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ARCVIEW TUTORIAL AND DATABASE DEVELOPMENT BASED ON A SENEGALESE LOCAL COMMUNITY CARTOGRAPHIC MODEL ROSS-BETHIO RURAL COMMUNITY

by

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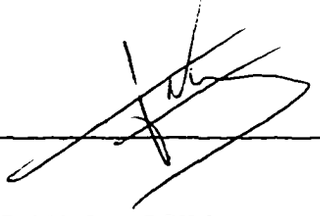
SIGNED: 

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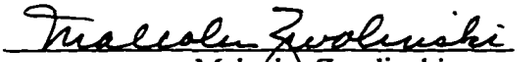

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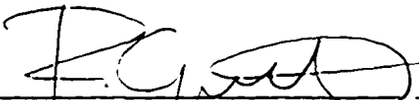

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DEDICATION

To my mother who always support her family.

To the memory of my father who always recommended hard working.

To my family.

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ABSTRACT

Through this work a database and an ARCVIEW tutorial based on a Senegalese local community cartographic model is developed. The Ross-Bethio rural community model was selected as an example of solving methodological problem in natural resources management at the scale of a rural local community. The tutorial developed will also support Geographic Information Systems Instruction for natural resources management in Senegal using a local known database model.

The process of solving the problems identified are based mostly on natural resources management concerns of the local community council and will help users to learn and understand the use of ARCVIEW GIS for spatial analysis.

A solution is provided that will help the instructors to evaluate their results with these in this study. However, the tutorial is not a self-taught one for ARCVIEW GIS, but an instructional supervised one.

I - INTRODUCTION:

A) – INTRODUCTION OF THE GENERAL CONTEXT OR THE RESEARCH.

The problem that this thesis will address is very important in our developing countries. In the past the tradition of the cartographic databases was either too **specialized** or **too general** with a special use by only some technicians, geographers or for academic purposes only. Thus, their use was very limited even if the research results they contained might be very important for farmers or entrepreneurs. The samples of the UNDP (**SEDAGRI. 1970**)soil map of the Senegalese river basin, and the Remote sensing and the USAID (**USAID. 1985**) Mapping of the Senegalese Natural Resources shows that there is good and important data, but, at the time they were made, nobody thought about their use by the local communities.

Some people can say that they were not designed for local communities but the problem is that, to use a map of soil fertility or suitability or capability you will need to apply it to the terrain. Therefore, you will necessarily apply it on local community land.

One of the most important issues nowadays, is the association of local people in all natural resources management projects. Almost all researchers agree that it is the key for a successful project in developing countries. Therefore, the use of new tools for Natural Resources Management (eg. GIS) are becoming more important and require the integration of the local community design and local needs.

The GIS project developed in this thesis will be used to build a powerful tool (model) which will allow the local community council in Senegal to better manage their natural resources . According to the New Agricultural Policies of the country, land management is now under the authority of the local community councils. All the data used in this project are derived from North Senegal. One rural community will be used as an example (Rural community of Ross-Bethio).

The choice of this local community is based on four years of research. The research was conducted through the Natural Resources Management Research Program of the Senegalese Agricultural Research Institute of Saint Louis in North Senegal, and most of the data used will concern that Saint Louis region. Additional data were received from other institutions such as the development agency (SAED) and another environmental private agency (CSE). However, the main focus of all these data is the local community of Ross-Bethio. The research in this area is important because of the fast changes that are happening in this area.

To make these objectives realistic we need to think about the human resources necessary to develop and manipulate the necessary database and also the people who will learn it and use it in their everyday life. Therefore, through this thesis focus will be on the development of a database and a series of tutorials that allow the users to learn in a known bio-physical environment and political context.

The target region is presented in the following chapter of this introduction.

B) - BACKGROUND:

1. Region of interest:

The region where the data are derived is located in the North West Senegal called "the low valley of the Senegalese river". It constitutes the downstream of the Senegalese River. In that area a dam was built to stop the intrusion of salted water from the sea into the low lands. Thus, the farmers could have sweet water (water without salt) to grow rice, vegetables and crops in that region close to the Saharan desert with very low precipitation. One major problem in that area is the salt that has accumulated over hundreds or thousands of years by the natural seasonal flooding of the land by the sea. To make the soils suitable for agriculture the engineers use technical methods to eliminate the salt. Another important aspect is that the distribution of the salt is not uniform in all types of soils. Other factors: the funds necessary for the management of a specific type of soil and its location, the amount of money available in the pocket of the owner, all influence the management process.

Since 1965, this region was managed by a national development company (SAED) whose goal was to help farmers to grow rice in that area. However, in 1984, the government decided to make the local communities more independent and enlarge their responsibilities for the control of their natural resources. So the functions, which were devoted before to a national development company, were transferred to the responsibilities of the local community councils. The major consequence of these new

policies since 1987, has been the ability of the rural community council to attribute lands and manage their natural resources.

The conjunction of all those preceding factors (availability of water and soils) for entrepreneurs favored a rush for "haven" lands. Even entrepreneurs from the towns were attracted. So the major impact of this policy was a big disturbance in the land management processes. Therefore, the local community lost the ability to monitor and evaluate efficiently the land management process. Fortunately, the Senegalese Institute for Agricultural Research (ISRA) conducted researches in that area.

2. Previous research

The database and tutorial we developed were based on researches started in 1990 and concluded with a final research report and a thesis in 1992, and a participatory local community development plan in 1994.

The methodological theory which focuses on the design of a database that are pertinent to the natural resources management unit (local community unit) as in this case was developed in the Senegalese Agricultural Research Center with a team of sociologist and law environmentalist and a geographer (**I. Dia, 1992**). The conclusion was that the best management level for natural management was the local community, the smallest administrative unit manageable.

The second important aspect was the necessity to realize a major research development goal that was the creation of tools (map, statistics) that allow a better management of the natural resources. Therefore, with the thesis I wrote in 1992 (**M.**

Niane, 1992), I had the opportunity to demonstrate the functionality of the approach which focus tools on the local community scale. Thus the tools (maps) developed at the national or regional level were less satisfactory for natural resources management. At the same time, statistical and text files were created to describe the socio-economic and juridical factors of the irrigated systems in the Ross-Bethio local community.

The third important aspect was the development of the participatory and contractual objective whose results were the involvement of the local community with their leaders; the local community council. The ultimate level was the realization of the Local Development Plan of Ross-Bethio (**J.Berthome, T. Gillet, Marsh 1992**). It was an opportunity to use all the information and tools accumulated to diagnoses the local community and propose prospective solutions for the local community problems.

While some of these previous results lacked flexibility of manipulation, this thesis will allow me the opportunity to overcome the "time problem". Therefore, the database will acquire more flexibility which means easy to update and easy to produce because of the digital form.

C) PROBLEMS:

1. The first problem:

The first important problem we have to think about is that the local community council has its own problems to deal with and which are located within the boundary of their own rural area:

- Land distribution process.
- The location of attributed lands
- Suitable land location
- Amount of land left versus used.
- Distribution of the infrastructures according to population density
- Tax implementation
- Non - agricultural land location (forest)

The local community council, which already made its first local development plan, has a strong opinion about what they want and already has dealt with the product we will use in this work.

2. The second problem:

The second important problem is how to design tools that meet the standards of the local community. To meet the local community council requirements we need at least the following information:

- Short time updated
- Large diversity
- Flexibility of manipulation

3. The third problem:

This last problem is the availability of human resources which are available to do the analysis. We found that the easiest and the cheapest way to develop this necessary human resource is to make instruction available.

To solve the third problem (human resources) we need at least three requirements:

- Academic institution (Universities, Institutes of training etc.)
- A local cartographic model, and database
- And a Geographic Information System (GIS) package.

The academic institutions and the geographic information system package exist but there is a lack of instruction. In addition, the local cartographic model does not meet the requirement for use in one specific package. Therefore, one main goal is to meet those requirements.

II - OBJECTIVES:

Through this thesis the following major objectives will be met :

A) METHODOLOGICAL

The purpose of this objective is to develop a database based on a local community boundary and procedures which allows natural resources managers in rural areas to develop new technological products more adapted for use by local people. Maps help the local council to understand the change in their environment and enable them to design the changes they want to implement. In addition, it helps them to communicate with managers or researchers. Thus, those abstract representations which are based on visualization will facilitate rural community council decision making.

B) PEDAGOGICAL

The purpose of this objective is to develop tutorials that can help reach two goals:

- To teach how to use GIS analysis functions in natural resources management
- To develop GIS courses based on the local database.

The data used will be standardized for use with ARCVIEW desktop mapping package. However, the data will come from ARCINFO or other sources convertible to ARCVIEW format or ARCINFO format.

C) – JUSTIFICATION OF THESE OBJECTIVES.

1. Methodological:

The increasing political and managerial power and responsibility of the local community council over their territory and resources make those spatial units the best target for natural resources management. The research we conducted during our four years stay in the rural agricultural environment showed that much research was being conducted with millions of dollars, but nobody can use those results. Why? Because of the format they have. As I said in my introduction, the soil map funded by international organization has very little use for the farmer who will have to pay someone else for very expensive soil analysis using them. That means that, to use those research results we will need another treatment of the information already gathered with lots of money.

For these reasons, the design of a database that fits exactly a local community (the smallest administrative unit of Senegal, and is also the largest administrative territory lead by the local community) is a major change. This major change is in the way the researchers see the local community; instead of being people who have to consume what we produce, they will become the people who are the producer of what they want. Therefore, they will certainly take care of that.

Therefore, my focus on the boundary of the rural community of Ross Bethio is the symbol of a major methodological problem which will allow the result of the research be more useful at the scale of the local community.

2. Pedagogical:

Today in the two universities in Senegal, GIS courses are not taught despite the fact that GIS technology is present in some development agencies, university departments, research centers, etc. Even though in the private sector its use is still rare, the training and development of human resources is very important.

It will be very important for Senegal, dealing with so many constraints on our natural resources, to introduce the teaching of GIS. The universities have a major research role to play in the thinking and evolution of the use of GIS technology. The tutorials implemented in this thesis will help establish basic training using sites known and accessible for field trips.

The database and tutorial may support queries on location, suitability, availability of natural resources and, in addition, proximity of the resources to habitat, mode of transport, water resources, livestock trails, infrastructures (industrial, roads) and markets.

3. Management perspective:

From a management point of view, GIS technology may help analysis , simulation of hypothesis and scenario, and decision making for managers. A second important issue is the use of GIS products (maps) as tools in rural areas. One of the main tools used by peoples in those areas is based on visualization and graphics. It is well

known that people in rural areas know their environment very well but the problem for developers is that the information is mental information (mental maps), therefore, there is no hard copy. However, if we translate the information to thematic maps they can navigate with them, and usually they can help us to correct some distortions in our research.

The management units defined in our local community model represent the way the Ross-Bethio local community council defines their administrative units and boarders. Therefore, it will be possible to print and use automatically the product developed in this thesis.

III - DATA ACQUISITION:

Database development is a very complex and time-consuming process, because of the requirements for data quality (precision, accuracy, consistency, etc.).

During this work, three sources of data were used:

A)- DATA RECEIVED:

1. Ecological Survey Center(CSE):

Data were received from the Ecological Survey Center (CSE : Centre de Suivi Ecologic) in PC ARC/INFO coverage with a scale of 1/1,000,000. Those coverages were available for the area of concern: the local community of Ross-Bethio. In addition we have the map of all of Senegal. The following coverage were available in the database.

At the level of the local community area we have:

- The frame (box) of the extent of the local community
- Soils coverage (morphopedology)
- Habitat and demography coverage
- Road networks
- The local community boundary and administrative surroundings.

At the level of the country I received a vegetation map which gives two major information types:

- The different agro-ecological regions

Sahelian (with grass)

Sudanian (clear forest)

Agricultural lands

Muddy landscape

Forest

Mangroves

- The different species found in each region.

2. The National development Agency (SAED):

The data received from SAED were in Mapinfo Interchangeable File which can be converted to a shape file by ARCVIEW. Therefore, the product generated by ARCVIEW is convertible to ARCINFO shape file. The coverage is at a 1/50,000 scale which gives more detail inside the irrigated systems of the rural community land. From that database I received the followed coverages:

- Hydrology (different streams and rivers)
- Hydraulic infrastructure network (canals)
- Hydraulic pomp
- Agricultural perimeters units
- Major village boundary
- Soil map

B)- DATA BUILD:

Using the technological resources available at the ART Lab, I constructed additional data which can help meet the goals and objectives. The package I used to accomplish this task is ARCINFO, and the data I digitized were at a 1/50,000 scale. The complex process of database development includes the following processes:

1. Data acquisition:

- Data capture using digitizing tablet
- Data attribution and display
- Data editing (check for error)

2. Data manipulation:

- Transfer and integration of data of same format
- Conversion of data from other format type to ARC/INFO type
- Join different pieces of the same area.

This process resulted in the following coverages:

- Roads, dikes and trails
- Habitat, ethnicity, and demography
- Parks and forest
- Streams and rivers
- Livestock trails

- Administrative boundaries of the local rural community: with the definition of the management units.

IV - TUTORIAL DESIGN:

The tutorial developed will be based on:

- The data available
- The problem to solve and related to the data.
- the software package

The software used is ARCVIEW desktop mapping package for all the exercises developed in the following chapters. Therefore, the data will be developed to fit the requirements of the software. The latest version of ARCVIEW: (ARCVIEW 3.0) has an additional spatial analysis extension which allows proximity and neighborhood analysis.

A. Exercise One:

1. Problem One

a. Problem statement:

Some fisheries researchers consider the riparian area along the river in the west coast of Senegal as the reproduction and growth area of fishes. Those areas are contact zones between the sweet river water and the salted sea water. The specific conditions which make the ecosystem suitable for the existence of "shrimp, nutrients" and the development of a characteristic riparian vegetation called "mangrove." Therefore, those areas need some attention. However, in those areas, some degradation happens because of drought, resulting in less supply of sweet water (rain or ground water) and more intrusion of sea water under very high evapotranspiration conditions.

Under those drought conditions two major problems were identified:

- increase in the rate of salinity
- degradation of the riparian vegetation

The main consequence was the development of a threat on the existence of fisheries and shrimp production.

The vegetation of those ecosystems called "mangrove" include wetland with muddy sand, and the vegetation stands on roots rising out of the water.

b. Potential questions and tasks:

- The ecosystem managers are interested in identifying endangered regions

(mangrove), and to locate areas to focus their research.

Therefore, your task as a GIS analyst is to submit two results:

- A ***map*** with all the ***regions of interest*** for this threat
- And the list of ***species*** generally found in those areas.

