Strengthening AID Supported GIS Activities in Niger

Draft Mission Report and Recommendations

Submitted to USAID/Niger

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ACRONYMS

AID	U.S. Agency for International Development
ANR	Agriculture and Natural Resources
APAP II	Agricultural Policy Analysis Project II
API	Assessment of Project Impact
ARC	AGRHYMETRegional Center
ASDG II	Agricultural Sector Development Grant II
AVHRR	NOAA/Advanced Very High Resolution Radiometer
BCR	Bureau Central de Recensement
bpi	bits per inch
BUCEN	U.S. Bureau of the Census
CCT	Computer Compatible Tape
CGRN	Cellule pour la Gestion de Ressources Naturelles
CIDA	Canadian International Development Agency
CILSS	Comité Inter-états pour la Lutte contre la Sécheresse dans le Sahel
CUI	Cropland Use Intensity
DHS	Demographic and Health Survey
DIAPER	Diagnostic Permanent
DPM	Disaster Preparedness and Mitigation
DSCN	Division de Statistique et du Census National
DT	Direction de la Topographie
EDC	USGS/EROS Data Center, Sioux Falls, SD
EPA	U.S. Environmental Protection Agency
ESRI	Environmental Systems Research Institute Inc., Redlands, CA
EWS	Early Warning System
FAO	U.N. Food and Agriculture Organization, Rome
FED	Fonds Européens de Développement
FEWS	Famine Early Warning System
FFR	FEWS Field Representative
FHD	Family Health and Demography
GDO	General Development Office
GIS	Geographic Information System
GON	Government of Niger
MAE	Ministère d'Agriculture et d'Elevages
MEP	Ministère d'Etude et de Planification
MHE	Ministère de l'Hydraulique et de l'Environnement
NAC	National AGRHYMETCenter
NGDC	NOAA/National Geophysical Data Center, Boulder, CO
NOAA	National Oceanographic and Atmospheric Administration
NRICG	WRI/USAID Natural Resource Information Consultative Group
NRM	Natural Resource Management
OSS	Obsérvatoire du Sahel et du Sahara
PAAD	Project Document
PID	Project Identification Document
PIGRN	Programme Intégré pour la Gestion des Ressources Naturelles
PNLCD	Plan National pour la Lutte Contre la Désertification
PSD	Private Sector Development
PTT	Poste, Téléphone, Téléphérique
REDSO/WCA	Regional Development Service Office/West Central Africa
SAFIRE	Southern Africa Food Information Resource Experiment
SAP	Système d'Alerte Précoce, Niamey
SNIS	Service National d'Information Sociale
SPOT	Système Probotoire pour l'Observation de la Terre
SRNRS	Surveillance des Ressources Naturelles Renouvelables au Sahel
SWDM III	Sahel Water Data Network and Management III
UNITAR	U.N. Institute for Training and Research
UNSO	U.N. Sudano-Sahelian Office
USBC	U.S. Bureau of the Census
USGS	U.S. Geological Survey
UTA	Unité Technique d'Appui
WMO	U.N. World Meteorological Officer
WRI	World Resources Institute, Washington, DC

I.Introduction

The purpose of this TDY is to respond to Mission request for assistance to coordinate and support spatial information systems development for project funded activities. These include the following:

Family Health and Demography (FHD) ;

Disaster Preparedness and Mitigation (DPN); and

Agriculture Sector Development Grant II (ASDG II).

Each of these projects have data needs that could benefit from spatial data for project management. Collectively such data could provide the basis for preparation of the Assessment of Program Impact (API) report.

In addition to these projects, the Mission has the responsibility for administration of the Sahel Water Data Network and Management III (SWDN III).

II. Background for Consideration of GIS

A. Current Data and Databases

As in most countries in Africa, the quality of data required for planning varies from sector to sector. The Mission has recognized the need for better data and is supporting or planning to support the improvement of data collection by the GON.

The FHD project has used the 1988 census data to develop a Demographic Health Survey (DHS). This survey was funded through the FHD project and was carried out by the Division de Statistique et du Census National (DSCN) assisted by the US Bureau of the Census.

The DPN is assisting the Système d'Alerte Précoce (SAP) to improve the collection of data on food production and need. The data will be used to target vulnerable populations and to prepare plans for preparing appropriate responses for famine mitigation of vulnerable populations.

The ASDG II project will need information on NRM indicators to monitor program impact and is interested in developing the capacity to collect such data by one of the GON departments.

