

GETTING GEOINFORMATION AND SPATIAL DATA INFRASTRUCTURE (SDI) TO WORK FOR AFRICA: THE RATIONALE BEHIND AESI-ALIGN

By

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1. INTRODUCTION

Africa needs geospatial information to enable it to identify where the neediest areas on the continent are so that they can follow a targeted approach in addressing the needs of the continent's poorest communities. Only through the use of geospatial information will African countries be able to effectively and sustainably implement programs that will enable them to address the Millennium Development Goals (MDG). To be able to monitor and evaluate the implementation of these programs again requires the use of geospatial information. A key area where geospatial information are beginning to be used more frequently is in monitoring whether the funds allocated for development programmes are in fact reaching the intended recipients and whether they are having an impact.

It is recognized within the New Partnership for Africa's Development (NEPAD) that the continent in the short term will remain dependent on donor funds to bring about its development. Therefore, it is important for mechanism to be implemented that will allow countries on the continent to target the neediest communities and monitor whether these donor funds are reaching them and are being effectively used. It is only through the use of geospatial information and geoinformation technologies that the provision of services to the people can be optimised. A key challenge is to make geospatial information available, accessible and useful to decision makers in bringing about sustainable development.

NEPAD also recognizes that to bring about development on the continent in the future will require an increase in Foreign Direct Investment (FDI) and the mobilising of domestic revenue. To encourage Foreign Direct Investment organisations need information on economic opportunities within different sectors, the extent to which a viable business can be established and whether there are sufficient skilled human resources to run such entities. The information needed to enable these decisions to be made all have a spatial dimension to it. Mobilising domestic revenue requires an understanding of where people live and who is employed so that the tax base of the country can be determined. Once this has been done countries can look at mechanisms of optimising the collection of domestic revenue so that these much needed financial resources can form part of the national fiscus.

The question that has to be posed is whether Spatial Data Infrastructure (SDI) has contributed significantly to enabling geospatial information to be used in addressing the above issues. African countries have been involved in SDI activities for more than a decade. However, recent studies have indicated that SDI implementation, in its formal sense, has not contributed significantly to ensuring that geospatial information is effectively used in decision-making in Africa. This has emanated from research done by the University of Cape Town and from the results of the Catalogue of Fundamental Geospatial Datasets projects undertaken as part of the Mapping Africa for Africa (MAfA) initiative of the United Nations Economic Commission for Africa (UNECA). A report by member states at the UNECA's Committee on Development Information Science and Technology (CODIST) in May 2009 further confirms that SDI is having a limited impact on ensuring that geospatial information is being used to address the development needs of the continent.

2. PRINCIPLES OF SPATIAL DATA INFRASTRUCTURE (SDI)

SDI is defined as the "technology, policies, standards, and human resources necessary to acquire process, store, distribute, and improve the utilization of geospatial data". According to the SDI Cookbook it is also about the critical mass of processes, policies, standards, enabling technologies,

mechanisms and key datasets required to make geospatial data readily available to the growing community of end-users. What is interesting to note is that the Infrastructure for Spatial Information in Europe (INSPIRE) does not use the more commonly known term of SDI, instead it provides a definition for infrastructure for spatial information that includes metadata; spatial datasets and spatial data services; network services and technologies; agreements on sharing, access and use; coordination and monitoring mechanisms and processes and procedures. Therefore, SDI is a fairly broad concept that encapsulates a range of factors.

In essence, the importance of SDI, and why it is an international best practice, is that it emphasizes that geospatial information is a necessity and a national priority like any other type of infrastructure (e.g. roads, telecommunications). By describing geo-information as an “infrastructure”, it is felt that policy and decision-makers will better acknowledge its importance to the development of a country. Therefore, national governments would allocate sufficient resources, especially finances, for collecting and capturing fundamental geospatial data sets, institutional mechanisms by which the data can be managed, maintained and disseminated as well as the policies that will regulate the geo-information industry in a country.

The continued challenge with the development of an SDI is how it is being implemented, especially as it is considered to be a mechanism by which there is the more efficient use, management and production of geospatial data. The problem is that in trying to implement SDI by placing equal importance on all the main components the initiatives have lost momentum and have come to a standstill. Considering the limited human capacity and financial resources in Africa, it is no wonder that when asked about the constraints of implementing an SDI, countries have identified a lack of resources as one of the major constraints (e.g. human, financial and technology). Furthermore, they have shown concern for the fact that SDI does not seem to have a policy framework that is pertinent to their country’s development priorities (e.g. poverty reduction strategies).

Other aspects that are seen to be challenges to the implementation of SDI in Africa is the lack of a culture of using geo-information, restrictions being placed by governments on getting access to data and a lack of awareness/support for the use of SDI in decision-making processes. These problems mentioned above must be addressed if SDI is to become successful. Considering the above, what should the approach be for Africa? It is accepted that the SDI concept should be used but that emphasis has to be put on the immediate development of the fundamental geospatial data sets.