Hints: You might focus your study in Central West and South West which have more natural phenomena.

c. General requirements:

Through this assignment we will have to produce two main results:

- A layout with the region of interest
- And a list of the species available in those riparian areas.

Using ARCVIEW desktop mapping package, the results will be displayed on maps with **legend, title** and the area of concern will also be **labeled.** To finalize the product we will create a layout which will be saved as an EPS file for further use. It will help to add all information needed on a map including title, scale bar, legend, text graphic and charts.

d. What you learned:

This assignment will be an opportunity to learn how to:

- Create, manipulate, display, and save a layout.

2. Problem Two

a. Problem statement:

The second concern of the research team is that the agricultural zones have suffered from vegetation degradation due to drought and from agricultural systems with the introduction of mechanization. Therefore, their concern is how to re-vegetate these agricultural lands.

They assume that the success of the operation depends on the adaptability of the species to the biophysical conditions of each area.

Another assumption is that to do so with the maximum chance of success, the least cost investment and the keeping of cultural use of the trees, they must use the vegetation of the closest natural area.

b. Potential questions and tasks:

- The natural resources managers want to re-vegetate the agricultural lands with the most suitable species.

The main task is to produce:

- A map of the different biographic regions around the agricultural regions.
- Hint: We know that the agricultural lands stretch from North to South, with the largest and most homogeneous area located in the central part of the country. However, spots exist all around the country.

c. General requirements:

To perform the task assigned, we will need to use a special advanced technique which require an additional feature which is optional in ARCVIEW3, the ***proximity analysis*** function. This function is under the spatial analysis extension. However we can use some more traditional techniques by selecting the agricultural lands and intersecting it with the species they include or we can investigate the surrounding regions. Then the species they contain will be the most likely to survive within an area and under those existing conditions. Therefore, you will submit:

- A map of Senegal with the different bio-geographic regions including natural and agricultural regions,
- To be understandable the final layout will be **labeled**, and in addition, a **legend, title, scale bar** and **problem number** will be added.

d. What you learned:

You will learn through this assignment how to make queries and creating new themes by:

- Selecting needed features, extracting them and creating new shape files

You will learn also how to submit a final map on a layout, and to save it as an EPS file.

e. The database available:

To perform the analysis in this first tutorial we have available a database of the Senegalese country with two major themes:

- Agro-ecological regions
- Vegetation types and species

B. Exercise Two:

1. Problem One

a. Problem statement:

This ancient no-man's land was only used in the past by livestock for grazing. With very low rain (250mm per year), these lands used to supply grass to herds via the remaining flood water of some local lakes. Over the last several decades the flooding has been controlled by dikes and recently (1988) by two dams which regularize the quality and the volume of sweet water necessary for the development of new irrigated agricultural systems.

Two major types of agriculture are conducted in this area: ***rice and vegetable production.*** According to the type, the structure, and the texture of the soils, the rice or vegetable agricultural capability is established. Therefore, the rice that develops under water needs fine soil texture which can hold water and tolerate more salt. On the contrary, vegetables need sandy soils which can drain water and salt very fast. We might add also that the proximity of the water is a very important factor in agricultural investment.

Some new entrepreneurs are interested in the development of the new agricultural opportunity offered by the environment of the New Agricultural Policy developed by the Government. That is why the local community council of Ross-Bethio is interested to characterize the land types.

The fact that the irrigated systems are very expensive, the access or proximity to markets is very important. Therefore, the local community council cares a lot about the transportation infrastructure, mainly roads.

b. Potential questions and tasks:

- The local community council is interested in determining the amount of

lands available for vegetable crop type, but to keep the investments low they ***prefer*** the sandy land to be within less than ***two kilometers*** of the body of water.

- To avoid the damages causes by pets, they think that the fields need to be ***300 meters*** radius from any habitat. All these operations take place exclusively inside the ***local community boundary***.

- The local community also wants to facilitate the flux of agricultural crops, therefore, they want to improve the roads and dikes' system. However, they do not have enough money in their budget and they want to raise taxes based on population size, but they know by experience that only the population who lives within a certain limit (one kilometer) of a road or dike will be willing to contribute to the funding.

- Therefore, to have a good idea of the funds they might expect, they want you to ***estimate the population*** which lives within one kilometer of a road or dike and create a ***list of these villages.***

The main tasks are:

- To find and map the land suitable for vegetables within 2000 meters of a body of water and not located within 300 meters from any human habitat.
- To find the villages located within 1000 meters from the road

or

dikes, and estimate their population.

- The village may be listed or displayed as a label on the map, each option is acceptable.

c. General requirements:

- We will need to use ARCVIEW to supply maps which indicate sandy land within two kilometers of a body of water with areas extracted that are within 300 meters from a village.
- For the second product we will have to overlay the buffer of one kilometer from any roads and the village's coverage.
- We will extract the village and compute a summary statistic of the population.

Hint: based on the soil name we can identify soil types. All soil name starting with E (e.g. E101) is sandy soil suitable for vegetable, and all others are suitable for rice.

d. What you learned:

This assignment allows you to use different ARCVIEW functions under advanced analysis features of the spatial analysis extension package. You will learn how to find distance, and perform map calculation.

2. Problem Two

a. Problem statement:

The specialization of this local community on rice and vegetable production obliges them to focus on two types of soil characteristics. The rice, which requires an important amount of water, must be developed in muddy (clay) soil which keeps the water without infiltrating underground. On the contrary, the vegetables are produced on sandy soil which allows easy drainage for water and an easier way to combat the salt. They want also to do an inventory of their surface water resources, because they constitute the irrigation sources. Therefore the local community council and the farmers' organizations agreed to ask for help the University GIS Lab.

b. Potential questions and tasks:

The memo they submitted to the university GIS lab addresses the following concern:

- The production of a soil map suitable for each agricultural crop theme

(rice or vegetables). Thus, they can direct easily the entrepreneur according to their desire.

- And a map that highlights all water sources available within the local community of Ross-Bethio.

The main task is to produce three maps which meet the specifications of the local community council.

Therefore, using the ARCVIEW GIS package we will produce the maps of soils suitable for rice or vegetable, and a water source map.

c. General requirements:

In this exercise mostly we will use basic ARCVIEW functions to select and intersect themes in order to extract the desired information. Therefore, we will produce three layouts:

- The first two layouts for rice and vegetable production will include at least soil type, local community boundary, and water sources.
- The water sources map will include water and the local community boundary.

All the maps will be labeled to make them intelligible.

d: What you learned:

This assignment will be the opportunity to learn with ARCVIEW basic queries, selection, extraction and shape file conversion of themes.

e. The database available:

For this second exercise the database will be: a soil map of the local community, a demography map, a road map, and a water map.

Hint: The water map will be extracted from the soil map because it has water features we can use even if some streams are missing.

C. Exercise Three:

1. Preliminary

Before dealing with the next analyses, we need to have a view of what was going on in 1994 with the irrigation systems. 1994 coincides with the tenth year since the government initiated the new agricultural policy with the leadership of the local community council policy. The development agencies whose role was reduced still remain important. The private sector has developed very fast with the extension of the irrigated lands.

It will be necessary to be familiar with the Ross-Bethio irrigated system composition. Therefore, using ARCVIEW, we are expected to produce a **reference map** with the following information:

- all natural water sources
- all channels
- all irrigated units (or management unit)
- all pumps used to supply water
- and finally the infrastructure like roads, etc.

The map should be complete with ***legend***, ***Title***, the North arrow and the ***scale bar***.

2. Problem One

a. Problem statement:

The rural community of Ross-Bethio is a region in development because of the irrigated systems. With the new agricultural policies, the rush for land resulted in disorder within the land management. Therefore, today the local community council is doing the best they can to develop a local community plan. This plan will help them to have more control over the resources allocation and management.

The first part of this exercise will concern essentially statistical methods, which will help the local community council to gather the information they need.

b. Potential questions and tasks:

The local community council wants to know in 1994 the distribution and amount of land allocation within the local community for:

- ***Irrigated agriculture*** (mostly rice),
- ***National forest and park***,
- and what were ***left for other purposes and agriculture extension***.

Therefore, our analysis will enable them to have an idea of their resources.

Our main task is to use ARCVIEW to perform analysis, and supply computed ***areas*** involved. In addition, we may draw ***diagrams*** and ***charts*** to facilitate comparison.

To facilitate your understanding during the analysis, the council will give you some guidance . They assumed that the areas with the densest accumulation of pumps,

fewest channels and remote from the roads are occupied by private entrepreneurs. The other sites are under the responsibility of the development agency. However, this information is not fundamental for the solution of the problems.

c. General requirements:

To get the result we will need to use at least three variables:

- The total area of the local community,
- The area of the parks and forest,
- And the area of the irrigated agriculture land.

Then, we can compute the area of land left. The chart function will be used to display the comparison result.

Hint: The resolution of this problem will use different unrelated data of the local community (from two or three). Using the theme's attribute table you can compute the different areas, build a new table with the new data, and at the end chart them.

d. What you learned:

You will learn with this problem, how to get statistical information from themes, how to build new table, and how to chart data.

3. Problem Two

a. Problem statement:

The local community council has to plan a yearly budget anticipating their needs at the beginning of the financial year. Therefore, they need to know the approximate size and distribution of the population ***within the Ross-Bethio rural community***. This will help them estimate the number of infrastructure projects (schools, etc.) needed within the community. In addition, many remote villages are located in areas where domestic water is very rare. The ground water is highly salted in those areas, therefore, no wells are dug. The major water source used is a car water tanker (car with a tank which can hold more than 1000 liters of water).

b. Potential questions and tasks:

The local community addresses their concern to the University GIS Lab through a memo where they request:

- A map which highlights the local community of Ross-Bethio with the villages and a summary statistic with the total population.
- A map with the villages whose size allows the supply of a daily full car water tanker.

The local community council supplies some conditions for the last question. So, they estimate that:

- A village needs to have at ***least 100*** persons to have its own supply.

Therefore, the smallest villages will still have to use the traditional supply methods which mean going to the nearest supplied village with an empty inner tube that they fill with water and put on the back of a donkey.

- In addition, the village needs to be ***within no more than 1000 meters from a road, dike or trail***, because all of these can be used by the car water tankers.
- However, the local community council made an objection by excluding

all villages locate within **1500 meters** of a water source.

The main task will be to derive summary statistics of the total population of Ross-Bethio from the demographic map, and do the analysis which meet the conditions for village car water tanker supply eligibility.

c. General requirements:

Using ARCVIEW to meet the requirements we will produce:

- A layout with all villages of Ross Bethio rural community.
- A final layout with the eligible villages within Ross Bethio local community.
- The infrastructures (roads), water sources, local community boundary will be added to the final layout.

Using the spatial analysis extension we will use the buffer map calculator capability to highlight the zone suitable for eligible villages. The layout will be labeled

with the village names, besides the regular legend, title, scale bar and surroundings of the local community.

It is very important to keep in mind that all the analysis are done within the boundary of the local community council. This operation can be done within ARCVIEW with the select by theme option. The resolution of these problems may have different path.

d. What you learned:

We will learn from ARCVIEW some the basic and advanced analysis functions.

e. The database available:

The coverages listed below will be critical for this exercise : the local community administrative boundary, habitat and demography, roads coverage, classified forest, water sources and rice perimeters. These coverages will include two sources the SAED data and the one I built.

D. Exercise Four:

The rural community of Ross-Bethio is the largest one in the northern part of Senegal. It is also the largest administrative unit led and managed by a local community council. They have developed some techniques to better manage their local community and its resources. The local community council divided their community into four spatial management units each led by one fourth of the council members. This technique helps them to have better control and monitoring over their space.

1. Problem One

a. Problem statement:

The local council has a concern about the distribution of all features within the whole rural community and within each management unit. Therefore they want to have a better understanding of what the distributions of population, parks, roads, water, and animal trails looks like.

The local community council would like the University GIS Lab to provide a wide array of information based on maps and charts. This information will focus on the scale of the management units and the whole community.

b. Potential questions and tasks:

The first concern of the local community council is:

- The distribution of the population and villages within the rural community and by management unit.
- They require some derived statistics.

Therefore our main task will be :

- To produce a ***map*** of the villages for each management unit of the rural community.
- In addition, we will have to compute the ***size of the population*** for each management unit and ***rank*** the villages size.
- The last thing they want you to supply them is a ***chart*** which compares the size of the population of the four management units.

c. General requirements:

This assignment will be the opportunity to submit:

- Four layouts representing the management units habitat and demography. They must be titled, labeled, with legend and scale bar. In addition, the size of the population will be written on the layout.
- The rank of the demography size will be done by using **gradual symbols.**
- To chart the size of the population for the four management units we will need to create with ARCVIEW a new table. It will be used for charting the data.

ARCVIEW allows us to build and manipulate a table independently from a theme.

d.What you learned:

The major new functions we will learn with this assignment are:

- To display ranking by using graduate symbology
- And, how to create and manipulate a table independently of a theme.

2. Problem Two

a. Problem statement:

We are also asked to do the same work with water sources, livestock trails, and roads features. The important thing for this database is that it symbolizes the major inter ethnic constraints in the agricultural system in these irrigated systems. The fact that the rivers and streams constitute the sources of water supply for agricultural, human, and livestock use, is the main source of conflict in this dryland low valley. Therefore, the contact between livestock trail and water sources which is buffered by irrigation perimeters occasions many conflicts between nomads and peasants. To avoid conflict, the local council decided to set the width of livestock trails at 100 meters. Therefore, it becomes forbidden to implement any agricultural activities in those buffer zones.

According to the information available we can assume that the major conflict zone is located within a 1000 meters buffer around the water sources because of the location of the irrigated agricultural lands which are supposed to have green vegetation during the driest period of the year.

b. Potential questions and tasks:

The local community council would like you to highlight:

- The 1000 meters conflict buffer zone around the water sources, and the 100 meters wide trail.

Therefore, our major task is to produce a map with those buffers labeled.

c: General requirements:

This assignment will be the opportunity for the student to submit:

- A layout with the two buffers labeled, and in addition will include the following themes: water, animal trails, and habitat.
- For pedagogical purpose, we will double the width of the animal trail buffers to make them visible.

d.What you learned:

The spatial extension functions we will use here were already done in the previous assignment.

3. Problem Three

a. Problem statement:

The local community council is developing a database where the different ethnic groups are registered to better monitor their specific problems. Indeed, the local community has a very localized and homogenous distribution of the three major groups. The Peul live within most of the continental or inland zone which is called Jeeri, the Maure in the South-West, and the Wolof at the boarder of the water sources (North-West, North, and West). However, the Wolof distribution is more random. Traditionally, the three groups were identified with different activities: The Wolof were identified with fishing and light summer agricultural activities, the Maure with livestock trading, and the Peul nomadic livestock raising. However, since the introduction of the irrigated systems, all ethnic groups are moving into those new systems while still predominantly living in their old sites, and duplicating their housing near the water sources. This strategy was mostly developed by the Peul to keep strategic positions for their access to water and grass.

