Spatial planning and Geoinformation in Central Mozambique. How to leave the beaten track?

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Abstract

Growing concern for the social and environmental side-effects brought about by fast economic development and the potential role of reliable information for planning and decision making prompted the Universidade Católica de Moçambique (UCM) to initiate a centre for research and documentation in Beira, Central Mozambique. From its onset in July 1997, this centre, called CIDDI (*Centro da Investigação e Documentação para Desenvolvimento Integral),* planed to use Geographic Information Systems (GIS) for documentation, data presentation and information management. In 1998, a co-operation project was initiated with the purpose to establish a GIS centre at CIDDI which can provide reliable and up-to-date geo-spatial information for planners and decision makers. To ensure the sustainability of this endeavour the project followed an approach which kept the external support at a minimum and emphasised the early integration of trained local staff in "train the trainers" programmes. After two years of financial support provided by the Austrian Development Cooperation, the technical infrastructure of the installed GIS laboratory can be maintained and serviced locally while the unit carries out first on-demand projects. This paper focuses on the role of GIS in support of spatial planning in Central Mozambique and considers the problems evolving around the use of geoinformation. Various applications demonstrate the demand for maps as well as decision support and first projects attempt to respond to this demand in a country where up-to date maps are still rare and information exchange is a relatively new concept.

1 INSTITUTIONAL BACKGROUND

The consolidation of peace in Mozambique depends primarily on how the reconstruction process addresses the profound social divisions, political alienation and poverty that sustained the war for so many years. It is crucial that reconstruction meets the needs of Mozambique's desperately poor rural populations who, isolated from large urban and economic centres, have so far seen few tangible benefits of peace. The resettlement of some six million displaced people and refugees continues to be a cause for concern, raising the spectre of severe and persistent land disputes. Given the desperate state of the country's social and physical infrastructure, the success of ongoing efforts for reconstruction will depend greatly on the efficient co-operation within civil society. In this regard, it will be essential to lower the persistently high levels of mutual distrust – between political parties, ethnic groups, government and citizens. Provision of up-to-date information and access to information is an important factor in this reconstruction process.

As a contribution to democratisation and national reconciliation, the Universidade Católica de Moçambique (UCM) was established in 1996 with two faculties: Economics and Management in Beira and Law in Nampula. Three additional faculties have since been added: Education (Nampula); Agriculture (Cuamba) and Bio-medical Sciences (Beira). The total enrolment is about 1,700 students; 40 per cent are women. In August the first groups of students received B.A. degrees in Economics/Management and in Law. In 1997 UCM initiated a centre for research and documentation within the Faculty of Economics and Management in Beira. The centre, named Centro de Investigação e Documentação para Desenvolvimento Integral (the acronym is CIDDI), is policy-oriented from its inception in 1997. CIDDI generates, collects, and disseminates reliable information for use by students, researchers, and decision makers and provides a forum for the discussion of issues of concern to the wider community. CIDDI is today a facility within the Economics and Management Faculty but will eventually become a semi-autonomous institution (see BLASCHKE et al. 2000a). With the advent of CIDDI-GIS and the dissemination of GIS products, the future role of information technology for all other faculties of UCM is widely discussed. Various proposals have been forwarded to the GIS unit to explore the potential for research and analysis, but also to test the framework of inter-university cooperation. Further issues to be discussed at management level are the organisational structure required to run the GIS-unit as a commercial service center located at UCM and the procedures needed to ascertain that access to geoinformation products is unrestricted and impartial.

2 Geoinformation in Mozambique and capacity building

Accurate topographic maps are not easily available and not every part of the country has recently been re-mapped. A lack of sufficient information on natural resources, coupled with inadequate environmental legislation and inappropriate land tenure systems, makes planning and management of development projects a difficult task. Uncontrolled agricultural and industrial activities, unplanned land use and unregulated exploitation of natural resources are the consequences. Various examples indicate that GIS can yield cost-effective, useful and accessible information for rural development and planning on regional and local levels (HARRIS and WEINER 1998, BLASCHKE 1997). It does not automatically lead to better results but it can provide basic information for scenarios to test policy options and assist in mediating agreements in case of conflict.