This must not be at the expense of certain basic building blocks such as an appropriate framework, spatial data model, procedures and data capture standards. Agreement on these issues can be achieved within a short time period so that the process of collecting the core data sets can be started. The reason that emphasis must be placed on the collecting of the geospatial data rather than all the other components of the SDI is because we are now in 2009 and by 2015 all African countries must have achieved their MDGs. So within the next four years the core data sets for African countries need to be in place so that geo-information can be used in the decision-making processes of countries and to give them any chance of them effectively achieving the MDGs.

The concern is that it might be already too late as this message was given to member states of Africa in 2003 and still the key geospatial datasets are not there. Much work has to be done in the next four years to ensure that geospatial data is used in the decision-making processes relating to the MDGs if one considers that the census data for most African countries is not available in a GIS format. Census data is the core dataset that provides much of the information needed for countries to determine whether they are achieving the MDGs. It is our belief that if the African and international geo-information communities were to stand together that much could be accomplished in the next four years, especially in the capturing of countries census data into a GIS.

It is suggested that as the other components of the SDI take time to formulate and implement that they be implemented at a stage when it is clear that the collecting of the geospatial

information needed to achieve the MDGs is well on its way. The time at which the next stages of SDI are started will be critical to ensure that national planners and decision makers use the information effectively. This suggested approach is not unique as it is largely the way geo-information has been implemented in many developed countries, such as the United States, and in some developing countries. In fact it would seem that countries that follow the approach of gathering their information outside of a fully conceptualized and implemented SDI are often more advanced than their counterparts when it comes to having access to geo-information.

3. A REVIEW OF SPATIAL DATA INFRASTRUCTURE IN AFRICA

A recent paper by the University of Cape Town and a report by member states of UNECA CODIST have reviewed the status of SDI in Africa. Responses were received from 29 and 14 countries respectively; suggesting that in reality there is very little activity in terms of national SDI coordination. This is apparent from the poor response to these , if the researchers would have been able to send their questionnaires to SDI committees that would have been able to provide a more representative response.

Nevertheless, the response from the 29 and 14 countries will provide a picture of what is happening with SDI in Africa. What the results of the research by the University of Cape Town shows is that even though there are coordinating bodies in 20 of the 29 countries that responded, there was very little political support. In only two countries (Rwanda and Uganda) do the SDI committee's feel that they are getting enough political support and this political support enables them to access adequate funding for SDI activities.

The UNECA reports that despite significant effort on their part to strengthen institutional structures; develop national policies and action plans; provide advisory services, information and capacity building and integrate SDI into the work of the National Information and Communication Infrastructure (NICI) strategies progress in developing SDIs in Africa has been very slow. In fact, only 24 of the 53 countries on the continent are recognized to have initiated SDI (Table 1). However, progress has been made on integrating geo-information policies into the national ICT policies of member States, developing National Spatial Data Infrastructures (NSDI) and Geo-information policies. The main reason given for the slow progress is poor awareness and understanding of the components of SDI and funding constraints that have stalled the implementation of technical components of NSDI. With these financial constraints, countries give priority to supposedly more important activities not realizing that without timely, accurate and reliable geospatial information they will not be able to effectively accomplish their national priorities.

Table 1: African countries that have initiated SDI

| Country | SDI initiated |
|---------------|---------------|
| Benin | Yes |
| Botswana | Yes |
| Burkina | Yes |
| Côte d'Ivoire | Yes |
| Egypt | Yes |
| Ethiopia | Yes |
| Gambia (The) | Yes |
| Ghana | Yes |
| Kenya | Yes |
| Lesotho | Yes |
| Madagascar | Yes |
| Malawi | Yes |
| Mali | Yes |
| Namibia | Yes |

| Country | SDI initiated |
|--------------|---------------|
| Niger | Yes |
| Nigeria | Yes |
| Rwanda | Yes |
| Senegal | Yes |
| Sierra Leone | Yes |
| South Africa | Yes |
| Swaziland | Yes |
| Tunisia | Yes |
| Uganda | Yes |
| Zambia | Yes |

The SDI committees report that participation by stakeholders is generally not satisfactory and that there is a lack of appreciation of the benefits of SDI. A review of the implementation of key components of SDI shows that there are major inconsistencies between countries. For example some countries have implemented operational clearing houses while other have national SDI committees. When it comes to clearing houses it is often large multilateral organizations and donor agencies that have taken the lead in providing these facilities (e.g. USAID's Africa Data Dissemination Service (ADDS), OCHA's Southern African Humanitarian Information Management System (SAHIMS) and UNECA data portal).

In terms of a legal framework for SDI most countries are still advocating the need for policies, while only six countries forming part of the study indicate that they have part of the legal framework in place. Even though South Africa has promulgated its Spatial Data Infrastructure Act in 2003 and has established institutional structures in the form of the National Spatial Information Framework (NSIF), the implementation of the SDI in South Africa has been slow over the last six years. The UNECA report shows that in terms of the SDI implementation process and the setting up of committees that this has stalled in many African countries. One of the key reasons given is the high cost of implementing the technical aspects of SDI. The inconsistencies in the implementation of SDI occur across the different SDI components including aspects such as setting up GNSS reference stations, geographical names authority, development of fundamental geospatial datasets, systematic revision of national topocadastral maps and the development of metadata clearinghouses.

