The limited access to geoinformation in African countries is also because people have limited skills and capacity needed to operate the technology (Brent Hall *et al*, 1997). Another barrier to the development of the geoinformation industry on the continent is the lack of analytical skills needed to develop an understanding of problems and using geoinformation for decision-making and bringing about integrated development in Africa. Mtalo (2003) at the previous meeting of CODI has pointed to the necessity for effective education and training in a broad spectrum of areas to overcome these skill shortages, including spatial and temporal analysis of data and the ability to write reports. People not having access to comprehensive geoinformation data sets that allow a thorough examination of a problem also contributes to analytical skills not being developed. It is well documented that limited access to finances is another major barrier in the development of the geoinformation industry on the continent (Zietsman, 2000).

Although there are many geoinformation initiatives on the go at the present moment, few really focus on the provision of the more key fundamental or core data sets, especially at a sub-national level and when considering the information needs of policies such as NEPAD. It is recognized internationally and regionally that Africa does not have all the data it requires to achieve its sustainable development objectives (UNECA, 2000). The NEPAD founding document identifies the need for cooperation in establishing regional Geographical Information Systems (GIS) largely to address this lack of data on the continent. One of these core data sets is the distribution of the population at a localized level that is generally produced from the censuses of a country.

The population data sets have not been developed in Africa in the past because the international donor community mainly provided funding for the development of geoinformation data to address natural resource, environmental and land management issues, especially in establishing early warning systems for food relief (Zietsman, 2000). More recent research has shown that it is still within these sectors that donor agencies are providing most of the funding. Fortunately, this trend is slowly beginning to change with more funds being allocated to the development of socio-economic geoinformation data set as more emphasis is placed on Agenda 21, poverty and the Millennium Development Goals (MDG's). The UNECA has recognized that the coordination of these funds is a critical aspect of the development of the geoinformation industry in Africa (UNECA, 2000).

Unfortunately, many countries in Africa still have incomplete population geoinformation. One of the main reasons for this is the base topocadastral maps or ortho-imagery needed to define the census boundaries have never been produced, are still in an analogue format, are not available or are out of date (Nwilo and Osanwuta, 2004). Furthermore, many African countries have not established their geodetic framework and have not captured the land cadastre into a GIS, which forms an important building block of other core data sets, including the population census database. Although initiatives such as the Unified African Geodetic Reference Framework (AFREF) and Mapping Africa for Africa have been launched to fill some of the gaps, others are still needed to address the remaining gaps in geoinformation.

To ensure that new initiatives are focused towards the policy and geoinformation needs of Africa it is critical that there is greater coordination. At the third meeting of the Committee on Development Information (CODI) held in Addis Ababa, Ethiopia in 2003, the author recommended that the UNECA play a key role in ensuring the coordinated development of geoinformation in Africa (Schwabe, 2003). Already the UNECA acts in an advisory capacity in the coordination of national SDI plans and should continue to play a role in ensuring the development of geoinformation on the continent (Nino-Fluck, 2000). The UNECA should work with international, regional and sub-regional agencies such as the United Nations Environmental Programme (UNEP) in ensuring more effective coordination of geoinformation development in Africa in the future. The geoinformation units in regional economic communities (e.g. SADC Regional Remote Sensing Unit), regional centres (e.g. RCMRD, Rectus, SEAMIC, ACMAD and AGRHYMET) and national ministries responsible for coordinating SDI's should also play a role.

International funding agencies have played a key role in the development of the geoinformation industry in Africa and will continue to do so into the foreseeable future. Research undertaken by Zietsman (2000) has shown that overseas development agencies (ODA) are the largest funders of geoinformation in Africa followed by the government sector. In South Africa the private sector is the second largest funder of the geoinformation industry while in the rest of Africa only 16% of projects get funding from this sector. There are strong indications that the continued growth of the geoinformation industry in Africa will come from the ODA and government sectors. However, there is a huge potential for the private sector to play a leading role in the future growth of the industry. This is because the private sector plays an important part in providing technologies and training, the capture of geoinformation and adding value to data products, which is ultimately required to generate the demand needed to grow the geoinformation industry. This will especially be the situation if NEPADS plan of increased mobilization of domestic revenue and private capital flows come to fruition.