B. The Use of Geographic Information Systems.

It is the Missions interest in the data needs and data production by these projects that has led to the consideration of developing geographic information system (GIS) as a means of coordinating the collection and use of data.. The development and use of a GIS is facilitated by the existence of the AGRHYMET Regional Center (ARC). The Mission has the responsibility for the administration of the Sahel Water Data Network and Management III project, the US support for the ARC. As a regional center for the nine CILISS countries, the ARC is an established center of excellence for GIS activities.

C. GIS and Assessment of Project Impact

The cable requesting the TDY also cited the Mission desire to develop a GIS to monitor program impact. Many of the Mission Goals and Strategic objectives lend themselves to spatial data presentation. Much of the data developed as a management tool in the FHD project could be mapped to show, not only the number, but the distribution of the facilities meeting the targets established under Strategic objective 1, **to increase the quality, coverage and use of family planning, maternal, and health services.** The spatial distribution of target indicators of Strategic Objective 2. **to increase the opportunities for sustainable agricultural production and rural enterprises**, would represent both a good management tool for achieving the targets as well as a way of presenting the data for the API.

In supporting the use of GIS, it is important to recognize and evaluate the value of GIS in managing projects as well as accumulating the data for the API. The spatial distribution of the project results may provide a visual display of the variance in project results that could lead to early interventions that would contribute to achievement of the project goals.

D. GIS and the Evaluation of Data Quality.

The APAP II Technical Report documented the variability of the data quality for agriculture and the difficulty of assessing the quality data. The use of a GIS could facilatate the selection of areas where accumulated production statistics are suspect. Subseting and testing area statistics for agricultural production would provide a basis for using existing data on production as the basis for developing an early warning of the need for famine mitigation. Since cereal production is the primary indicator of potential need for mitigation, the assessment of the validity of the statistics collected is important.

III. Agricultural Sector Development Grant II (SDG II) Findings

A. ASDG II is funding a variety of institutions which have been able to provide detailed budgets for their operating costs (office furniture, electricity, fuel, transport, per diem, etc.) but have not yet been able to provided any indication of the precise activities donor funding will support. If the objective is to build GON capacity to identify and execute NRM projects then it is important that AID support focus on those institutions which have the mandate, technical competence, and enthusiasm to collect, compile, and analyze the environmental data needed to provide meaningful information to GON, AID, and other donors.

B. The GON CGRN is receiving substantial ASDG II funding. The CGRN was set up in April 1992 through the merger of the Comité du PIGRN and the Comité du PNLCD to improve the coordination of donor funded environmental projects. Although it has been active for a year it is still concerned principally with conceptualizing the problems. FAO has recently completed a detailed report on the use of different soil conservation techniques within particular arrondissements (*Programme National de Gestion des Ressources Naturelles*. Report No. 52/93 CP-NER29. April 2, 1993). This report could provide the bridge between theory and practice. However, two problems remain: (a) there is no reliable means of communication between the departments and Niamey; and (b) although the report is likely to be of widespread interest, the CGRN is not prepared to share the report with non-GON staff until it is officially approved. This will not happen before October 1993 at the very earliest.

C. In January 1993, the CGRN received technical assistance from UNSO (Peter Gilruth) in the design of an environmental information system to help improve the collection and dissemination of information throughout the GON. Perhaps the most important finding from the mission was that although the opportunities for computer based data processing and the level of technical ability are higher in Niger than most countries in West Africa, these is a chronic shortage of reliable environmental information, whether they be recent aerial photos, topographic data, or thematic information on land use or vegetation cover. A recent overview of agricultural and natural resource statistics - *Agricultural Data and Databases in Niger*. APAP II Technical Report No. 122. November 1992 - made the following observations:

1. The core of Niger's agricultural data system is the MAE's annual pre-harvest survey of major cereals and legumes.

2. Neither the users nor producers of these data have much confidence in their accuracy. At the arrondissement level sampling errors of greater than 45% have been recorded and are never below 21%. Particular concern focuses on the manner in which the data are collected in the field.

3. The survey agents are the least trained, the worst paid, and the most heavily burdened cadres in the MAE. There is widespread suspicion that many survey agents either fail to visit their appointed fields or do cursory work when there.

4. Summary statistics at the arrondissement level are not available. A more decentralized system would require substantial donor funding for the provision of equipment and training at the department level. Such support has not been forthcoming.

5. Reviews of the natural resources data collected by the MHE are mixed: the water data base is thought to be quite good, while the forest resources information seems to be relatively weak.

6. Huge volumes of data are collected, but very little use is made of these data. This is due to the lack of demand for systematic policy analysis by decision makers. AID's projects should provide an excellent opportunity to both stimulate the demand for policy analysis and enhance the capacity of local institutions to meet those demands.

