

NATURAL RESOURCES SYSTEMS PROGRAMME
PROJECT REPORT¹

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Decentralised and participatory information system development in the Kintampo districts.

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SUMMARY

Information is a key ingredient for making effective policy decisions on natural resources management for improved rural community livelihoods. However, in the devolution of management responsibilities to local governments under the decentralization regime in Ghana, arrangements were not made to adequately equip them to generate data/information for management policy decisions. Consequently, local government policy decisions on natural resources and rural community livelihoods, to a significant extent, are not evidence-based. This renders most of their policy actions ineffective at addressing real problems related to natural resource use and community livelihood improvement.

The main goals for implementing this project was to develop a strategy that enhances the availability and use of information in policy decision-making for natural resource management and improved rural community livelihood. This was to be achieved by establishing a decentralised integrated geo-information infrastructure through: improving popular and institutional appreciation for information use in policy decision-making processes, building and enhancing local capacity to generate data/information through a participatory approach and integrating them in decision making at all managerial levels

The report briefly explores current dominant approach to natural resource management in Ghana, and information availability and use for natural resource management. The responsibilities of the local government structures and associated information requirements are outlined. Geographic information system and related technologies and the relevance of their applications to the promotion of participatory data/information generation for decentralised decision making are examined. Details of the application of participatory approach and principles to GIS development and implementation of a decentralised information system in the Kintampo District and Sub-districts are provided. In spite of the instructional, political, technological, social, cultural infrastructure and other challenges, there were worthwhile achievements. A participatory strategy for developing a decentralised information system at the local government level has been initiated for further improvement. Local capacity for generating data and information has been built for future up dating of database and transfer of the technology to other areas. To some extent data

availability and the sensitivity of the importance of institutionalising data/information in management decision have been improved. Importantly, there are lessons observations, recommendations whose due considerations are important for improving on the process further improving up-take in future up-scaling processes. The purpose of this should be to optimise the generation of data/information for decision-making at the local government level, for enhanced natural resource management policy process and improved livelihoods in most deprived rural communities in Ghana.

CONTENTS

SUMMARY.....	2
LIST OF FIGURES.....	5
LIST OF PLATES.....	5
ABBREVIATIONS.....	6
1. Natural resource management at the district and sub-district levels.....	7
2. Environmental and natural resource management, policy decisions and Environment.....	10
Information systems and natural resources management for improved livelihoods.....	10
3. Geographic information systems and related technologies.....	15
4. Decentralised participatory GIS development approach: the Rationale and principles.....	22
5. Participatory GIS application in the kintampo district and sub-district to enhance natural resource management policy process and rural livelihoods.....	25
6. Feasibility studies and identification of beneficiaries.....	31
7. Institutional context, partnership, collaboration and need assessment.....	34
8. Up-scaling.....	61
9. Collaborative/participatory management of the information system.....	64
10. Observations, lessons, challenges, constraints and achievements.....	67
11. Recommendations.....	70
12. References.....	73

LIST OF FIGURES

- 1: Environmental resources are heterogeneously distributed in space: Water bodies' distribution and the topography in the New Longoro Area vary in space
- 2: GIS handles both locational and descriptive data. Arcview showing spatial and attribute information on the environment and levels economic activities New Longoro Area
- 3: Some essential elements of thematic spatial database for sub-district gis
- 4: Data Entry Views of SPSS
- 5: Form for data entry
- 6: Free-hand drawn map by New Longoro AC members
- 7: DEM representing the topography of sections of the Kintampo Districts
- 8: Land-use/cover of the Kintampo Area
- 9: SPSS information output from the NLA survey
- 10: Thematic GIS information output from the NLA survey

LIST OF PLATES

- 1: The research team in an initial consultative meeting with potential beneficiary Sub-Districts
- 2: Multi-stakeholder discussions on improving information use in policy decisions among a group of workshop participants in Kintampo
- 3: AC, MOF and Community members in a training section for Data entry and analysis
- 4: A community member using a GPS receiver to map resources and new settlements
- 5: A trained New Longoro Area member training members of the Babato for questionnaire administration

ABBREVIATIONS

AC	Area Council
CERSGIS	Centre for Remote Sensing and Geographic Information Services
CHIPS	Copenhagen image Processing System
CSIR	Council For Scientific and Industrial Research
DEM	Digital Elevation Model
DPCU	District Planning Committee Unit
EAP	Environmental Action Plan
EISD	Environmental Information System Management
EPA	Environmental Protection Agency
EPC	Environmental Protection Council (Currently EPA)
GERMP	Ghana Environmental Resource Management Project
GIS	Geographical Information System
GPS	Geographical Positioning System
KNUST	Kwame Nkrumah University of Science and Technology
MLGRD	Ministry of Local Government and Rural Development
MOFA	Ministry of Food and Agriculture
NDPC	National Development Planning Commission
NFSTZ	Northern Forest-Savannah Transitional Zone
NGO	Non Governmental Organization
NLA	New Longoro Area
NLAC	New Longoro Area Council
PM	Presiding Member
ERMS	Environmental Resource Management System
RPCU	Regional Planning Coordinating Unit
SPSS	Statistical Package for Social Sciences
SRI	Soils Research Institute
UN	United Nations Organization

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1. NATURAL RESOURCE MANAGEMENT AT THE DISTRICT AND SUB-DISTRICT LEVELS.

Policy decision informed by inaccurate or no information fails to respond and address real problems for which it is intended. Information is a key input for sound policy decisions in all sectors of management. This applies more especially in the effective management of natural resources use for improved livelihoods at the local and the community levels where effective daily decision-making on competing multiple and conflicting natural resources uses are inherently prevalent.

At the local government and community levels, the multi-sectoral resource-use activities vary widely across space of different scales. Consequently, local government management policies, development programmes and interventions *must* have accurate spatial reference and context as information input for decision- making process, and as output in terms of development plans and implementation, if they are to be more effective and beneficial to rural communities.

The multiplicity of users and managers of natural resources makes it imperative that information input for policy decisions on resource management and exploitation is multi-sectoral and organizationally cross-cutting. Policy decisions must seek to practically integrate the multi-directional biophysical and socio-economic information in a unified or holistic policy formulation. Therefore, to a significant extent, the approach and strategies to data/information gathering should be firmly embedded in the principles of, consultation, consensus building, participation, partnership and networking. Addressing the issues related to data/information generation and use requires the adoption of an information system whose development and implementation provide platforms and opportunities to generate a multi-sectoral data/information system at the local government level based essentially on participatory approach and principles.

Geographic information system provides the requisite setting for developing such a system. The integration of functionalities, practical applications, the principles of participation as they are related to the responsibilities and functions of individuals, groups and institutions in the local

government structures as they are related to natural resource use and management, and improved livelihoods of rural communities highlight the need for adoption of GIS as an information management decision tool at the local government in Ghana.

Present approach to natural resources management and information

Traditionally, communities (including individuals and groups) manage natural resources by knowledge acquired through experiences and those bequeathed by previous successive generations. These management skills and knowledge are formed through a slow process of experimentation, accidental observations and trial-and-error. Natural resource management at this level is linked with community livelihood strategies. The reverse is also true. Thus, individual socio-economic status is a product of the quality of his decision-making process, which is partially but dependent on relevant information.

There are also traditional institutions with restrictive interventions and belief systems for managing natural resources. These are proving inadequate at managing natural resources as socio-economic and cultural environments undergo transformations and the traditional authorities wane. Many institutions: both public and private contribute significantly to managing natural resources. Even though these have expressed objectives for rural livelihood enhancement, actual benefits are, practically, not felt. Besides, they are yet to provide adequate proof of their capacity to manage natural resources sustainably.

Socio-economic, demographic and biophysical processes, that in various forms of combination and intensity drive the expression of particular and local- specific living conditions and natural resource status are important in identifying and addressing real natural resource management and community livelihood challenges. However, this is poorly understood due to inadequate information.

Hence, at the local government level, natural resource policy decisions are generally not informed by real and timely data/information input. Rather, policy decisions are generally based on assumptions and perceptions: where there is lack of relevant data and information; or generalised, inaccurate and outdated information: where some form of information exists.

Generally, there is inadequate or lack of socio-economic data/information at the local government level. Where, they exist, it may be available for only a limited number of localities. Available spatial data of roads and settlements for the country were captured as far back as the early 1970s. Only a few localities have been updated since then. Where local government departments and institutions attempt a production of their own information, the quality of the final products are inadequate in terms of scale and the level of aggregation. Besides, available information may be generated for limited or specific issues or a single sector rather than multi-dimensional sectors or issues that is typical of the real decision making situation at the local government level. In some cases, the existence of available data may be unknown to those who may need them.

The culture of rationally using information in a systematic policy decisions is not adequately developed. Rather than taking pains and time to ensure that sufficiently good information is acquired for decision-making, it is often preferable to adopt a quick and more short-circuited approach of basing policy decisions and development plans on assumptions, inaccurate or no information. This has not helped a progressive evolution of the culture of institutionalizing of multi-dimensional information in a systematic rational decision process.

In the management of natural resources, local specific concerns, aspirations and the various uses of natural resources are not factored into policy decisions. Effectively, the top hierarchy of the local government structure has succeeded in excluding the local government substructures, communities and resource-user groups in the natural resource management policy decisions, at the heavy cost of policy relevance, resource-user cooperation and acceptability, particularly, at the implementation phase.

As external and locally generated factors introduce conflicts that complicate natural resource management, it becomes crucial to improve only the quality, but also speed up the traditional and institutional core processes of generating knowledge and acquiring new skills for enhanced natural resources management processes.

2. ENVIRONMENTAL AND NATURAL RESOURCE MANAGEMENT, POLICY DECISIONS AND ENVIRONMENT

Accurate, up-to-date and detailed information is a critical input for rational decision-making process for sound management policy formulation. This is, particularly, important local government administrative setups. Accurate and evidence-based information reduces the level of uncertainty in the decision-making processes by improving our knowledge of situations.

Rational formulation on resource management policies requires identifying signals of existing underlying problems or needs, a systematic analysis of problems, the setting of objectives and standards of acceptable level of addressing the needs. All these demand substantial inputs of evidenced-based information.

Selecting the right management policies for resolving problems at the district level must involve evaluating information on the potential benefits of socio-economic and environmental consequences of alternative courses of policy actions on natural resources and community livelihoods. It is argued that without the right kind of information input, there can be no sound policy decisions on natural resource management for improved community livelihood.

Managerial responsibilities at the Local Government level

Rural communities, groups, families and individuals make daily decisions that affect their livelihoods and the natural resources on which they depend. Accurate and timely information could enhance their decision processes for improved choices related to livelihoods and natural resources management. Consequently, this would improve their quality of life and the environment. According to the UN Millennium goals (Goal 8), access to information is a universal right and an essential means to fight poverty.

The decentralized local government administrative units: the districts and sub-districts are empowered to implement national, regional and district natural resource management policies. Within the framework of the national and regional development policies, the districts and sub –

district structures are expected to construct local-customised development programmes and implement them in communities under their jurisdictions. They are also empowered with the capacity to pass local byelaws to enforce natural resource-use policies. The Area Councils are the sub-district administrative structures for rural level development programme implementation

It is at these levels of local government set-ups that policy formulation and implementation must make the collection of detailed data; processing, analyses and information communication integral elements of policy formulation and implementation processes. Institutionalization of information and data for rational management decision-making must be prioritised. Presently, however, lack of requisite capacities to effect these management activities at this micro-administrative level places significant limitations on their capacity to effectively discharge these assigned roles as key partners in natural and environmental resource management.