The reasons for these inconsistencies are attributed to a lack of policies and more importantly, the lack of national guidelines. Within most African countries no institutional structures have been set up and, therefore, SDI activities remain informal with individuals driving the process. The report by the UNECA also shows that these informal structures lack clear guidelines on roles and responsibilities that complicate the implementation of SDI. Funding remains a critical inhibitor to the implementation of SDI. This is exacerbated by the lack of facilities and access to obsolete equipment.

Awareness and expertise in the principles and implementation of SDI remains a major problem. With the informal nature of SDI in Africa a lack of continuance amongst stakeholders participating in the processes adds further burden to the successful implementation of SDI. Having considered the above what does Africa need to do to ensure that SDI is more effectively implemented? In other words, what conditions are needed for the effective implementation of SDI that are not there at the moment. The key is to show decision makers the value of geospatial information.

A paradigm shift is required towards a development driven SDI. Geospatial fundamental datasets need to be developed to address key issues such as poverty, agriculture and food security, health and education planning, climate change, transportation planning, access to optimized services, supply of water and sanitation, disaster and early warning assessments and human settlements. This must be done at the local level so that targeted development interventions are maximized. The operative word here is that the geospatial information must be made available and accessible.

By demonstrating the value of geospatial information the support of decision-makers can be obtained. By making the geospatial information available will also enable new economic and information markets to be developed. As the value for geospatial information for decision making becomes more known, it is more likely that political support will follow. Financial support does not always follow political support and may take time for large funds to be allocated to development SDI. This emphasizes the evolutionary nature of developing geospatial information.

Part of the evolutionary process, is the need to ultimately catalogue and archive fundamental geospatial datasets using a clearinghouse. One of the major challenges is the archaic practices of government departments charging large sums of money for users to get access to fundamental geospatial datasets. Ultimately, SDI needs to be institutionalized within the decision making processes of government.

4. THE MAPPING AFRICA FOR AFRICA INITIATIVE

The extent to which countries on the African continent have access to the necessary geo-information needed for sustainable development and the implementation of the Millennium Development Goals (MDG) was largely unknown. Practitioners from across the continent have in various forums raised the concern about the lack of fundamental geospatial datasets. They have also raised the concern about the availability of base maps, maps being out of date or of too course a scale, geo-information not being complete or comprehensive enough and not being in an electronic format. This is not to say that Africa has no geospatial information at all.

Research has shown that indeed many countries on the continent have access to geospatial data. There are many initiatives on the continent that have and are collecting geo-information. Some very good examples of these are the Africover initiative that resorts under the Global Land Cover Network (GLCN) of the Food and Agriculture Organisation (FAO), the Global Mapping Project being implemented by the International Steering Committee for Global Mapping (ISCGM), the Geohazards project as part of a Global Earth Observation System of Systems and the TIGER initiative (UNECA, 2005), to mention but a few. It is therefore not necessarily the case that Africa does not have the geoinformation that it requires to bring about its own development.

The question then is - what information is available for each of the different countries of the continent and is it in a form that will allow it to be effectively utilized in decision-making? What is important to emphasize in looking at the availability of geospatial information is that it is done within an appropriate framework. The problem in Africa at the present moment is that there is insufficient knowledge of what geo-information is available, at which scale and format. In addition, the key issues that have been identified are the availability and accessibility of geo-information on the continent.

Based on the above issues an initiative was proposed at a special workshop of representatives from African countries held in August 2003 in Durban, South Africa. The outcome of this workshop was the Durban Statement on Mapping Africa for Africa (the Mapping Africa for Africa – MAFA - initiative). This Durban Statement was adopted by the General Assembly of the International Cartographic Association in 2003 and by the Committee on Development Information's Geo-information sub-committee (CODI-Geo) at the third meeting held in Addis Ababa in April 2005. The document provides a set of recommendations and an action plan for the implementation of geo-information activities in association with international and continental partners.

The vision of MAFA is to accelerate the development of the geo-information industry in Africa so that it can contribute to sustainable development on the continent and enable the goals and objectives of the New Partnership for Africa's Development (NEPAD) to be accomplished. Key recommendations included that CODI-Geo in collaboration with the ICA coordinate the implementation of MAFA activities. These activities would need to be in line with the priorities

of the NEPAD and would be implemented through the establishment of a working group (Nyapola, 2005).

The Durban Statement recommended that regional centres and institutions should play a key coordination role in the communication of MAFA activities and in the dissemination of information. Priority activities included the identification of fundamental geospatial datasets and the conducting of an inventory of these datasets and resources within each country. However, for this to be done it was decided that an initial project needed to be undertaken to define what is meant by a fundamental geospatial dataset.

