World Spatial Metadata Standarts 1
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Spatial metadata in Africa and the Middle East

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1. Introduction

With well over 60 different countries in Africa and the Middle East, a review such as this can sketch only the background for understanding the use of spatial data across the region, especially the use of standards for spatial data, including metadata. The region stretches from the Caucus Mountains in the north down to Antarctica, incorporating a diverse range of terrain and environment: alpine to ocean, tropical to temperate, desert to jungle, rural to urban, landlocked countries to island states. There is also a wide diversity of cultures and languages and varying levels of information and communications infrastructure, resulting in a heterogeneous environment.

This chapter attempts to paint a broad picture of the spatial metadata situation in Africa and the Middle East, through describing briefly the activities in countries and regional bodies across the region, and providing more detail in one or two countries as examples. We describe first some activities that span the whole of the African continent and then, for convenience, we have grouped the summaries by region: western, eastern, northern and southern Africa, and the Middle East. Recording and making available metadata is crucial for increasing access to spatial datasets relevant for policy and decision makers at all levels, for addressing issues such as land reform and administration, environmental management, ensuring food security, alleviating poverty, combating diseases and implementing global conventions.

This chapter draws heavily on the survey of spatial data infrastructures (SDI's) in Africa [Gavin 2000], conducted by the National Spatial Information Framework (NSIF) Directorate in South Africa on behalf of the SDI in Africa Initiative (on-line see http://www.nsif.org.za/sdiafrica). In addition, an attempt has been made to solicit information on their spatial metadata activities from all the member countries of the International Cartographic Association (ICA) in Africa and the Middle East (Algeria, Ghana, Guinea, Iran, Israel, Jordan, Madagascar, Morocco, Nigeria, Qatar, South Africa, Sudan, Tanzania, Tunisia, Uganda, Yemen). We have also used the best practices studies of the Environmental Information System Programme for Sub-Saharan Africa (EIS) [EIS 1999].

In addition to considering spatial data organisations, we will also consider specific once-off projects or initiatives, as many of these have a better resource than national organisations and produce legacy base datasets (hopefully with metadata), and consequently have a significant impact. It should be noted that there are also many global initiatives in which countries in Africa are involved, such as Global Map (on-line see http://www.iscgm.org), including 19 participating countries in Africa. The resources involved in these initiatives may be significant in comparison with resources invested by countries in their own spatial data collection and management.

2. General regional structure for spatial data organisation

There are a number of organisations addressing the need for spatial metadata across Africa, including the United Nations Economic Commission for Africa, the Spatial Data Infrastructure in Africa initiative, EIS-AFRICA and the United Nations Environmental Programme.

2.1. *United Nations Economic Commission for Africa*

In June 1999 in Addis Ababa, the first meeting was held of the Committee on Development Information (CODI) of the United Nations Economic Commission for Africa (UN ECA). CODI, as one of the seven subsidiary bodies of the Commission for Africa, was established in 1997 by the twenty-third meeting of the Conference of African Ministers responsible for Economic and Social Development and Planning. (For further details, including the report from the first meeting, refer to the UN ECA web site, http://www.uneca.org/.) CODI provides policy and technical guidance to the ECA's sub-programme 'harnessing information for development'. At the June 1999 meeting, CODI's three sub-committees met in parallel, bringing together several previously separate initiatives to improve co-ordination in the area of development information:

- Sub-committee on Statistics: this replaced the Co-ordinating Committee on African Statistical Development (CASD), the primary task of which was developing the strategy of the Implementation of the Addis Ababa Plan of Action for Statistical Development in Africa in the 1990s;
- Sub-committee on Information and Communication Technologies: this sub-committee focuses on the development of information and communications technology (ICT) infrastructure, embodied by the African Information Society Initiative (AISI), which was adopted at the ECA Conference of Ministers in 1996;
- Sub-committee on Geo-information: known as CODI-GEO, this replaces the previous Regional Cartographic Conference for Africa. The terms of reference agreed upon for CODI-GEO at its first meeting include those of:
  - facilitating capacity building with regard to spatial information capture, management, dissemination and utilisation;
  - promoting the development of standards in these areas and of resources.

Currently, CODI-GEO is compiling a list of successful GIS projects in Africa, with the intention of identifying a few to use as case studies for developing best practices. At its September

2001 meeting, CODI-GEO will focus on SDI development, including metadata capturing and publishing.

2.2. *The Spatial Data Infrastructure in Africa initiative*

On 15 July 1999, immediately following the Earth Data Information Systems (EDIS) 1999 Conference held in Pretoria, South Africa, a workshop was convened to consider the development of a Spatial Data Infrastructure (SDI) for Africa. It was organised by the Program on Environment Information System in Sub-Saharan Africa (EIS) and the South African National Spatial Information Framework (NSIF) Directorate.