D. The need to improved data is a recurring theme. Until this need is addressed in a serious and systematic manner,

improved coordination is unlikely to have any significant impact on GON agricultural or NRM planning. Given this need it might be expected that the CGRN would pass through a portion of its $1.6 m budget to those GON and donor projects which are collecting reliable environmental data. However, this support was not envisaged in the 1993 workplan. As an indication of what could be achieved, SPOT Image has proposed that the whole of Guinea (25 m ha) be mapped at 1:50,000 using stereo SPOT PAN images at a cost of FFr 7 m ($1.4 m). This is equivalent to less than $10,000 per 1:50,000 map sheet. The conventional aero-photogrammetric approach would cost about $25,000 per sheet. Although Niger is much larger (125 m ha), the area under cultivation, permanent pasture, or forest is relatively small (15 m ha) and concentrated below the 300 mm isohyet. This figure is therefore a reasonable estimate of what it would cost to produce a digital map base for the most populated and vulnerable part of Niger.

E. The greatest constraint on crop production and vulnerability modelling is the lack of information on is land use. Given the large areas involved, a two stage approach should be adopted:

1. A first level classification would be derived from Landsat imagery using traditional photo-interpretation techniques. The synoptic view provided by each 190 × 190 km image facilitates the discrimination of broad land use categories. EDC already has complete 1985-88 MSS coverage for the southern portion of the country. Up to data coverage for the same area would cost $72,000 for TM (7-band, 30 m pixel) or $3,200 for MSS (4-band, 80 m pixel) for data more than two years old. Training in photo-interpretation of false-color infrared images could be provided by a PASA agreement. Field checking would be carried out to verify the classification. The land use boundaries would be traced onto Mylar and then digitized at ARC which has the appropriate equipment and training.

2. Improved land use discrimination would be possible from airborne video. Videography is a low cost alternative to photography as it is cheap to acquire, does not require film or developing, and can be viewed, edited, and stored on a suitably equipped TV/VCR (analogue) or PC (digital). Unlike MSS, video could be used to help identify improved NRM indicators such as: tree plantations, wind breaks, half-moons, rock ridges, fencing land, fallow land, and forests. By combining the video with a GPS, the precise latitude and longitude of each frame is known and can be compared with other georeferenced data.

F. One group which could benefit from ASDG II support is the Unité Technique d'Appui (UTA). The UTA was set up in September 1992 to provide the GON with an institutional "memory" of all the data that are currently being collected and compiled by environmental projects. A number of activities have been identified including production of a forest map by May 1994.

IV. Disaster Prevention and Mitigation (DPM) Findings

A. Système d'Alerte Précoce (SAP) is basically a consumer of biophysical data and has neither the need, nor the resources, to manage a sophisticated GIS. SAP's immediate needs are for information on rainfall and population that can be used to map those areas at risk from drought. DPM plans to invest in a GIS using Atlas*GIS and Idrisi. A closer relationship between ARC and SAP is a precondition for a more effective EWS. ARC is uniquely positioned to provide SAP with the following data services:

1. ARC holds the most comprehensive agrometeorological data bases relevant to the SAP mission.

2. ARC holds additional data on soils, CUI, and population which could be used to model the likely impact of drought. ARC is currently digitizing the position of all 25,000 villages in Niger. This will give SAP the ability to predict impacts at the sub-canton level. In the event of drought, this would have clear logistical benefits for a DPM effort.

3. ARC has all the equipment and software necessary to build and run sophisticated multi-variate models should the demand arise.

4. The imminent arrival of Diagnostic Permanent (DIAPER), the CILSS agricultural statistics office, will strengthen ARC's capacity to monitor yields and predict agricultural production.

5. Phase III of the Fonds Européens de Développement (FED) funded Surveillance des Ressources Naturelles Renouvelables au Sahel (SRNRS) project will be based at ARC. Earlier phases have successfully mapped agricultural land use potential at 1:100,000 from SPOT XS data for twelve test sites across the Sahel.

However, ARC neither has the staff with the necessary background in demography, health, and the social sciences nor does it currently have the mandate to interpret and act upon the wealth of data which an ARC-SAP collaboration could provide. Additional staff with the appropriate backgrounds would be needed to turn the raw data into useful information.