It is very important to notice by looking at the ethnic group distribution that the animal trails lay most of the time between Wolof and Peul villages. That fact explains most of the conflict within the local community, because of the difference between activities and lifestyle. The contact between animal and field ends mostly with conflict.

b. Potential questions and tasks:

The local community council is interested to know:

- The location of each ethnic group

- Which ethnic groups are likely to be in conflict.
- The space the animals need for their safety (trails and around the Peul's home).

From this information the local community council wants to meet the requirement that the ***Peul*** can get to the fields safely and the livestock are able to eat and drink safely. According to the nomads, they need at least ***300*** meters radius from their home free from any field, and with this they can guarantee that any animal will not go through the fields. In addition the local community council decided to allocate ***100*** hundred meters wide for animal trail.

Therefore, our main task is to produce a map that display the space reserved to ease the livestock using buffers around Peul houses and animal trails.

c.General requirements:

To give an idea about the potential social conflicts, you will have to submit:

- A detailed layout which show the location of each community with water sources and animal trails. This can help to explain why conflict can happen between agricultural people which buffer the water sources and nomadic people who conduct livestock toward the water sources.
- For pedagogical reason, you will need to double the reserved space which may

be to hard to see. Therefore, we will use 600 meters instead of 300 for buffer around villages and 200 meters instead of 100 for trail width.

e. The database available:

The coverages listed below will be critical for this exercise : the local community administrative boundary, habitat and demographic, water sources, animal trails. These coverages will include two sources the SAED data and the one I built.

V- SOLUTIONS

The following solutions will give you an idea about what the analysis results will look like. However, it is important to keep in mind that ARCVIEW offers a large variety of functions which allow different analysis methods. Therefore, each student can have his or her own way to solve a problem.

The solutions are organized into four exercises with at least 2 problems each.

A. Exercise one:

1. Problem One

- Solution Problem 1

Finding the riparian fisheries regions threatened by the long drought in Senegal

During this analysis, the first thing which comes to mind is how, from one single map, can the regions of interest be shown and also the species involved. You will need to think how to get a permanent representation of the region of interest (mangrove) you can edit, because any time you select a theme or feature you have the possibility to create a new theme. Extracting that region and converting to a new shapefile theme can do that. Then you can add special symbols to differentiate it with the other regions when you add it to the original final map. With the species you will be interested by the ones which belong to the region of interest. This means that you will have to select the points features which fall within the mangrove region and also convert them into shapefile theme. Thus, using the identity tool you can see the species present. The final map will be the addition of these previous themes.

a. Results:

You may reach at the end of your analysis the solution displayed on the layout of page (56) with the following results:

- A map titled " ***Riparian Fisheries Regions at Risk in Senegal***" (**Exer1pb1**) with a legend, North arrow, a scale bar
- And a list of the mangrove species we found.

The species are listed on the same layout than the map, under the legend.

b. Steps to get the results:

The analysis we have done for the local community council was reached through the steps described below.

- *b1 First step*:

After you start ARCVIEW, you will create a new project for **"exercise 1"**. From the **project windows** you will open a new view and using **"add button"** load the themes called "vegtype"from the data sources **"Ross"**. The themes are composed with one polygon and one point coverage with the same name "vegtype".

- To have different name for the two coverage in order to facilitate the queries, you will use ***"theme proprieties"*** and change the point theme name to **"species"** and the polygon which represent the biogeographic regions **"vegtype".**

- You will set a projection to the view: **projections of the world-geographic**, and map units (**meters**) using the ***view proprieties***.

- From the biogeographic regions theme you will extract the **"mangrove region".** Using the ***theme proprieties*** and ***query option*** you will extract the mangrove region , and use it as new theme. The new theme is named mangrove using the **theme proprieties** option.

- From the original biogeographic regions theme, you will select the **mangrove region** by using "***select by theme***" option under ***theme menu***. In this case the selected region will be selected and active feature. Using the same option, you will use the species point theme to select the species that fall within the boundary of the mangrove

areas. In this case the selected feature will be **mangrove region** and the active features will be **species**

- Using the **table icon,** you will display the **attribute table** of the active species theme, where the selected species that fall within the boundary of the mangrove region are highlighted. Therefore, you can **list them**.

- Using ***convert to shapefile*** under the ***theme menu,*** the **selected species point features** will be converted to a new theme.

- To reach the desired solution we will copy to a new view the mangrove theme and the new species shapefile using the ***copy theme*** function under ***edit menu.*** However, in order to contrast the result within Senegal, we will **add** with them the Senegalese biogeographic regions theme.

- For the final map we open the ***legend editor*** by double clicking on each theme and assigned to them different color and symbol. Therefore a red color was assigned to the mangrove region, green triangles to the species, and all other in transparent.

- You will also label the different biogeographic regions. After making the theme active, you will choose the ***text labels*** function under ***theme proprieties***, and select the label field you want to use for labeling your theme. Using the drop down list select "**nom**" which is "**name**". You will close the dialog box and select ***auto-label*** under theme, and by choosing the default, the labels will be added with the best locations.

Therefore, the analysis was done, and the summary of the analysis is the layout we produced. The list of the species were typed on the layout.

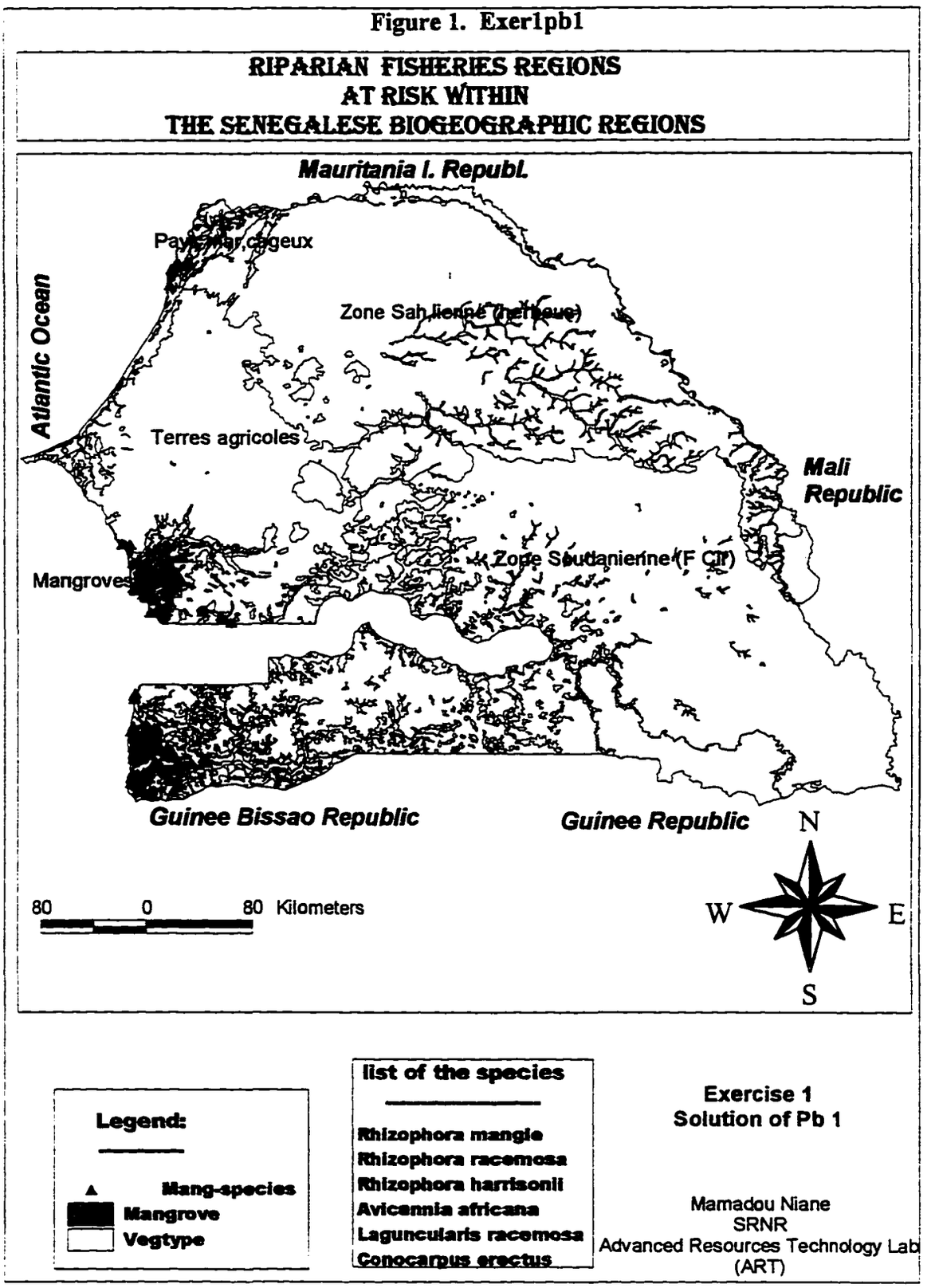
b2 Layout:

To make a layout, you will use the ***drop down list*** under ***view menu*** and choose layout. The **template manager** will be displayed, and by choosing one you will be asked from a **view-layout window** if you want to open an existing layout or a new one. Choose new layout and you will have automatically a layout with the active view with the title of the view, the legend, the North arrow and the scale bar.

- You can modify any label and write the list of the species found within the mangrove region on the layout by using the ***text tool button.***
- Using the ***text tool button*** we add the additional text and the **assignment number** on the layout. The student might be asked to write his or her name as the creator of the layout.

The project will be saved under the name **Exercise 1** and the layout **exer1pb1**.

Figure 1. Exer1pb1



2. Problem Two

- Solution Problem 2

Identifying the surrounding regions that can help re-vegetate the agricultural lands in Senegal.

It will be important for you to identify all biogeographic regions in Senegal and see the regions of interest (agricultural regions). You will see that it is made of a tremendous numbers of regions with the largest in the Middle-West of the country commonly called the peanut basin. To make a meaningful representation of the final map, each biogeographic region will be represented on the legend. Therefore, each of them will be a separate theme. During your analysis the agricultural regions and all biogeographic regions will be selected and converted into shapefile themes. The addition of the different themes in a single final map researchers will see which agricultural lands fall within which biogeographic region. Therefore, it will be easy to identify the surrounding species necessary for the re-vegetation plan. As you noted in my reasoning, I will not use advanced functions.

a.Results:

The solution is displayed on the layout of page (62) with the following results:

- A map of Senegal titled: " ***Senegalese bio-geographic regions***

sources for agricultural zones re-vegetation"(**Exer1pb2**). Each region of the map is labeled with its name which make easier for researchers to find from what region we can get trees for re-vegetating the nearest agricultural land.

- The legend also represents the different bio-geographic regions that I create as new themes.
- The map is completed with scale bar, North arrow, and the exercise number.
- The Senegalese country map will be labeled with the features (countries or ocean) surrounding its boarders.

This last information helps better understand the location of the country.

b.Steps to get the results:

We derived from the assumption of the local community council that agricultural lands exist within any bio-geographic region. We consider that they consist into spots within those regions. Therefore, each region highlighted include agricultural land that it can re-vegetate even if we do not recover the original cover.

-b1. *First step*:

You will start ARCVIEW and open the project **Exer1**. You will open a new view from the **project window**, and using the **add button** function load the **"vegtype"** theme from "**Ross**" data sources. For this analysis you will need only the polygon theme "**vegtype**".

■ A **projection** (Projection of the World -geographic) and **map units** (meters) will be assigned the same procedure as in **problem 1**. After that, you will do the analysis according to the following steps:

■ From the base bio-geographic polygon theme "**vegtype**", you use the ***query option*** under ***theme proprieties*** of **theme menu** to extract the agricultural lands and the other bio-geographic regions as new themes. The query will be processed with the ***definition icon*** of theme proprieties activated. After the query of each theme you will use ***convert to shapefile*** under the ***theme*** menu.

■ Using the same dialogue box of the theme proprieties you will give a name to each of the themes. Therefore, the agricultural lands will be named **Agricultural lands** and the other biogeographic regions the following names: **Wetland**, **Forest**, **Mangroves**, **Soudanian zone** (light forest), **Sahelian zone** (grass). You will assign to each theme a symbol, and color using the ***legend editor***. This can be done by double clicking on the legend of the view.

■ To have the final map you will add all the other themes to the agricultural lands by using ***copy*** and ***paste*** under ***edit*** menu. Then you will label all of them with the ***auto-label*** option under ***theme***. As we explained in the previous problem, make sure that the ***text labels*** under ***theme proprieties*** is set to **nom** (name).

■ To know which species to use for re-vegetation of any

agricultural land, select the bio-geographic region of their surrounding, and open the ***attribute table*** to find the suitable species or the easiest way is to use the ***identity tool*** over each polygon and scroll down the ***identify results*** dialogue box to find them..

The summary of the analysis is on the following layout:

b2 Layout:

To make a layout, you will use the ***drop down list*** under ***view menu*** and choose layout. The **template manager** will be displayed, and by choosing one of them you will be asked from a **view-layout window** if you want to open an existing layout or a new one. Choose new layout and you will have automatically a layout with the active view with the title of the view, the legend, the North arrow and the scale bar.

- You may modify the legend to a more adequate font and size for example (***9-14***), because some times you do not have enough room for all that is needed to achieve the final results. To do that you use ***show symbol window*** under ***window*** menu and choose font palette. Therefore you could select the ***font and size*** you want from the drop down list.

- Usually, you can choose the default for the **North arrow** and the **scale bar**, however, if they are too large you can adjust them by using the ***pointer*** (or ***selection tool***) .

- To complete the layout, I use the ***text tool*** to add the surrounding features label (country or ocean). In order to make the text aligned with a feature you may be rotated the way you want using the ***rotation angle degrees*** under the ***text proprieties*** dialogue box.

- The map in the layout is automatically assigned the title of the view, therefore, if you want a new title, you will have to use the ***text tool*** to write the new title.