An interim task team was established, which is conducting an on-going survey of SDI in Africa [Gavin 2000], co-ordinated by the National Spatial Information Framework Directorate in South Africa. The interim task team has been liaison with CODI-GEO about forming an African SDI, and organised a meeting on SDI in Africa in Cape Town, South Africa, on 15 March 2000, in association with the 4th Global Spatial Data Infrastructure (GSDI) Conference. At that meeting, two Working Groups were established to address the most critical issues inhibiting the development of SDI in Africa:

- Metadata Working Group: led by the Regional Remote Sensing Unit in Harare, Zimbabwe. This group will address issues such as standardisation and the publishing of metadata records;
- Geodetic Working Group: led by the South African Chief Directorate of Surveys and Mapping in Mowbray, Cape Town. This working group will focus on the development of a sound geodetic network for Africa, with the rekindling of the ADOS project by the IAG.

The interim task team aims at stimulating the sharing of ideas and participating in other initiatives world-wide (especially GSDI), through establishing and maintaining a network of interested individuals. Significant incentives for an African SDI are to promote investment opportunities (through providing data to assist potential investors), more-informed decision making, trans-border decision support systems (especially for natural resource issues), aligning regional projects, developing a common understanding amongst countries and disaster mitigation and prevention. The SDI in Africa mailing list is being used to debate these issues.

Major obstacles include the perceived control of SDI by national mapping agencies, different political systems and legacies between countries, lack of awareness of the value of SDI's and spatial information, varying stages of information technology development and the availability of resources, especially money.

2.3. *EIS-Africa*

Since its inception in 1990, the goal of the Program on Environment Information Systems (EIS) in Sub-Saharan Africa has been the promotion of information usage in decision-making, particularly within the context of environmental management and sustainable development. The Program is now entering a new phase, in which it will in future operate as a non-profit organisation, under the new name 'EIS-AFRICA: Network for the Co-operative Management of Environmental Information' (on-line see http://www.grida.no/prog/glob/eis-ssa/index.htm/). EIS-AFRICA has been registered as an 'association', that is, a non-governmental organisation (NGO), in South Africa.

Over the past decade, the program has assisted Sub-Saharan African countries to develop operational EIS's in order to meet the most important needs of decision-makers, planners and users of resources, through networking and capacity building efforts. The need to harmonise geo-spatial information collection efforts has been emphasised. EIS-AFRICA aims to play a leading role in continuing to facilitate the strategic development and use of geo-information in support of the effective management of, including monitoring and the reporting on, environmental resources for furthering development.

An aspect identified as critical to success in achieving the aim of increased information use in decision-making, is the increased availability and accessibility of policy-relevant information to policy and decision-makers at all levels. The information required for effective environmental management is pertinent also to a variety of other programmes, such as land reform and administration, ensuring food security and poverty alleviation, as well as the implementation of global conventions at the local, national sub-regional levels, all require the same basic datasets. Central to accomplishing the goal of readily accessible and relevant information, is the promotion of a unified approach to the development of inter-linked national, sub-regional and continental geo-spatial data infrastructure for Africa, supporting the sharing and reuse of data by different users for a variety of applications. Thus EIS-AFRICA will in future be emphasising the need to align standards for digital spatial data, especially with respect to the capturing of metadata and it's publishing.

In association with the African Organisation for Cartography and Remote Sensing (AOCRS), EIS is involved in organising the Africa GIS meeting, held biennially. This presents an important platform for exchange of knowledge and experience within the geographic information community in Africa.

2.4. *UNEP-GRID and UNEP.Net*

The United Nations Environmental Programme (UNEP) is, through UNEP-GRID (its Global Resource Information Database), in the process of producing sub-regional State of Environment (SoE) reports for Southern, Western and Central Africa. All of these reports will have associated SoE metadatabases. The most advanced SoE initiative is that for Southern Africa. UNEP's collaborating institution on this initiative is the Regional Remote Sensing Unit of the SADC Food Security Programme in Harare. The unit has already drafted a strategy to develop the SoE metadata, for which UNEP will soon provide the necessary funding. The SoE metadata for West Africa will be developed later this year. CEDARE (Centre for Environment and Sustainable Development in the Arab Region and Europe) in Cairo represents another Collaborating Centre of UNEP on environmental assessment and reporting.

UNEP is aiming to establish UNEP.net (http://www.unep.net/) as the authoritative portal for environmental information. A portal for Africa will be developed, and, as with all regional portals, will include metadata and associated spatial datasets.

3. African regions

West Africa

3.1. *West African regional initiative*

The AGRHYMET Centre in Niamey, Niger focuses on hydrological and meteorological data.

AGRYHYMET has been involved in capturing a considerable amount of metadata for the Sahelian countries of West Africa.