An area that still needs much attention in Africa is the generating of awareness amongst policy and decision makers about the value of GIS in formulating policy, implementing decisions, monitoring performance, evaluating the impact of programmes and showing the financial benefit of using geoinformation (Mtalo, 2003). The UNECA recognizes that not enough is being done in making decision makers aware of the potential uses of geoinformation and they have identified this as an area for their intervention in Africa. With greater awareness comes the need for the provision of skilled geoinformation practitioners and specialists as well as developing a culture of analyzing geoinformation for decision-making purposes. Although training in the use of geoinformation is continuously being done on the continent there are strong feelings amongst many academics and practitioners in Africa that insufficient resources are being allocated to educate geoinformation professionals (Ruther, 2003).

One factor that is felt to contribute significantly to the lack of development in the geoinformation industry is the absence of institutional capacity at a regional, sub-regional and national level. Institutional capacity is required to coordinate the geoinformation industry on the continent, assist with the development of geoinformation and contribute to the training and capacity building of practitioners in Africa (UNECA, 2000). Molenaar (2002) feels that large amounts of investment are required to overcome this problem and Beerens (2004) adds that this must happen within appropriate policy, legal and institutional frameworks. International best practices in the development of geoinformation industries (e.g. North America, Asia and South America) should be considered and it is felt that United Nations agencies should play more of a role in providing funds for the development of institutional capacity on the continent.

A factor that is felt to be key to the future development of the geoinformation industry is communication. It has been shown that limited or non-existent communication networks in developing countries contribute to geoinformation not being used in decision-making and limits the growth of the industry (Menneke and West, 2001; National Research Council, 2002). One of the approaches suggested is the development of a web portal that actively distributes information on research and work that is being done in the industry on the continent. Core to the web portal would be to create linkages to existing initiatives (e.g. EIS-Africa, Africa SDI) and creating a network of

geoinformation practitioners across Africa. The portal would also attempt to facilitate access or links to existing geoinformation initiatives. Part of the purpose of the web portal would be to act as a catalyst in local and international stakeholders gaining access to the geoinformation needed to encourage private sector investment and donor funding in Africa. Ideally, this communication mechanism would encourage the overall development of the geoinformation industry in Africa, especially in the private sector.

There is no doubt that for the geoinformation industry in Africa to develop requires a partnership between the international community and the broad spectrum of geoinformation stakeholders across Africa (National Research Council, 2002). NEPAD emphasizes that any partnership must be based on mutual interest, shared commitments and binding agreements. Partnerships will be required to ensure that sufficient funds are allocated for the establishing of an institutional capacity, the development of individual capacity and the collection of fundamental and core geoinformation data sets needed to bring about Africa's socio-economic development. Through this process it is hoped that geoinformation can play a prominent role in the sustainable development of Africa.

3. A REVIEW OF THE AFRICOVER AND GLOBAL MAPPING INITIATIVES

To reflect on the geoinformation industry in Africa a review of two of the more prominent initiatives happening on the continent will be done. The two initiatives are AFRICOVER, initiated by the United Nation's Food and Agricultural Organization (FAO), and the Global Mapping project, initially implemented by the Ministry of Construction in Japan. These two initiatives have been selected as they are considered to provide the widest coverage of countries on the continent with AFRICOVER focusing on environmental/natural resources and the Global Mapping project amongst other focus areas, making a contribution on the surveys and mapping side (Hoshino et al, 2004). The main focus of this section will be to provide a brief overview of how they have contributed to the geoinformation industry in Africa. This commentary has been generated through the conducting of key informant interviews, soliciting responses to questionnaires and by evaluations of the international literature.

One of the most impressive geoinformation initiatives that have been implemented in Africa over recent years is the AFRICOVER project. While focusing on the provision of primarily land cover information for twelve countries in eastern and central Africa (i.e. Burundi, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania and Uganda) this initiative has developed an international standard on the classification of the land cover. The geoinformation that the initiative has collected at scales of between 1:100 000 – 1:250 000 includes land cover, geodesy, geographical placenames, roads and hydrography. More recently, this information has been value added by countries and integrated with other data sets, such as socio-economic data.