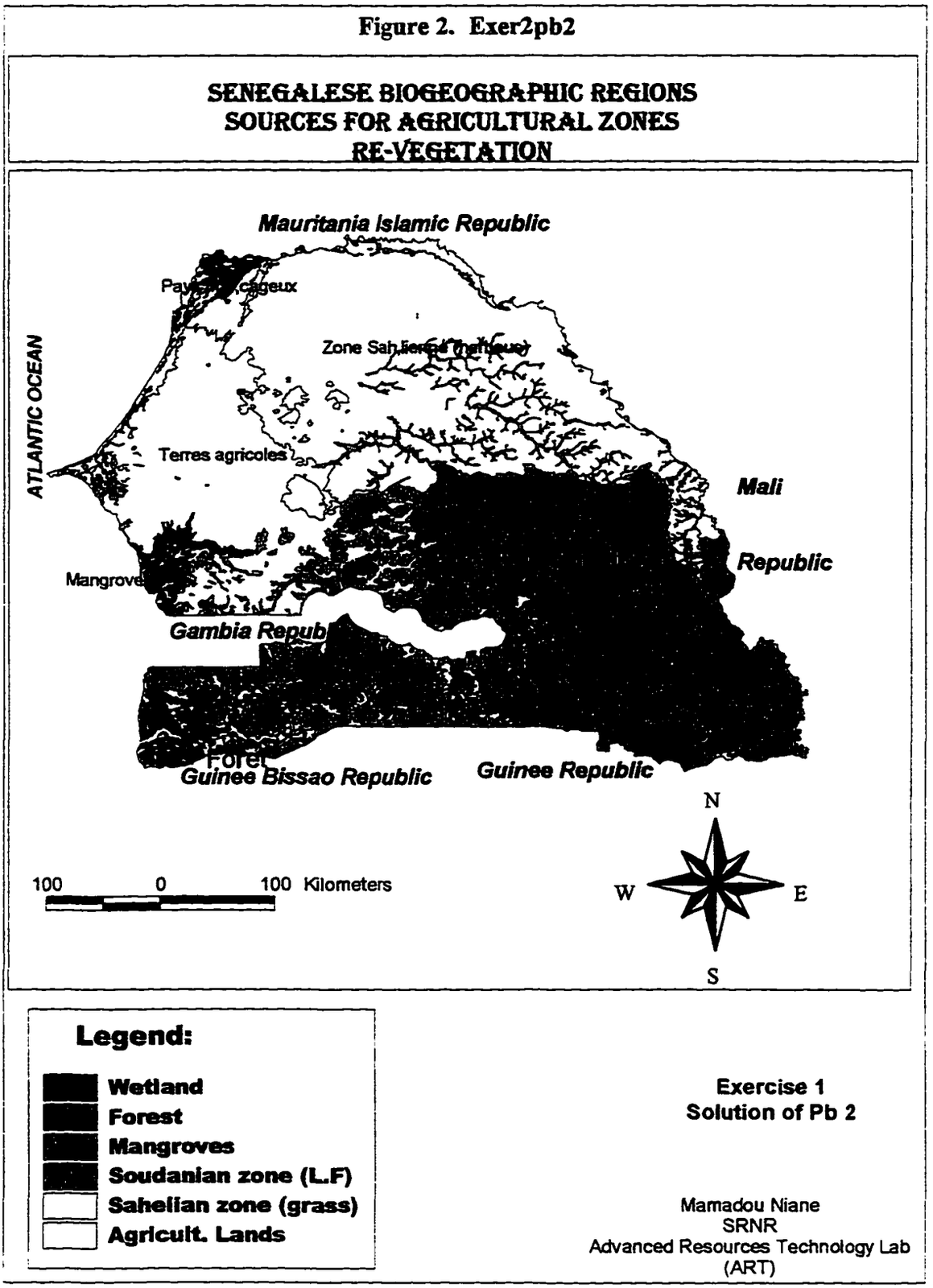
- After this analysis you will name the layout **exer1pb2,** and ***save*** the project **Exercise 1.**

These two previous problems of the exercise one are base on the analysis of two themes.

c. Themes analyzed:

Two themes (one point and one polygon coverage) named "vegtype" are analyzed. The data was provided by CSE (Centre de Suivie Ecologic).

Figure 2. Exer2pb2



B. Exercise Two:

1. Problem One

- Solution Problem 1

The analysis of this problem will need some logical thoughts that you may write down in flow chart if you want to avoid some confusion. You were asked by the local community council to find the best soil for vegetable production based on soil type (sandy), proximity to water sources (2000 meters from water), and distances from villages (300 meters). From these requests you will need to use besides basic functions some advanced techniques like ***find distance*** or ***map calculator*** under the ***spatial analysis extension***. After that you will have to solve their second concern which is to identify the villages and population which will have to pay the required rural tax for roads funding. Same as the previous analysis, the ***spatial analysis extension*** will be very helpful. As you can see lots of **buffers** and **operations** are involved.

a. Results:

The solutions of problem one are displayed on the layouts of pages (68,73) with the following results:

- The first layout represent the solution of ***problem (1 a)*** which is the map of the cheapest investment cost of soil suitable for vegetables. The layout is titled "***Suitable vegetable soil with the lowest investment cost within Ross Bethio local community***". (**Exer2pb1a**)

- The second layout represent the solution of ***problem (1 b)*** which is the representation of the villages that have to pay the tax. The layout is titled "***Ross Bethio villages required for the rural tax***". **(Exer2pb1b)**

- All the layouts are labeled and have legend and scale bar. In addition, where statistic information were needed they were added to the layout. Therefore, the statistics of the population subjected to taxes were added to the layout of the villages selected.

b. Steps to get the results:

The review of the problem statement will help you to design a flow chart for the steps you have to accomplish before the final results, and the data you have to use. However, because of the type of advanced analysis you will do, you are required to set the advanced ***spatial analysis extension*** by clicking on the file menu and click on extension. It will give you the opportunity to ***check*** spatial analysis extension.

b1 steps:

After you start ARCVIEW you will create a new project named **exercise 2**. Using the ***add button*** you will load from **Ross data** sources all themes required for the problem assignment. Therefore, you will add the following themes named: **crbethio** (the rural communities polygons), **demogr** (habitat and population of Ross Bethio), **routes** (roads) and **sols** (soils).

As in the previous problems I will assign the same projection to the views (**projections of the world**) and the same map units (**meters**) with the same procedure.

Problem 1 a

■ The first step you will have to perform in this problem is to extract from the soil map the soils which intersect or are within the boundary of the local community of Ross Bethio. Therefore, you will first use the ***select by theme*** under ***theme*** menu to select the Ross Bethio rural community. You will after make the soils theme active and using again the ***select by theme*** function to select the soils which ***intersect*** or ***fall within*** the boundary of Ross Bethio rural community. The theme may be called **rossb_soils**

■ Using the query option under theme proprieties with the active theme rossb_soil you will extract the sandy soil suitable for vegetables based on their name. The type of soil must be differentiated based on their name. Therefore, under the theme proprieties dialogue box you will activate the definition button and using the query tool open field . Then scroll down and choose MAPU which represent the soil type name. It is very important to know that all names starting with "E" are sandy soil types, and all the others stating with "L" are favorable to rice. You will follow the following procedure to get to the soil you want: double click on MAPU to select it, click on and operator (=) and double click on a value name (E101) for soil suitable for vegetables. However, if you have to select all soil units suitable for vegetable you will have to combine the same operation many times using the logical operators (or). (example; [mapu] = E101 or [mapu] = E102...). Therefore, the logical **or** will add all the units selected in the same map. Thus, you will create the suitable soil theme for vegetable: **suitsoil_veg** .

■ To find the best soil according to the requirements you will have to find the sandy soils which fall within 2000 meters of a body of water and 300 meters far from

a village. Therefore, you will have to create buffer themes for sandy soil, water and village themes.

■ To create a new buffer theme for suitsoil_veg you will create a distance map. You will select the theme, and use ***find distance*** under ***analysis*** menu. The dialogue box which will be open will allow you to set the resolution (50 meters would be good) of your output theme. The output will be reclassified using ***reclassify*** under ***analysis*** menu, and this last operation will give you the binary buffer suitable soil map. During your reclassification you will assign from **0 - 50 meters** the value **1** and every thing else **0**. As you know the buffer start at the boundary of the feature buffered, therefore the closer the reclassification the closer you get the real values. That is why I choose 50 meters which is the smallest element you can manipulate (the pixel). You will name the map **suitsoil_buf.**

■ The second analysis will concern the water theme, however, you might see that we do not have a separate water theme in our database which means that we have to find it some where. While you where extracting the suitable soil theme you might notice that a "**mapu**" with the value name **water** exist. Therefore, you will have to extract the water theme from the soils map using the same query function under theme proprieties and convert it into shapefile.

■ You will rename the new shapefile theme **water resources** by using the procedures learned before. From this last map you will use ***find distance*** under ***analysis*** menu to compute distance from the water path. To meet the requirement of the local community council you will ***reclassify*** the distances map into a binary map (buffer

zones) where from **0 - 2000** meters is assigned the value (**1**) and everything else is assigned (**0**). You will name the map **2000 waterbuff**

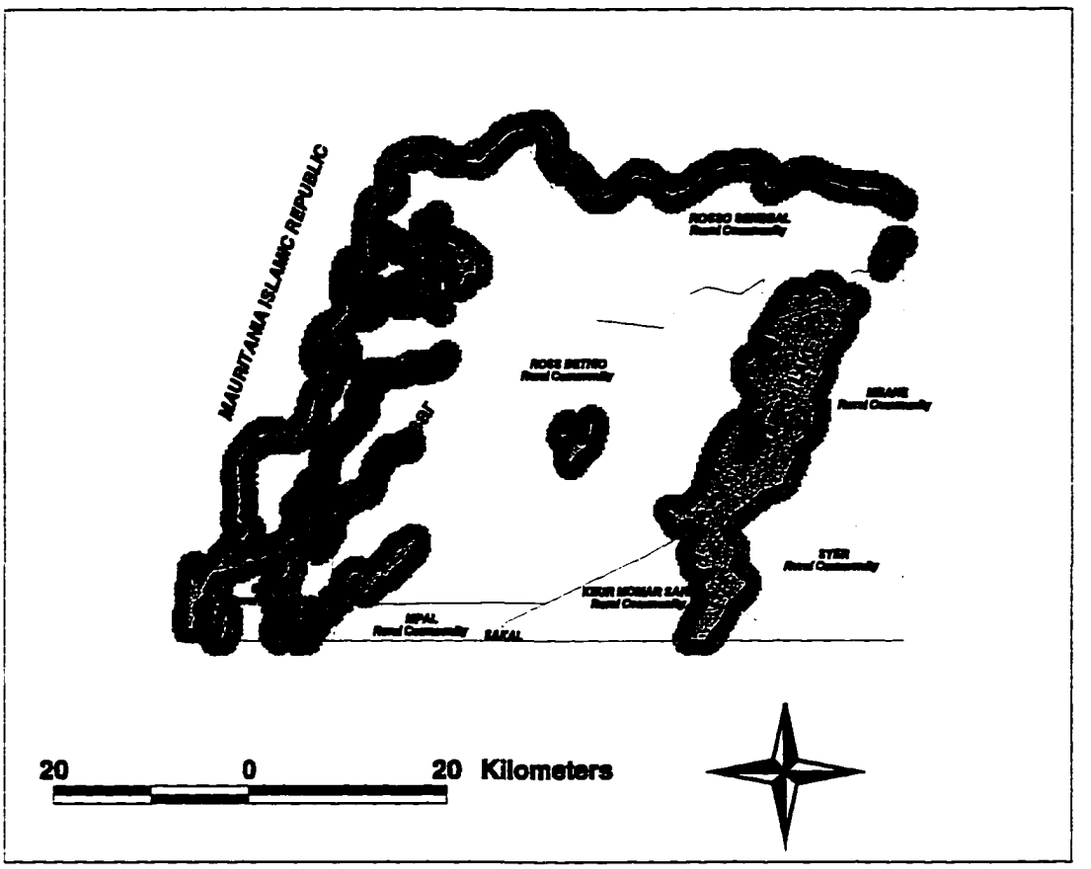
■ To keep the fields safe from animal damage you will keep them 300 meters from any habitat. Therefore, I will run the distance analysis with the **demogr** theme, and reclassify it into buffer zones where **0-300** will be assigned the value (**0**)and everything else will be given the value (**1**). You will name this map **300 villbuff**.

■ To get the final result with the best suitable soils you will use ***map calculator*** function under the analysis menu. Therefore, you will first multiply suitsoil_buf and 2000 waterbuff to get the eligible soil in a temporary binary map. However to get the best soil for investment we subtract 300 villbuff from the output and a map whose values were (-1, 0, 1). This last map will be reclassified with **-1** and **0** assigned a **0** value and **1** will stay **1**. This theme will be labeled **best soil**.

■ The final step you will do in this analysis is to turn all 0 values of the map to transparent using the legend editor. Thus, it will be easy for you to add the required maps together. You will find the way to display the results of the analysis in an understandable fashion; add 2000 waterbuff, best soil, water resources and the surrounding rural communities (crbethio map).

Fig 3: Exer2Pb1a

Soils suitable for vegetable with the lowest investment cost within Ross Bethio rural community



Legend:

suitability
- 0
- best soils

Rural Communities
Water resources

Water buffzone
- 2000 waterbuff
- 0

Exercise 2
Solution of Pb1a

Mamadou Niane
SRNR
Avanced Resources Technology Lab
(ART)

Problem 1 b

The ARCVIEW functions you used to solve problem 1a will be helpful for the solution of problem 1b. With only simple queries it is possible to find the villages required for the rural tax within 1000 meters of the roads. However, extra credit will be given to those who use advanced spatial analysis to delineate the buffer of the eligible area around the roads.

- Working still under the project **Exercise2**, you will open a new view where you will copy or load the theme you will need during this analysis. Therefore, demogr, crbethio, and routes (roads) are loaded, and as in the previous problems you will assign the same projection and map units.

- In order to select the required villages for the rural tax, you will need to make the roads active theme and using the select by theme function under theme proprieties you will select all roads. While the roads are selected theme you will make the demogr active theme and using the select by theme function, you will create a new selection based on the villages which are within 1000 meters from the selected roads.

- The selected village which turn yellow will be convert to a new theme called **village_tax** by using the convert to shapefile function under theme menu.

- In order to get the statistics from the villages required for the rural tax, you make active the theme village_tax and open the attribute table by clicking the table icon. Therefore, you will scroll until you see the field pop_88 (which mean the population of the 1988 national general survey), click on the name of the field, and click

on statistics under field menu. Thus, the demographic statistics will be automatically with the name of the area of concern.

- You will also have to present the list of the villages concerned by opening the table proprieties under table. Therefore, we will hide the field we do not need by checking them off under visible. You can chose also to display the village name by using auto-label under theme.

