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23058

Findings

WORLD BANK

Africa Region . Number 24 . September 1994

Findings reports on ongoing operational, economic and sector work carried out by the World Bank and its member governments in the Africa Region. It is published periodically by the Africa Technical Department on behalf of the Region.

Environmental Information Systems in Sub-Saharan Africa : Investing in the Future

Sub-Saharan Africa is probably moving faster than any other region of the world in terms of land use and renewable resources policy, thus making the need for geographically-referenced information crucial. Yet, due to financial constraints and limited technical capacity, the countries of SSA have been unable to meet this need. Cost-effective, demand-driven information systems are urgently needed to be put into place. The World Bank, together with other donors, has launched a program to promote information systems in SSA. It has helped to establish an International Advisory Committee, comprising of key academics and experts in the information field, both African and non-African which advises countries and donors on the technical, institutional , financial and economic aspects of these systems.

Land reforms are generally regarded as being essential to economic and environmentally sustainable development. These reforms are information intensive and involve the creation of cadastral maps overlaid on geodesic networks. They also require that titles be given to private and community land owners and often that land ownership be transferred from the public to the private sector.

During the 1980s many governments seemed incapable of handling such processes, and one of the many consequences was a delay in the delivery of title. A report from Cameroon, for example, indicates that the registration process can take from two to seven years. As a result, demands for titles have been accumulating, and only 6 percent of the plots have been registered.

Land management for all sectors requires a strong geographically referenced information base. Unfortunately, except for Kenya and Zimbabwe, most African countries have not maintained their geodesic network, their base-map stock, or even their mapping capacity.

Meanwhile, information technology has been improving rapidly, especially spatial information (SI)

technology. While in its early stages, SI technology was often used for research, without any specific developmental objectives it has now become reliable and affordable enough to be rationally employed in projects in SSA and has the capability to manage large data bases useful for national or regional projects. The World Bank has supported the demand approach through National Environmental Action Plans (NEAPs) and the Program for Environment Information Systems in Sub-Saharan Africa (PEIS-SSA).

Program on Environment Information Systems in Sub-Saharan Africa (PEIS-SSA)

By the early 1990s, many African countries were involved in the design of NEAPs (AFTEN, 1991). However, the spatial information needed for a comprehensive NEAP was not available, and it became clear that geographically-referenced information was critical for a variety of indicators. Several donors, including the World Bank and USAID, were already involved in coordinating efforts of African countries to design Environment Information Systems. Within the World Bank, professionals began to recognize the importance of spatial information technology associated with land tenure and information management.

In 1990, the Program on Environment Information Systems (EIS) in Sub-Saharan Africa was launched. The main goal of PEIS-SSA was to provide a forum where information management professionals and representatives from African governments could share their experiences. In 1991 a PEIS action plan was formulated and sought to:

- Assess the environmental information requirement and priorities of the participating countries;
- Assess the in-country capacity to manage information;
- Elaborate a long-term strategy;
- Identify low-cost interventions;
- Prepare a first investment segment; and

Initiate implementation with adequate financing.

Immediate funding for environmental information systems in projects was a priority. Although the Bank's interest in spatial information systems are reflected in the NEAP, PEIS initiatives and in the World Bank's SSA project portfolio, funding commitments to spatial information components has been limited.

Definitions of spatial information components

GEODESIC INTERVENTION. "...the process of determining the exact geographic coordinates and altitude of a series of points on the earth surface." Although this definition sometimes extends to the creation of topographic base maps, this analysis does not consider that aspect.

CADASTRE AND TITLING This component groups all activities pertaining to cadastral survey and land registration. It does not include general land management activities, such as creating urban parcels, if the activities did not involve physical surveys or lead to land registration.

GEO-REFERENCED DATABASE As its name indicates, this component consists of all activities which help create a database in which information is linked to its geographical location. One example of such a database is a Geographic Information System (GIS) in which the information is geo-coded and linked to recorded geographical features and locations.

PHOTO-BASED CARTOGRAPHY. This refers to photo-mapping and includes aerial photography and everything involved in making a map from a photograph. Note that, in the mapping process, the information outlined on aerial photographs has to be geo-coded. As such, it enters a geo-referenced database.

SATELLITE-BASED CARTOGRAPHY This component is similar to photo-based cartography. It differs only in the source and scale of the information. In this case aerial photos are replaced by satellite images either in a digital or printed format.

Sector-specific inputs

GEODESIC INTERVENTION AND SATELLITE-BASED CARTOGRAPHY. For these components the major sectors of activity are agriculture, environment, and forestry. This is to be expected as these SI activities are typically used to gather and manage information in rural environments.

GEO-REFERENCED DATABASE. This component, which usually overlaps and complements all other spatial information components, is prevalent in agriculture and industry. Industry, which was not a dominant sector for SI, becomes significant in relation to geo-referenced data base. Of the three "industry" projects, two pertain to mining-in Mali and Zambia. The other, a Madagascar agricultural project with industrial crop components, pertains mostly to the agricultural sector. It is noteworthy to mention that Urban Development has not used geo-referenced database in projects. Geo-referenced databases are not restricted to rural area information and can store and manage urban spatial information. It is therefore not surprising that urban development has not made more use of it.