In the management of natural and environmental resources in Ghana, local governments are expected to take an active role in enforcing bush-fire laws, initiating tree-planting campaigns, regulating chain saw operators, setting aside district reserves and plantations, terracing and planting denuded hillsides and prohibiting clearing and cultivation of riverside (Ref)

The National Development Planning Commission (NDPC) demands that both the district administration, districts sectoral departments, institutions and the sub-districts generate and convey information on their areas of operations, development plans and other activities as inputs for national and regional development and management policy decisions (NDPC and MLGRD, 2004). To this end, the District Planning Coordinating Unit (DPCU): the inter- sectoral planning body of districts in Ghana are expected to establish database systems to generate information. (NDPC and MLGRD, 2004).

3. INFORMATION SYSTEMS AND NATURAL RESOURCES MANAGEMENT FOR IMPROVED LIVELIHOODS

Goal 8 of the UN Millennium goals mentions the need for everyone to benefit from information and communication technologies. Information technologies offer a unique opportunity for developing countries to increase political, social and economic participation by promoting access to and sharing of knowledge, creation of networks and strengthening of decision-making processes.

New information technologies are not a luxury but an essential instrument for sustainable development. In Ghana, there have been real achievements in the applications of information and communication technologies in different areas. However, there is a mismatch and gap between rhetoric and the real applications of information technology in natural resource management and planning for improved rural livelihoods at the local government level.

The context and nature of management and policy decisions at the local government level and Information Systems

a. Spatial and non-spatial data for resource use and management in space.

Typically, rural and poor communities under local governments are distributed across a wider space. Unlike management and governance of compact urban systems, local government and institutions make decisions on rural communities and land resources of differential spatial reference.

In the rural dominated districts and sub-districts, human needs, socio-economic activities, socio-economic development levels, cultures, needs and aspirations, population density, groups, human migratory patterns, etc. vary in space. Topography, geology, soil types, land suitability for crop types, distribution of water bodies and wetlands vary significantly in space at the sub-district and district levels.

Given the diverse spatial distribution of land and environmental resources and human activities at the local government level, policy management faces the challenge of proper identification of real states of natural and environmental resources as they are distributed in space. Again, developmental efforts and limited management resources must be applied or targeted to ensure spatial efficiency and equity of natural resource management and utilization among communities.

Management policies aimed at addressing natural resource issues for improved community livelihoods must be sufficiently informed by adequate knowledge. To confront and successfully address these challenges, some basic conditions must be fulfilled: the provision of timely and adequate information on natural resources base and their various uses as they are distributed in space.

Acquiring these information demands making a comprehensive inventory of land and environmental resources available, and assessing their quality. Land and environmental resource managers and users must also know where significant changes occur in the quality and quantity across the landscape over time. This calls for regular monitoring. Where necessary, remedial measures can be taken before significant damage is done to sensitive land and environmental resources. Again, to ensure that natural and environmental resources uses are carried out according to planning standards, actual land resources use must be evaluated and compare with management policy benchmarks for efficiency or sustainability.

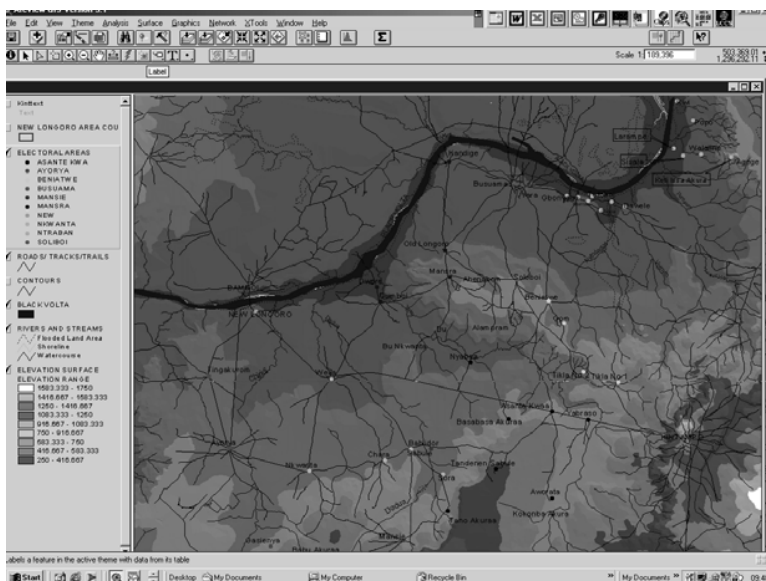


Figure 1: Environmental resources are heterogeneously distributed in space: Water bodies' distribution and the topography in the New Longoro Area vary in space

b. Multi-dimensional and Multi-sectoral integrated resource use and management

The high diversity in the nature of land and environmental resources is a constant. Natural resource use is a multi-sectoral activity that involves different groups and individuals at different localities. These make different uses of these resources for diverse needs. Therefore, a sound environmental and natural resource management must not only be multi-sectoral but integrated and holistic. This suggests that management must integrate data sets from different sectors and localities to formulate planning strategies.

Data and information requirements at the local government level are multi-sectoral. As earlier indicated, the district authorities in Ghana are expected to make and implement policies on natural resources and livelihoods. They must handle data from different sectoral departments and institutions and also provide information for development programmes at the national, district, institutional and community levels for planning and implementation activities. Different communities and sectors of economic activities make specific and differential uses of different resources in different locations, which may be determined by distinct market demands; culture; quality and quantity of resources available, technology for resource utilization and government policies.

Given the wide range of the diversity of resource and the associated issues in different communities, management faces the challenge of integrating a multiplicity of different data sets and information in natural resource management in a holistic policy and management decisions in order to minimize conflicts between users and uses, and to ensure harmony and efficient resource use and management. Thus, both natural resource management and users need multi-dimensional information, including biophysical, socio-economic, cultural, and demographic, etc. if they can make informed decisions.

This information must be freely shared and communicated among all individuals, groups and organizations with stakes in the management and use of these resources.

c. Participative natural resource management style

As previously stated, natural resource use is a multi-user activity. That is, people in the same locality may make different uses of the same resources. It presupposes that different data and information related to resources and activities at the same locality must inform local government policies. This will provide a holistic appreciation of issues related to management of resources.

Given the growing range of actors concerned with environmental issues, the increasingly contested nature of environmental problems and the importance of building trust around decision-making, a more participatory approach to environmental policy processes is often required. Across the world there is a growing concern about the links between environmental and livelihood/lifestyle issues among a wide range of actors. There is also a heightened demand for access to decision and policy-making processes of central and local government institutions.

In such changing contexts, then, participation in natural and environmental policy process will become a basic requirement, not an add-on extra. Thus, any information technologies to be used at the local government level must have the capacity to provide platforms for the participation of the various stakeholders in the various processes of the policy formulation at different levels.

4. GEOGRAPHIC INFORMATION SYSTEMS (GIS) AND RELATED TECHNOLOGIES

Geographic information system is a powerful computer-base technology that enables the collection (inventorying), storage modelling, analysis, integration and display of data on objects and activities distributed in space. Though comparatively young, it has many useful applications that cut across a wider spectrum of human activities related to space.

Geographic Information Systems functionalities provide the capacity for carrying out the relevant management activities Natural resources management includes planning, implementation, monitoring and evaluation activities. The functions of GIS offer opportunities for carrying out

these land and environmental resource management activities. Thus, GIS is the most suitable information technology since it is capable of supporting management decisions on spatial-based natural and environmental resources and livelihoods at the local government level.

Therefore, in the opinion of researchers and communities who appropriate and apply this and related technologies to enhance resource management and livelihoods, GIS means more than the various technical descriptions currently available. The development and implementation of GIS projects provide opportunities for initiating essential social processes critical for participatory policy process development. In the application of GIS for enhancing community livelihoods and natural resource management, GIS connote:

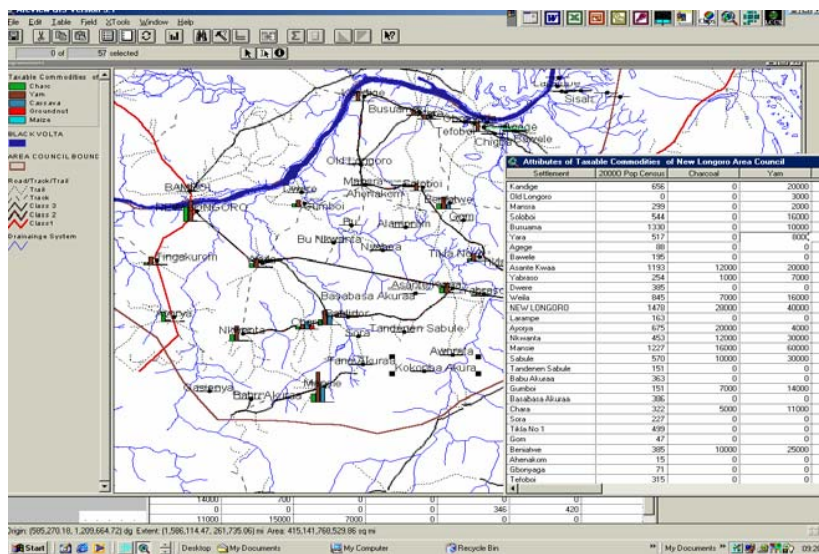
- Consultation
- Dialogue and consensus building
- Openness
- Community empowerment through enhanced awareness on of ones environment by improved spatial perception, available resources, alternative livelihoods, etc,
- The building of a sense of ownership through participation
- The building of confidence and self-worth through acquisition of modern technological knowledge
- Improved communication across the various levels of administration
- Networking between stakeholder

To be fully effective, GIS needs to link and map data derived from local knowledge, empirical surveys, topographical maps and satellite imagery or aerial photography at suitable scales for micro-level case studies (e.g. 1:5000 or 1:10000 scale maps) and for wider overviews (1:50000 upwards).

Geographical information systems are useful as a tool for combining social and biophysical database to facilitate and allow an integrated multidisciplinary analytical approach to a holistic

understanding of a particular natural resource management and allows enhancement of rural community livelihoods, improving spatial perception, etc.

The difference between GIS and other information systems is that GIS can handle spatial or locational data as well as descriptive information on objects and activities, whereas the others cannot. That is where the strength of GIS technology lies, and makes it suitable for application in dealing with information on land and environmental resources which are distributed in space at

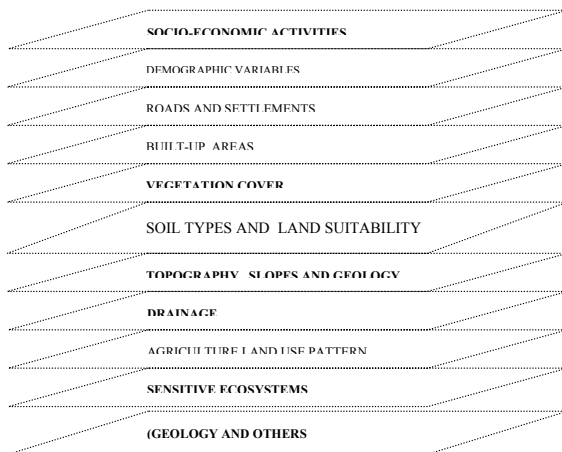


both the sub-districts and districts level.