3.2. *Benin*

In Benin, the governmental authorities responsible for the management and distribution of digital spatial data (from remote sensing sources), on behalf of the public sector, are:

- ASECNA: for data with low resolution (e.g.: NOAA and METEOSAT); and
- CENATEL: for data with high resolution (e.g.: SPOT and LANDSAT).

Both, ASECNA and CENATEL, act as agents for the producers of the data, funnelling requests through to them. CENATEL is involved in regional initiatives for establishing SDI's. The private sector, universities and non-governmental organisations use pre-processed digital spatial data for their applications. Currently, the Internet is not used to provide access to spatial data in Benin.

There is no central budgeting or co-ordination for acquiring digital spatial data of Benin, or for the development of a spatial data infrastructure. Development projects funded by international organisations continue to be a major source of data. However, progress is being made in sensitising the Executive and Legislative branches of the government about the need for a well-established spatial data infrastructure for Benin.

3.3. *Ghana*

The National Framework for Geo-spatial Information Management (NAFGIM) co-ordinates the production and exchange of compatible spatial data. The NAFGIM co-ordinator is based in the Environmental Protection Agency. Five datasets (topography, meteorology, land suitability, land use/land cover and land ownership) are being produced under a government-funded project on Environmental Resources Management Project (GERMP).

Though some institutions in Ghana have been recording metadata for their data holdings, they have not been doing this in a co-ordinated manner. The result is that much of the data of Ghana that could be shared is either undocumented, or has not been documented to any widely used standard. Data is then distributed mainly in response to requests to suppliers, often in hard copy format. Using the freeware metadata tool CorpsMet95, which complies with the current FGDC metadata standard (on-line see http://www.fgdc.gov/metadata/), the Remote Sensing Applications Unit (RSAU) of the University of Ghana has captured the metadata for the land-cover and land-use coverages resulting from the Ghana Environmental Resource Management Project.

There is a keen awareness of the need to implement metadata standards in Ghana, and with this in mind, the Environmental Protection Agency arranged for the FGDC to run a workshop on metadata in Ghana in August 2000. It is anticipated that metadata will be published through the web site of NAFGIM, presently under construction, before the end of 2001.

3.4. *Ivory Coast*

Within the Ivory Coast, government institutions, researchers and academics play an important role in gathering spatial data. There is a degree of co-ordination by governmental institutions

in this arena. Spatial data are exchanged between individuals in response to requests, and are published in reports. A project to develop a water resource database in order to predict well productivity in the crystalline basement in Ivory Coast is capturing metadata, along with hydrological and rainfall data, as well as crop statistics. However, there is no focus on making this metadata readily available to other potential users of the datasets under development. Spatial data standards are being addressed within the context of the project.

East Africa

3.5. *East African regional initiative*

Plans for a clearinghouse in East Africa were discussed at the Regional Integrated Information Systems (RIIS) Strategy workshop, organised by the Intergovernmental Authority on Development (IGAD), which was held in Jinja, Uganda, 26–29 July 1999. IGAD's initiative to develop a regional network of data producers in Eastern Africa is still at a formative stage.

3.6. *Ethiopia*

In Ethiopia, the main government organisations that are involved in the capture of digital spatial data are the Ethiopian Mapping Authority (EMA, on-line see http://www.telecom.net.et/), the Ministry of Water Resources and the Ministry of Agriculture. The spatial information captured includes data from satellite imagery, as well as that used in topographic and thematic mapping. The Geophysical Observatory and Geology Department of the Addis Ababa University also capture spatial data. There is no known private sector involvement, and NGO involvement in this area is limited to capacity building.

By proclamation, the EMA co-ordinates public programmes involving spatial information. The EMA distributes digital data topographic and thematic data using floppy diskettes, CD-ROM and magnetic tapes. Spatial data are also distributed as part of research reports.

In June 1999, the Environmental Support Project (ESP), which aims at enhancing data management, was initiated. This project involves the collection of metadata, making the data available to users, developing spatial data standards, developing a legal framework for accessing and distributing data and developing a pricing policy. Currently, the ANZLIC spatial metadata standard is being used. The metadata are not confined to only the spatial data, but also encompass projects, experts, reports, etc. The ESP will not attempt to create basic datasets of Ethiopia, but rather to enable access to existing spatial data, by providing metadata on CD-ROM's, in catalogues or over the Internet. The project currently involves the Ministry of Water Resources, the Ministry of Mines and Energy (in particular the Institute for Geological Surveys), the Ministry of Agriculture, the Environmental Protection Authority, the EMA and the Ethiopian Science and Technology Commission. The regional offices will be included at a later stage. A Protocol for Inter-Agency Co-operation has been drafted and is in the process of being signed by the participants. By the end of 2000, the Environmental Support Project will have established their Web site. The project is scheduled to finish in February 2003.