- As I said before, to give a nice look to the final result you are asked to put a 1000 meter buffer around roads. Analysis which can be done with the advanced spatial extension (**follow the same procedure than in the previous problem**). In order to keep the roads buffer exactly inside the Ross Bethio rural community we will create a distance map from Ross Bethio and reclassify it into binary with 0 - 50 the value 1 and everything else 0. The roads buffer also was assigned 0 - 1000 the value of 1 and everything else 0, and using map calculator you will multiply the two buffer to get the buffer which fit exactly the rural community of Ross Bethio. To differentiate Ross-Bethio rural community from the others local communities you will use the query builders under theme proprieties to extract the rural community and convert it to a new you can use the legend editor to give it symbols and color. The remaining rural communities will be in another theme called **other r. com**.. The point feature which represents each rural community will be symbolized as a **star**

The summary of problem 1a and 1b are on the following layouts.

PAGECOUNT

We will not repeat the process of making the layout in this solution part. Therefore, you are advised to follow the procedure described in **Exercise One**.

- The final layout for problem (1-a) will have besides the buffer zones, the water sources theme.
- The final layout for problem (1-b) will have besides the buffer region and the taxable villages, the demographic statistics.

These two layouts are completed as followed:

- The legend will be added with the adequate font and size (9-14).
- Usually, you can choose the default for the North arrow and the scale bar.
- To complete the layout use the text tool to add the surrounding features label (country or ocean). The text may be rotated the way we want using degrees.
- The layout is assigned automatically the title of the view therefore, if you want a new title, you will have to double click on it and write the new title.

These two previous problems of the exercise two problem 1-a, 1-b are based on the analysis of the following themes:.

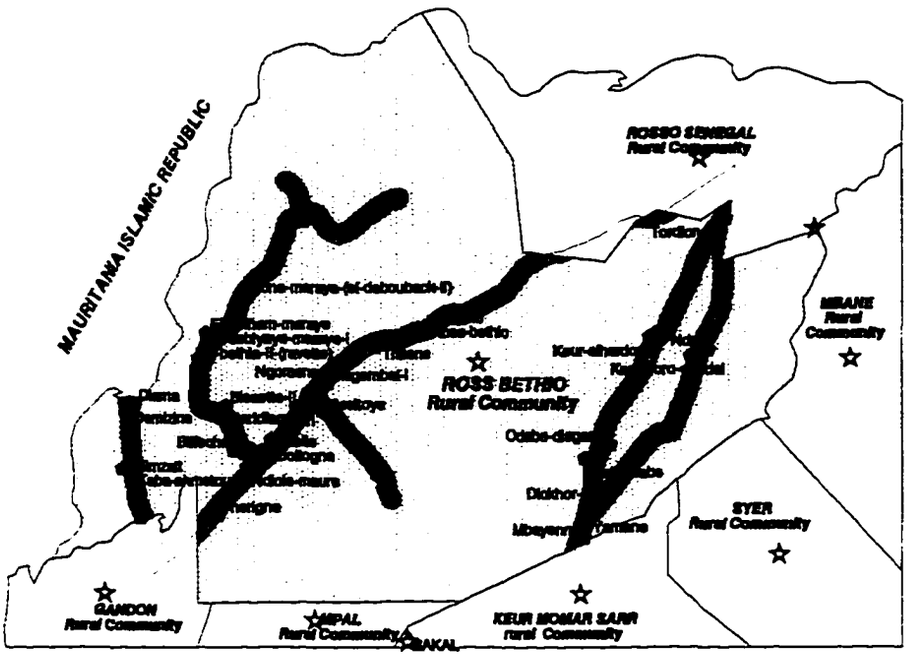
These two previous problems of the exercise one are based on the analysis of two following themes.

c. Themes analyzed:

Three themes (one point, one line and one polygon coverages): sols (soil) , demogr, and routes (roads) were analyzed. The new themes extracted will be appropriately named.

Fig 4: Exer2-Pb1b

Villages required for the rural tax



N
W E
S

10 0 10 Kilometers

Legend:

- Rural Communities
- Other R. Com.
- Village-tax
- Roads

Roadsbuff

- 0
- 1000buff

Rbethio-Rural-Com

Statistics for taxable population

Sum:	16598
Count:	36
Mean:	461
Maximum:	3105
Minimum:	23
Range:	3082
Variance:	272272
Standard deviation:	522

List of the villages

(See additionat text file)

Exercise 2
Solution of Pb2

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SRNR
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(ART)

2. Problem Two

- Solution Problem 2

This problem will not present major difficulties for you , because they will require only simple queries. Indeed, your goal is to present to the local community council the information about the suitable soil for vegetables or for rice, and the last information you will be asked to supply is water sources within their rural community. The soil theme has all the information you will need to handle this problem, so you will create the new themes from it. Even if it is not said you will have to add the administrative theme which is crbethio.

a.Results:

The solutions of problem two are displayed on the layout of pages (79, 80, 81) with the following results:

- The first layout represents the map of the suitable soil for vegetables, and the map is titled " ***Suitable soil for vegetable within the rural community of Ross Bethio***". **(Exer2pb2a)**

- The second layout represent the map of the suitable soil for rice, and the is titled "***Suitable soil for rice within the rural community of Ross Bethio***). **(Exer2pb2b)**

■ The third layout represent all the water sources of the local community. The map is titled " ***Water sources within the rural community of Ross Bethio***.) **(Exer2pb2c)**

b.Steps to get the results:

You will follow the same procedure than in the previous problems and assign a **projection** and **map units** to the soil theme as in the previous assignments.

This problem does not present major difficulties, because simple queries help solve the questions. Thus, three maps were produced.

b1 steps:

■ You will start ARCVIEW and open the project **exercise 2**. After that you will open a new view from the window project and load the **soils** and **crbethio** themes from **Ross** data source using the add button.

■ From **crbethio** theme you make active, you will select the Ross Bethio rural boundary by clicking in its polygon using the ***select feature*** icon tool. Then make the soil map (sols) active and using the query by theme under theme, you will select the soils which intersect or fall within the boundary of the rural community of Ross Bethio. The new soil theme may be called **ross_soil**. However our goal is to extract types of soil and water sources from the soil theme we have.

■ In order to create the sandy map soil suitable for vegetables from the rural community soil map you will use the ***query builder tool*** under theme proprieties using the names of the soils. If you choose **mapu** from the field of the dialogue box you will be

able to see the names of the soils . The sandy soils are represented by all names which start with "**E**" like "E101". From the dialogue box you will double click on mapu to select it, and you click on the operator you want **(=)** and finally you double click on the soil name you want. However, if you want to select all the soils suitable for vegetables you will need to combine a series of queries by using after each queries the **operator (or)**. Therefore, the following example will help you query the soil suitable for vegetable:

example: [mapu = E101] **or** [mapu = E102] etc.

- You can call the new sandy soil theme **Jeeri soil.** You may know also that to retrieve the original theme you can activate the actual theme and by using ***theme proprieties*** clear the selection and hit ***OK***, and it will give you the original theme.

- The second theme you will create is the Ross Bethio suitable soil for rice, you may chose another way by using the attribute table of Ross Bethio soil theme. From the Ross Bethio soils attribute table select all the soil name starting with "**L**" and then convert the selected feature to a new shapefile using ***convert to shapefile*** function under theme menu. The new theme which represents the soil suitable for rice production will be named **Waalo soil**.

We called these two new themes Jeeri and Waalo because the population define Jeeri as soil never reach by flooding and Waalo soil with seasonal flooding. They are the two major soil types in all the Senegalese river basin.

- The last query you will perform is the extraction of the water sources from the original soil theme **hydrol94**. After this query you might be familiar now with

creating a new theme using the ***query builder*** under ***theme proprieties***. Therefore, to use ***query builder*** under ***theme proprieties*** you will double click on **mapu** under fields and you must click on (=) and finally double click on water the last name under values. After you hit **OK** you will get the new theme you will rename **water**.

Therefore, the query builder under theme properties is the major selection tool in this problem.

b2 layouts

The three layouts will have, besides the major theme they represent (soil or water sources), the rural community boundary and the water theme. To be understandable the maps need to be labeled as followed:

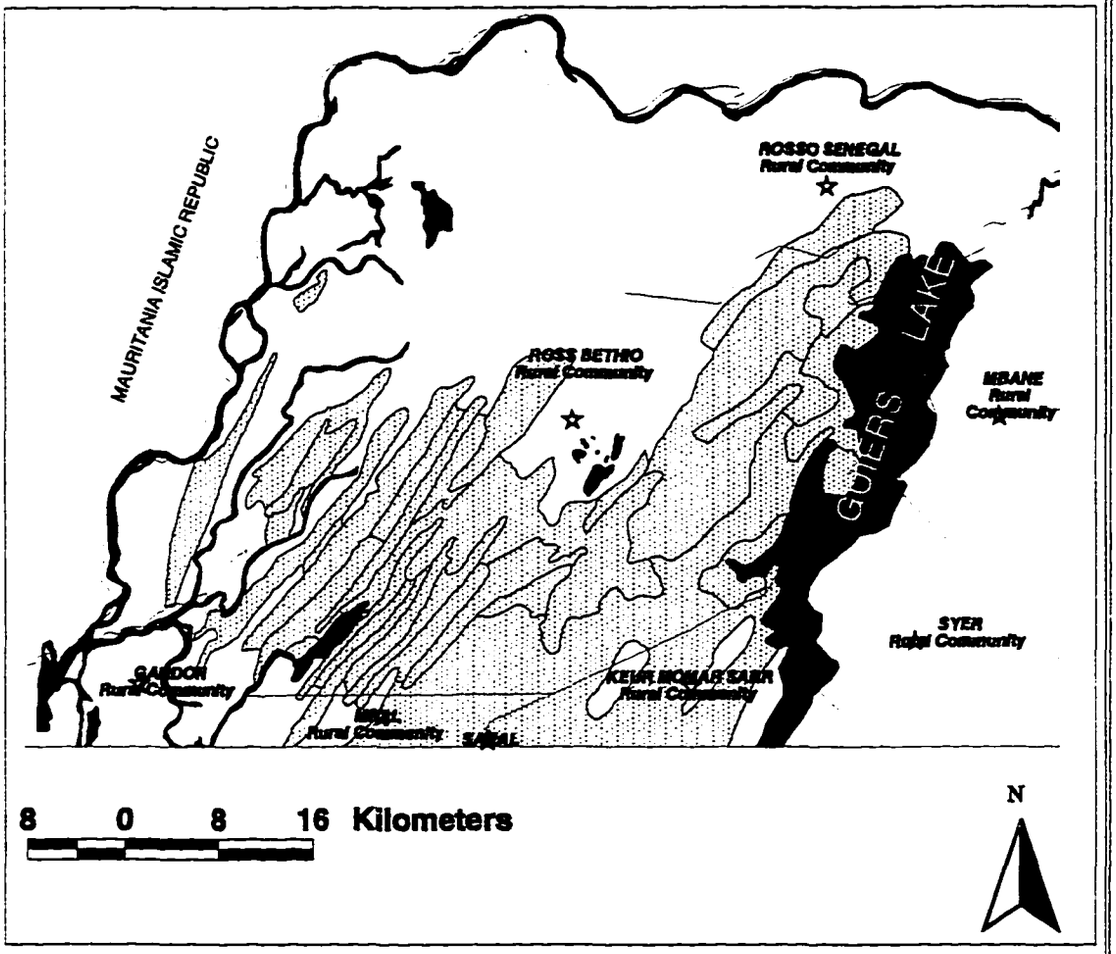
- The legend was added with the adequate font and size (9-14).
- Usually, I choose the default for the North arrow and the scale bar.
- To complete the layout, I use the text tool to add the surrounding features label (country or ocean). The text may be rotated the way we want using degrees.
- The layout is assigned automatically the title of the view, therefore, if you want a new title, you will have to double click on it and write the new title.

c. Theme analyzed:

These two previous problems of the exercise two problem two are based on the following soil coverages of the CSE data: **sols** (soils), and **crbethio** (rural communities administrative boundaries)

Fig5: Exer2pb2a

Suitable soil for vegetable production within Ross Bethio rural community



8 0 8 16 Kilometers

N

Legend:

- Rural Com. bnd
- Water
- Rural Communities
- Jeeri soil

Exercise 2
Solution Pb 2a

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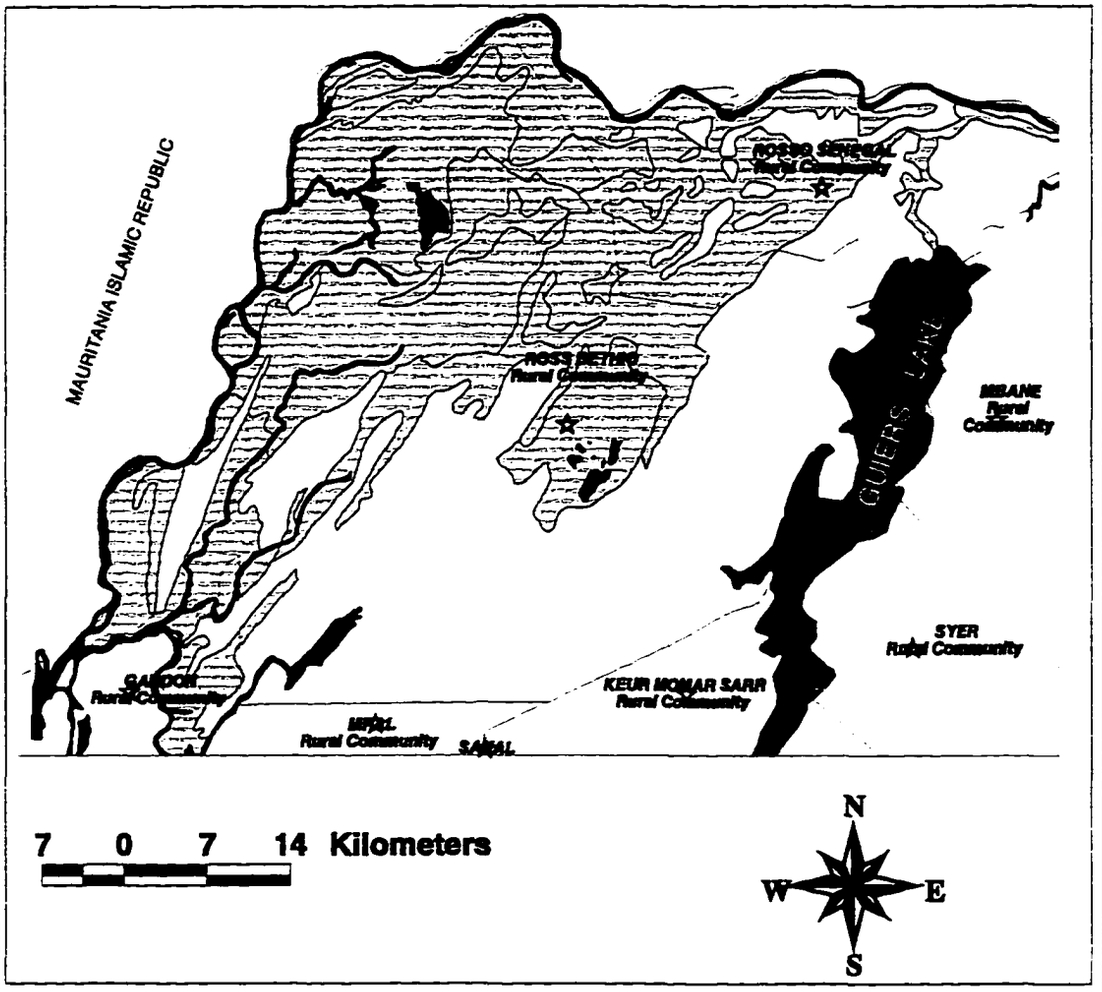
(ART)