5. DEFINING THE FUNDAMENTAL GEOSPATIAL DATASETS FOR AFRICA

A project was undertaken by EIS-AFRICA and the Human Sciences Research Council (HSRC) in 2005 that was commissioned by the UNECA. To undertake the project the sub-regional centres of the UNECA and organisations from the different sub-regional economic communities of Africa were used in the collection of the information. A questionnaire was put together and sent to stakeholders in all African countries. Where necessary, telephonic interviews with stakeholders was also done. A number of multinational organisations that have participated in the development of geospatial data for Africa were also included in the study. From the study a definition of what users considered to be fundamental geospatial datasets was developed and the fundamental geospatial datasets were identified.

The results were gathered from some of the most prominent players in the geo-spatial information arena in Africa and internationally. Therefore, the definition and list of geospatial fundamental datasets developed in the study are felt to be a true reflection of the needs of geo-spatial industry on the continent. This study has importantly put forward a single unambiguous definition of fundamental datasets for Africa. The task was necessary to guide the development of SDI on the continent and to determining what datasets are needed for Africa's development. The definition of fundamental geospatial datasets is:

Fundamental data sets are the minimum primary sets of data that cannot be derived from other data sets, and that are required to spatially represent phenomena, objects, or themes important for the realisation of economic, social, and environmental benefits consistently across Africa at the local, national, sub-regional and regional levels.

The study identified and defined levels, categories and data themes that constitute the fundamental geospatial datasets. The levels reflect the relative and sequential importance of the different data sets in the development of a universal set of geo-spatial information for the African continent. The categorization reflects the functional uses of the fundamental data sets in terms of their use as a geographic reference frame, as base geography and as a geo-coding scheme needed to give non-spatial data a geographical reference. The practical implication of identifying these fundamental geospatial datasets is that they should have national coverage for use in planning, management and decision making and should be considered essential for all countries. Depending on the theme and scale of the data, they should be made available at the local, national, and sub-regional levels.

A list of the fundamental geospatial datasets was identified and is presented in the Table 2 below.

Table 2: List of fundamental geospatial datasets for Africa

| Level | Category | Date Theme | Datasets |
|-------|-------------------|--------------------------|-------------------------|
| 0 | Primary reference | Geodetic control network | Geodetic control points |
| | | | Height datum |
| | | | Geoid model |
| I | Base geography | Rectified imagery | Aerial photography |

| Level | Category | Date Theme | Datasets |
|-------------------------------|---|--------------------------|--------------------------|
| II | Administration and spatial organization | Hypsography | Satellite imagery |
| | | | Digital elevation models |
| | | | Spot Heights |
| | | | Bathymetry |
| | | Hydrography | Coastline |
| | Natural water bodies | | |
| | Infrastructure | Boundaries | Government units |
| | | | Populated places |
| | | | Enumeration areas |
| | | Geographic names | Place names |
| Feature names | | | |
| Landed management units/areas | | Land parcels/cadastre | |
| | | Land tenure | |
| | | Street addresses | |
| | | Postal or zip code zones | |
| | | Land use planning zones | |
| Transportation | | Roads | |
| | | Road centre lines | |
| | | Railways | |
| | Airports and ports | | |
| Structures | Bridges and tunnels | | |
| Utilities and services | Power | | |
| | Telecommunications | | |
| III | Environmental information | Natural environment | Land cover |
| | | | Soils |
| | | | Geology |

A comparison of the themes and datasets identified for Africa with that of INSPIRE for Europe shows some interesting similarities. The first is the categorisation of the themes and datasets into sequential levels of importance. Although not explicitly stated, the Directive establishing INSPIRE places greater importance on spatial data themes in Annex I followed by Annex II and III based on the timetables defined for creating metadata and implementing rules. Although a number of the themes and datasets are the same for both the Africa and Europe there are distinct differences in terms of the prioritization of themes and datasets in the different levels. The one common factor is that both Africa and Europe identify primary reference or coordinate reference systems as being one of the most important themes.

An important recognition made by geospatial practitioners on the continent is that these fundamental datasets are not static and rigid. In other words, these data sets should be reviewed on a regular basis as many of them are based on priorities at that time. Priorities and development needs across Africa continue to change and so too will fundamental datasets. An important aspect in this study was the consultation and consensus building in determining the fundamental datasets.

It was recognized that fundamental datasets at all scales are an asset to African member states, economic regions and the continent as a whole. Once it is recognized as an asset and is seen as the bedrock from which intelligent decisions about Africa's development can be made, only then will

A survey questionnaire approach was adopted as the main tool for the systematic collection and cataloguing of the relevant information from countries. A desktop study of inventories and catalogues of geospatial datasets in Africa and elsewhere in the world was also undertaken. ISO standards were used in the capture of available metadata and the information stored on the UNECA metadata clearing house. An information gap analysis was undertaken to determine whether the fundamental geospatial datasets were available, how complete they were, what the extent of the spatial coverage was, whether there were any inconsistency, what metadata was available and what the overall quality of the data was. On completion of the study the results were presented to member states and request made to them to review and validate the findings for their countries.