Ethiopia, through the EMA, is participating in the Global Map programme (on-line see http://www.iscgm.org).

3.7. *Kenya*

There are many government departments in Kenya that deal with spatial data, though none is mandated to be the co-ordinator of such activities. They include the Department of Resource Survey and Remote Sensing (DRSRS), the Kenya Wildlife Service (KWS), the Forestry Department, Kenya Marine Fisheries Research Institute (KMFRI), National Museums of Kenya (NMK), Central Veterinary Laboratory (CVL), Department of Natural Resources, and Surveys of Kenya. Three major providers of spatial data within Kenya are Surveys of Kenya, DRSRS and the United Nations Environmental Programme (UNEP), which is based in Nairobi and which provides Internet access to digital data. Few private-sector organisations are involved in digital data capture or application development; they mainly specialise in aerial surveys and map production. There is little effort to incorporate other non-digital information on to the maps.

Academic institutions involved in managing spatial data include the University of Nairobi, Moi University and Egerton University. The Kenya Polytechnic presents several training courses that include components on GIS and Remote Sensing, and as such, is involved in capturing spatial data, as well as associated metadata, which is made available to potential data users. NGO's that need to use spatial data generally contract universities or private firms to do the work.

The Kenya wetlands conservation and training programme aims at conserving Kenya's wetlands and building capacity for the management and sustainable utilisation of wetland resources, which includes the mapping of marine and terrestrial wetlands. The Nairobi City Council captures and documents data needed for managing the city. The Nairobi Informal Settlements Co-ordinating Committee (NISCC) co-ordinates a wide spectrum of stakeholders.

In Kenya, there is no agency specifically tasked with the distribution of spatial data, so in general users have to search for what they need. There is also no forum, wherein users can voice their needs for data. Many organisations do not yet capture metadata, but awareness of the need to do so is growing. Kenya's National Environment Secretariat (NES) and the Forest Department were funded to develop a clearinghouse mechanism for Kenya, but this has not yet been implemented. Organisations in Kenya have in the main not yet embraced the need for spatial data standards, and at present, no organisation is mandated to develop standards.

3.8. *The Seychelles*

The Seychelles GIS Centre was established in 1996 by the Ministry of Land Use and Habitat (MLUH), for the purpose of capturing, manipulating and distributing spatial data, as well as linking with other spatial data distributors and users. Other major users and distributors include other divisions in the Ministry, other Ministries, Departments and private firms, including utilities. A publicly funded orthophoto-mapping project began in 1998, and reached completion in February 2000. A dataset called the National Inventory for Seychelles, including roads, rivers, land use, topography and cadastre, is under development.

Spatial data are distributed in hard copy as well as via the MLUH's Intranet to MLUH users. Metadata is collected and made available to spatial data users. Web pages for the GIS Centre are being developed. The MLUH is not currently involved in developing standards or

policy for spatial data other than a pricing policy. MLUH has links with MAPS in the United Arab Emirates.

3.9. *Uganda*

In Uganda, the main government Departments involved in the capture of digital spatial data are the Departments of Surveys and Mapping, Planning, Petroleum Exploration and Water Development. There is no known private sector involvement in digital spatial data capture in Uganda. The United Nations High Commissioner for Refugees (UNHCR) has been collecting data on feeder roads in areas of their operations but maintenance plans for these data are not clear. From the academic sector, Makerere University Institute of Environment and Natural Resources (MUIENR) has a database on Uganda bio-diversity.

Concerning co-ordination of the capture and maintenance of spatial data in Uganda, the Information Section of the National Environment Management Authority (NEMA) has taken the initiative to co-ordinate the capture, maintenance and management of spatial information through providing financial and material support. This arrangement, called the Horizontal Environment Information Network, covers only a few governmental organisations at present and should ideally be broadened should funds become available for this.

The Surveys and Mapping Department sells topographic maps from their offices in Entebbe. The National Biomass Study has a website (http://www.imul.com/forestry) for viewing and downloading less-detailed digital data. Digital and paper copies with more-detailed information can also be bought from their office or ordered by other means. The aim of the National Biomass Study, which operates nationally in Uganda, is the provision of reliable and regularly updated data, information and knowledge about land cover and biomass for use by key stakeholders. The National Biomass Study has six datasets covering the whole country: land cover (use), rivers, and roads, gazette areas, administrative units and contours.

The metadata concept is new to many organisations in Uganda and no formal or *de facto* standards exist. However, data capturing organisations have records concerning lineage and data quality.

The National Biomass Study has a liaison with a regional initiative IGAD's Regional Integrated Information Systems (RIIS), although the RIIS is still in a formative stage.