Figure 2: GIS handles both locational and descriptive data. Arcview showing spatial and attribute information on the environment and levels economic activities New Longoro Area

GIS is capable of addressing many natural and environmental resource use and management questions such as: identification of vulnerable landscapes that must be protected, identification of crops cultivated at different localities; identification of soils that are suitable for specific crop types, identifying deprived communities with special interventions and needs.

Figure 3: SOME ESSENTIAL ELEMENTS OF THEMATIC SPATIAL DATABASE FOR SUB-DISTRICT GIS



Issues that evoke questions involving spatial consideration find GIS a useful tool in their analysis for proper understanding. Geographic information system is capable of integrating data/information on multi-sectoral activities for a holistic understanding of real situations and management through overlaying of all relevant information.

Some General Cost And Benefits Of GIS Applications

Cost (Direct and Indirect)

- Hardware and software
- Maintenance
- Database (creation, maintenance, updating)
- Training and administration

Benefits (Direct and Indirect)

- Fewer staff required
- Less space for data storage
- Less time for repetitive activities
- Faster data/information provision
- Availability of information
- Up-to-date information
- Better quality information output
- Improved information sharing and flow
- Better informed decision making
- Greater analysis and understanding of problems
- Justification for decision made
- Improved visualization of data

Present Approach To GIS Project Development And Implementation In Ghana

There has been tremendous effort at applying GIS in natural and environmental resources Ghana. Most of these are projects that are largely donor or central government funded with narrow and predetermined objectives. The private enterprises are driven by immediate economic considerations. These are set up mainly for data (biophysical) generation, storage, a few research activities and the provision of other services. Actual applications of GIS in natural resource management for improved livelihood are limited.

Largely, they are established in government departments, the universities and research intuitions (egs University of Ghana, KNUST, survey department, and CSIR) located in cities at the regional or national levels. Application of GIS at the districts and sub-districts where the core activities are related to management of natural resources that are distributed in space are practically non-existent.

Much less, the approach to design and implementation of GIS projects has largely exclude the involvement and consideration of the districts, sub-districts and communities. This reflects the popular thinking that information technology belongs to the highly trained experts and not the illiterates and uninitiated rural community dwellers.

Normally, the high-level-GIS skill and low level application projects are preferred. Thus, with the exception of isolated cases, most GIS projects are led, designed and implemented by foreign highly technical and specialised GIS experts. The local assistants are also technically trained. Little attention is given to the real applications of GIS functionalities to manage resources for improved livelihoods. Thus, the awareness, knowledge of the applications and relevance of GIS has remained the exclusive preserve of a few technocrats who are hardly managers of natural resource uses.

The approach to GIS implementation has been fundamentally technically driven: the vital human processes that promote the principles of data/information user participation and their relevance to the real needs of society, and also ensures sustainability of GIS implementation are not prioritised.

Typically, biophysical data are captured into or generated by GISs. In most cases sectoral, rather than multi-sectoral information are considered. Actual use of socio-economic and demographic and their integration with biophysical data for a comprehensive analysis of management issues for holistic natural resource management are limited. Thus, even though human activity and natural resource inter-relationships are strong, present approach to GIS development portrays the reverse impression.

Data collection is not initiated at the lowest level of society, where opportunity would be created for policy-maker-rural community interactions for mutual understanding. Consequently, information generated by these systems often fail to address real resource management and developmental needs at the rural communities, sub-districts and districts levels where information for natural resources management and enhancement of livelihoods is critical.

If GIS establishment engages the participation sub-district and communities, information output would reflect local realities; it will provide opportunities for communities to provide inputs for natural resource management policy decisions at higher levels. This will encourage the practice of bottom-up approach to natural resource and environmental management and also promotes management regimes that deal with real community needs and concerns rather than those based on speculations and generalizations handed down in a top-down management fashion. Awareness and demand for relevant information resources will encourage information flow and use for resource management and livelihood decisions.

The Ghana Environmental Resource Management Project (GERMP) was implemented to support the effective implementation of Ghana's Environmental Action Plan (EAP) (EPA 1996, EPC 1991). An Environmental Information System Development project (EISD) was implemented to support the Environmental Resource Management System (ERMS) component of GERMP through the provision of environmental information. In spite of these and other efforts made in this direction, the expected benefits from the implementation of these projects are yet to be fully realized at the national level, and much less so at the district level. This is due to problems related to:

- data accessibility, information flow and sharing
- information on data sources
- culture of lack of appreciation for data/ information in decision making,
- institutional and management resistance to change,
- real and imagined cost of information technology
- Bureaucracy
- information management policies
- unavailability of socio-economic data

- lack of awareness of the existence of the information/data or information system.
- the bureaucratic approach to data acquisition

(EPA, 1998).

As mentioned earlier, the usual approach to establishing these GIS projects led to the exclusion of the district and sub-districts. Yet, little has been done to create awareness of the existence of the projects outputs. The level of spatial scale and generalization of some of the information also made them somehow unsuitable for use at the community and local government levels. In some cases, data that were incorporated were outdated; and therefore may not accurately reflect present realities. Relevant socio-economic and demographic data were not at all considered.

5. DECENTRALISED PARTICIPATORY GIS DEVELOPMENT APPROACH: THE RATIONALE AND PRINCIPLES

It is widely accepted that effective natural resources management for enhancing rural community livelihoods must involve the participation of all relevant local interest groups and sectors. That means, management policy processes must include the actors that are affected by or influence natural resource management policies. Especially, the voiceless, poor and vulnerable rural communities at the lowest level of societal organization that directly depend on natural resources and, who are the ultimate targets of natural resource policies must not be excluded. This is the fundamental principle for the operation of the local government concept.

Thus GIS design, development and implementation at the local government level processes must incorporate activities that provide niches which create platforms that evoke a spirit of participation and inclusiveness of the various actors in natural resource management. Activities that promote the social processes of participation in GIS development include:

- consultations and awareness creation
- setting of project objectives
- determination of data and information needs
- questionnaire design and administration,
- data entry and data analyses,
- data processing and modelling, information display and discussion.
- Joint implementation and management of information system.

Participatory GIS also seeks to incorporate local knowledge, concerns and expectations. This approach means that all categories of beneficiaries should have access to GIS facilities and GIS products for management activities and advocacy. The purpose for this approach and principles are to enhance the achievement of these social benefits:

Community empowerment and the sense of ownership and GIS

Empowerment in this sense does not mean power-balancing or redistribution, but rather, increasing the skills and conditions of individuals, groups, institutions and communities to make better decisions to manage the environment and improve their livelihoods.

Knowledge is one path through which the rural poor can be socio-economically empowered. In addition to improving their choices in the adoption of potential livelihood alternatives, it gives voice to the poor and enables their participation in managing their own natural and environmental resources. Ultimately, it is the poor themselves that can improve their lot through individual and collective actions.

Being able to use modern technology enhances self-confidence and worth. Geographic information technology is potentially an enabling technology for social empowerment since it is a vehicle for accumulating and disseminating. Thus, user-centred and participatory GIS design and application must ensure a high degree and comprehensive user participation in GIS development.

To do this, they must be educated, trained and engaged in the entire process of establishing the information system. By this, they will be empowered to implement and manage such systems on their own, as the project term ends. Moreover, participating in building the information system increases their sense of ownership and reduces the tendency to resist the implementation of the system.

Consultation and awareness creation for collaboration

Change begins with a process of communication and agreement. This can be achieved through consultation and awareness creation. The aims are to build up the participating actor's capacity to act, and support them in improving their problem situations in a self-reliant and empowering manner. Lasting improvement requires that researchers help clients to change themselves. Effective social change depends on the commitment and understanding of those involved in the change process. In other words, if people work together on a common problem "clarifying and

negotiating ideas and concerns, they will be more likely to change their minds if research indicates such change is necessary. Also, it is suggested that collaboration can provide people with the time and support necessary to make fundamental changes in their practice which endure beyond the research process

Thus, consultations is seen as an important means of creating avenues for communication and negotiation for communities, individuals and groups to articulate their needs and participate in seeking solutions either among themselves or with local authorities. The work setting of GIS promotes inter-sectoral and holistic resource management strategy formulation where all communities are considered.

Communities who live off the land have good spatial awareness. In many instances where conventional maps are unavailable, they are capable of innovating suitable spatial representations of important geographical landmarks in their communities. Rural communities can better relate to GIS, which can improve their spatial perception; interpretation and better represent their local knowledge.

Other benefits for implementing GIS at the local government level.

Granted, Geographic information system application involves obvious cost, yet, the many direct and indirect substantial benefits and its unique advantages over other information management systems make GIS an indispensable tool in natural resource management and use efficiency at the district and sub-district level.

The application of GIS confers enormous advantages. Directly, there is less space requirement, fewer staffing needs, saving of time from repetitive routines such as manual map drawing (in GIS maps are digitised and stored in digital formats which can be used whenever needed) and the fostering of up-to-date information provision. Other indirect advantages of using GIS are: improved data/information identification, sharing and flow among the diverse users; better informed decision making; strong competitive ability since management and individuals are aware of problems and available advantages; greater understanding and analysis of issues and problems; justification for decisions made, and improved information visualization (Figure 1).

In recognition of its potential benefits, not only to fill the information needs, but to improve the very process of decision making for sound policy formulation for effective environmental and land resource management, a user and community based GIS development is being undertaken with a comprehensive application of participatory principles in the New Longoro Area Council in the Brong Ahafo Region of Ghana.

**6. PARTICIPATORY GIS APPLICATION IN THE KINTAMPO DISTRICT AND
SUB-DISTRICT TO ENHANCE NATURAL RESOURCE MANAGEMENT
POLICY PROCESS AND RURAL LIVELIHOODS**

The Kintampo District

The Kintampo District (now the Kintampo North and South Districts), occupies the geographical heart of Ghana. It occupies an area of. 6,500 m²: 4747.1 m² for north and 1697.8 m² for south. It is located toward the northern section of the NFSTZ. Soils and vegetation are therefore savannah and forest types. Due to its location in the transitional zone, it has high amounts of savannah woodland mosaic landscapes. Socio-economically, culturally and demographically the district is highly diverse for its size. Practically, all ethnic groups of Ghana are present. The district may be one of the most ethnically variable in Ghana.

The high heterogeneity of socio-economic activities and cultures influence individual and group management of natural resource use practices. Correspondingly, this complicates natural resource management. Consequently, the area requires a spatially, multi-culturally, socio-economically and biophysically comprehensive data sets for effective decision-making in managing natural resources and improving livelihoods the area. A management approach that will have a high chance of success in effectively dealing with issues in the area must make a rigorous analysis that reflect the individual and the synergistic impacts of the complex socio-economic, demographic and biophysical dynamics of the area.

Local Government Management and information requirements

In terms of information infrastructure and the capacity to generate information, the district was just a typical district in Ghana. The local government structures, institutions and government were inadequately developed to fulfil their managerial assigned roles to generate and rationally institutionalise information in the policy formulation and the implementation processes.

Analysis of the District Assembly, the Area Councils and the government departments prior to this study revealed that the Kintampo District and the constituent sub-districts (Area Councils as they are known in Ghana) had no form of information systems as tools to facilitate management

decisions. No systematic and comprehensive generated empirical information and data existed as inputs for the formulating natural resource management policy decision-making processes.