The overall findings of the study showed that most African countries have access to some of the fundamental geospatial datasets. Table 3 below gives an indication of the percentage of African countries forming part of the study that have access to the different fundamental geospatial datasets. Only seven datasets are available in less than 50% of the countries and these include the geoid model, census enumeration areas, land tenure, street addresses, postal and zip codes, power and telecommunication infrastructure. The datasets that had the highest levels of availability in African countries included satellite imagery, digital elevation models, natural water bodies and bathymetry, government units, place names, roads and railways and airports and ports. One of the main reasons for this is that these datasets have been developed by and sourced from international agencies. However, the quality of these data remains questionable.

Countries with gaps in fundamental geo-spatial datasets do exist and those with the most gaps are Angola, Botswana, Burundi, Cape Verde, Eritrea, Ivory Coast, Liberia, Libya, Western Sahara and Zambia. Contrary to what might have been expected, a low percentage of datasets available (less than 10%) on the continent are in non-GIS format. This means that most of the fundamental geo-spatial datasets should be easy to integrate into a traditional GIS environment. This knowledge makes it easier to plan for future geo-information initiatives on the continent.

The value of metadata is not seen as being important and therefore the keeping of metadata is not prioritised. Many institutions did not have metadata while others did not have it in a format which could be easily catalogued. The low priority on metadata can be seen in the fact that it was only those datasets that were developed by international agencies that had complete metadata and these datasets included the digital elevation model, natural water bodies, roads and railways, airports and ports. The lack of metadata means that the existing geo-spatial data are not as useful as they could be, since they could not be described in terms of its attributes, how it was created and its quality.

This has major implications for the implementation of the SDI in Africa. Much work has been done over the past decades in Africa to develop SDI. This included developing several key components of SDI namely, the establishment of national geo-spatial data committees that look at national fundamental geo-spatial datasets, data standards (including metadata) and the development of clearinghouse facilities where one could search for data or links to data. What this study has revealed is that while many countries have established SDI's at various levels, many of these where in all practical terms non-existent. National data committees existed only in name and many SDI websites had no data, metadata or contactable links.

Table 3: Availability of fundamental geospatial datasets within African countries

| Level | Category | Datasets | Percentage countries having data available |
|--------------|-------------------|-------------------------|---|
| 0 | Primary reference | Geodetic control points | 58% |
| | | Height datum | 58% |
| | | Geoid model | 36% |

| Level | Category | Datasets | Percentage countries having data available |
|-------|---|--------------------------|--|
| I | Base geography | Aerial photography | 75% |
| | | Satellite imagery | 100% |
| | | Digital elevation models | 100% |
| | | Spot Heights | 60% |
| | | Bathymetry | 100% |
| | | Coastline | 70% |
| | | Natural water bodies | 100% |
| II | Administration and spatial organization | Government units | 96% |
| | | Populated places | 69% |
| | | Enumeration areas | 42% |
| | | Place names | 98% |
| | | Feature names | 69% |
| | | Land parcels/cadastre | 64% |
| | | Land tenure | 38% |
| | | Street addresses | 45% |
| | | Postal or zip code zones | 29% |
| | | Land use planning zones | 56% |
| | Infrastructure | Roads | 100% |
| | | Road centre lines | 56% |
| | | Railways | 100% |
| | | Airports and ports | 100% |
| | | Bridges and tunnels | 58% |
| | | Power | 47% |
| | | Telecommunications | 44% |
| III | Environmental information | Land cover | 76% |
| | | Soils | 67% |
| | | Geology | 64% |

The results of the surveys and lessons learnt points to a failure in SDI development in Africa. One can conclude that a re-think in the approach used to implements SDI is needed. The implementing of structures might be too abstract for the solving of real data issues. Approaching SDI from a development needs and data demand perspective could result in the more effective implementation of SDI in Africa.

This study has illuminated the need for human capacity building and continued awareness programmes. From responses received it could be concluded that respondents did not know about the existence of many geospatial datasets, because they were either not informed enough or the data was not recognized as being of any value. To resolve this situation, one needs to consider building the human capacity on the continent. It is also an important factor to consider if international agencies are planning to fill the geospatial data gap in Africa.

UNECA CODIST has an important role to play on the continent as the coordinator of SDI in Africa as it needs to ensure the effective entrenchment of the fundamental geospatial datasets in national structures. It should also place a priority on the development of those priority datasets which have a low representation on the continent (i.e. those which are available in less than 50% of the countries). At the same time, CODIST should encourage the continued maintenance of

fundamental geospatial datasets that already have good coverage in African countries. UNECA CODIST should also be encouraging the international and donor communities to allocation funding for those core data sets that are the fundamental to the future of SDI in Africa.

Funding for the African the Geodetic Reference Frame (AFREF) initiative should be obtained as it will contribute to establishing a primary reference base for Africa and contributing to the capture of census data into GIS in the 2010 round of censuses. Since UNECA CODIST does not have enforcement power, it should place stronger emphasis on the role of national government structures in capturing the fundamental geospatial datasets for Africa.