3.10. *Sudan*

The Sudan Survey Department will have been transformed by the end of 2000 into the Sudan National Survey Corporation, under the supervision of the Ministry of Survey and Physical Development. It will be the major supplier of spatial data in the Sudan, together with the National Remote Sensing Centre. Sudan is a member of the Regional Centre for Surveying, Mapping and Remote Sensing, which is based in Nairobi, Kenya, and of the East African Section of the Africover Project.

Several Ministries and Departments in the Sudan are in the process of setting up the hardware and software needed for storing their data digitally. By the end of 2000, it is expected that the Sudan National Survey Corporation and several other organisations in Sudan will be able to organise their metadata in accordance with the international standards specifications.

North Africa

3.11. *Morocco*

Several departments are users of spatial data, mostly as hard copy, but increasingly, in a digital format. The two most significant organisations with respect to the creation, management and distribution of digital spatial data at a national level are the Administration for Land Conservation, the Cadastre and of Cartography (L'administration de la Conservation Foncière, du Cadastre et de la Cartographie) and the Royal Centre for Remote Sensing (Centre Royal de Télédétection Spatiale, CRTS). Other departments involved in the creation of base digital spatial data are the Geology Directorate (Direction de la Géologie) and the Statistics Directorate (Direction de la Statistiques). The limited involvement of the private sector focuses largely on the development of specific applications.

The Department of the Prime Minister is creating a National Council for Geographic Information (Comité National de l'Information Géographique, CNIG), that will develop the digital geographic information sector and put in place an institutional framework for the coordination of exchange procedures and the dissemination of digital spatial data. Currently the National Council for Cartography (Comité National de Cartographie) deals with aspects relating to mapping, while the National Council for Remote Sensing (Comité National de Télédétection Spatiale), established by the CRTS in 1993, has recorded information concerning existent programs and base data developed by different departments. Both these committees' research users' needs and initiate programmes in response to these needs.

Each institution is responsible for disseminating the data it produces. The CRTS provides information on the availability of digital spatial data and how data may be accessed via its website (http://www.crts.gov.ma). A further project underway is an archiving and access system for digital data, which will be operational in September 2000.

A study is underway regarding metadata and procedures for access and utilisation of digital spatial data. There is an awareness of the role that the availability of metadata can play in minimising duplication in data capture and ensuring appropriate use of existing data. While standards in general are addressed by a component within the Ministry of Commerce and Industry, which by and large adopts international standards, it is anticipated that the CNIG will form a working group to deal specifically with digital spatial data.

3.12. *Algeria*

In Algeria, the National Council for Geographic Information (Comité National de l'Information Géographique, CNIG), acts as a co-ordinator with respect to the capture and processing of spatial data, digital and analogue. National institutions, which are major spatial data users or producers, are represented on this council. The National Institute for Cartography and Remote Sensing is a major data producer, while the National Centre for Spatial Techniques is also involved with processing digital spatial data. There are many other users of spatial data, including universities, research centres and other government departments, such as Agriculture and Geology.

The National Institute for Cartography and Remote Sensing distributes spatial data. The Internet is not used for distributing spatial data at this stage in Algeria. The NCGI is responsi-

ble for standard development, through its Commission for GIS and standardisation. Currently, there is no liaison with international standard development initiatives.

Southern Africa

3.13. *The Southern African Development Community (SADC)*

There are currently 14 member states of SADC, several of which do not, from a geographical perspective, really form part of 'southern' Africa. The member states are: Angola, Botswana, Democratic Republic of Congo (DRC), Lesotho, Malawi, Mozambique, Mauritius, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. There are many SADC programmes, one of which is the Food Security Programme. There are also other regional initiatives covering subsets of countries within SADC, such as the Regional Tsetse and Trypanosomosis Control Programme (RTTCP), which involves the countries of Zimbabwe, Zambia, Mozambique and Malawi, with the Zimbabwean Ministry of Agriculture as the lead agency.

The secretariat for the SADC Food Security Programme is based at the Regional Remote Sensing Unit (RRSU) in Harare, Zimbabwe. The RRSU is a centre of technical expertise, which provides training and technical support in the fields of remote sensing and GIS, to advance both early warning systems for food security and natural resources management. The RRSU operates largely on funding provided by the SADC Member States, which will continue for an indefinite period. In addition to SADC funding, the RRSU will receive some funding from the Netherlands Government, until June 2001. The RRSU has links with South Africa's National Spatial Information Framework (NSIF), and has also been active in GSDI's Technical Working Group, contributing to the SDI cookbook it is publishing.

There are many role-players with respect to digital data within the SADC region. In general, one would find the following major role players within each country within the region:

- governmental departments: typically the Office of the Surveyor General, Central Statistical Offices, National Meteorological Department (Weather Bureau), Department of Agriculture or equivalents;
- universities and other research institutes;
- organisations, especially a range of UN organisations such as FAO, WFP and UNEP; but also WWF, FEWS (USAID) and the Red Cross;
- national and international NGO's.