The lack of information required for improved planning and management of natural resources, in the context of district and community development, has led to the plan to install a Geographic Information (GI) infrastructure based at CIDDI of UCM in Beira. Given the importance of reliable data, the CIDDI project statement included a proposal for the installation of Geographic Information Systems (GIS) which could support planning and decision making in the central provinces of Mozambique (SCHULTHEIS 1999). The Austrian Development Co-operation (ADC) responded to this need and provides funding for a initial three years set-up phase. CIDDI intends to install a database for Sofala Province while simultaneously building up a meta-database for a greater region including the provinces of Manica, Tete and Zambezia. To this end, a comprehensive project proposal for the establishment of a GIS unit at CIDDI was elaborated by the Department of Geography and GeoInformation of the University of Salzburg (BLASCHKE 1998).

The project contributes to an overall objective of national priority, namely to improve civil society participation in planning for sustainable development on municipal, district and provincial level. During the initial three year period the project partners aim to establish a geoinformation service centre at CIDDI/UCM for providing reliable and up-to-date geo-spatial information for planners and decision makers. By means of financial and technical support as well as capacity building measures the main goal is to establish a sufficiently equipped and adequately staffed geoinformation laboratory at CIDDI/UCM (for more detail see BLASCHKE et al. 2000a). The project is jointly executed by CIDDI and the Department of Geography and Geoinformation of the University of Salzburg.

In a situation where 60 per cent of government spending was made up by foreign aid (1997 figures), one has to face the question of who can guarantee the continuation of essential services for government administration, social reconstruction and political stability presently dominated by foreign experts should aid dry up (RUPIYA 1998). With this in mind, the project partners embarked on a process which aims beyond technology transfer: intensive consultations with stakeholders (government departments, provincial administrations) take place frequently to inform about the units progress, new projects and developments as well as to allow the participants to contribute to the project's planning process (FIG. 1). CIDDI-GIS staff already started with a capacity building programm for users and promotes an outreach process aimed at decision makers to be made aware of the potential of geoinformation for regional rural development.

FIG. 1 Visualisation of information need and production at various institutions (need on top of wallpaper, information product at the bottom; string: possible exchange); Workshop Beira, March 1999, P. Zeil

3 Spatial planning applications

The concept of the CIDDI-GIS project is strongly focused on application projects. This means, that from the onset, externally funded contracts are to be included in the capacity building process. Several projects are already identified and proposals have been submitted to donors and clients. Cartographic aspects, for instance, are taught within real-world environments resulting in maps needed in provincial government offices. Instead of using external sample data provided by software companies the trainees are working from the beginning with national and local data sets.

3.1 Rural development/community-integrated GIS

The core capabilities of GIS, namely spatial analysis, map making and modelling, for decision support in planning and environmental impact assessment, promise to fit perfectly with the overall aim to support participation and improved decision-making. There is growing concern, that GIS-based development planning might further marginalize communities from development planning, project formulation and access to geoinformation in general (PICKLES 1995). Current trends in hardware and software and a more decentralised GIS-approach however facilitate participation and interaction by end users. Several examples show the potential of 'community-integrated GIS' as a participatory variety of the tool (HARRIS and WEINER 1998, WEINER and HARRIS 1999). Community-integrated GIS are built on traditional geoinformation handling (in a technical sense) and include local knowledge as data layers. Communities also help to establish the initial search questions for the participatory project. This approach tries to avoid the negative effects of top-down planning, promotes more democratic spatial decision making, broadens access to spatial information technologies and data as well as incorporates socially differentiated local knowledge about the landscape.

First application projects will be established in conjunction with ongoing research in the district of Buzi (40km west of Beira), where several projects concerning local communities and their needs are under way (see also chapter 3.3).