The layers of geoinformation are freely available and registered users can download the spatial information from the AFRICOVER web page with software that can be used to interpret the information. The information is also disseminated in industry standard formats so it can be easily used on desktop GIS. According to its own evaluation documents, each country that participated in the project also contributed to the work and had their capacity built. However, practitioners from some countries have suggested that much more could have been done in the development of institutional and individual capacities. It would seem that the driving objective of AFRICOVER was to provide the critical layers of geoinformation needed to monitor natural resources in eastern and central Africa.

The project has really created the foundation upon which much more analysis can be done and further complementary information collected and integrated. From this perspective, it is believed that AFRICOVER has contributed significantly to the growth of the geoinformation industry, whether directly or indirectly so. It has also developed innovative techniques and systems that will stand Africa in good stead in future years, especially as it will allow standardized approaches to be used in the collection of similar geoinformation for countries in other regions of Africa. The success of this project has resulted in it being extended not only to other sub-regions of the continent but to

other continents in the world. The project is now being implemented under its new name of the Global Land Cover Network (GLCN).

What stands out about the Global Mapping Project is that it aims to provide standardized geoinformation for all countries on the globe at a 1:1 million scale by the year 2007. This will be accomplished by working with a set of global partners and the national mapping agencies of countries that participate in the project. Although the information is collected at a coarse scale it does provide geoinformation for countries on the African continent. To date countries in Africa that have completed the collection of their base geoinformation as part of the initiative are Botswana, Burkino Faso, Swaziland and Kenya. Several other African countries are at the stage where they are verifying the geoinformation that they have collected and this includes Algeria, Congo, Ghana, Liberia, Namibia, Niger, Senegal, South Africa, Sudan and Tanzania.

The project collects information on elevation, land cover (i.e. land cover, land use and vegetation type), transportation (i.e. airports, railways, roads, tracks, structures), boundaries (i.e. political and coastline), water resources and population centers (i.e. built up areas and settlements). One of the intentions behind the collection of this information is to make it available to as wide an audience of users as possible. For this to be accomplished the Global Mapping Project has developed international and national partnerships. This allows them to access different sources of reliable geoinformation that can now be integrated and disseminated. Prior to the Global Mapping Project this combination of geoinformation used in the project was not being disseminated in a coordinated and open manner. The project works with national mapping agencies to prepare these data sets and where there is the necessity, they replace parts of the information with more accurate data.

The project also ascribes to the principles of Global Spatial Data Infrastructure (GSDI) and, consequently, this ensures that the geoinformation can be used across Africa and its sub-regions. By providing access to this information the project believes that they are encouraging economic and sustainable development in the regions where geoinformation has been collected. Probably of greatest importance is that they are developing the capacity of users. It is believed that by having access to this comprehensive set of geoinformation, even though it is at a coarse scale, geoinformation practitioners are developing their analytical skills and new uses for the data. This enables them to then apply this newly gained knowledge to data sets at a finer scale. This principle has been found to be equally applicable to the use of the geoinformation coming out of the AFRICOVER initiative.

Many other initiatives that are taking place on the African continent could have been described in this section and the benefits arising out of them would have been equally important as those coming out of the AFRICOVER and Global Mapping Projects. These initiatives have made important contributes in all spheres of the geoinformation industry on the continent. This is largely because they have access to the financial resources, support structures and geoinformation expertise needed to implement large initiatives of this kind. What is imperative is that any international geoinformation initiatives conducted in Africa should ensure that they develop taking into consideration the political and strategic frameworks of the continent, sub-regions or countries and that individual and institutional capacity is developed.

4. A CASE STUDY OF GEOINFORMATION IN SOUTHERN AFRICAN DEVELOPMENT COMMUNITY (SADC)

Access to fundamental, environmental and socio-economic geoinformation for countries in the regional economic communities (REC) in Africa is critical for the implementation of NEPAD, strategic plans and reporting on the State of Environment (SoE). This is to enable effective targeting of the most needy communities or areas, to identify what would be the most appropriate interventions and to ultimately measure whether these interventions or government responses have had an impact. Accessing socio-economic and environmental data for many countries in SADC remains a major problem and the producers of the SoE reports have had to rely on fragmented information or data from sources outside the continent (FAO, 1990). Consequently, the regional development plans and SoE reports have largely been unable to provide a detailed and

objective picture of the socio-economic and environmental situation that would allow targeted interventions to be developed and implemented by national decision-makers and planners.