Spatial data would most often be distributed within the region in hard-copy format, often as a component of a report. In general, there is no centralised system for distributing data in a digital format, although a number of initiatives do exist. Data are distributed mainly on CD-ROM, with the provision of some information via the Internet.

The RRSU maintains comprehensive metadata on datasets it compiles, which cover the entire SADC region. In 1999 these metadata records were captured using MetaLite, an FGDC-compliant metadata-capturing tool (on-line see http://www.fgdc.gov/metadata/), and published through the clearinghouse administered by NSIF in South Africa. The RRSU is also involved in developing spatial data standards and framing policy relating to the accessing and distribution of spatial data. The RRSU regards the development of standard data (transfer)

formats and operation data policies as critical factors for the successful development of SDI in the region.

The Environment Resource Centre for Southern Africa also based in Harare, Zimbabwe, runs the Environment Reporting Programme for Southern Africa, covering the SADC region. There is a focus on raising awareness of environmental issues and influencing policy and decision-making. The Centre is affiliated to UNEP-GRID, and interacts with the RRSU, SIRDC, CSIR (based in South Africa), State of Environment reporting practitioners and the offices of the Surveyors General within the region. Data are collected at the SADC, national and river basin level. Metadata is also captured and is made available to spatial data users.

3.14. *SAFARI 2000*

SAFARI 2000 is a regional science initiative in southern Africa to study land-atmosphere processes and emissions (biogenic, pyrogenic or anthropogenic), and the consequences of their deposition to bio-geophysical and bio-geo-chemical systems. It builds on a number of existing activities undertaken by the National Aeronautical and Space Administration (NASA), the international community and African countries. Data for SAFARI 2000 are being gathered from ground-based and airborne platforms, as well as earth observing satellites such as the NASA EOS Terra platform. The project covers: terrestrial ecology, land use and land cover change, aerosols and trace gas chemistry and transport, surface radiation, cloud characterisation and radiation effects and modelling (on-line see http://www.wits.ac.za/fac/engineering/civil/Safari/index.html).

The key outputs from the project are a database of all known emissions in the region for several key pollutants and with models that can predict where the pollutants go and how they are chemically altered. The project team has recognised how crucial it will be to record metadata for all the datasets, to prepare data for synthesis and analysis and to archive and distribute data after the completion of the SAFARI 2000 project. A metadata editor on the Internet has been developed to allow participants to capture their metadata, critical to the design of this tool has been the realisation that not all researchers will have access to high-speed Internet connections. The tool also allows researchers to keep their metadata private until their datasets are ready for publication. Once captured, the metadata records are loaded onto NASA's metadata search facility hosted by the Oak Ridge National Laboratories [SAFARI 2001].

3.15. *South Africa*

In 1997, resources were set aside by the Department of Land Affairs to develop the National Spatial Information Framework (NSIF), South Africa's SDI building programme. The aim of the programme is the establishment of a technical and policy framework, enabling unimpeded access to and utilisation of spatial information for effective and efficient governance, planning and decision making, through all spheres of government. This includes the provision of systems supporting access to key spatial information. Like similar initiatives elsewhere, along with standard development and the framing of policy and institutional arrangements, there is a strong focus on the development of a clearinghouse, and as part of this, the capturing and publishing of standardised metadata.

Currently an FGDC-type clearinghouse, termed the Spatial Data Discovery Facility (SDDF, on-line see http://www.nsif.org.za/), makes available close to 3000 metadata records, including records pertaining to datasets covering the whole SADC region. These records correspond to spatial data holdings within both the public and private sectors in South Africa. A metadata standard was *de facto* imposed through the provision of free metadata capturing tools, both MetaLite and a web-based system for capturing metadata. South Africa has been a pioneer in the development of standards for spatial data [Cooper 1991], and work is proceeding on developing a national standard for metadata, through the profiling of the international standard, ISO 19115 [ISO 19115], amongst other standards [Gavin 2001].

3.16. *Lesotho*

The major spatial data producers and users in Lesotho include several government departments and agencies, such as the Departments of Environment, Statistics, Lands and Survey, the Lesotho Highlands Development Authority and the National Environment Secretariat. Other role players are the SADC Water Sector and SADC Environment and Land Management Sector, both of which are based in Lesotho.

Currently spatial data are distributed using CD-ROM and floppy diskettes, as well as in the form of hard-copy maps. While there is not yet any formal policy concerning spatial data access and distribution, informal agreements between users and suppliers are usually entered into ensuring that information concerning any updating or modification to the datasets will be provided to the parties concerned.