3.2 Emergency, hazard mitigation and early warning system

Mozambique was seriously devastated by floods and cyclones in February-March 2000. During the event and for a brief period after, the world focused its attention on Mozambique. After some delay, international relief efforts were mobilized to assist with rescue and emergency relief missions. The general extent of the damage is known: an estimated two million people were directly or indirectly affected by the floods. Preliminary calculations indicated the inundation of 10 percent of the country's cultivated area, damage to 90 percent of the country's irrigation infrastructure, the loss of 20,000 head of cattle, and the destruction of many schools, health centres and other public buildings. The United Nations Office for the Coordination of Humanitarian Affairs (UNOHAC) estimated the number of affected people in the southern provinces of Maputo and Gaza at some 200,000. Along the Buzi River in Sofala Province, floods put at risk some 20,000 people and destroyed an estimated 50 percent of the maize, 80 percent of the rice and 40 percent of the sorghum crops. Many communities have yet to recover fully; in some areas, bridges and roads, key elements in the national infrastructure, have not yet been rebuilt. Much of the economic development of the past five years has been lost and future development is jeopardized (UNDP 2000).

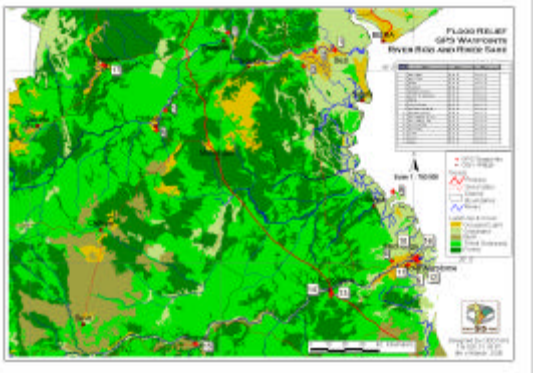

FIG. 2: Locations of landing spots and affected villages based on GPS measurements with a land use map as background.