The lack of access to geoinformation, especially socio-economic data, was identified early on in the process of developing the SoE reports for SADC and other regions on the continent. Consequently, it was decided to implement a project that would attempt to collect the socio-economic data for a set of indicators at a sub-national level or district level in each of the 14 SADC countries. What was concluded in the study is that many countries in SADC have a great deal of geoinformation. A number of the countries have gone as far as developing comprehensive atlases, such as Mozambique's socio-demographic atlas, and Malawi implementing their "One-stop shop". However, access to socio-economic and development data for reporting and mapping at a district level remains a problem. This is mainly because data is not easily accessible, it has still to be accessed from a diversity of sources within a country, policies restrict access and it is made available in a variety of formats. These limits to accessing data is manifest in the fact that nine out of 14 countries in SADC have captured their census data into GIS but only two could make this information available for use in the SoE reporting process for SADC.

The type of information that can be accessed for different countries in SADC includes administrative boundaries, agriculture, vegetation types, climatic, conservation and tourism, development funding, education, energy, geographical placenames, geology and minerals, health, hydrology, judiciary, land, police and crime, service access, socioeconomic, soils, telecommunications, topography and transport. Of the 14 SADC countries South Africa was able to provide geoinformation for all these categories at a sub-provincial level. The only other country that was able to provide a comparable set of geoinformation to South Africa was Namibia. The reason the other countries did not provide geoinformation is not necessarily because they do not have any but it is because the geoinformation was not actively publicized and national partners could not identify individuals within organizations that could give them access. In some instances, the geoinformation exists but cannot be made available to non-government organizations.

Other countries that provided some geoinformation included Lesotho, Mauritius, Seychelles, Swaziland, Tanzania, Zambia and Zimbabwe. Two countries in SADC were unable to provide any data and they were Angola and the DRC. This inability to provide even the most basic information is attributed to the political conflict that existed in these two countries until recently and the lack of institutional and individual capacity required in disseminating this information. Fortunately, through international initiatives, such as AFRICOVER, ADDS and Global Map, countries that are behind in having access to geoinformation are being assisted.

With the limited success of national partners getting access to geoinformation in their countries, a new approach was tested in the SADC project. GIS Specialists were sent to Malawi, Botswana and Mozambique to see if they could facilitate greater access to geoinformation of relevance to the study. In Malawi the government has the National Spatial Data Centre (NSDC), which is a semi-autonomous agency operating under the supervision of the Malawi Geographic Information Council (MAGIC). Although the Centre is intended to operate as a "one-stop-shop" for digital spatial data and as a service agency, the formalization of MAGIC is not yet complete. Therefore, policy and operational procedures for centrally archiving and releasing data is as yet not in place and requests for data have to go to each individual data custodian for authorization to release the data, even in cases where the data is available at the NSDC. Some of the geoinformation was not in a readily useable format and no data dictionary was available.

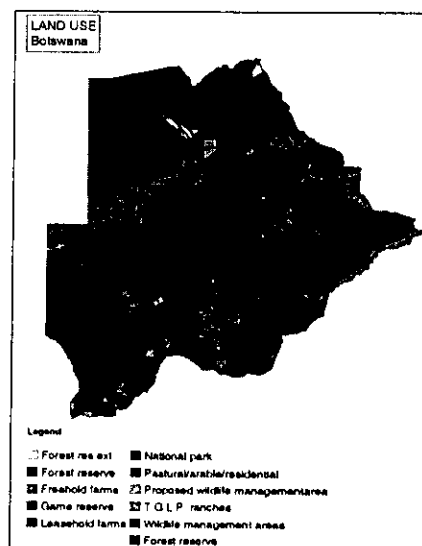
The NSDC was able to provide extensive amounts of information on socio-economic characteristics of Malawi at a localized level (Figure 1). This data emanates from Malawi's 1998 census and was used in the development of their very comprehensive socio-economic atlas for the country. The entire atlas is also available in PDF and JPEG formats on the web site of the National Statistical Office (<http://www.nso.malawi.net>). Other key data sets that could be accessed from the NSDC and other sources included district boundaries, villages and geographic placenames, soils, rivers and lakes, land cover, health and education facilities, conservation areas, roads and railways.