The Committee on Environmental Data Management (CEDAMA) was established in February 1999 to advise the National Environmental Secretariat on issues pertaining to environmental data management. These include fostering institutional arrangements that will support co-ordination of efforts in gathering and managing spatial data, as well as researching policies and standards to promote the sharing of spatial information and raising an awareness of the importance of spatial data for Lesotho. CEDAMA is involved in collecting metadata and making metadata available to potential data users. South Africa's NSIF participated in a workshop in Lesotho in 1999 to share its experiences, and a follow up workshop is planned to establish a clearinghouse for spatial data, following the capturing of metadata on spatial data.

3.17. *Botswana*

In Botswana the major producers, distributors and users of spatial data include several government departments such as:

- Department of Surveys and Mapping (DSM);
- Department of Town and Regional Planning;
- Department of Lands, Housing and Local Government;
- Department of Geological Survey and Mining;
- Department of Agriculture and Water Affairs;
- Department of Wildlife, Conservation and Tourism,

as well as parastatals, i.e., quasi-governmental organisations, such as:

- the Botswana Power Corporation;
- Water Utilities Corporation;
- Botswana Telecommunications.

DSM is responsible for creating the Botswana National Atlas and the National Integrated GIS (to be completed in 2004). As the major producer and user of spatial information, DSM plays an informal co-ordinating role with respect to publicly funded projects relating to spatial information.

DSM does collect metadata, and makes this available to potential spatial data users. DSM is also involved in developing standards for digital spatial data in general. Botswana, through DSM, is also participating in the Global Mapping Project.

3.18. *Namibia*

The Surveyor General and the National Remote Sensing Centre, falling within the Ministry of the Environment and Tourism, are the major data producers in Namibia. Metadata is captured as a matter of course. The private sector is also active in producing spatial data. Often spatial data are distributed in the form of paper maps. A body to co-ordinate the gathering and management of spatial data within the public sector was established recently.

The State of Environment Reporting Programme (SOER) operates from the Department of Environmental Affairs and promotes sustainable development. Spatial data are distributed largely in response to individual requests. There is liaison with other SOER programmes in the SADC region. Metadata is collected and made available to data users, as is the case for similar programmes running throughout the region.

3.19. *Zambia*

The role-players in spatial data production, distribution and maintenance, as well as the major users within Zambia, include national planning units, local government institutions, pilot communities for the Environmental Support Programme (ESP), donors, researchers and academic institutions. The Environmental Information Network and Monitoring System, which operates within the Ministry of Environment and Natural Resources, aims to provide action-oriented environmental information system and decision support tools to various stakeholders, providing them with better access to information on environmental issues and plans (on-line see: http://www.menr.gov.zm). Metadata on datasets such as those pertaining to air and water quality, wildlife distribution and soil degradation, is collected and made available to users.

An Environmental Information System Forum is involved in co-ordinating publicly funded programmes involving spatial information. Spatial data are distributed using websites and on CD-ROM, but also through publications such as newsletters and conference proceedings, meetings and electronic billboards.

Middle East

3.20. *Saudi Arabia*

Today, the scope of geographic information activities in the Kingdom of Saudi Arabia encompasses: strategic applications, the planning and management of infrastructure, agriculture,

environment, industries, health, education, communication, telecommunication, electricity, transportation, roads and highway development, census, coastal studies, engineering, natural and human resources, national economy, general welfare, geology, land use analysis, urban and rural planning, mineral exploration, sand control (desertification), water resources assessment, hydrographic studies, tourism, oil spill monitoring and many other applications and future planning. Therefore, the Kingdom of Saudi Arabia became a member of the ISO/TC 211 in 1998 and supports several research and development projects. One of these projects is the development of Geographic Information Infrastructure. This project revolves around the development of long-term strategy for national geographic information infrastructure (SNGII) design. It includes the implementation of geographic information standards, data documentation, metadata standards, national geographic information clearinghouses, procedures, policy institutional, technical issues, and other issues effecting the collection, processing, display, storage, distribution, availability, reliability and accessibility of correct, up-to-date geographic information in the Kingdom of Saudi Arabia.

In the near future, the Kingdom of Saudi Arabia hopefully will create the infrastructure necessary for providing rapid access to accurate and current geographic information at the national level. The Data documentation and metadata standards, which will be used in the Kingdom of Saudi Arabia, will follow very closely the ISO/TC 211 standards (with certain modifications to suite the country).

3.21. *Israel*

Geo-related standards in Israel are one of the responsibilities of the Survey of Israel, under governmental resolutions in 1989 and 1993. Work on the Israeli metadata standard started in 1991, as part of the then newly developed data transfer standard (IEF'91). The basic idea was to supply each of the features in the databases and transferred datasets with 'source' information. Thus, each of the features (objects, entities) within the National GIS databases was provided with an additional attribute: 'Source-ID'. This was an integer value serving as a pointer to a relate table. In this table, for each entry is stored metadata including the date of acquisition, method of acquisition, positional accuracy and supplier ID. Thus, when most of the data were acquired by photogrammetric mapping, all features in a large area received the same source-code entry. It is important to notice that all metadata was focused on spatial information.