B. Despite the obvious benefits of greater collaboration between ARC, FEWS, and DPM, ARC has no mandate to provide satellite data to either FEWS or DPM - hence the absurdity of FEWS receiving 4 km resolution GAC data from Washington, when 1 km LAC data are available from a local source. In fact ARC and AID appear to have reached a plateau of mutual misunderstanding. All four bilateral AID projects have an emphatic need for the products and services that ARC can offer. On the other hand, the AID funded ARC staff are stretched so thin meeting their immediate responsibilities that they have not been able to respond in a helpful manner to outside enquiries for technical assistance. It is unrealistic to expect AID to be able to define at an early stage in the project design their precise current and future needs. At the same time, it is unrealistic for AID to expect ARC to be able to provide the support needed until it is properly funded and managed. This situation will only improve when:

1. ARC and AID begin to work together in designing and implementing projects with a geographic information component.

2. Project funds are allocated to provide for some form of supplement to the present ARC staff to work with the Mission and the Mission funded projects to support the needs for sny aspect of related to spatial data collection, entry, and use.

V. Family Health and Demography (FHD) Findings

A. SNIS has a clearly defined need for a GIS. The 1988 census and the 1992 DHS both provide village level information which could be used in combination with data on transport, land use, drainage, and weather to:

1. Map the demand for, and possible impact of, new health centers. Decisions on where to locate new centers are currently based on political rather than scientific considerations.

2. Help identify the limiting factors which determine the uptake of these services by the catchment population. This may depend upon transport, income, ethnicity, and other variables contained within a GIS.

3. Provide thematic maps of the census and HDS data aggregated to the canton or arrondissement level.

4. Map, model, and help design strategies for controlling the impact of infectious meningitis, malaria, and AIDS.

Although each village has a code which provides a location within the administrative hierarchy, the latitude and longitude is unknown. SNIS need to know the geographic location of the 9,000 administrative villages in order to relate them to the road network and other geographic variables. This information can be easily obtained using low cost, hand-held GPS receivers but would require a significant investment in training and logistical support. In 1991 the FAC funded Fichier de Localité which was to provide this information for all 25,000 hamlets and villages. However, according to IGNN, which was responsible for the GPS campaign, the project is now dormant awaiting further donor funds. Given the widespread need for this information, a joint AID-GON initiative to relaunch the Fichier de Localité is an obvious next step. The cost of the campaign could be reduced by: (a) using the available 1:200,000 maps to locate villages in the drier northern departments where they are likely to be collocated with wells and other water supplies which are unlikely to have moved since the maps were produced; and (b) only locating the 9,000 administrative villages.

B. Given: (a) the size and complexity of the data set; (b) the need for sophisticated geographic decoding; and (c) the need to build a GIS that will meet the needs of GON planners at both the national and department level, DHP could benefit hugely from collaboration with ARC. In particular, ARC could help with: (a) the data base design; (b) the installation and maintenance of GIS hardware and software at the DSCN; (c) initial training and ongoing support; and (d) the use of ARC's large format color printers for report generation. DHP is currently considering the use of Atlas*GIS. The use of Atlas*GIS presents two potential problems: (a) it may not be able to handle the complex data management tasks that will be required; and (b) it uses a proprietary GIS file format. An alternative strategy would be for the DSCN to use the same GIS - Arc/Info - as ARC uses (except running on a PC rather than a VAX) and to equip the seven department PCs with Arcview. Compatibility with ARC's data files and data base management software would therefore be assured. This would facilitate data sharing and technical support. These issues - the need for training and improved data collection, standardization, and distribution - are not new to Niger; they are recurrent themes.

VI. Recommendations

A. The short history of donor funded GIS applications in Africa has been disappointing. One reason why GIS has often failed to make any significant contribution towards improved development planning has been the short term nature of most of these activities. The short time span for most projects has had a number of serious implications:

1. Data collection has not been considered a priority task. As a result, relatively few resources have been allocated towards collecting the primary data which are needed to provide the baseline information against which project impacts can be assessed.

2. GIS has often been implemented as a part-time activity managed by staff with little or no relevant expertise. Because the data are often collected in a haphazard and unprofessional manner, they may be of unknown quality and incompatible with available data sets.

3. Because there is no tradition of data sharing, the data are effectively lost once the project ends. This is compounded by the fact that very few copies of the maps, reports, or other project material are reproduced and distributed.

4. Much of the work is often done abroad which is where the data and experience remain.

Because the collection, compilation, and analysis of environmental data has not been institutionalized, there has been no sustained improvement in the availability of reliable environmental information which could serve a diversity of purposes.

B. The CILSS countries face very similar environmental problems. The problems therefore lend themselves to solutions that should devised and implemented on a regional basis. As a regional institution, ARC provides the CILSS countries with an opportunity to improve their data collection activities and to apply these data to the solution of common problems. Yet there is no established mechanism by which ARC's human and technical resources can be harnessed to help in a systematic and sustained manner the numerous development projects which are both producers and consumers environmental data.