Figure 1: Total population at an enumerator area level in Malawi



The Botswana National Atlas was produced by the government's Surveys and Mapping Directorate. The atlas can be accessed in hardcopy from the web (www.atlas.gov.bw) or on CD. It contains extensive amounts of spatial information on topics such as geology and geomorphology, weather and climate, rivers, soils and vegetation, conservation areas, agriculture, minerals and mining, energy, land use planning, land administration, tenure systems and housing, wildlife, tourism, population, education, health services, public finance and economic development, commerce and industry, transport and communication, culture and heritage, democracy, governance and politics, law, justice and security, women in development, youth and national development and the Okavango delta. This geoinformation provides a comprehensive overview of the country. One problem experienced with the data was that it could not be easily overlaid with other data from Botswana and countries in SADC because of its projection. Thus, emphasizing the necessity for standards so that data sets of adjoining countries can be integrated.

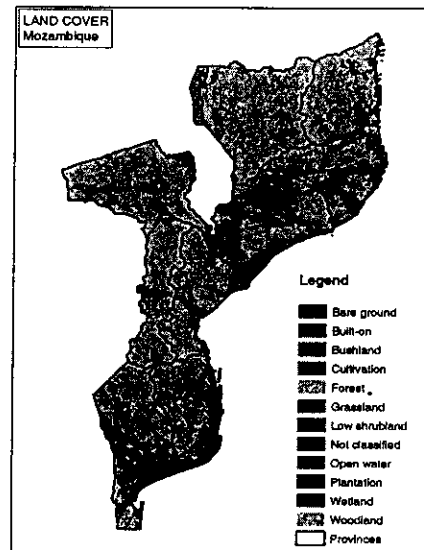
Figure 2: Land use for Botswana



Mozambique in recent years has developed quite extensive geoinformation data sets for the country. Two organizations that play a leading role in the provision of geoinformation in Mozambique are the Institute for National Statistics (INE) and the National Directorate for Geography and Cadastre (DINAGECA). The INE has published several demographic and socio-

demographic atlases for Mozambique with the data being mapped at a provincial level. DINEGECA is presently capturing into GIS the cadastre and have in the past mapped the land cover for the country. The two organizations are working together to capture the census data into GIS. Several data sets at a provincial level were accessed for Mozambique and the country has an extensive list of geoinformation that can be purchased. One of the few problems that were encountered with the data sets was that the information is in Portuguese and, therefore, had to be translated into English for it to be effectively used in the project.

Figure 3: Land cover map of Mozambique



The constraints in accessing geoinformation in SADC call for a structured way of collecting, synthesizing, storing and presenting geoinformation. Other challenges being faced in SADC is geoinformation being outdated and it being difficult to use in populating indices needed for development planning or SoE reports. There is also a lack of clear guidelines, definitive common standards, and legal and institutional frameworks that result in collected data not being user driven and policy relevant. Consequently, there is a dire need for the implementation of an effective SDI in the region. The necessity to implement a regional GIS, as has been stated earlier, is identified within the NEPAD document as critical for geoinformation to be effectively used in decision-making on the continent.

Part of what needs to be done is the enactment of a protocol on regional information management and sharing. This will contribute to easing the difficulties of accessing data across the region. There is also a disharmony in the data sets that countries can provide because the priorities, policies and strategies that guide their development, ensure that different core datasets are collected. This makes the integration and analysis of geoinformation for regional decision-making cumbersome.

There is significant duplication of effort at the regional scale in the acquisition and processing of regional-scale data, especially satellite remote sensing products and socio-economic information. Furthermore, many organizations have digitized their own spatial base maps from existing topographical maps creating multiple incompatible data sets. The linkages amongst geoinformation practitioners in and between most countries are also weak and lead to unnecessary duplication. Networking needs to be expanded to make more effective, efficient and economic use of existing geoinformation expertise. The duplication of effort happens as a consequence of there being a near total absence of data documentation or metadata across southern Africa.

Even considering the above, it must be stated that there is great opportunity for the growth of the geoinformation industry in SADC and similarly in other sub-regions of Africa. There is much hope that the NSDI will play a key role in providing a structured approach to providing geoinformation at

the national and sub-regional levels. However, the issues listed above need to be seriously considered and appropriate remedial action taken by organizations in Africa. The potential role of the NSDI in this regard will be touched on in the next section. There is further hope that emerging technologies and approaches will assist in rapidly collecting and providing access to the core data sets, which is critically needed to achieve the reconstruction and development of the continent.