Thus, even though the need for data/information has been widely acknowledged, very little has been achieved in the overall process of encouraging the incorporation of information in the policy-processes. The culture of institutionalizing information for rational decision-making processes was practically non-existent. Largely, policy development process for natural resource management has not been evidenced-based.

In theory, they accepted that natural resource management policy must seek to be comprehensively decentralised and incorporate grass-root participation. In practice, however, the style and approach for management policy development lacked the essential elements of consultation and participation, which are key to popular acceptance and easy implementation for sustainability.

For these and other related reasons, most of the policies on natural resource use management fail. Characteristically, most policies generate either passive or active popular resistance and protest since they apparently fail to identify and deal with the actual concerns, problems and aspirations of the people. So they are perceived as insensitive, anti-social, anti-developmental and counter-productive.

Goals and Objectives of the Project Development

The main broad objectives for implementing this project was to develop a strategy to institutionalise information use for policy decision-making to ensure:

- Effective natural resource management and
- Enhance rural livelihoods.

These were to be achieved through the:

- Build capacity in data and information generation at the community and district levels
- Establish and information system for the AC and the District

- Provide information
- Build on their sensitivity of the need to institutionalising information and data in policy decision processes

Among others, the achievement of these goals would largely dependent on:

- enhanced access to information and data by all interest groups
- willingness of managers and policy makers to use information and data for decision-making
- the willingness to share data
- the capacity to update database of the information system
- the capacity to maintain system

General Approach and Outline

The methodology emphasised a high degree of decentralization. Decentralization dictated that the process takes place at the lowest level possible of the societal organizational unit of the communities, local government structures and institutions

Its execution was rooted in the participatory approach and principles. In this project, a true participatory projects is one that empower people by building skills, interests, commitments, and capacities that continue even after the project ends. This implies the institutionalisation of such initiatives and the corresponding capacity for activities to spread beyond the immediate project in both space and time. In the context of this project, therefore, participation in the planning, development, implementation and management of the GIS projects connotes:

Engaging all relevant actors and beneficiaries: individuals, groups, communities, AC, DA, sectoral agencies, NGOs and others in an interactive communication and practical-oriented learning environment where beneficiaries and other actors are empowered by skills and

knowledge acquisition for developing, implementing and managing their own management information system.

The purposes for adopting this operational approach was to ensure that:

- There is improved awareness creation
- Opportunity to address the concerns of all stakeholders, especially the communities
- There is a high level of commitment
- Local inventiveness in problem solving can be drawn upon
- Capacity for transferring the technology to other ACs and DAs is built at the subdistricts
- They build the sense of ownership and acceptability
- Facilitate data identification and gathering since they know their area better than others, and also many community volunteers will be involved
- Communities acquire skills and knowledge that enable them repeat the process to update their database for analysis
- Inherent risk in the project is minimised

BROAD STAGES AND ACTIVITIES OF THE PROCESS

The process of establishing an information system is classified into broad categories based on the typical activities characteristic of the process. There are different traditional categorisation schemes. Considering the low level of socio-economic, educational and technological development in the area, and the high level of user participatory in the process, significant necessary modifications to the typical stages.

Depending on the level of relevance in the process, some stages were more extensive and prominent than others. For practical reasons, it was a challenge to assign some activities to distinct stages. Some stages could not be entirely de-linked from others. Steps in the process of developing the system were not necessarily undertaken in isolation. Some steps either overlapped

or occurred concurrently to ensure optimum management of time and for other practical reasons.

The identifiable stages include:

- Feasibility and planning
- Design
- Development
- Implementation and up-scaling
- Management

Identified activities and specific expected products characterised each stage. The above phases were not separate distinct series of activities. Some of the activities of different phases run parallel or overlapped

The project was carried out with reference to these issues and broad activities:

- Consultations and awareness creation
- Feasibility assessments
- Identification of primary beneficiaries and other stakeholders
- Definition of common objectives and shared expectations
- Allocation of responsibilities
- Establishing of a network of collaborating actors
- Analysis of the sub-district as a system, with structural and functional component parts, and the interactions among them. These are:
 - Communities at all levels of physical and socio-economic developments (towns, villages, hamlets),
 - Natural resources (including potentially exploitable ones),
 - Resource uses and conflicts over resource uses
 - Information flow within the sub-district, between the sub-district and other sub-districts, and the district
- Determination of data/information requirements
- Identifying existing information system (s)
- Training for data acquisition and analysis and the filling of data Gaps

- Identifying available data and information,
- Identifying data/information needs
- Data/information sources
- Questionnaire design
- Training for:
 - data acquisition(socio-economic and demographic),
 - data input,
 - data analysis
 - the use of GPS
- Questionnaire administration,
- Geo-referencing of new settlements by GPS
- Socio-economic and demographic data entry into computers
- Data analysis, interpretation of information and possible applications.
- Institutionalizing of data and information in the decision-making processes
- Up-scaling (technology transfer to ACs and the District levels)
- Management of information system
- Minimising constraints to data/information use for multi-stakeholder users.

Specific activities that practically lend themselves to participation of various actors, at all levels, in the project were identified. These include:

- beneficiary consultation,
- analysis of the local government structures and substructures,
- the determination of data needs,
- determination of information flow,
- questionnaire design and administration,
- data entry and data analyses,
- data processing and modelling, information display and discussion.
- management of information systems, etc

Awareness Creation and Feasibility Studies and Identification of Beneficiaries

Before GIS project development, it is important to consider just who the users would be: an import precondition for a user-entered approach. This means identifying and interacting with a cross section of all the potential beneficiaries: both direct and indirect. Even though not GIS experts, they have a better appreciation of potential GIS applications and the organizational contexts in which the GIS would be implemented.

These are in a better position to articulate their data/information needs and expected outputs. It offered the opportunity to access the feasibility of implementing a GIS project in the various localities, and to generate the commitment that would sustain their corporation. The interactions potentially reduced the possibility of popular resistance to the GIS development, implementation and management. It was an appropriate forum to educate potential beneficiaries on the benefits of GIS development and implementation, which are justification for and user collaboration.

Specific purposes and activities/objectives of this stage are as indicated below.

Purposes: Identify Beneficiary Sub-districts

Activities/objectives:

- Awareness creation and expressions of intents
- Feasibility studies and identification of beneficiary Areas
 - Evaluating the conditions for establishment information system
 - Assessing the level of and building on beneficiary commitment
- Involving local beneficiaries in decision making and other activities from the very outset
- Build network of potential collaborators, actors and willing partners

Consultation, dialogue and consensus building among all concerned actors drove this phase. The process began with visits to a number of potential beneficiary ACs in two districts of the Brong Ahafo Region of Ghana. These ACs included Babatorkuma, Nsawkaw, Badu and New Longoro. On these initial visits, representatives (counsellors) were met for interactions. There was a

comprehensive discussion on the implications of proper natural and environmental resource use for rural livelihoods. The research team and the council accepted that information on resources; the communities and all forms of human activities are central to developing management policy actions that ensures the derivation of optimum benefits from natural resource uses. The relevance and benefits of information and data in the decision-making for management of natural resources use were discuss. It was commonly agreed that information would enhance individual and group decisions and choices for improved livelihoods.

The research team expressed their willingness to assist the Area to develop and implement their own information system. This means empowering the council through training and education. In this project, the point of ensuring actual participation of the communities was overriding concern. But, that decision will depend on their level of commitment, which is paramount and a crucial determinant of the success of such a project.

Choice of Area Council

The conditions or terms of references for assessing the success of the project was essentially social, and to a limited extent, infrastructural rather than technical. Even though all the sub-districts wanted that the project started with them, the New Longoro Area was selected to start with. The choice was largely based on the high social capital (commitment), greater awareness of the need for data/information in management decision-making and their keen demand for data/information in decision-making



Plate 1: The research team in an initial consultative meeting with potential beneficiary Sub-Districts

The New Longoro Area

It is an area (sub-district) in the Kintampo District. Coincidentally, they had felt the need for collecting and documenting household data and information for the area council activities: specifically revenue collection. They had already designed a questionnaire to gather socio-economic and demographic data. The idea of establishing a computer-base information system was not part of their project.

On their own, they had made a sketchy spatial representation of their Area Council, indicating some communities, roads, bridges, rivers, revenue-collecting communities, etc. This common basis nurtured a collaborative and user-centred development of an information system that was driven by the aspirations of the communities.

INSTITUTIONAL CONTEXT, PARTNERSHIP, COLLABORATION AND NEED ASSESSMENT.

Local authorities, institutions and departments are mandated to collectively make policies and implement development action plans that influence rural communities (NDPC and MLGRD, 2004). Certainly, the quality of their policy decisions will determine the kind of impact they will have on the livelihoods of the poor in the communities and the natural resources.

Knowledge of the local government institutions was, therefore, considered very crucial in determining the long-term success of the project goals. It can work against genuinely participatory approaches if measures are not taken to provide appropriate processes to promote the development of shared understandings among diverse stakeholders at the district level. Accordingly, local government departments and institutions were investigated to ensure that the necessary conditions are promoted to support and sustain the development, implementation and management of the system.

The project was designed to be executed with close institutional participation, corporation and collaboration., and eventually scale up to the district level, even beyond the term of the project. Again, the mechanism of scaling up was to be achieved through active district level institutional participation and supervision. This was an important methodological strategy adopted in establishing GIS at the local government or district level.

Discussions at the Kintampo District Assembly, District Department and other institutions.

Key departments and institutions with responsibilities in natural resource management, environmental policy making and other related planning and development activities in the districts that affect the Area Councils and communities were visited. A couple of non-governmental organizations (NGOs) operating in the district, groups and individuals were also informed. Whereas others were involved in many important areas throughout the execution of the project, others only played marginal roles. Some were only informed with no practical roles. The constitution and the roles of these actors changed over time, depending on the area of concern at given phases of the project development and implementation.

In the various institutions and departments, the following issues were examined.

- Assessing the institutional capacities to implement and manage an information system
- Examining the level of appreciation of spatial dimensions and information requirements for management decisions at the local level
- The level of awareness of conducting surveys for data and information
- The importance of making policy decisions information-base
- The need for information and data sharing for effective functional interactions across the entire spectrum of the local government organizational structures and across the various intuitions
- Availability of data
- Demand and need for GIS application

In practically all the departments and institutions, the use of GIS was demonstrated along with discussions

District Assembly and Government Institutions

The DA is a major actor in the management of land and environmental resources in the districts. So the Kintampo District Assembly was informed of the decision to establish the information system. Their involvement and commitment were sought in establishing the system. They needed to explain how they interface with the Area Councils (ACs) in terms of information flow. Their plans and programmes, implementation strategies and specific objectives formulated and set to fulfil these responsibilities were requested for. Available information system in terms of documentations, database and computer hardware and software were explored. All other possible means of functional interfaces between the DA and the ACs were examined. Even though the Environmental Committee represented the District Administration in collaborating with the researchers in establishment the system, all relevant departments, officers and other organization participated in vital areas.

Individuals and Departments of the DA

At the DA, the following were met in the course of the project execution.