7. LEARNING FROM THE PRINCIPLES OF INFRASTRUCTURE FOR SPATIAL INFORMATION IN EUROPE (INSPIRE)

The issues that formed the basis for the conceptualisation of the Infrastructure for Spatial Information in Europe (INSPIRE) initiative are the same as those that are faced by the African continent in the development of their SDI. It is only after the inventory and cataloguing of fundamental geospatial datasets was undertaken in Africa that the full extent of the fragmentation of datasets and sources was realized. Previous sections have articulated what is considered to be fundamental geospatial datasets in Africa and the extent to which they are available. Although there are many datasets available in the different countries of Africa one of the key issues that the continent continues to face is country's restricting access to these fundamental datasets.

INSPIRE recognizes that one of the key problems that needs to be addressed is the identification, access and use of available geospatial data. These are the fundamental issue that Africa has started to grapple with in the development of SDI on the continent. However, there is a need to focus on the development of the fundamental geospatial datasets and making them available so that they can be used in decision making on the continent to address the many development and policy imperatives. What is possibly more important is that by making the geospatial information available new markets will be developed in African countries that will allow the value of geospatial information to be emphasized to decision makers in both the public and private sectors.

Like in Europe there is awareness in Africa of the need for geospatial information. However, with the European Union being far more advanced in the development of their institutional structures, decision-making processes, policies and strategies for unification compared to the African Union, it is no wonder that there is a great awareness and understanding of the need for geospatial information in Europe. A further complicating factor is that African countries are far behind most European countries in the development of their geospatial information. This is why SDI is not gaining the recognition that it has in Europe. Nevertheless, there is a glimmer of hope with NEPAD recognizing the need to establish regional cooperation in the development of geospatial information.

What is needed is that the lessons learnt in implementing INSPIRE in Europe and SDI in other continents is of benefit to developing SDI in Africa. One of the lessons that can be taken from INSPIRE is to ensure that SDI is complementary to policies at a continental and national level. By focusing on the provision of information needed for policies relating to the protection of the environment prominence was given to INSPIRE to the extent that it was promulgated as a directive of the European Union. Furthermore, that by implementing SDI there can be a significant cost savings for governments and the ability to generate much needed domestic revenue in the exploitation of geospatial information.

Some of the key lessons that can be learned from INSPIRE is the need to establish coordination structures; establish mechanisms for the exchange, sharing, access and use of interoperable spatial information, including the use of clearing houses; the development of implementing rules or guidelines for the implementation of SDI and metadata that is needed to ensure the effective exploitation of available geospatial data. What is needed in terms of coordination is the development of appropriate structures and mechanisms to identify user needs, identify relevant

datasets and provide knowledge on what is happening in the geoinformation industry. Africa is well situated in this regard in that the UNECA through the Committee on Development Information and Science and Technology (CODIST) has been mandated to fulfil this function by member states. Unfortunately, insufficient political, institutional, financial and human resource support results in the Geo Information Systems section of the UNECA being limited in extent to which it can fulfil the coordination role in Africa.

Through MAFA a lot has been done in the defining and developing an inventory and catalogue of fundamental geospatial datasets. It is clear that the UNECA is providing information to the geoinformation industry in Africa. There are also independent initiatives such as EIS-AFRICA, Africa SDI and various web portals or clearing houses that providing information to the geoinformation communities in Africa. However, much more needs to be done to keep geoinformation practitioners informed as to what is happening in their industry across the continent. Cognisance must also be taken of the fact that the African continent is significantly larger than most other continents, especially Europe, and therefore the challenge of establishing SDI in Africa is that much more of a challenge.

In many African countries there are policies that prevent access to public sector information. This is a major hurdle that needs to be overcome if geospatial information is to become part of the mainstream decision making of the country. However, there are African countries (e.g. Malawi) that have recognised the need for the sharing of data and have developed a one-stop centre to access geospatial information in the country. INSPIRE identifies the need for the identification of contact points within countries that will facilitate the sharing of geospatial data between government authorities and international agencies but does not include the private sector which it should.

INSPIRE also stipulates that countries need to take cognisance of their national legislation on data sharing. The directive stipulates that national contact points should be able to licence users or get users to pay for the geospatial information. It goes further and indicates that the charges for accessing geospatial information should be kept to a minimum but should enable countries to have a reasonable return on investment. In many countries Access to Information Acts have been promulgated and within these policies there are often clear guidance as to what can be charged for in the provision of geospatial information.

Africa can learn a lot from Europe in how the directives for INSPIRE were promulgated. Furthermore, Africa can also learn a lot in the development of implementing rules on interoperability and harmonisation of geospatial information. The UN ECA has recognised this need and has developed a guideline on Spatially-Enabled Government Services (SEGS) that is based on experiences in selected African countries. Part of the implementing rules of INSPIRE is to use a framework for the identification of geospatial information, spatial objects, key attributes, defining the temporal dimension of data and metadata. Through the two initiatives conducted under MAFA that defined Africa's geospatial datasets and conducted an inventory and cataloguing of them this has been accomplished. Clearly there are many areas where Africa and Europe can exchange ideas so as to make SDIs development more successful in both continents.

The UNECA has established a Metadata Explorer that enables users to search for available data sets in Africa. This clearinghouse provides a facility for member states to publish the metadata of their available data holdings, so that users can discover and use accurate data sourced from their original producers. The Metadata Explorer contains more than 10 000 geospatial metadata records. This is a key component of SDI development and of INSPIRE. Metadata should provide information on conformity to international standards; conditions for the access and use of the geospatial information: accuracy, completeness and quality; information on the data custodians and any limitations that user's should be aware of.