4. THE ROLE OF NATIONAL SPATIAL DATA INFRASTRUCTURE

The FGDC (1996) describes Spatial Data Infrastructure (SDI) as an "umbrella of policies, standards and procedures under which organizations and technologies interact to foster more efficient use, management and production of [geographic] data". Furthermore SDI is about providing a consistent framework and standards within which a country can develop their fundamental and core/thematic data sets and metadata. This will best be accomplished by the coordinated harnessing of resources and experts and the development of partnerships. Key to making geoinformation more available for use in decision-making is the SDI principle of promoting access to data and the use and sharing of geoinformation. Clearinghouses are identified as a means by which this information can be made more readily available (National Research Council, 2002).

In many countries across Africa, NSDI committees have been established and are coordinating the geoinformation efforts of countries. These committees come under a variety of names and are housed in different ministries from country to country. In some countries these committees have achieved a degree of independence from government and are driven by NGOs. These committees create a network of geoinformation practitioners from ministries in the public sector to NGOs and organizations in the private sector. Through this medium, geoinformation practitioners are beginning to communicate with each other and the decision-makers of the country.

They are also beginning to address the key issues that are encapsulated in the implementation of SDI from the development of policies and standards and the establishing of partnerships in the collection of geoinformation through to looking at mechanisms of disseminating geoinformation. The importance of ministries budgeting sufficient funds for the development and maintenance of fundamental and core data sets is also emphasized. The development of policies is not only about the establishment of NSDI's in a country and the accessing of geoinformation but it should also include using national policies in defining the geoinformation needed to address societal problems. Unfortunately, this is not being done as much as it should be.

Although countries have established their NSDI committees and some have even developed the necessary policies, many are not fully operational. Several reasons for this situation can be identified including the limited support received from government and the lack of financial and human resources. It is argued that this is a result of governments not being fully informed about SDI, there being no policies and no coordinating body. Furthermore, the implementation of NSDI's takes a lot of time, especially in the developing of policies and standards. It must also be recognized that the establishment of NSDI's will differ from country to country and that time will be required to allow them to evolve their own NSDI (Nkwae and Nichols, 2002).

An examination of NSDI's that seem to be working well indicates that this is because there is someone driving the process. This is what Nkwae and Nichols (2002) calls "the champion factor". Part of this process is getting as many ministries, NGOs and private organizations involved as possible and the establishing of a strong network of geoinformation practitioners. This network can then be used to make decision makers aware of the value of geoinformation, especially if they can be shown how spatial data can be used to address national priorities in a cost-effective manner. Members of the NSDI can also be used to lobby their ministries and organizations to ensure that sufficient funds are allocated for the development and maintenance of geoinformation.

What is imperative in all of this is that the NSDI's become operational as soon as possible and decision makers can see "quick wins" from them supporting these initiatives. This is needed because decisions have to be made now to address the national priorities. If the NSDI cannot be

used to solve these problems in the short term then decision makers might become reluctant to support NSDIs in the future. It is for this reason that it is often recommended that NSDI or geoinformation is implemented in incremental stages and that they focus on government's immediate priorities (Al-Ankary, 1991; Nino-Fluck, 2000).

5. CAPACITY AND CHALLENGES IN THE GEOINFORMATION INDUSTRY

In partnership with organizations in Africa, key informant interviews were conducted and questionnaires completed by leading regional and sub-regional geoinformation institutions on the continent. A total of 41 organizations participated in the research, which included the African Union (AU), UNECA, UNEP, EIS Africa and the regional centers, to mention but a few. The intention of the research was to determine whether there is a lack of capacity in the development and use of geoinformation/GIS on the continent. The research also gave an insight into the existing operational geoinformation capacity and what types of capacity needs to be developed.

Questions on geoinformation personnel, the application of GIS and geoinformation, hardware and software, networks and partnerships, policy and geoinformation theory, best practices and problems in the geoinformation industry were asked. An understanding was also obtained on what are the priority development sectors in Africa and how they influence the development of fundamental and core geoinformation data sets. Key informants were asked about what challenges exist in the geoinformation industry and how they influence the building of capacity on the continent and in the sub-regions. From the analysis of the results, challenges for the geoinformation industry on the continent were synthesized.