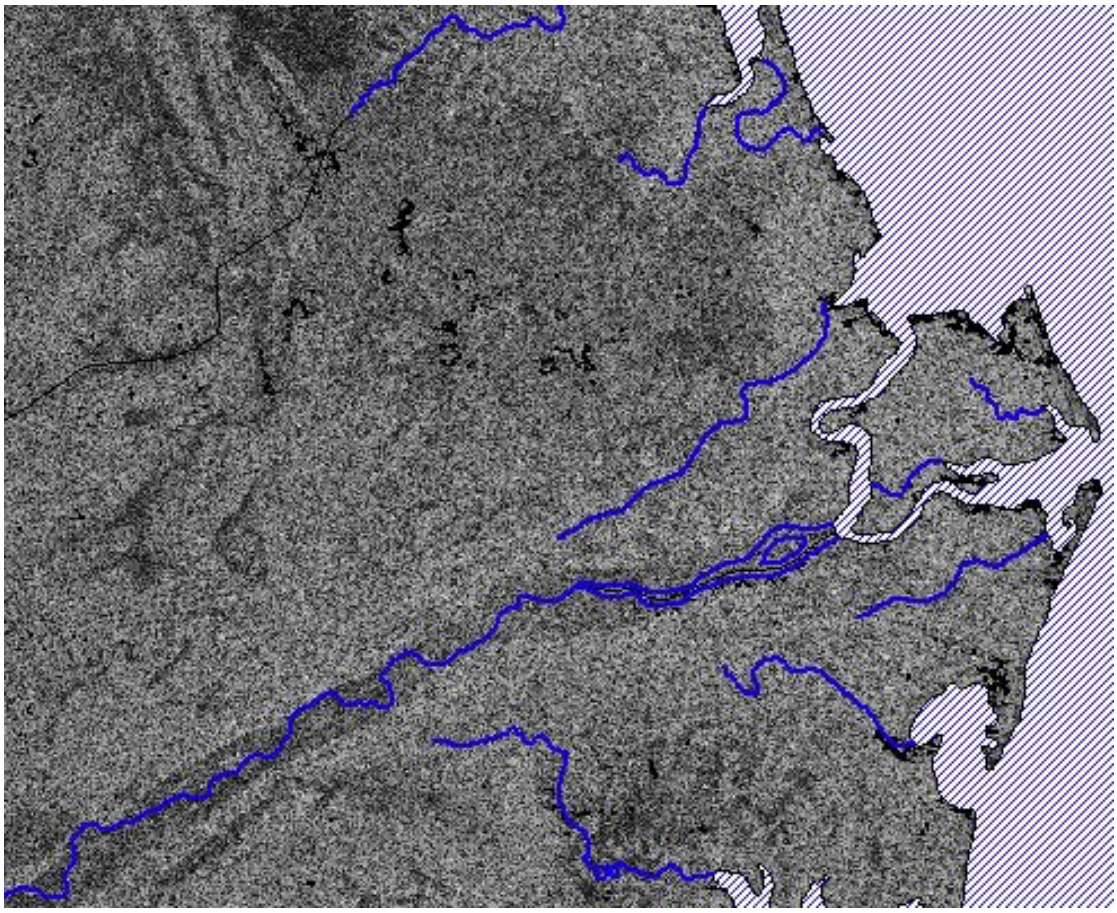

FIG. 3 Water mask derived from a radar image (ERS Tandem Data). The figure shows the usual river run and flooded areas along the river Save.

The areas most devastated were in the Incomáti and Limpopo River Basins in southern Mozambique and the Save and Búzi River Basins in central Mozambique, with the loss of lives and damage to property most severe in the cities and larger towns on the banks of these rivers: Chókwè, Guijá and Xai-Xai on the Limpopo River, Magude and Xinavane on the Incomáti River; Machanga and Nova Mambone on the Save River; and Búzi on the Búzi River. During the emergency phase of the floods, the liaison officer of the UN Disaster Coordination Committee (UNDAC) in Beira requested CIDDI-GIS technicians to provide maps with coordinates of the affected villages in the Save and Buzi River Basins (see FIG. 2). At that time Caritas requested CIDDI to coordinate the information flows on the floods and to network with communities about longer term rehabilitation plans. Visits to the affected areas followed.

As an immediate response to this situation the FLAME project was initiated which focussed on rapid flood assessment.. The main purpose of the project was to supply geoinformation up-dated by satellite imagery for the effective implementation of future flood relief through improved information and coordination. Mainly concentrating on short- and medium-term activities (see table 1) it provides building stones for a catchment information system of the affected river basins, and finally contributes to establish a regional flood early warning system.

In the event of natural disasters Mozambique can not rely on an effective warning system. For this reason decision-makers are considering to establish an early warning system, for the provision of food stores and to construct shelters in “safe areas.” The second wave of flooding following the cyclone Eline was due to rivers bursting their banks after heavy rainfalls occurred upstream in Zimbabwe and South Africa. Across the region there is no reliable system for sharing information about rising water

short-term	✍ support of rescue flights
	✍ maps of landing spots
medium-term	✍ Food and water supply
	✍ Resettlement, land re-use
	✍ Establishing emergency shelters
long-term	✍ Flood early warning system
	✍ Catchment Information System
	✍ Integration in regional and (inter-)national information system

Table 1 Activities for the mitigation of flood induced hazards.

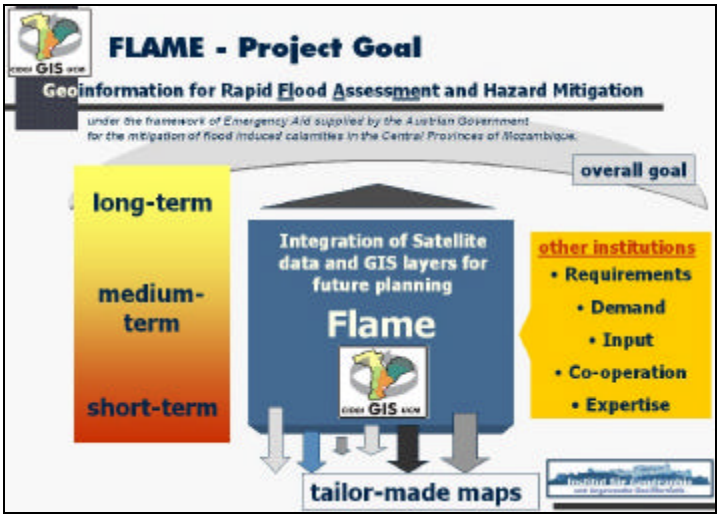

FIG. 4 Project goal and design of the FLAME project.