- District Chief Executive
- The District Planning Coordinating Director
- Assistant District Coordinating Director
- Town and Country Planner
- Budget officer
- Environmental officer
- Information officer
- Head of water and sanitation department
- Head of Community and Stool Lands
- The Presiding Member (PM)

These heads of departments and institutions of the DA pledged their support and corporation. Apart from important individuals, namely, the Coordinating Director, Coordinating Assistant Director, Town and country Planner, who were regularly contacted throughout the project, the environmental sub-committee was the main body that represented the assembly.

Departments and Organizations Outside the DA

Apart from the departments in the DA, other decentralised and non-decentralised government departments and organizations outside the DA were contacted. These included:

- Ministry of Food and Agriculture (MOFA)
- Forestry Services Commission,
- Statistical Services Department
- Kintampo Health Research Institute
- Electoral Department, etc.

Kintampo Health Research Institute

The Kintampo Health Research Institute was an important source of point spatial data for updating information on community location. The director showed a keen interest in the project.

Regional Level

At the regional level, the Information Department of the Regional Planning Coordinating Unit (RPCU) was informed of the project. The participatory nature of the project design was stressed. Since the remote sensing and GIS components of the information system to be developed not quite familiar to most of the personnel, they were educated on the relevance of these, particularly in relation to natural resource management. This was illustrated with real data and information (hard copies and computer presentations) on sections of Kintampo District(s). There was an attempt at integrating the databases of a proposed regional-coordinate project coordinated at the Regional level and this project. However, this has not been possible since that project has not progressed beyond discussion phase.

Observations and Response

All the institutions appreciated the need and relevance of information in effective decision-making process. However, their appreciation for the use of spatial information in decision-making at the local government level was limited.

Practically all the local government officials, institutional and departmental heads acknowledged lack of data and information for their decision-making processes. At the District Administration, specifically the District Town and Country Planning office, the map that was available had many mistakes. Some information in the map was outdated. The information content was not comprehensive enough for managing natural resources and planning for community livelihoods. Up-to-date demographic data for all the communities was not available to policy makers for management purposes. Even, at the AC, complete lists of communities under their jurisdiction were not available. Many communities were unknown to the counsellors. No information or data management systems existed in the district.

With the exception of the Kintampo Health Research Institute, none of institutions and departments (including the regional) visited had any GIS facility and GPS receivers. These were essentially for mapping of communities and households. Foreign experts introduced these. The much useful functionalities of GIS are not utilised.

PARTICIPATORY PLANNING AND ANALYSIS

We acknowledge that one of the main reasons why environmental information systems fail to be integrated into mainstream decision making processes is that they are often developed apart from management and policy making processes, rather than emerging from within. And that for information to be appreciated and used those who are expected to use it must be aware of how and why it has been produced. Therefore, project deemed it important to involve the potential users of the information by assigning them appropriate role. This included the determination of data needs based on the mutisectoral development decisions, responsibilities and plans.

Being one of the primary beneficiaries and users of the products of the project, the NLAC was visited for both formal and informal meetings. Since, ultimately, the NLAC would be owners of the information system, they needed to go through a process of developing a sense of ownership by being part of the processes of establishing the system at the very beginning.

Considering the broad objectives and the specific expected products and activities that will go into achieving them, some responsibilities were assigned to the New Longoro Area Council.

At the NLA, a working group of councillors was formed. These represented the NLAC and actively collaborated with the researchers in the development of the system. Other individuals from the communities also showed interest and assisted in the course of the project execution. Being the primary beneficiaries at this stage, members of the NLA were allocated more responsibilities than others.

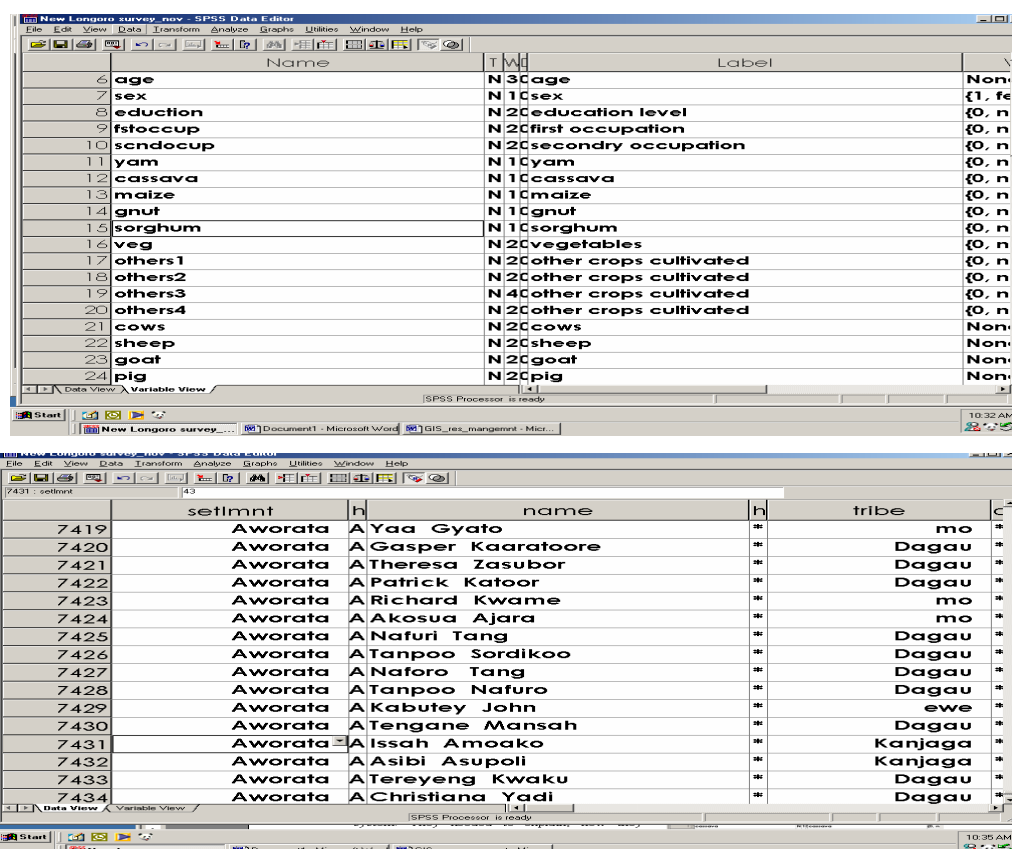


Figure 4: Data Entry Views of SPSS

Determination of Data/Information needs and flow.

The first task of the group involved assisting the researchers to determine the data/information needs of the area. This involved a series of participatory, consultative and interactive discussions between the researchers and the working group.

Data/Information Requirements

An important objective was to build a broad base database that supports decision-making needs of a wide range of diverse multi-dimensional and multi-sectoral problems and issues on natural and environmental resources use and management, as well as community livelihood improvement.

The census was that human uses of natural resource through various activities are crucial agents of transformation and conversion of natural and environmental resources. So we agreed that knowledge of the resources available and the human activities that affect them:

It was also important to know available land resources, their quality, and distribution over space and changes that they have undergone over a period of time with use. Information on groups who exploit particular resources in various localities and the intensity of exploitation, and available forms of livelihoods were considered important.

The information requirements for the management of natural resources for improved livelihoods demand a mixture of the following:

- Biophysical,
- Socio-economic,
- Demographic,
- Infrastructural,
- Cultural, etc.

The objectives of the information system were to generate data and information for the formulation of management policies, implementation and advocacy programmes in relation to natural resource use livelihood enhancement of the communities. Since the AC must provide information to the DA for a district-level management policy decisions, planning and implementation that benefits the communities, information needs for that purpose were also considered. Information requirements for individuals and groups decision-making processes for well informed choices related to livelihoods were considered.

Given its important role in the natural resource management human resource development in the area, the DA and other government and departments were met for discussions. They provided details of their programmes and plans and the relevant information data/information needs.

Information flow

Seen as a part of structurally hierarchical organizational entity or system of the local government structure, the area council could be considered as being at the level of operations. Practically, the DA for implementation must validate all their decisions.

Information flow within the DA is: up, down, some outward, inward, horizontal. The upward flow could be considered as information originating from the communities through the AC to the DA. The flow of information from the DA to the AC and the communities could be considered as the downward information flow. The AC and the DA can also interact independently with organizations and individuals such as NGOs, Government departments and agencies, individual investors and others. Engagement between these organizations, groups and individuals may initiate information flow in and out of the organization.

Information flow within the AC is effected by the representative councillors. These are expected to examine and identify information on the concerns, needs, the state of the, environment and natural resource base, socio-economic status, education, etc. of the communities and the ACs to the DA. These are either dealt with through programmes organized at the AC level or forwarded to the DA for attention. They also convey national and district policies, goals, strategies, directives, etc to the communities for implementation as a downward information flow.

Considering the importance of their responsibilities and messengers of critical management and policy information conduit, it was thought that they would be more effective if:

- there is adequate community representation on the AC and the DA. All communities were to be identified and allocated a representative on the council.
- Since information flow requires proper reporting and communication, it was thought that problems and constraints of communication be identified and dealt with.

In small meetings and workshops, means of facilitating information flow were discussed to improve communication between the representative councillors, the DA and the communities.



Figure 2: Multi-stakeholder discussions on improving information use in policy decisions among a group of workshop participants in Kintampo

INFORMATION SYSTEM DEVELOPMENT

- Determination of data types
- Software and Hardware identification
- Data acquisition instruments
- Training for data acquisition
- Data acquisition
- Input Interface and Database Design
- Data input and Administration (SPSS, ARCVIEW)

Determination of data types

The quantity, quality and type of data used are important determinant for the specifications of hardware and software types and specifications to procure. It also determines the training to provide and the analysis to do. So relevant questions such as these were addressed:

- The kind and amount of data to be used

- The kind of analyses conducted in the project
- Geographic extent of area
- Geographic features to deal with
- Levels of details required
- Attribute data to integrate with geographic data for display and analysis
- Coordinate system and projection types
- Currency of data
- Periodic updates, etc.

Software and hardware

Since the project did not involve the development of new software, limited attention was devoted to technical issues in the analytical phase. Rather, effort was devoted to:

- Identifying the appropriate software that can carry out the various processes to yield the expected information and output formats, and
- Identifying software that can handle the data the capture, transformation, analyses, projection, interpretation, storage and backup procedures. Most of these are important in GIS procedures.
- Database design for data entry and management
- Determination of suitable hardware specifications for processing speed, memory capacity, storage space, etc

Existing GIS software were used. They were customised for simplification of the user interface to be user-friendly. Different software were used for purposes namely:

- data entry, storage and management
- processing,
- analyses

The software used were:

- *GIS*: Arcview 3.0.

- *Image Processing*: IDRISI and CHIPS for image processing
- *.Statistical Package*: SPSS
- *Microsoft Access*: Database Management

ID	1st Occu	Other 1	teak
Settlements	2nd Occu	Other 2	charcoal
Hse No	Yam	Other 3	cashew
Name	Cassava	Other 4	other
Hse Hold	Malze	Pig	
Tribe	Gnut	Sheep	
Age	Sorgh	Goat	
Sex	Vegetable	Cows	
Educ Lev	Rice	grasscut	
Beek-ping			

Figure 5: Form for data entry

Due to the high volume of raster data formats and the computationally demanding vector analyses, a high-capacity computer was procured. Other devices were a printer and Geographic Positioning System receiver (GPS)- Garmin E-Trex .

The beneficiaries have had very limited practical knowledge or previous experience of both computer software and hardware use and the purchase of them. So the choice of computer hardware and software became the exclusive responsibilities of the research team.