Fig6: Exer2pb2b

Suitable soil for rice production within Ross Bethio rural community



Legend:

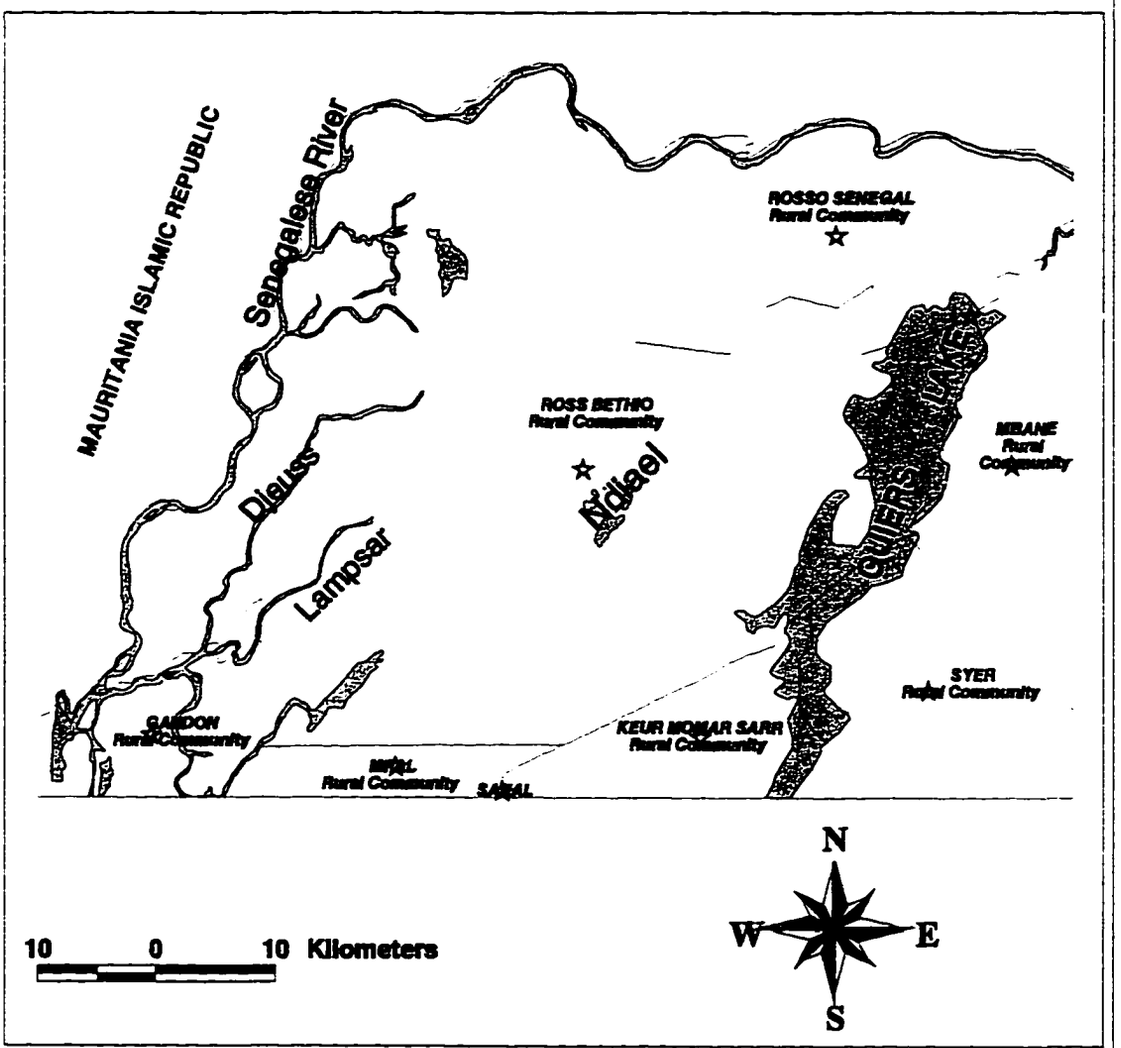
- Rural Com. bnd
- Water
- Rural Communities
- Waalo soil

Exercise 2
Solution Pb 2 a

Mamadou Niane
SRNR
Avanced Resources Technology Lab
(ART)

Fig7: Exer2pb2c

Water sources within Ross Bethio rural community



Legend:

- ☆ Rural Communities
- Rural Com. bnd
- Water

Exercise 2
Solution Pb2 c

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C. Exercise Three:

1. Preliminary

- Solution Preliminary

In order to see what the Ross-Bethio rural community irrigation environment look like, you are asked to load all the necessary themes to build an image of the community. You will use a new data source (pixs3unz1) with UTM projection. The data available under that directory which will have to load are **water sources** (***hydrol94***), **channels** (***hydra94***), **pumps** (***pomp94***), **roads** (***equip94***), and **irrigated units** (***ahumv94***).

You will see that the Ross Bethio rural community is a highly irrigated area . The two major productions are rice and vegetables.

a.Results:

This exercise has a preliminary question which allows us to present the irrigated system environment of the local community of Ross Bethio.

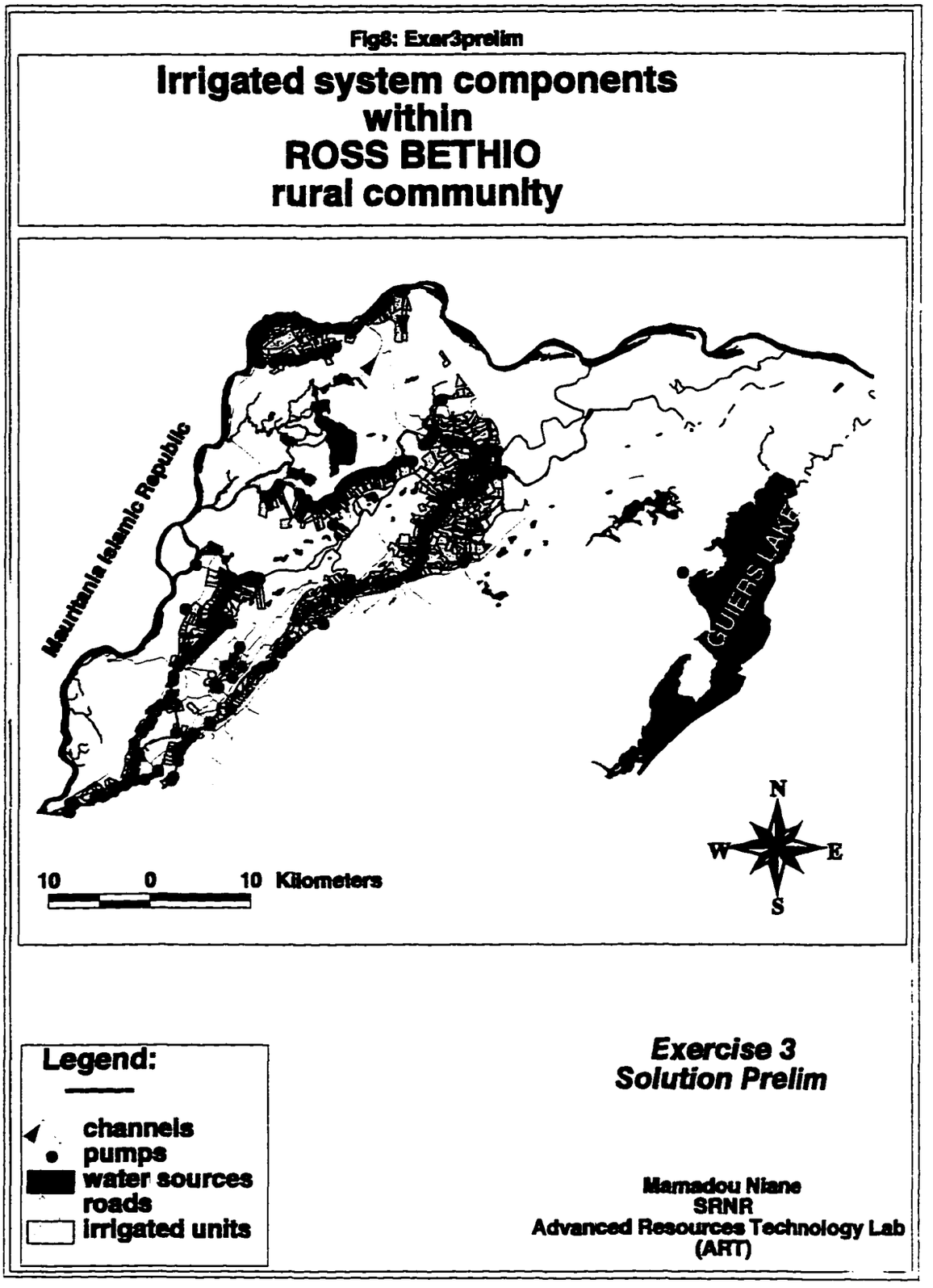
The solution is displayed on the layout of page (84) with the title "***Irrigated system components within the rural community of Ross Bethio***". (**Exer3prelim**)

b.Steps to get the results:

After starting ARCVIEW you will create a new project called **exercise 3**. Open a new view and using the **add** button you will load from **pxs3unz1** under **Ross** the following themes: ahumv94 (**irrigated units**), hydra94 (**channels**), hydrol94 (**water sources**), pomp94 (**pumps**), and equip94 (**roads**).

The layout solution is an addition of the following themes: water sources, irrigation channels, irrigated units (perimeters), water supply pumps, and roads.

Fig8: Exer3prelim



2. Problem One

During the analysis of this problem you are required to supply information about the areas of the major land components within the Ross Bethio rural community. The different data sources you have present two major spatial components: the **irrigated units (irrigated units)**, and the **forest and national parks (rossclforest)**. Therefore, you may be able to compute the land left for other features (habitat , infrastructures, roads etc.) by computing the difference between Ross Bethio rural community total area and the sum of the two major components. You may use the **Ross Bethio administrative** boundary (**rossadmin**) to compute the total area of the local community.

In this assignment, we may present the result only on chart and table, but we want to show what the areas of concern look like by displaying them on layouts.

- Solution Problem 1

a. Results:

The solutions of problem one are layouts, table and chart: we use the layouts only to make a clearer understanding of our statistical results:

- The first layout show the area of the total rural community with the derived statistics. It is titled "***Ross Bethio rural community areas***" (**Exer3pb1a**). (p. 89)
- The second layout has the irrigated units (perimeters) areas. It is titled "***Ross-Bethio 1994 Irrigation Management Units***"(**Exer3pb1b**).(p. 90)

- The third layout has the national forest and park areas. It is titled " ***Ross Bethio National Forest and Park***" **(Exer3pb1c)** (p. 91)

- The new table has the computation of the areas of the different themes and the difference between the total area of the rural community and what is used. The table is titled: " ***Table and Chart of Ross-Bethio features areas***" **(Exer3pb1b)**. (p. 92)

- A chart which compare the different areas of the rural community is also produced.

As in the previous assignments, all the layouts are labeled, and have legend, scale bar, arrow head, and statistical information.

b. Steps to get the results:

In this assignment you receive data from two major sources, the ahumv94 (irrigated units) come from pixs3unz1, and rossclforest and rossadmin will come from ross2. As said before, to make a more interesting visualization you will associate them with rossadmin. Therefore, you will put each theme on a separate layout.

You will also use two different projections in this assignment, because the data from pixs3unz1 are in **UTM ZONE 28** projection. For the other themes you will use the **geographic projections of the world** and the map unit in **meters**.

b1 steps:

- After you start ARCVIEW, open project **exercise 3** and you will create a new view for each of the themes you will add to the project. Using the add button open pixsunz1 under ross and load **ahumv94**. Do the same procedure to load rossadmin and rossclforest from ross2 under Ross. You will assign projection and units;

UTM ZONE 28 and meters for ahumv94 and **projection of the world** and meters to the other themes. You may add later additional themes to complete your final layout.

■ To extract the area's statistics information from the theme you will make active the theme and ***click on the table icon*** to open the ***attribute table***, and you will select the **field area** and click on the field name. Then click on the **field menu** in ARCVIEW menu and choose ***statistics***. It will automatically compute and display for you the statistics of the areas. You must write down the area and keep it for the table you will build.

■ After you are done with the irrigated units, rossclforest, and rossadmin, you will compute the sum of the first two and subtract them from rossadmin. Therefore, you will get the fourth variable which is the area left for others. However, it is very important to know that the areas are in **square meters** for most of the theme except for the irrigated units which are in **hectare**. Therefore, you need to convert the data into one unit. You may use **square kilometers** for all of them.

■ From the four values you will create a new table using ARCVIEW. From the project window you will double click on table to create a new empty one. You will be asked to give a new name and in a default location that you can change. Then you can edit the new table using add field and add record. The add **field** dialogue box will ask you to supply a name for the field, the type, and the length. In this table we will have two fields; one which represents the feature name and the other one which represents the areas. The first one is character type (choose **string**) and areas is **number**, and for number you may define the numbers of decimals. After creating the field you

will create the **records** by clicking on edit menu and select add record, it will create a new record. After you create the field and record you can add the data you want by using the ***edit icon***. If you click it in any box you may be able to edit it. When you finish go to table menu and chose stop editing.

- The last thing you have to do is to compare all the areas by charting them. To chart the areas, you will make the table active and using chart under table menu you will display a chart proprieties dialogue box where you are asked to give a new name to the new chart, and under **fields** you will choose and add the field (areas sq. km) to be charted to **groups**. Finally you will have to choose the **label** (feature name) you want for the chart and hit OK.

b2 layouts and chart

- The three layouts focus each on one specific theme, and each will has the necessary information and labels for an easy understanding.