It should be clear from the above that there is much in common in terms of what Africa and Europe want to accomplish in the development of SDI on the two continents. However, Europe at this moment time is more advanced in the setting up of their SDI. What needs to happen is that African European GIS practitioners need to engage with one another to see how Africa can

benefit from Europe's experiences. This engagement should be a two way process so that Europe can also learn from best practices in Africa.

8. A JOINT INITIATIVE - THE AFRICA-EUROPEAN SPATIAL INFRASTRUCTURE ALIGNMENT (AESI-ALIGN).

The development challenges on the African continent are many and immense. To be able to address these development challenges there is no doubt that there is a need for geospatial information. Geospatial information is needed to identify where the most impoverished or hungry are situated so that appropriate development programmes can be implemented. As donor funding will be used in many instances to address these problems it is important to monitor whether the neediest are receiving these funds and whether the implemented programmes are having an impact. For the sustainable development of Africa in the future, access to accurate, comprehensive, appropriately scaled and standardised geospatial datasets will be required. To ensure the sustainable provision of the geospatial information will require the implementation of SDIs.

As has been portrayed in this paper the success of SDIs in Africa has not been what it should have been. This is after much effort has been put in to the development of SDIs by many organizations and institutions on the continent. Clearly, something more needs to be done and it is hoped that by establishing a partnership with Europe, which is the largest provider of donor aid to Africa, that significantly more progress can be made in the implementation of a SDI in Africa. More specifically, the partnership has been established with the International Affairs Working and Advisory Group of EUROGI in 2006. Since then proposals for funding have been submitted to the European Union and it is hoped that in future years funding will be obtained to enable this partnership to come to fruition.

Regional (e.g. UNECA, EIS-AFRICA, AARSE) and sub-regional organisations (e.g. RCMRD, RECTAS, CEDARE, SADC RRSU) have the expertise but require further knowledge, capacity and financial support to ensure the implementation of a needs driven and development focussed SDI. It is for these reasons that African institutions have engaged with EUROGI and agreed to the concept of the Africa-European Spatial Infrastructure Alignment (AESI-Align) initiative. The main principle behind this initiative is that lessons learnt through INSPIRE will be transferred to African institutions. At the same time, lessons learnt in Africa will also be communicated to institutions in Europe.

It is recognized that for this initiative to be successful will require the creation of a framework within which there will be alignment of African and European SDIs. This framework will provide the opportunity for the sharing of expertise amongst members of the SDIs communities in Europe and Africa. It is further recognized that there are comparable conditions in the recent SDIs developments between the two continents that will be of benefit to the initiative. A key area that the initiative will focus on is the development of policies like the INSPIRE Directive and the development of implementing rules that will enable the integration of fundamental geospatial datasets in Africa as well as globally.

The four main components of the strategic partnership will be the strengthening of the SDIs initiatives and development of continental (e.g. INSPIRE) and national SDIs in both Africa and Europe. By doing this it is hoped to help Africa in its endeavours to achieve the Millennium Development Goals and other development aims and objectives that the continent has set itself. The alignment of the SDIs will also be a key focus of the initiative to ensure high levels of interoperability of geospatial datasets. This is a necessity in ensuring that the European aid program becomes more focussed to the needs of the continent and to enable them to monitor whether their funds are being effectively used. By bringing about this alignment it is believed that it will advance the building of a global SDI and that the lessons learnt from this initiative would be of benefit to other continents in the world.

8. CONCLUSION

Geospatial information must be made available, accessible and used in decision-making so that the socio-economic and service needs of the most impoverished communities in Africa can be addressed and the Millennium Development Goals accomplished. Geospatial information is also required to enable international donor agencies and governments to monitor whether funds are getting to the neediest communities and whether they are having an impact. Geospatial information is also needed to encourage Foreign Direct Investment and to mobilize domestic revenue. For geospatial information to be used successfully and sustainably in addressing the development issues of Africa requires that they be developed within a Spatial Data Infrastructure (SDI) framework.

SDI is recognized as an international best practice that is being implemented in many regions of the world. The value of SDI is that it recognizes geospatial information as a critical infrastructure that is needed in addressing the development challenges of Africa. It also recognizes the need for various components, such as standards, institutional structures and policies that will allow the geospatial information to be properly managed, maintained and disseminated. Unfortunately within Africa little is happening in the SDI arena with only 24 out of 53 African countries having initiating SDIs.

In those countries where SDIs has been initiated they have stalled and there is a belief amongst many practitioners that SDI has failed in Africa. The reasons given for this failure are many, including a lack of political support, inadequate funding and a lack of policies or national guidelines. Therefore, a rethink in the approach to implementing SDIs is needed. It is believed that to make SDI in Africa more viable there is requirement for it to be development driven, it must be complementary to key policies and the geospatial fundamental datasets needed to accomplish this must be developed immediately.