Training Programmes for Local Capacity Building

Having recognized that constructive change can only happen and be sustained if the people involved are included, we decided to empower them to participate in meaningful activities that bring about changes. Readily available capacity and skills for data acquisition, entry and analysis are important for sustaining information system implementation. Training programmes were

therefore organised to build their capacity for undertaking these core activities. Specific objectives for adopting this approach was to:

- build capacity in the Area for independent implementation and management of the system
- create opportunity for local participation in the project execution.
- build appreciation for the relevance and importance of the project
- to build the capacity for community-to-community, AC-AC or AC-DA transfer of technology in an up-scaling process
- minimise the cost of project execution
- intensify the process of building a sense of ownership of the project is

Training For Questionnaire Administration

Members of the working group were trained to enable them train others in questionnaire others. These trained councillors selected members from the communities in the area and trained them for administration of questionnaires. More than 30 volunteers took part. Some benefits for training and allowing them conduct their own survey:

- building capacity in the Area for future update of their database
- minimise the cost of conducting the survey
- members of communities know the area better than others
- reducing the level of language barrier
- their knowledge of acceptable cultural norms of behaviour in inter-personal interactions in the area
- good personal knowledge of respondents and thus, able to intercept wrong responses
- mutual checks of the validity of information collected among questionnaire administrators.

Training For Data Entry and Analysis

The AC was asked to select individuals. A couple of personnel from the district Ministry of Food and Agriculture (MOFA) joined the exercise. Only a minimum level of formal education to allow for reading and writing was required. They were to be persons who would stay in the Area to

assist others. Gender balance was prioritized in the selection process. Among those who were selected were farmers, food sellers and hunters.

SPSS

Initially, many were introduced. However, eight (8) (Including four females), were trained for data entry in SPSS. Three were given further training to handle some analysis in SPSS.

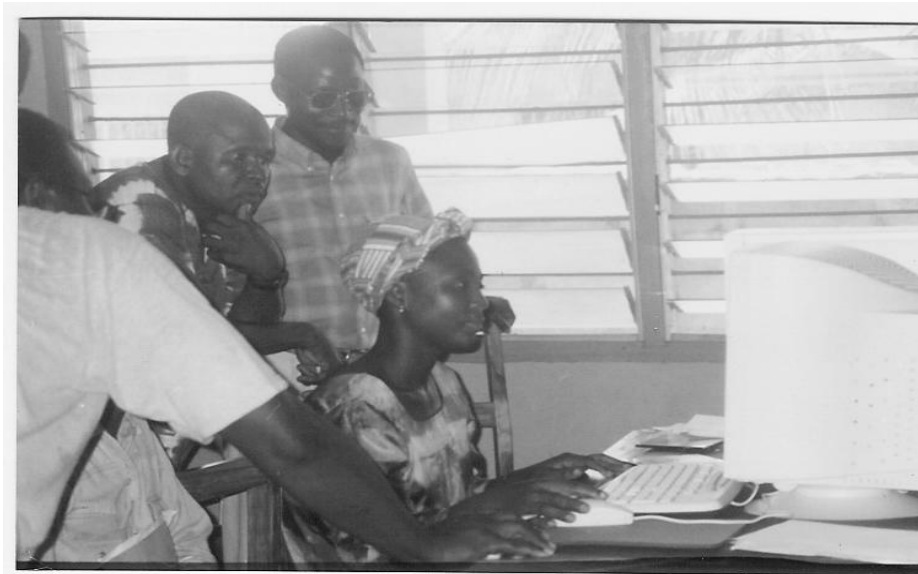


Plate 3: AC, MOF and Community members in a training section for Data entry and analysis

They were taught to summarise and analyse data for associations between variables using the cross tabulation sub-menu. The associations were particularly based on resource use activities on the one hand and identifiable group of individuals and settlements on the other.

GIS (ArcView)

At the local government level, explaining the concept of Geographic information system is much easier than in the urban communities. This is because rural communities and resources are spread over a wider space. Thus, people in rural communities have higher spatial cognitive capacities. Before introducing the practical aspect of GIS, a brief theoretical background was given. About 10 persons: councillors and other community members received the initial introduction to Arcview. They were thought to load spatial data, view it, and work on attribute data. Three members received further training in Arcview to enter and edit attribute tables.

GPS

The teaching process de-emphasised the technical processes underlying the functioning of the receiver. It focused mainly on the functionalities and, particularly, the ability to read off and recording measurements.

Even though many had the opportunity to learn to read off and record coordinates, a few community members were trained to use the GPS receiver on the field.

Participatory Data Acquisition

Data acquisition in this context is essentially related to the various activities for obtaining data for the information system. The data gathering approach was largely participatory and integrated. It was integrated since different data sets on different sectors were gathered. These were socio-economic, demographic, infrastructural and biophysical data. To the extent possible, the communities either carried out some of the activities exclusively on their own or were important participants.

Existing data

In developing the database, we thought it would be better to build on existing data/information sources. The purpose was to reduce time and cost of data gathering, entry and modelling. Therefore institutions, departments and other places were visited for data and information.

Demographic Data

Data from the 2000 national census was applied for at the Statistical Service of Ghana in Accra since the available reports from the census cover only a few bigger towns of the district. The 1984 data was also collected. This was to give an idea of population sizes and the amount of survey work to expect. It provided information on communities in the district and sub-district and the changes in population over years. Upon examination, it was realised that some communities of the district were not visited for the national census in 2000. Population figures of some communities were inaccurate.

Socio-economic data

The revenue office was visited for records of items traded in over the years and the amounts produced. The NLA also provided similar data. These were collected on the community level. This provided an idea about the types of crops and levels of production in the various communities.

Spatial Data

A district map prepared by the District Town and Country Planning was collected at the District administration. The scale: 1:250,000, was coarser for effective use at the District and Area levels. Only settlements and roads were showed on the map. The settlements and roads were outdated. Most of the roads and settlements were not accurately located. Others were wrongly oriented. At the Area level, a free-hand map produced by the councillors was collected. It contained a few communities, roads, and revenue collection points and bridges. Another sketch of the Area in a primary school textbook was also obtained. There were appreciable inconsistencies in spellings and pronunciations of the names of the settlements.

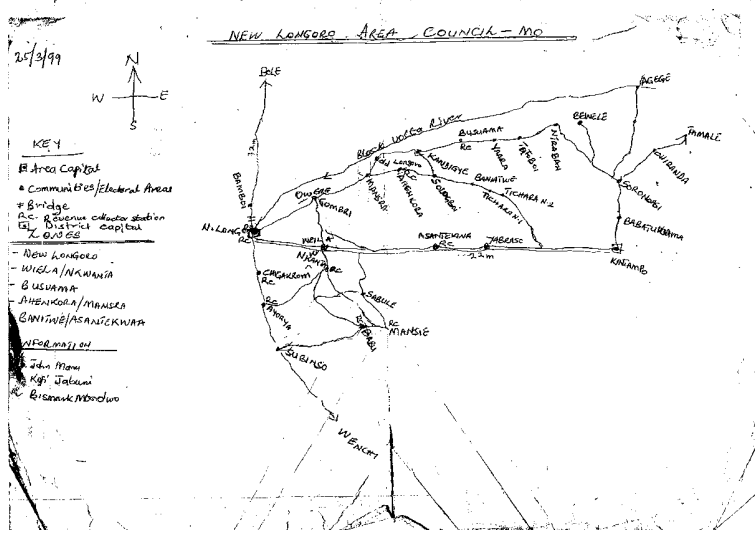


Figure 6: Free-hand drawn map by New Longoro AC members

b. Socio-economic and Demographic

Questionnaire Design:

The questionnaire used was originally designed by the NLAC to generate data for revenue collection in the NLA. In view of the expanded scope and objectives of the information requirements, new data/information items were considered. The questionnaire was modified and simplified. This was achieved through a process of interactive discussions and consensus building process between the working group and the research team. It was finally word-processed.

The questionnaire was designed to generate a multi-user (multi-sectoral) data/information at the individual level in all the communities. These were information on the house number, literacy, sex, age, tribal affiliation, livelihood, cropping systems, charcoal burning, animal rearing, bee keeping, tree plantation, occupation, etc.

Participants were made to administer questionnaires in their respective communities and localities. In this way, they were able to explain the purpose of the survey well. Finding their way was not an issue. Actually, there was no need for maps to guide them. Their participation

was instrumental in the identification of communities that were not known in the beginning of the exercise. The questionnaires were administered in a good time, since many volunteers participated in the exercise. A couple of administrators were made to repeat the exercise since their colleagues doubted the credibility of their work.

Digital Spatial data

These were of both vector and raster data format. In some cases, there was inter-conversion between the two formats depending on the type of process, analysis and output desired. Data were collected on:

- settlement (vector)
- road network
- drainage (rivers, streams, flood-prone and marshy areas)
- topography (represented as Digital Elevation Model-DEM, surface and contours)
- land-use/cover
- land-use/cover change
- soil types
- geology
- contours
- slope

The drainage system, settlements, roads and tracks, contours and other geographical features were digitised from the topographic map of Ghana with a scale of 1:50,000. The topographic map was generated from aerial photos flown in the early 1970s. Consequently, the data on settlements and roads were outdated. A few settlements have been deserted. Many new ones have sprung up. As mentioned earlier, many of the settlements were not on the list that was provided by the NLAC at the beginning of the study.

Data-Gap Filling

Updating of Spatial Data/information

The list of communities (settlements) was updated from data from the results of the household survey and records collected from the 2000 national census. The trained community members were charged to locate and record the coordinates of the newly identified communities. Most of these were inaccessible by road. In most cases, volunteers had to reach the communities by canoes. Others used bicycles or walked long distances using narrow and bushy paths. Enhanced satellite imagery, especially, the 1990/1 and the 2000/1 provided additional information on new and abandoned settlements.

Over the years, the road network has undergone significant changes. New ones have been constructed and others improved. Others have either deteriorated and overgrown with bush due to non-use. To the extent possible, the road network was updated with satellite image information and field visits with GPS receiver.

Boundary re-location

Throughout the country, accuracy of boundary location between neighbouring districts has been a contested issue. Even, many DA do not know where the boundaries are located. The latest district map of Ghana is a classical example. The boundary between the North and the South Kintampo Districts is wrongly located.

The best way to address this will be identifying the boundary communities – including smaller ones that belong to neighbouring districts. Albeit, the difficulty in using this approach, as found in the study, is that these boundary communities, most of which are minor, are unknown to the sub-districts representatives, and much less so to district, regional and national authorities.

Visits were made to the communities to contact unit committee members, assemblypersons and councillors to confirm and verify the district and the sub-districts to which they belong. This assisted in the re-demarcation sections of district boundaries using GPS.



Plate 4: A community member using a GPS receiver to map resources and new settlements

The Kintampo Health Research Institute also provided digital point shape spatial data of settlements for the updating exercise.

Soil and Geology

The Soil Research Institute (SRI) of the Council for Scientific and Industrial Research (CSIR) in Accra provided the digital maps with the textual information on soil associations, series and land suitability of the Area. These were in vector formats.