C.AID can play a crucial role in supporting the development of a model in which ARC can serve as a source of expertise for guidance to USAIDs within CILSS. If a portion of the project budget was allocated to the collection of data within a framework designed in collaboration with ARC, the process of building a national GIS would be greatly accelerated.

D. ARC should become the center for Missions that need GIS expertise. The relationship would involve funding an associated unit at ARC with a senior GIS expert and a single staff person to assist in project related work. The result would be a loose client-server relationship which could assist with the following project activities:

1. Design of the data collection framework (sampling strategy, data verification, etc.).

2. Map digitization.

3. Data base compilation.

4. Reproduction and distribution of digitized geographic data sets to all users.

These data sets would be stored as Arc/Info files at ARC (the server) within a centrally maintained data base. These files would be distributed on diskette to users (the clients) who could view, combine layers, manipulate the symbology, and print out maps, images, and tabular information on any PC running Windows and Arcview.

Arcview was designed by ESRI, the authors of Arc/Info, as a low cost, Microsoft Windows based map viewer/composer that is 100% compatible with Arc/Info. The end user would have access to exactly the same data as ARC but would be able to view and analyze the data at a remote site with minimal training. By standardizing on Arcview, there will be no need to convert data between Arc/Info, Atlas*GIS, and Idrisi. Arcview can transparently handle both raster and vector data. Arcview Version 2.0, due for release in September 1993, will let the user relate the boundary files to external data files held in the popular dBase or Lotus 1-2-3 formats. This will allow users to integrate data into a common geographic framework. The advantages of working with Windows based applications are threefold: (a) the graphic, point and click environment greatly increases the ease of use; (b) it is possible to cut and paste data between different programs; and (c) Windows supports virtually every available printer and graphic display.

E. ARC currently has neither the mandate nor the resources to provide this level of support. To meet AID's needs, a full time Project Manager would have to be seconded to ARC. This staff member would be responsible for coordinating and providing ongoing technical assistance to any AID project which bought into the program. Specialized training would be provided through short term TDYs. The following budget is for the first year.

1. Data Entry/Digitizer (CILSS national)	$11,000	
2. Project Manager		$95,000
3. UNIX Workstation and software	$60,000	
4. PC and software		$10,000
5. ARC's G&A (15%)		$26,400
6. Six 2-week USDA PASA TDYs		$33,000
7. Books and periodicals	$10,000	
First Year Total		**$245,400**

If the total were shared by ASDG II, DPM, and FHD, the cost per project for the first year would be about $80,000 per annum - a fairly small fraction of their project budget which would nonetheless have a significant impact on the technical quality of the work. Subsequent annual costs would not necessarily include hardware and software. This transaction based relationship between ARC and AID projects could become a model for other CILSS countries.

F. A closer link between ARC and AID projects could assist the compilation of a body of analytical techniques which could be applied across the region. This is a priority goal for Glenn Rogers, REDSO/WCA Program Economist, who has identified three "returns" to AID investment in GIS:

1. Cost reduction by: (a) taking advantage of computer based map making and spatial data analysis; and (b) tailoring field data collection efforts to spatially and sectorally complement existing data - in effect reusing old data.

2. Improved decision making. This can be achieved by using a GIS to provide estimates based on the available data sets. This has particular relevance for the design and collection of API indicators.

3. Improved data integration and visualization. The ability of a GIS to allow specialists from different sectors to work together rather than in isolation provides real benefits by focusing the research questions and bringing a critical mass of specialist knowledge to bear on a problem.

By encouraging an effective working relationship between ARC and AID, USAID/Niger has the opportunity to assist the useful application of the lessons learned in Niger.

G. ARC is currently selecting methods for telecommunications. Regardless of the selected telecommunications link between ARC and the CILSS, it is important that data links within Niger be improved. ARC could form a hub in a communications network which includes the NAC, GON agencies, FEWS, the Internet, and via the Internet, collaborative institutions such as EDC, ESRI, and Idrisi Project/Clark University. Each point would require:

1. A PC.

2. A modem.

3. A clean telephone line (any line that can carry a fax can carry e-mail).

4. Initial training and on-going technical support in the use of Fidonet software.

The initial training could be provided by the FFR. It should be emphasized that this is not an experimental technology. Two centrally funded AID projects - FEWS and SAFIRE - already make extensive use of Fidonet for communicating text and data files both internationally and across Africa.

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