Although there are sub-regional and national variations, the results of the research show that institutions feel that there is generally a lack of geoinformation capacity on the continent, especially at an institutional and technical level. What the research also showed is that this is very much dependent on the discipline. The people coming from the survey and mapping environment tend to say that there is enough GIS capacity while those in the environmental and socio-economic sectors tend to suggest that there is not enough. This could be due to the fact that Africa historically has had strong survey departments located in several universities and the two regional centres of RECTUS in West Africa and RCMRD in East Africa have focused on the training of people in this sector. However, concern has been voiced by academics on the dramatic decline in survey departments in many universities on the continent, which is and will continue to influence the availability of this capacity on the continent (Nwilo and Osanwuta, 2004; Ruther, 2001).

Reasons given for the lack of capacity is trained people are absorbed into other sectors, especially managerial positions, and universities in the past provided no or limited training in geoinformation. The feeling is that universities that provide training do not have the necessary facilities and cannot provide the practical skills.

From the research it was established that most of the GIS professionals are employed in the government sector, especially the environmental, surveys and mapping and planning departments. The next most prominent areas where GIS professionals are employed are in academic and semi-government institutions. According to the UNECA, training and capacity building is required to identify and use techniques/methods in applying geoinformation to problem solving. This points more broadly to the overall lack of analytical skills in the geoinformation industry on the continent, which is felt to be one of the main reasons why geoinformation and GIS is not more effectively used in decision making on the continent. Consequently, it will be necessary for training courses to be developed that take into consideration the disciplinary areas where GIS is being applied, the types of decisions that need to be made, the availability of local GIS data and the type of GIS functionality to improve the geoinformation capacity in Africa.

It is recognized that the surveys and mapping and environmental sectors is where there is still the greatest investment and collection of geoinformation on the continent. This not only shows the historic dominance of these sectors in Africa from a geoinformation collection perspective but also reflects that much work is still required to provide African countries with a total coverage of these

basic framework data sets. The collection of environmental information emanates from the environmental crisis in the 1970's that was identified as a critical issue and saw international communities funding large environmental monitoring and early warning system projects across the continent (UNEP, 1999; Zietsman, 2000). Sadly, little emphasis has been placed on the importance of socio-economic geoinformation data sets even though it is considered a foundational layer of information (National Research Council, 2002).

According to the multilateral agencies, the recent driving forces behind geoinformation development on the continent stem from various sources, including international, continental and sub-regional protocols (e.g. Agenda 21, WSSD, African Ministers Conference on the Environment). The role that ODA's have played in defining what geoinformation needs to be collected cannot be over emphasized. The level of development of the geoinformation industries within the sub-regions of the continent will also be a critical consideration in defining what needs to be done in the geoinformation industry. In each of the different sub-regions, the private sector is also playing a role and the organizations driving the development of geoinformation it is largely dependent on the main economic activity in that area. For example, in West Africa the petrochemical companies are major players in the geoinformation industry. According to the UNECA and UNEP the core data sets that still need to be developed are the environmental, topocadastral maps and poverty.

The institutions interviewed stated that the future growth of geoinformation industry in Africa will be in the telecommunication, disaster management, governance and policy development, location based services, marketing and sales, environmental management and utility sectors. What is also apparent is that the future growth of the geoinformation industry will vary from sub-region to sub-region and is very dependent on what problems are being faced in those areas. For example, in Central Africa the focus is on forestry issues while in North Africa it is mainly on water. The overall perspective given is that this growth will remain project orientated and largely dependent on funding from ODA's. According to these institutions the critical issues that Africa is currently facing are HIV/AIDS, drought, food insecurity, poverty, governance and economic development. All of these need geoinformation to be fully and effectively addressed.

A factor that is systematically quoted as impacting on the geoinformation industry and the development of capacity on the continent is the lack of funds, lack of policy and a lack of standardization. Another area that is felt to be critical in the development of geoinformation capacity in Africa is the development of clearinghouses that provide a medium by which geoinformation practitioners can access information, share ideas and retrieve research findings from across the continent. Not only must decision makers be made aware of the use of geoinformation but communication strategies must also be devised. Networks and partnerships are acknowledged as a key component of capacity building.