PARTICIPATIVE IMPLEMENTATION

This phase covers all activities that were undertaken after data has been entered or captured into the computer. These are:

- data processing,

- modelling,
- analysis,
- information display,
- printing.
- Information and data use

In this project, the information system was designed to be implemented as a decision support system rather than an expert system. The idea is that most of the decisions would be semi-structured, rather than structured. Data and various levels of processed data were to be used as inputs to aid the effectiveness rather than the efficiency of decision-making. An important consensus was that it would be more beneficial to build a multi-sectoral database and information infrastructure at this stage rather than spending all resources on modelling a system that deals with only a small aspect of a complex and multiplicity of issues in different localities.

Some of the activities at this stage occurred concurrently with those of other earlier stages. For instance, records on the 2000 census were given to many user institutions and departments before the socio-economic and demographic survey of the area and other activities started.

This phase was driven by consultations of the AC and the various government departments and the DA Discussions on information needs of the Area and their responsibilities as data and information providers to the DA. Required data/information were examined in the light of possible programmes to improve community livelihoods, natural resource management policy process and education, information flow to the district assembly, project implementations. Communities were explored.

Various government departments and agencies and the DA were consulted for possible information requirements for their activities and programmes on natural and environmental resources management and community development in the various Areas and communities.

The form and nature of data/information output were discussed. In this regard, the following were considered:

- The frequency of the need for updating data or an information
- Capacity of users to interpret data/information
- Capacity of users to analyse and model information
- Clarity

Socio-economic and Demographic Data

The communities audited the database in SPSS for errors and corrected them to improve data quality before the analysis.

They analysed the data by summarising and cross-tabulation for association. Associations were based on the dominant natural resource-use activities on the one hand and identifiable groups (sexes, tribes and age group) and settlements on the other. Relevant outputs were converted into tables.

Biophysical Spatial Data/Information

Vector and Grid Formats

Roads: In Arcview, the vector digital data of *road network* of different classes; tracks and major footpaths were recoded for simplification of information interpretation and ease of use by the end users.

Settlements: The coordinates of the new communities were converted into digital point shapes in Arcview. They were projected and registered to the topographic map. These were merged with the existing digital community point shape.

Rivers and Streams: The Black Volta, the most important water body in the area was extracted in the wider sections as in a raster format from the 1991 image and vectorised as a polygon. The

narrow sections were represented as enlarged line symbols. The flood prone and marshy areas were represented as broken lines with different colours.

Topography: Digital Elevation Model in a grid format was generated from digital line contours of an interval of 50ft. The elevation was exaggerated by about to times.

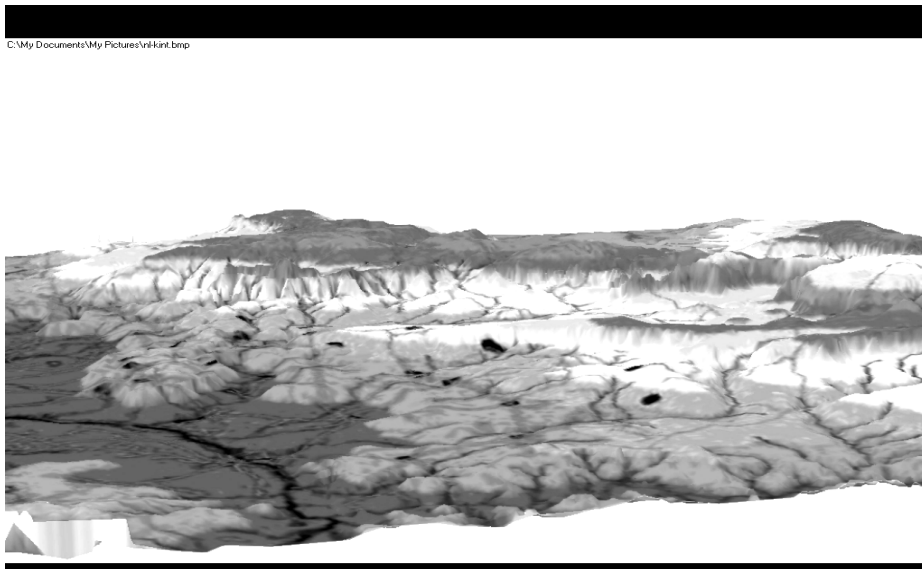


Figure 7: DEM representing the topography of sections of the Kintampo Districts

Soil and Geology: Digital map of soil and geology were classified into kinds using different colours. The characteristics of some soils as they respond to use were documented at the level of association and series classification levels. Land-suitability characteristics were also provided at the same level of classification. Recommended strategies for soil management for sustainable production and environmental protection were given.

Land-use/cover

Even though land-use cover data exist for the country, it was not used for reasons such as:

- The need for unclassified data for educational purposes
- The need to control errors in classification of the images for land-cover/change

Large formatted maps

Large formatted composite district maps of 43 by 30 inches of scales 1:150,000 and 1:120,000 were printed. These were at the request of the DAs, sector departments, agencies and other institutions. The features of this composite maps were:

- settlements (district capitals, area capitals, other communities)
- road network
- drainage system (rivers/streams, marshy areas, flood prone areas, etc.)
- water falls
- mineral deposits
- Black Volta River
- district and regional boundaries

Data Integration

Data integration in the sense of visual, aggregation and geographic-attribute data linkages were used to varying extent. It is expected that these modes would yield optimal information at this level of GIS application. For instance, exploring the spatial relationship between objects in composite maps will be very important in drawing conclusions. .

Socio-economic and demographic maps

The attribute data based on settlements were captured into the Arcview attribute table. These were used to compose thematic maps with different symbology. Among these were:

- population sizes of all communities
- percentage of females and males in the communities
- number and percentages of females and males in the cultivation of all crops
- number of animals: goats, cattle, sheep and pigs in all communities
- Number of persons owning specified number of animals in all the communities
- number and percentage of males and females in charcoal burning, etc.

The screenshot shows a Microsoft Word document with a table titled "POPULATION-BY-SETTLEMENT". The table has three columns: "Settlements", "No-of-Persons", and "%". The data is as follows:

Settlements	No-of-Persons	%
Agege	72	1.0
Ahenakom	125	1.7
Asantekwaa	486	6.5
Aworata	73	1.0
Ayorya	357	4.8
Babildour	35	.5
Babu Kurom	144	1.9
Baniantwe	221	2.9
Basabasa	120	1.6
Bewele	83	1.1
Bonyonga	27	.4
Busuama	365	4.9
Chara	160	2.1
Chigba	276	3.7
Dakore-Babu	21	.3

The screenshot shows a Microsoft Word document with a table titled "EDUCATIONAL-LEVEL-IN-2003". The table has three columns: "Highest-Level-of Education", "No-of-persons", and "%". The data is as follows:

Highest-Level-of Education	No-of-persons	%
No-Formal-Education	5845	77.9
Primary	89	1.2
Junior-Secondary	1273	17.0
Senior-Secondary	252	3.4
Teacher-Training	18	0.2
Vocational	10	0.1
Tertiary	18	0.2
Total	7505	100.0

Figure 9: SPSS information output from the NLA survey

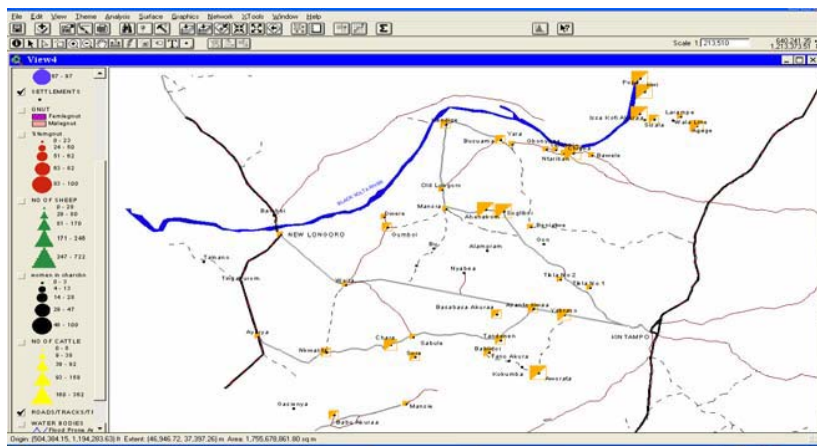
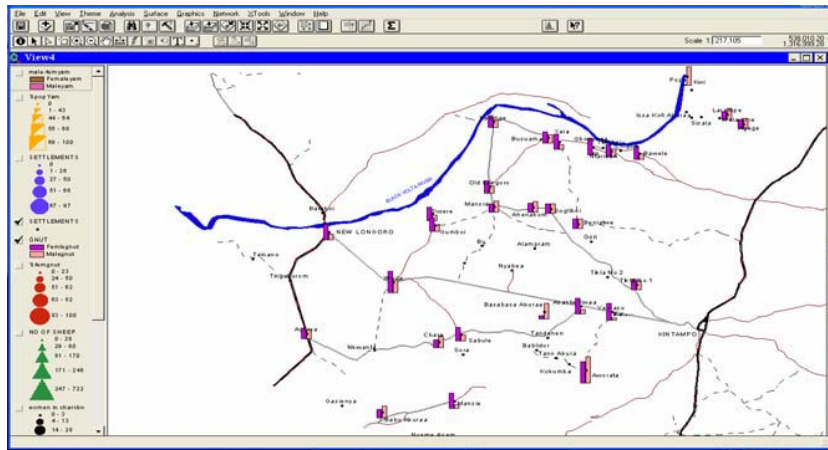
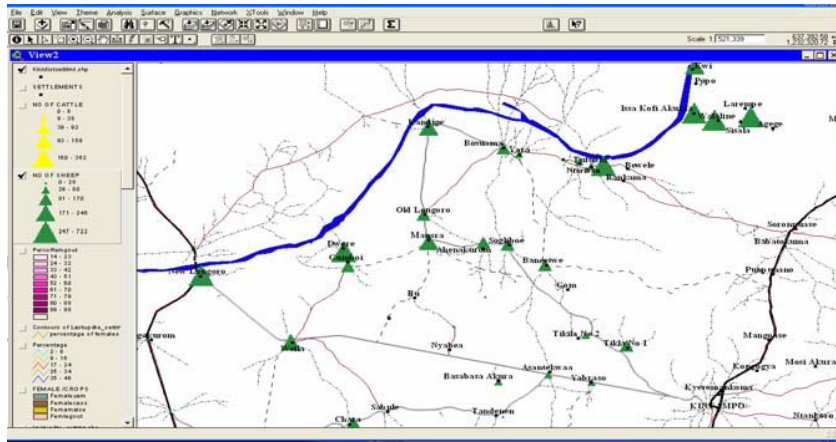


Figure 10: Thematic GIS information output from the NLA survey

DATA/INFORMATION FEEDBACK, ACCESSIBILITY AND USE

The composed maps, tables and graphs were first displayed on the screen or printed as hard copies for all categories of users, including individuals who were directly involved in various aspects of data acquisition and policy makers. The feedback of information to the users serves these important purposes:

- validation of information content of maps. Some communities had to be relocated again since their location in the map were disputed.
- generation of additional information as discussions of possible applications ensued. In fact, data requisition from the institutions and departments exceeded what the project could afford.
- promotion of local community participation in natural resource management.
- communication of information to decision makers
- knowledge of available resources and available forms of livelihoods in the localities.
- Promotion of institutional collaboration

It was realised that using soft copy computer presentations as the main means of accessing data/information will have practical difficulties due to:

- unavailability of computers,
- unreliability power supply. There may be no power when one needs to access information
- the difficulty with easy access to the information system.
- the difficulty with handling of data/information

UP-SCALING

Up-scaling in this project involves extending or diffusing the technology by replicating relevant activities of establishing participatory decentralised information system to generate and use data/information in other local government setups. One crucial element that drives the process of up-scaling a decentralised participatory information system is a built local-level capacity that initiates and diffuses the process with limited or no external assistance. A program of testing the local capacity to transfer the technology was incorporated into the project.