In 1995, when National GIS was established, some non-spatial data were added to the basic spatial data. In addition, some government ministries began to develop their own value-added layers, based on the 11 topographic layers generated by the Survey. In order to co-ordinate all these databases into the envisaged national GIS, the Survey began to produce a Spatial Data Index. At this time, it was realised that the next step should be the adoption of an independent metadata standard. The idea was to wait for the ISO standard and to generate an appropriate Israeli profile. By 1998, it was clear that ISO would not finish the work in time and work began in October 1998 to develop an Israeli metadata standard.

The Israeli Metadata Standard (Format) IMF2000 is aimed at establishing the framework and mechanism for transferring information related to spatial data. Originally, it was launched to supplement spatial data offered, by the Survey of Israel, from the National GIS databases. Finally, the proposed standard was developed to accommodate any spatial data regardless of

their origin, format or domain (vector, raster or textual). In addition, the standard was devised as an instrument of spatial data marketing and distribution. Thus, the standard was divided into separate chapters that each accommodate various aspects of the description and quality definition of the spatial data in terms of spatial accuracy, completeness and currentness, and information related to availability of information and its accessibility. The major motivation in the development and the emphasis of the separate structure of individual chapters was to accommodate many optional models and a variety of data without using separate profiles, but rather various parts (chapters) of the common standard.

The standard is in its final stage of approval. The final draft has been tested and is adopted officially in December 2000, with a mandatory review in October 2001. The additional options embedded in the metadata standard required the Survey to upgrade its transfer standard (after 10 years of usage), again, to accommodate metadata information within the framework of the transfer standard. Thus, the later will enable the transfer of free text attributes and encoded metadata information, as well as the spatial and other non-spatial information.

4. Summary and conclusions

Africa and the Middle East are entering a period in which one may expect rapid growth in the capturing and publishing of spatial metadata. Many countries are poised to formalise a co-ordinated approach towards the development of their spatial data infrastructures. As a focus on metadata, almost invariably forms a part of the strategy towards developing spatial data infrastructures. It is inevitable that this will reinforce the need to capture and publish spatial metadata in a standardised way. The growth in international co-ordination through regional and even global initiatives will reinforce the progress towards the standardisation of metadata capture and publishing.

It should be noted that there are a number of challenges impeding the implementation of spatial data infrastructures in many countries in the region. These include political priorities not supporting spatial data infrastructure development, a lack of national mapping or SDI policies. But also, national mapping agencies steeped in tradition whose products are still paper-based, difficulties with obtaining inter-agency co-operation, few standards and poor compliance to them, and the lack of resources and skilled personnel [Clarke 2001]. However, these impediments are hardly unique to the region and are also to be found, to some degree at least, in many countries in more developed regions.

These trends towards the co-ordination of efforts to develop spatial data infrastructure, coincide with the completion of the ISO metadata standard. Nevertheless, this fact augurs well for the development of systems supporting the meaningful comparison of spatial metadata held within different metadata repositories, as these are likely to be developed in alignment with ISO guidelines. Further, many current metadata repositories in Africa have already been developed within the ambit of FGDC standards. This can, in no small measure, be attributed to the availability of free, easy-to-use tools to capture metadata to FGDC standards.

The provision of a tool (or platform-dependent tools) to capture metadata to ISO standards would, in all likelihood, greatly encourage the wide usage of this standard, especially by nations or regional initiatives lacking resources to develop their own standards and capturing tools. Work has already begun on the development of an ISO equivalent of MetaLite

[FGDC/NSIF 2001]. There is also likely to be a tool available in the future to migrate legacy metadata, captured according to FGDC standards, to the format of ISO 19115 [Pearsall 2001].

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Organisation	**For on-line contact see:**
CRTS, Morocco	http://www.crts.gov.ma
EIS-AFRICA	http://www.grida.no/prog/glob/eis-ssa/index.htm/
Environmental Information Network and Monitoring System, Zambia	http://www.menr.gov.zm
EMA Ethiopia	http://www.telecom.net.et/
FGDC metadata standard, U.S.A.	http://www.fgdc.gov/metadata/
Global Map (programme)	http://www.iscgm.org
National Biomass Study	http://www.imul.com/forestry
SAFARI 2000	http://www.wits.ac.za/fac/engineering/civil/Safari/index.html
SDDF, South Africa	http://www.nsif.org.za/
SDI in Africa Initiative	http://www.nsif.org.za/sdiafrica
UN ECA	http://www.uneca.org/
UNEP.net	http://www.unep.net/

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