- The chart which compares the different areas has also the appropriate labels, a legend and a title which make them easy to understand.

Using the same tools than in the previous assignment, the layouts are titled, labeled, and all the necessary information are added.

Fig9: Exer3pb1a

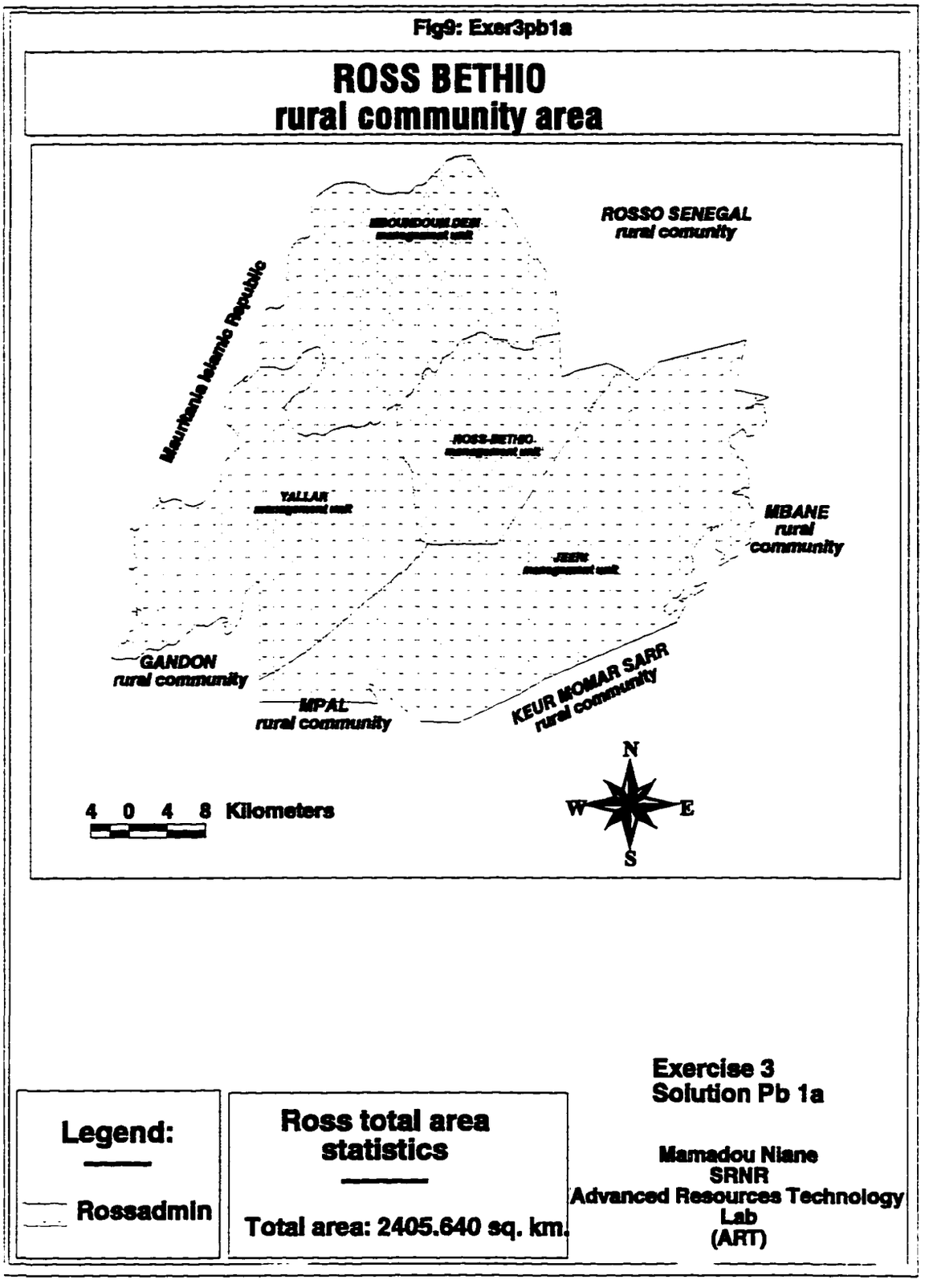


Fig10: Exer3pb1b

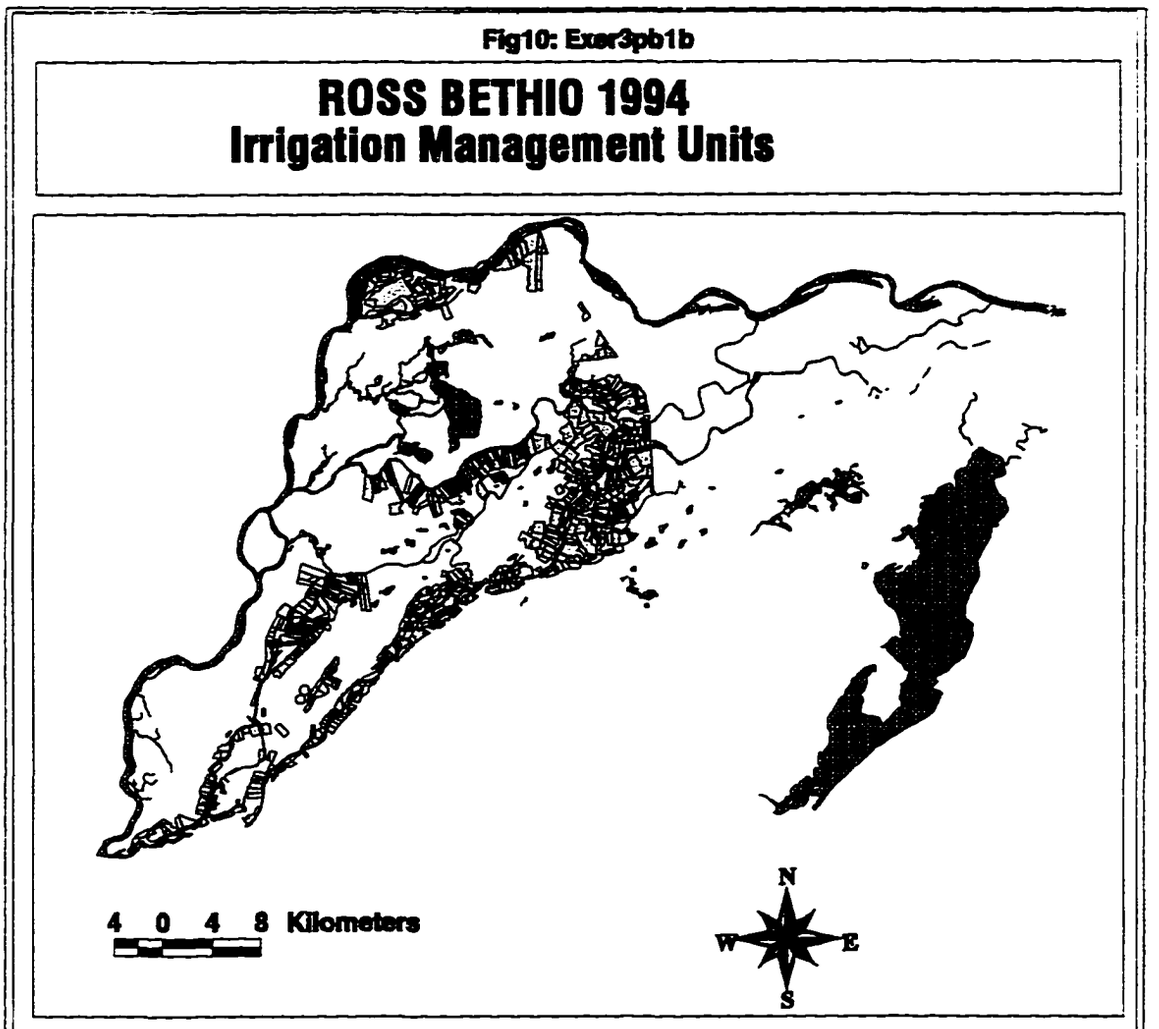


Fig 11: Exer3pb1c

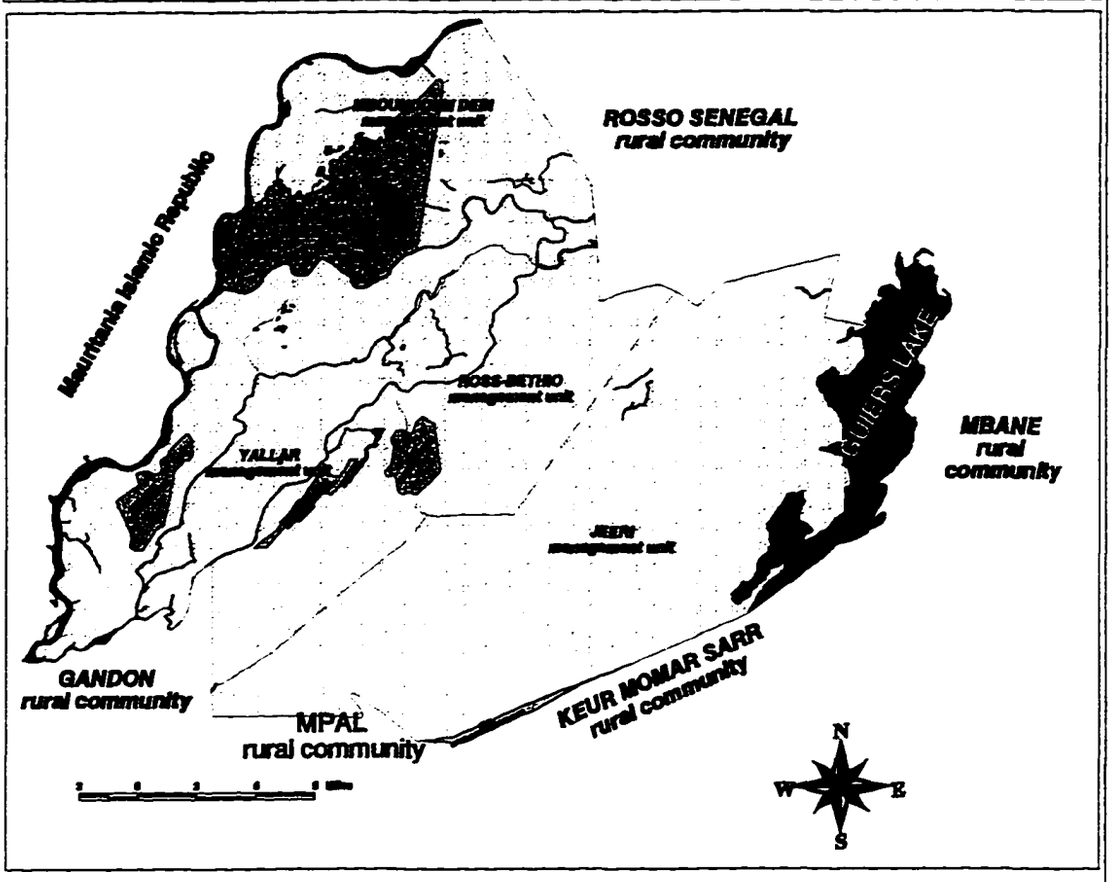
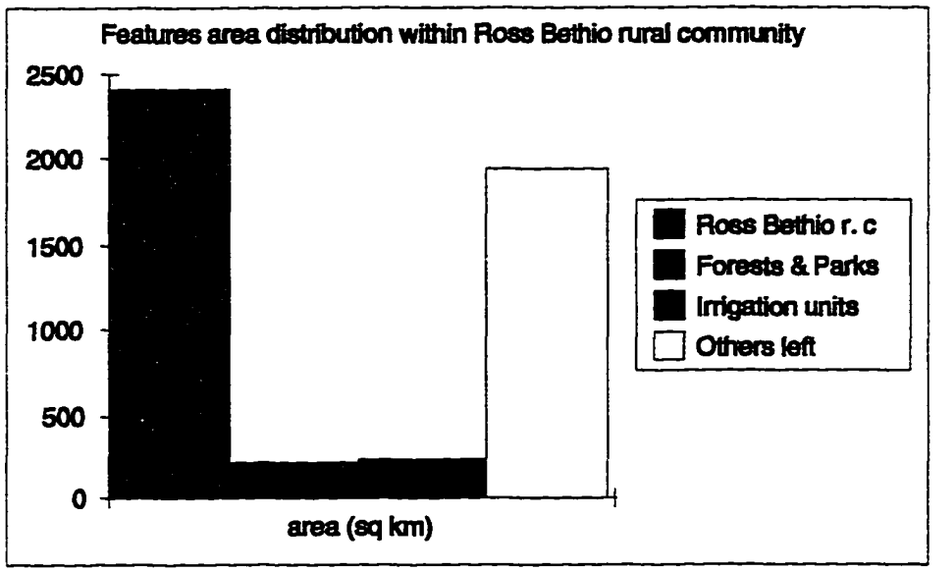
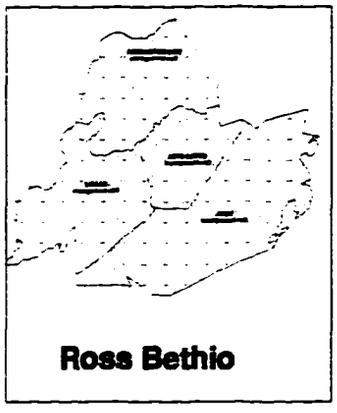


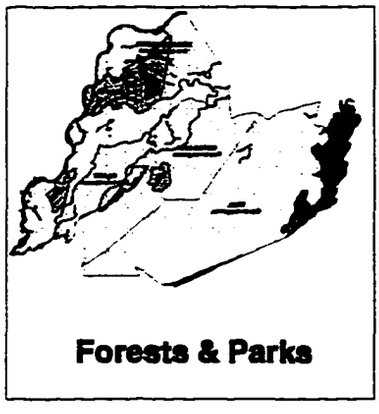
Table 1: Exer4pb1ch

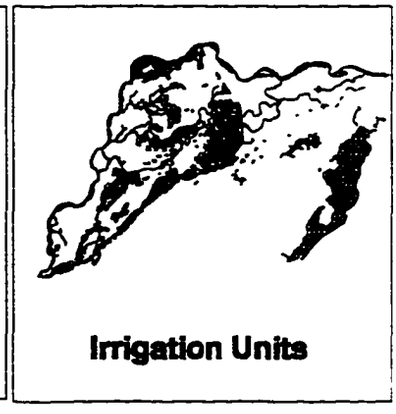
Table and chart of Ross Bethio features areas

feature name	area (sq km)
Ross Bethio r. c	2406
Forests & Parks	218
Irrigation units	242
Others left	1946









3. Problem Two

The information that the local community council wants you to supply take you through simple and advanced analysis. For almost all the problems it is not necessary to use advanced techniques like the analysis extension to solve the problems, however, we use it because it allows people who are not familiar with maps to understand better using buffer zones to highlight the results. The analysis for Ross Bethio population habitat and distribution involve very simple queries. However, for the selection of the villages eligible for car water tanker, the selection processes and display of the result were more complex, because of the series of selection exclusion operations.