PHOTO-BASED CARTOGRAPHY AND CADASTRE AND TITLING. As expected, typically urban information activities strongly dominate in urban development and agriculture. Photo-based cartography is necessary for large-scale maps, which are used extensively in urban environment where small details are essential. Photo-maps or ortho-photo maps are often used for urban cadastre in conjunction with ground survey for outlining property boundaries. As land tenure reforms are promoted throughout Africa, cadastre work and titling are becoming more important. The high allocation of spatial information funding for cadastre and titling, as well as for photo-based cartography, reflects this demand.

Issues

The World Bank commitment to developing geo-referenced information systems is not yet reflected in

its operations. This review highlights the relatively low investment level in geo-referenced information systems. Total investment during the last six years has been US$83 million (only 0.4 percent of the total Bank portfolio).

Investment in geo-referenced information systems has been concentrated in only a few countries and projects. The review has revealed a skewed investment distribution among Bank operations and countries. Only 10 percent of the total number of projects (i.e., 54 projects) have included investments in geo-referenced information. Furthermore, only 9 projects (less than 2 percent) have had the lion's share of the total investment in this field (more than 60 percent).

Investment has been concentrated in four sectors (agriculture, forestry, urban projects, and environment), which together represent about 87 percent of the total amount invested in geo-referenced information systems. Thus underscores the important role of geo-referenced information in these location-specific sectors. However, evidence has shown the relatively low and uneven percentage of projects in these sectors which include geo-referenced information systems: about 13 percent in agriculture, 47 percent in urban development, 53 percent in forestry, and 56 percent in environment. It is also important to note that funding for geo-referenced information systems was relatively insignificant in the first series of projects prepared under the pilot phase of the Global Environment Facility (GEF).

There are no clear trends in investment over time to increase the use of spatial information components. Some projects focus more on the development of geo-referenced information systems than others. This review has not revealed any clear trends in the volume of investments and their related sectoral distributions. On the contrary, annual fluctuations have been surprising, with an investment peak in 1990 followed by the lowest level in 1991.

Land titling and, more recently, environmental planning seem to stimulate investment in geo-referenced systems. Land titling and cadastral activities have been the main applications of geo-referenced information systems accounting for about 55 percent of the total investment. This was expected since these activities require such systems. However, the steady decrease in investment from 1988 (when investment in information systems for land titling and cadastral activities represented more than two thirds of the total) to 1993 (when it represented only 12 percent) was unexpected.

Table 1 lists all the countries for which spatial information funding was allocated. The 10 countries with an allocation greater than $2 million for the 1988-1993 period are Burkina Faso, the Central African Republic, Cameroon, Cote d'Ivoire, Ghana, Madagascar, Mozambique, Nigeria, Senegal and Tanzania. Together, these 10 countries which represent 23 percent of all sub-Saharan African countries, receive 81 percent of the Bank's spatial information funding. The tropical forest countries of SSA seem to be the areas where spatial information activities are in greater proportion relative to the rest of the region.

Table 1: Number and funding of World Bank projects with spatial information components for Sub-Saharan Africa, 1988-1993

Countries	*Number of Projects*	*World Bank funding (millions of $US)*
Angola	2	1.08
Benin	1	1.65
Burkina Faso	4	2.97
Burundi	1	0.04
C.A.R.	1	4.80
Cameroon	2	3.74
Chad	1	0.50
Côte d'Ivoire	4	7.50
Ghana	4	7.50
Guinea	2	1.60
Lesotho	2	1.60
Madagascar	2	16.40
Malawi	1	0.40
Mali	3	0.81
Mauritania	1	0.10
Mauritius	1	0.64
Mozambique	3	2.87
Nigeria	6	12.55
Rwanda	1	0.33
Sao Tome & Principe	1	1.94
Senegal	1	4.30
Somalia	1	0.97
Sudan	3	1.30
Tanzania	1	5.88
Togo	1	0.39
Uganda	2	1.55
Zaire	1	0.03
Zambia	1	1.30
Total	54	86.68

Steps to promote and develop Information Systems in Africa

- Strengthen and improve support to the design and implementation of information system components in Bank-financed projects.
- Draw on the experiences of the "best practices" from the Bank and other donor experience
- Assist in initiating and sustaining special efforts in capacity building and technical advice.
- Use the NEAP process as a vehicle to initiate and strengthen the development of information systems.
- Include an information component in projects dealing with location-specific sectors (agriculture, urban projects, infrastructure and the environment).
- Reinforce donor coordination.

Spatial information technology has now become reliable and affordable enough to be used in projects in SSA and it has the capability to manage large data bases either for national and/or regional projects. The effective planning, preparation and monitoring of environmentally sound projects will depend, to a considerable extent, on the constructive use of environmental information systems.

Jean-Michel Pavy. 1994. Spatial Components in World Bank Projects : Sub-Saharan Africa. AFTES Working Paper No. 3. Technical Department, Africa Region, World Bank.

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