Some specific objectives for incorporating this element were:

- to create opportunity for trained local persons to deepen and internalise their knowledge, experiences and skills,
- expand the benefits of developing information systems to other areas.
- allow the research team to improve on the methodological process.
- building the capacity of the AC and DA to transfer the technology to neighbouring district,
- building the capacity of the DA to manage the system.

Up-scaling at the Babatorkuma Area.

The process of technology transfer was affected by the trained members of the New Longoro Area. This initial attempt was a transfer to the Babatokuma Area in the Kintampo District. The research team played only a supervisory role. Some members of the DA and government departments were invited to be involved in the process to enable them learn to coordinate and supervise future transfer of the technology in a more systematic fashion.

Up-Scaling at the Process at the Babato Area:

The process involved a series of activities, most of which are a repetition of those carried out in the NLAC. Others were modification of the original ones or entirely new additions peculiar to the up-scaling process. Some of these were:

- Consultation and Awareness creation; this was not the first time of visiting the Babator AC. So the meeting at this stage was to inform them of the intention to pass on the technology to them through the NLA.
- The benefits and experiences at the NLA were shared. Hard copies of the maps, images and tables of the NLA were showed to them.
- Members of the NLA who were in the meeting narrated their experiences and explained their responsibilities in the process of transferring the technology. This was largely communicated in a common local dialect.
- They outlined activities that would be involved in the transfer, and indicated what their primary responsibilities would be.
- The Babato Area Council was asked to select members in the various communities for the survey. Unlike the NLA, an emphasis was placed on gender sensitivity and balance in the selection of people for the questionnaire administration and the other activities.

- **Training for questionnaire administration**
A meeting was organised for the training of selected members of the Babator Area. Maps of their area were used to ensure thoroughness in coverage of questionnaire administration of the communities and to guide monitoring.
- Based on recommendations and other observations, the content of the questionnaire used in the NLA was modified by including some additional new crops that are common in the Babato Area.
- A member from the NLAC was made primarily responsible for explaining the content of the questionnaire. He drew their attention to difficulties and challenges they encountered

in their area, and stressed the need for avoiding a repeat of these problems. Members of the research team offered only a few relevant suggestions and comments.



Plate 5: A trained New Logoro Area member training members of the Babato for questionnaire administration

Training for Data Entry and Analysis

The council members selected eight (8) persons: four males and females. Some members of the NLA who have been trained previously were invited as trainers for members of the Babato Area. Apart from explaining some fundamental concepts of GIS and their applications, the responsibility of the research team was essentially supervisory. Within a period of one week, the trainees started entering their own data with the supervision of the trainers from the NLA.

Observations and Lessons: The attitude of councillors, all of whom were males, was negative about the ability of the potentials of their females in the communities. However, they expressed satisfaction at the performance of the females during the exercise.

COLLABORATIVE/PARTICIPATORY MANAGEMENT OF THE INFORMATION SYSTEM

It would have been more appropriate to allow the Area Councils and the communities take ownership and responsibility of the system. The consensus, however, was that there is limited financial and technological capacity to maintain the system at this level. Besides the limited capacity of the AC and communities to use system, and the smallness of the population will not help optimise the benefits and sustain the running of the system. It was agreed that centralising the use of the system would encourage sustained interactions between the ACs and the DA, which is a crucial objective for the project. This will be on condition that the DA will not exclude the ACs, government departments and institutions, etc. from using the system.

Based on recommendations made at workshops, informal meetings and personal suggestions, we concluded that an institutional collaboration would reduce administrative cost. It will also ensure that as many groups as possible use the system, thus making it more efficient. A committee of selected individuals is being formed to take care of the day-to-day administrative issues related to the system. Among these were individuals from the ACs, government departments, the DA and other government institutions. The following issues were considered important for optimising the use of the system.

- Ease of Accessibility
- Data/information Management
- Database up-date
- Maintenance
- Privacy

Ease of Accessibility

This is to ensure that stakeholders have easy access to use the information system. This was a major concern for many potential users.

User Accessibility

- ✓ The suggestion was that the system should be located at a place where people would not feel intimidated to use it. Many people feel that the DA would not be appropriate.
- ✓ That conditions for accessing the system should not be bureaucratic
- ✓ That there should be a good physical access
- ✓ People should have authorization before using the system

Data/information Management

Who will be responsible for:

- ✓ data entry, analysis, printing and other such routine activities
- ✓ how often should files be backedup?
- ✓ train others in these activities
- ✓ the suggestion is that those involved in developing the system should be used if they are willing to do so.

Database up-date

- ✓ Time frame should be set to regularly update the database. In this case, the socio-economic and demographic information should have a priority.

Maintenance

- ✓ Who will carry out routine maintenance of the system?
- ✓ Who will pay for the maintenance?

Potential source of funding

- ✓ Should token charges be taken for using information and data?
- ✓ NGOs,
- ✓ DAs,
- ✓ ACs, etc
- ✓

Privacy

This bothers on the ethics on the usage of data or records, particularly, on individuals. How is it ensured that the privacy of individuals is not violated in the use of personal data: This can be addressed by finding appropriate answers to questions such as:

- Who gains access to what data/information?
- What data/information should have restricted access?
- What use of data/information will be disallowed?
- Should people specify the use of certain data/information?
- What data/information cannot be made public?
- What personal data/information could be used only when persons involved are first consulted and the said individuals explicitly grant permission.

OBSERVATIONS, LESSONS, CHALLENGES, CONSTRAINTS AND ACHIVEMENTS,

Observations and Lessons

- Contrary to the general perception, rural communities at the sub-districts have a keen appreciation for the need of data and information in natural resource management and socio-economic development.
- Engaging communities from the very beginning of the information systems analysis, design and implementation is an important requirement for generating high social capital for collaboration and commitment that sustain information systems project
- It is spurious to assume that rural folks with minimal formal educational background cannot be trained to perform simple tasks in computer-based information system management. If the training method is adapted to their circumstances, and is practical-oriented, the desired results will be achieved. Obviously, this comes with a worthwhile cost of additional time.
- The sense of commitment and attachment and ownership is very high when information system is established at the lowest level of the societal organization. They feel they are

working for people they know personally and themselves, and so are concerned about the success of the project.

- The sub-districts know their communities well. With their collaboration, it becomes easier to identify data sources, establish gaps in information flow in terms of community representation in what is expected to be a seamless two-way information flow between the communities and the sub-districts. They are also able to intercept wrong information provided by members of their communities in questionnaire administration.
- It is cheaper to establish a community information system at the sub-district level since members are ready to work on a voluntary basis. The trained individuals are more likely to offer their services in future when information is to be updated.
- Sectoral government agencies are more data conscious than the local government authorities
- The sub-districts and communities have intimate knowledge of their environment. easier to identify data sources able to establish gaps in information flow in terms of community representation
- Developing a decentralised participatory small-scale GIS project at the district and sub-districts affords the opportunity to minimise risk associated with large GIS projects. It also reduces the cost and time for development and implementation. There is the opportunity for rural communities to communicate the state of their environment and their livelihoods system to local government authorities and other local government agencies by gathering relevant information about their communities. By this, they participate in local governance.

Challenges

The approach of participatory decentralised GIS application is evidently a more effective and efficient data and information generating strategy for improving management policy decision decisions on natural resources and rural community livelihoods. Yet, there are peculiar associated problems due to the infrastructural, technological, societal, etc. level of development in the area. Equally important are some institutional/organizational conditions that constrain information use. The following are a few of the challenges:

- Convincing and getting the commitment and support of organizational and administrative heads and staff who are reluctant to corporate
- Creating awareness of the relevance of GIS among people with little appreciation and knowledge of information systems application in decision making process
- Institutionalising information in decision-making in an environment where the reverse has been the culture for years.
- Involving a wide range of stakeholders in establishing an information system
- Teaching people with low level of formal education applications of GIS and associated technologies
- Mapping and administering questionnaires in communities with poor accessibility

Dealing with institutional and social challenges

- Extensive visits and communication
- Extensive consultations and discussion of issues with relevant actors
- Consensus building
- Involving all relevant actors
- Adapting training and educational programmes to the circumstances of the people
- Ensuring that the development and implementation of the system has minimal effect on the activities of the institutions and individuals

Constraints,

- ✓ Bureaucratic approach to management, planning and policy formulation processes.
- ✓ Top-down management approach
- ✓ Lack of openness and transparency in management policy decisions
- ✓ Restricted data/information sharing culture among departments and institutions
- ✓ Inability of the ACs to formulate their own management programmes where data can be used
- ✓ Lack of collaborative management policy development and planning at the district level
- ✓ Infrequent meetings of AC members makes it difficult to engage in activities that necessitates data use
- ✓ Inadequate collaboration between government departments, thus constraining data/information flow
- ✓ Inadequate collaboration between the DA and the AC in the performance of their activities
- ✓ Divisive local politics

Some important achievements and level of up-take

Given the challenges such as the low technological development, low formal educational background of the local participants and real constraints, the projects can be credited with some achievements such as:

- ❖ Being able to decentralise GIS application to the level of the District, Area and rural community
- ❖ Improved level of awareness creation of the need for policy-makers to use data/information among policy makers
- ❖ Getting users to make ordinary but informed decisions using data/information
- ❖ The level of involvement of communities in the execution of the project
- ❖ Improving the quality data/information at the Kintampo Districts

- ❖ Building capacity at the community that can assist the diffusion of the technology with little external assistance
- ❖ Creating a common platform of activities in establishing an information system that will promote collaborative policy decision-making between actors of natural resource management.
- ❖ Sensitizing ACs on the need for women to be involved in activities to develop the area.

RECOMMENDATIONS

For improving on the process

- ✓ The research team should replicate the process in other districts and areas to improve and fine-tune the process.
- ✓ Dissemination at workshops, meetings and consultations for recommendations to improve the process

For improving data/information use and flow

- ✓ The DA should encourage collaborative planning and management between the District Administration and the District Departments
- ✓ The DA and the AC should improve their corroboration in the policy process
- ✓ The DA should intensify the consultations, consensus-building and bottom-up approach to policy process

- ✓ The capacity of the AC to proactively formulate development and advocacy programmes should be built
- ✓ Institutionalise information/data-base rational policy decision-making process at the DAs and ACs
- ✓ Ministry of local government should streamline the responsibilities of the various structures of the district assembly structures

For establishing data/information infrastructure at the district and areas

- ✓ The NDPC should monitor and ascertain that their mandate, which directs the DA and AC to establish data/information infrastructure, is complied with.
- ✓ The DAs should establish functioning integrated information and database management systems.

Data availability, exchange and awareness creation of data sources

- ✓ The Ghana Statistical Service should make available detailed data and information to the district and areas
- ✓ CSIR, CERSGIS, SURVEY DEPARTMENT, etc should create awareness of available data and information
- ✓ Institutions, departments, non-governmental institutions, etc should promote data exchange

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