Generally, it was accepted that Africa has much geoinformation in certain sectors but it faces problems in that this information is not being made accessible, there are no standards for the exchange/transfer of geoinformation, there is limited geoinformation infrastructure and geoinformation that is available is not being effectively publicized. In most sectors of the industry there is still a lot of missing or outdated information, especially topocadastral maps. Other problems that the geoinformation industry is facing include a lack of coordination, there being no inventory of data sets, no integrated policies and geoinformation practitioners have limited analytical skills. The institutions feel that the establishment of NSDI committees will minimize these problems and that this remains the priority in ensuring the future growth of the geoinformation industry in Africa.

6. CONCLUSION: PROPECTS AND POTENTIALS

What has been attempted in this paper is to create a framework within which the prospects and potentials of the geoinformation industry could be discussed. An overview has been provided of the issues and challenges that the geoinformation industry in Africa is facing and what are the possible solutions. It is clear that international geoinformation initiatives, the development of National Spatial Data Infrastructure (NSDI) and the development of institutional and individual capacity must be part

of the solution. However, this must happen within an appropriate framework and be properly coordinated. Research conducted in one of the regional economic communities in Africa has shown the wealth of geoinformation that already exists. What the paper should ultimately tell the reader is that although the geoinformation industry is small and has its problems, a platform has been established to begin to look at the prospects for its future development and the maximizing of its potential.

The critical question that must now be asked is - how must this happen. One answer to the question might be that it will happen on its own as individuals, organizations and national governments start to slowly embrace geoinformation as a decision-making tool. Another response would be that it should be left to the private sector as it has been shown in other regions of the world they are a key catalyst in the development of the geoinformation industry. A more cynical answer might be that regional and sub-regional efforts to develop the geoinformation industry in the recent past have not made much difference so why do anything now. Another answer might be that something desperately needs to be done to speed up the process by which countries and sub-regions get access to geoinformation so that they will be able to start addressing their societal priorities and the goals and objectives of the Millennium Development Goals (MDGs) and NEPAD.

- If one considers that the MDGs have to be accomplished by the year 2015 this means that we have less than ten years to fill the information gap that exists. Having developed the core geoinformation it can then be used to develop appropriate programmes and interventions. To accomplish this we cannot wait for countries and sub-regions to slowly embrace geoinformation. There is a desperate need for a pan-African organization to take the responsibility of coordinating geoinformation initiatives at a regional, sub-regional and national level. This will enable the wealth of geoinformation from existing and proposed international initiatives to be harnessed for the benefit of the continent. It will also allow the funding from ODA's to be more effectively directed towards the critical geoinformation needs of Africa. The private sector must be seen as a resource in the development of geoinformation for the continent and opportunities must be sought to establish Public-Private-Partnerships (PPPs) with them.

In the development of geoinformation capacity in Africa there is the need to develop partnerships with international institutions (e.g. ITC), the regional centers, academic institutions and private organizations. Ultimately, a network of training institutions should be developed that will provide the infrastructure to train geoinformation practitioners throughout the continent. International best practice and case studies of African countries must be considered in developing the capacity of geoinformation practitioners. The future of the geoinformation industry must include a research and development component that must be coordinated. Examples of how geoinformation research and development is done in developed and under developed countries should be examined and the lessons learnt used to develop a strategy for Africa.

There is much potential in Africa. Countries and sub-regions in collaboration with international collaborators have started to put together some of the critical baseline information needed to bring about sustainable development on the continent. Partnerships have been established in the region and internationally to provide the critically needed training and education of geoinformation practitioners. Further commitment is required by the international community to provide the geoinformation infrastructure that is lacking on the continent. Decision makers at regional, sub-regional and national levels must also be encouraged to play their part in the development of the geoinformation industry on the continent.

If the above is achieved then the prospects are enormous. Firstly, the geoinformation industry will begin to take its rightful place as an indispensable source of information in achieving integrated and sustainable development. Secondly, decision-makers will be able to use the geoinformation to get a more holistic understanding of the societal problems facing the continent and they will be empowered to implement appropriate interventions. This will also encourage further ODA funding and create an environment that will encourage private sector investment. Lastly, Africa will be able to use the geoinformation to assist it achieve the MDGs and redefine its relationship with the international community.

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