Some of the core datasets need to be developed in the next four years so that the information can be used in the decision-making needed to accomplish the MDGs and other development goals. For this to be accomplished requires a partnership amongst the international geoinformation community. It is further believed that by developing these fundamental geospatial datasets that new economic and information markets will be developed in Africa. By following this approach the value of geospatial information can be shown to decision makers.

The Mapping Africa for Africa (MAFA) initiative was implemented under the auspices of the United Nations Economic Commission for Africa (UNECA) to accelerate the development of the fundamental geospatial datasets so that they could be used in accomplishing the MDGs and the goals and objectives of the New Partnership for Africa's Development (NEPAD). Two initiatives developed under MAFA were to define the fundamental geospatial datasets of Africa and to conduct an inventory of them so that they could be catalogue on the UNECA's metadata clearing house. Geoinformation practitioners from across the continent defined the fundamental geospatial datasets as being:

.....the minimum primary sets of data that cannot be derived from other data sets, and that are required to spatially represent phenomena, objects, or themes important for the realisation of economic, social, and environmental benefits consistently across Africa at the local, national, sub-regional and regional levels.

From this definition it was then possible to identify the levels, categories, themes and datasets that constitute fundamental geospatial datasets. The levels identified reflect the relative and sequential importance of the different categories, themes and datasets. A review of the levels and themes identified in the Infrastructure for Spatial Information in Europe (INSPIRE) show similarities to those of Africa with both identifying primary reference or coordinate reference systems as being the most important. The inventory and cataloguing of the fundamental geospatial datasets showed that African countries have access to these datasets but they are very fragmented.

Another key challenge faced in implementing SDI is that countries restrict access to their fundamental geospatial datasets. INSPIRE believes that the identification, access and use of

available geospatial datasets is foundational in making SDI work. A review of the implementation of SDI in Africa and Europe shows that the two continents have much in common and that there are many areas where there can be the exchange of ideas and the sharing of expertise. A partnership between the European and African geoinformation community has been proposed so that key lessons can be learnt from the implementation of INSPIRE and the development of implementing rules. The partnership known as the Africa-European Spatial Infrastructure Alignment (AESI-Align) initiative will contribute to the strengthening and alignment of SDIs and hopefully contribute to the development of the two continents.

BIBLIOGRAPHY

European Union, 2007. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 Establishing an for Spatial Information in the European Community (INSPIRE). Official Journal of the European Union L 108, 25.4.2007.

FAO, 1998, The FAO AFRICOVER Programme, www.fao.org/sd/EIdirect/

FAO, Multipurpose AFRICOVER database for Environmental Resources. www.africover.org/MADE.htm (accessed 3 August 2005)

Gavin, E., and Gyamfi-Aidoo, J., 2001, Environmental Information Systems Development in Sub-Saharan Africa — Approaches, Lessons and Challenges, EIS-AFRICA, p. v

Luzet, C. and Murakami, H. (eds.), Geospatial Data Development: Building data for multiple uses, “In: Nebert, Douglas D., (Ed.), 2004, Developing Spatial Data Infrastructures: The SDI Cookbook, Version 2.0”

Masser, I. 2005. GIS Worlds: creating Spatial Data Infrastructure. ESRI Press, New York.

Makanga, P. And Smit, J., 2008. A review of the status of Spatial Data Infrastructure implementation in Africa. University of Cape Town.

Mavima R, Noongo EN, 2004, Spatial data infrastructures in SADC countries: Status and future directions.

Menneke, B.E. and West, L.A., Jr, 2001. Geographic Information Systems in developing countries: issues in data collection, implementation and management. Journal of Global Information Management, Vol 9, No. 4.

Nyapola, H., 2005. Mapping Africa for Africa. GIM International, Vol 19, No. 1.

Ottichilo, W.K., 2005. Key Role for GIS in Developing Africa. GIM International, Vol 19, No. 1.

Schwabe, C.A., 2002. Information: the foundation of sustainable development. Occasional Paper No. 7. HSRC Publishers.

Schwabe, C.A., 2003 Between poverty and prosperity – the new development agenda for Africa. Africa GIS Conference, Dakar, Senegal.

Schwabe, C.A., 2004. Geoinformation in support of NEPAD. In: Africa Networking: Development information, ICTs and governance. International Books, Utrecht.

Schwabe, C.A., 2005. Geo-information and NEPAD. Third Meeting of the Committee on Development Information (CODI IV), UNECA, Addis Ababa.

SCHWABE, C.A. 2005. The geoinformation industry in Africa: prospects and potentials. In: Proceedings of the Fourth Meeting of the Committee on Development Information (CODI IV), UNECA, Addis Ababa.

United Nations Development Programme and United Nations Environment Programme, (1994), International Symposium on Core Data Needs for Environmental Assessment and Sustainable Development Strategies. Volumes I and II. Bangkok, November 15-18, 1994.

United Nations Economic Commission for Africa (UNECA), 2005. Report on the Workshop on use of Geoinformation in Development. Fourth Meeting of the Committee on Development Information (CODI IV), Addis Ababa, Ethiopia.