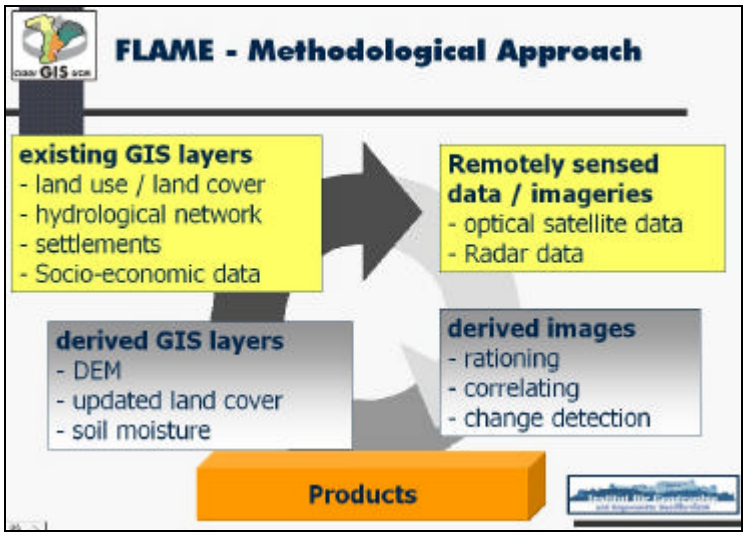

FIG. 5 Producing tailor-made maps as a cyclic process: existing data sets are used to support the analysis of satellite imagery, from which new GIS layers are derived. At the same time remotely sensed data serve as cross-validation for existing GIS layers.

levels. A flood monitoring system based on a network of meteorological stations measuring both rainfall and discharge as well as procedures for information exchange on river basins could assist in forecasting potential crises and facilitate the early arrival of rescue and relief operations in emergency situations. Even though SADC (Southern African Development Community) has several units which collect information at a regional basis (e.g. FSTAU, SETU), awareness about this information sources and the use of the available data are still at low levels in Mozambique. The CIDDI-GIS attempts to overcome these deficiencies by building institutional networks with other organisations and centers in the region.

3.3 Social research: Affectedness of local communities and vulnerability

An effective program to mitigate flood damages requires a better understanding of the impact of recent floods. Although some studies have been carried out, detailed maps on the exact delineation of the flooded areas do not exist. Comprehensive studies on the human, social and economic dimensions of the floods have yet to be undertaken. Before the memory of the floods vanishes, it is urgent to chronicle the extent of the floods and to assess the social, economic and ecological impact on communities in the affected areas.

A new project proposed, referred to as the INTEGER Project, extends and deepens these earlier studies. The INTEGER Project will utilise the CIDDI-GIS laboratory and equipment to analyse satellite imagery. CIDDI research teams have already visited communities in the affected areas and their findings have been partly incorporated into GIS spatial models. These community surveys will be extended in a participatory approach that is known as CiGIS ("community integrated GIS"). CIDDI and CIDDI-GIS have already conducted three workshops and public seminars in which community leaders, government officials and representatives of non-governmental organisations discussed preliminary findings and the impact on their own programs (LANG et al. 2000; TSAMANEA 2000; JOSÈ et al. 2000). The INTEGER Project will continue these initiatives and make the results more widely available to communities in affected areas and to the policy and planning community, both governmental and non-governmental.

An underlying objective of the INTEGER Project is to build capacity in the academic and scientific community with the aim to address pressing national problems. The Project addresses this objective by a close integration of research and education. Senior staff of CIDDI and CIDDI-GIS will introduce students and junior researchers of both UCM and the Pedagogical University in Beira to the technical features of Geographic Information Systems and the use of remote sensing by means of a "learning by doing" approach. Several introductory courses along these lines have already been offered to technicians and planners from Tete, Manica and Sofala provinces. The INTEGER Project will also involve students in community based field studies which will take mapping products derived from satellite images to communities and return with a verification of spatial locations and the accumulated knowledge base of local communities. Aspects of the methodology known as CiGIS are being developed in another study in conjunction with the University of West Virginia and the University of Pretoria. CIDDI is already working closely with the Associação de Serviços Comunitários (ASSERCO), which has a range of development projects in Buzi District and has done extensive surveys on the impact of floods in these communities.

Another project deals with the affectedness of local communities by landmines and demining activities. The scientific objective it to gain insight into the socio-economic and cultural significance of the presence of landmines for the population. In other words: how do people perceive and deal with the presence of landmines in specific spatial contexts? The research would apply a cultural-geographical approach towards the nation-wide landmine problem which has a strong spatial component. The project would study how individuals make trade-offs between getting an income (for example in agriculture) and the risk of being injured or killed by a landmine, thus shaping the landscape and ascertain subsistance. The analysis will also compare trade-offs in different environments. For example, what is the influence of a higher risk to be killed by a common disease as compared to the risk of a fatal landmine while fetching firewood?

The objective is to improve the effectiveness of demining programmes by introducing knowledge about the socio-economic and cultural significance of the presence of landmines and thus improving the multicriteria analysis that is presently used. The

comparative analysis allows decision makers to apply fair and scientifically sound criteria for the rating of mined zones and make the prioritising of areas to be cleared easier and less arbitrary.

3.4 Planning and implementation of a reconstruction programme.

The needs of the affected communities cut across several time frames. The first was the emergency and the survival phase, in which the principal concern was to save the lives of marooned individuals and families and to supply them with the basic provisions needed for survival. The second was the rehabilitation phase, in which communities and support groups sought to rebuild houses and restore basic services (see table 1). By the end of 2000, communities have largely returned to a normal functioning, although many basic services and access roads have not been restored.

The Mozambican Government's rehabilitation program includes for the first time a component on planning for future emergencies and mitigation of the hazards. Whatever the uncertainties, Mozambique is characterised by regular climate fluctuations, with periodic cycles of drought and floods. Whether global warming will make these patterns more pronounced remains to be seen, but surely the country will experience more floods, if not during the next rainy season then the next year or the year after. When the direct hazard for life and properties has been dealt with, only rapid and appropriate resettlement of displaced people can guarantee food security and continuous economic development in the areas affected. The resettlement should be accomplished according to defined principles and established norms, in way to avoid spontaneous informal settlements and the breakdown of water and sanitation services. To accomplish this, the planning scenarios will have to be based on reliable map information, from which, for example, the safest areas or areas with a reduced vulnerability risk could be chosen. Informal settlements in low-laying areas close to rivers not only put their inhabitants at risk, but pose administrative problems for their localisation and evacuation in case of emergencies. In addition, the flooding of wide-spread cultivation (e.g. rice crops) along the rivers endanger food supply and destabilise the riverbanks, thus increasing the volume of material washed out during successive floods.

4 DISCUSSION AND PRELIMINARY CONCLUSIONS CONCERNING THE ROLE OF GI IN SPATIAL PLANNING IN CENTRAL MOZAMBIQUE

Geoinformation plays undoubtedly an important role in spatial planning. Regional development, environmental monitoring, dealing with emergencies are processes where geoinformation is required. That the actors involved request the information and have the means available to use GI effectively for planning and decision making, is however an important pre-condition for seeing the benefit of it all (see RUFAI MENDES et.al. 1998) . To set-up CIDDI-GIS as a technical facility and to train personnel to operate the laboratory reflects important achievements in the development process, but several other steps have to follow.

Mozambique's decentralisation process is still young and spatial planning on provincial level and below represents quite a new concept. The traditional hierarchical system does not change quickly which evokes questions about mandate (in regard to the permission to acquire and hold certain data or information) and responsibilities (who should disseminate certain information and to whom?). Experiences have shown, that activities have to be undertaken with the aim to change the attitude in regard to information sharing. The facilitation of this change process is an important factor in a society still polarised in geographical, political, economical and educational terms. The unrestricted access to geoinformation at a centre such as CIDDI can contribute to the building of mutual trust and better options for conflict resolution.

We believe that research is a driving factor for development. Research projects open up new areas for development co-operation, particularly in the field of GIS and remote sensing applications (e.g. BLASCHKE et al. 2000a,b.). Geographic Information Systems have to be embedded in the existing institutional, organisational and cultural framework (TAYLOR 1991, HARRIS and WEINER 1998). This creates specific research needs addressing GIS in organisational development and the political dimension of GIS with specific focus on developing countries.

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