- Solution Problem 2

The analysis you will make will involve the four following themes from ross2 data sources: rossadmin, rossroads, rossfwater, and rosshab.

a. Results:

The solutions are displayed on the layouts of pages (97,98) with the following results:

- The first layout represent the map of all villages of Ross Bethio rural community with the summary statistics of the population. It is titled " ***Ross Bethio rural community habitat and population***" (**Exer3pb2a**).

- The second layout which is the final one, represents the eligible villages for a car water tanker. The map is titled " ***Eligible villages for car water tanker supply within Ross Bethio rural community*** " (**exer3pb2b**)

The layouts have all the necessary information for an easy understanding.

b. Steps to get the results:

After you start ARCVIEW open the project **exercise 3** from **Ross**, and create new views where you will add the new themes; you will load in the first view the themes named rosshab and rossadmin from ross2, and in the second view you will load rossfwater, rossadmin, rosshab and rossroads from the same ross2. As in the previous assignment the first operation is to set the projection (projection of the world) and map units (meters) which allows you to be able to assign scale or to compute distance on the theme.

b1 steps:

- After the rosshab and rossadmin maps are loaded on the first view, make active the rosshab theme and click on the table icon to open the attribute table. Then click the field name **demogr** to select it and click on statistics functions under field menu. Therefore, you will get the **summary statistics** for Ross Bethio population (30,898 people were found which is a little lower than the real number). You can use the name you want to rename the themes. I renamed the rossadmin theme Ross Bethio rural com
- We can say that the solution of **problem 2a** resulted from simple operation, however **problem 2b** will involve different steps.
- To solve problem 2b the first operation you will have to do is to exclude the villages whose size is less than 100 inhabitants by using the query builder under

theme proprieties. Therefore, you will double click on demogr, click on (>=) (higher or equal) and double click on 100 and hit OK. This new theme can have a temporary name.

- The second analysis you will have to do is to select all villages within 1500 meters of a body of water and exclude them. You can do it by selecting water first, and while making active the new temporary theme, you will use the ***select by theme*** option under theme to select in a new set of active features (villages) within 1500 meter of a water sources.

- To get the village still eligible you will open the attribute table of the temporary theme and using the switch button you will select the villages still eligible. Using the convert to shapefile you will create a new theme with the villages left.

- The third operation to meet the third criteria is to select the villages within 1000 meters of **roads**, **trails** or **dikes**. Therefore, you will select **rossroads** and using the select by theme you will select the villages within 1000 meters of **rossroads**. The highlighted villages will be converted to a new theme which may be called **demoeligible**. Therefore, you have the eligible villages.

- You will add **rossfwater** and **rossadmin** to the eligible villages but for **rossroads** you will select and extract each particular type of roads, make a new theme with a new line symbol. Therefore, trail will become **rosstrail**, the national road national2rd, dikes **rossdikes**, and secondary roads **2ndaryrd**.

- To make the map easier to understand you create a buffer around the eligible sites. This can be done by creating a distance map from rossroads that you will reclassify into a binary map where 0 -1000 meters from roads will be assigned 1 and

more than 1000 will have 0 value. From rossfwater also , you will create a distance map that you will reclasssify by assigning 0 - 1500 meters the value 0 and more than 1500 meters the value 1. After these two operations you will use map calculator under the analysis package to multiply the binary maps and get the eligible site buffer named **1000rdbuff**.

- If you do not remember how to perform the find distance and reclassification return to ***Exercise two problem 1a*** to see the procedure.
- The last theme 1000rdbuff will be added to the final map.

b2 layouts

- The first layout has besides the villages , the summary statistics of the population.
- The second has the eligible villages for car water tanker, but to highlight the eligible village and their proximity to the roads, I had the road 1000 meters buffer to the final map.

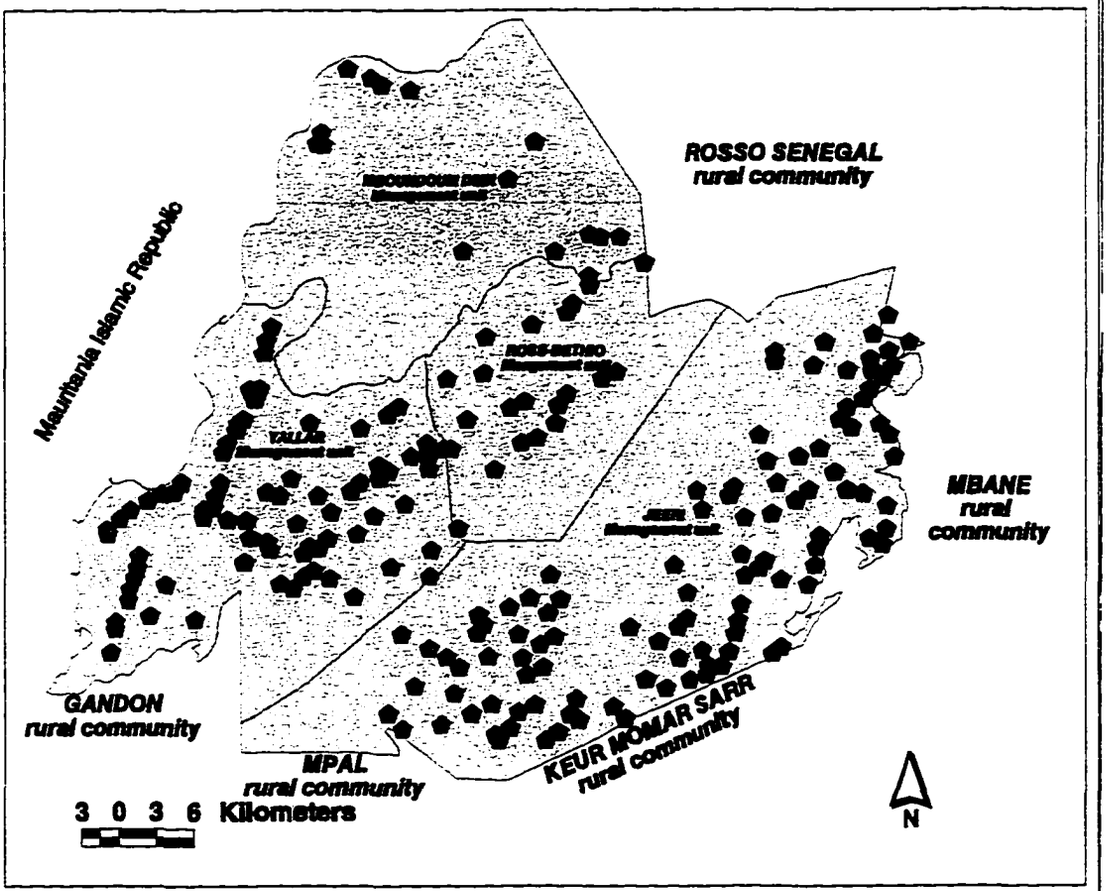
The two layouts, are titled, labeled, and scale bar, legend and North arrow added. In addition, the local community boundary, the water sources and the roads are added on the final product.

c. Theme analyzed:

During the analysis of this problem, the following themes of ross2 data sources were analyzed: rossfwater, rossadmin, rosshab, rossroads.

Fig 12: Exer3pb2a

Ross Bethio rural community habitat and population



Legend:

Rosshab
Ross Bethio Rural Com.

Population statistics

Sum: 30898
Count: 222
Mean: 139
Max: 3105
Min: 0
Range: 3105
Variance: 81460
Standard deviation:

Exercise 3
Solution Pb2 a

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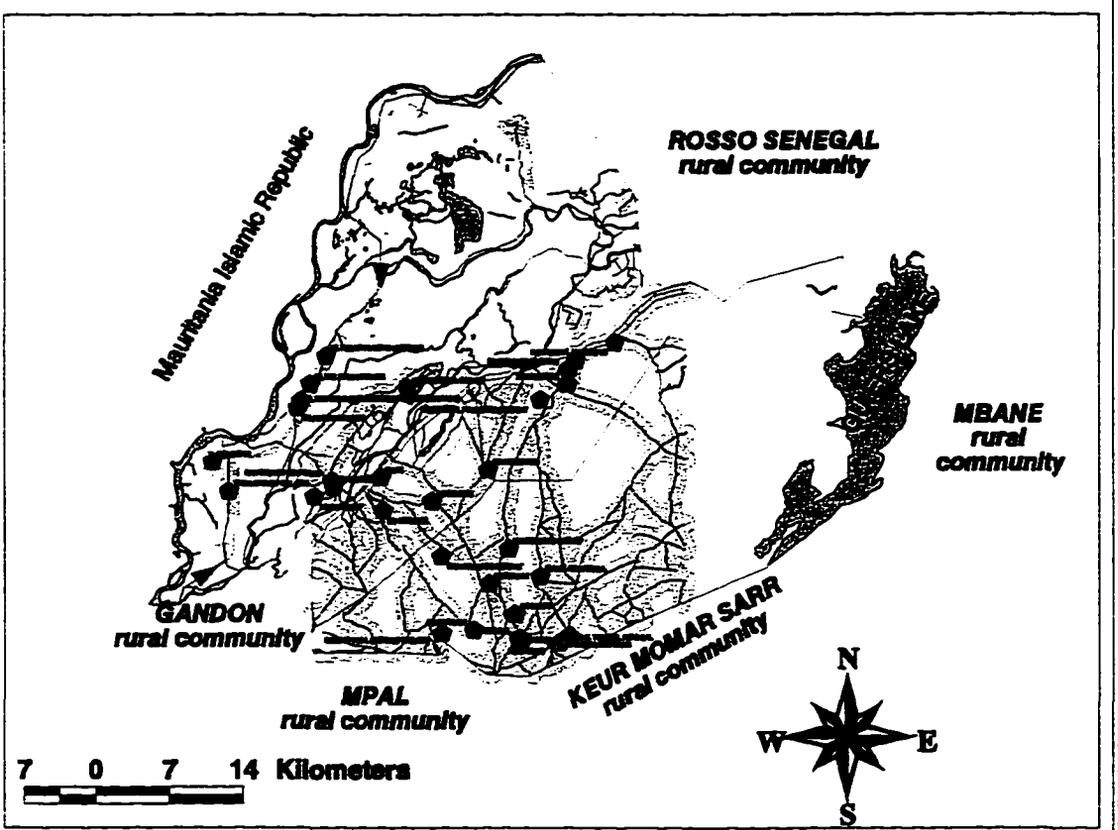
Fig 13: Exer3pb2b

Eligible villages for car water tanker supply within Ross Bethio rural community



Legend:

- Rossfwater
- Rossadmin
- Demoeligible
- Rosstrail
- National2rd
- Rossdikes
- 2ndaryrd
- 0
- 1000rdbuff

Exercise 3
Solution Pb 2b

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D. Exercise Four

1. Problem One

The analysis of this problem will help the local community council to have an idea about the distribution of the population by management unit. In addition, with the addition of roads and animal trails on each management unit, it is possible to foresee from their density and connection where potential problems may develop. The design of this problem will help you go from the whole rural community to the management unit. In addition you will be able to extract and put the needed roads and trails for each management unit.

- Solution Problem 1

Almost all the analysis you will have to do will be done from the following themes: rosshab (habitat/population), rossadmin (administrative boundary), rossroads (roads, trails, and dikes), and rossntrail (animal trail).

a.Results:

The solutions of problem 1 are displayed on the layouts of pages (103,104,105,106,107) with the following results:

- A map titled " ***Population distribution within Ross Bethio rural community***"(**Exer4pb1a**) which represent the demography and habitat.

- Four maps which are representations of population, habitat and features within each management unit. Each of them is titled with the name of the specific name of the management unit:

- Jeeri titled " ***Jeeri management unit population distribution***" (**Exer4pb1b1**).
- Ross Bethio titled " ***Ross Bethio management unit population distribution***" (**Exer4pb1b2**).
- Mboundoum titled " ***Mboundoum management unit population distribution***" (**Exer4pb1b3**).
- Yallar titled "***Yallar management unit population distribution***" (**Exer4pb1b4**).
- The statistics for the population of each management unit is written on each layout, and in addition the village sizes are ranked from the smallest to the biggest.

b.Steps to get the results:

After you start ARCVIEW you will create a new project named **exercise 4**, and you will open a new view where you will add rossadmin, rosshab, rossntrail, and rossroads themes which are the ones we will need for the analysis of problem 1.

The analysis for this exercise was done by the following steps:

b1 steps:

- To do the analysis for problem 1a related to the distribution of the population within the Ross-Bethio rural community you will have to follow the same procedures as in **Exercise 3 problem 2a**, therefore, we will not repeat the steps in this assignment.

■ How to get to the summary statistics, was learned also several times in **exercise 3**. Therefore, you will use the attribute table of population theme and using statistics under field , compute the summary statistics.

■ For the four management units maps, the process was more complicated:

. The first thing you have to do is to extract each management unit by selecting them with select feature tool and convert them to shapefile using the covert to shapefile function under theme.

. Then the following step is to extract all needed features (population, roads, animal trails) for each management unit from the community themes. This can be done by adding first the theme we need to extract with rossadmin, and after selecting the management unit we want with the selection tool and using the select by theme under the theme menu you will select the active feature which falls within the boundary of the selected management unit.

. Each of the selected features will be converted to a shapefile, and when all the new themes are created you will add each of them with the appropriate management unit.

. To **rank the villages size** you will make the theme active and use the ***legend edit***or by double clicking on the theme view legend. It will open the legend editor dialogue box which gives you theopportunity to choose from the legend type drop down list the graduate symbol and from the classification field to choose the name of the

feature to be ranked. You have also the opportunity to manipulate the symbol using the palette windows or changing the values or labels.

. For each management unit, using the attribute table you will compute the population statistics, and write it down on your final layout.

. The last operation you will have to perform is the creation of the table with the four management units population and compare them on a chart using ARCVIEW. A complete description of the process of creating a table and charting it is explained in **Exercise 3 problem 1**. It will be useful for you to have a look at it.

b2 layouts and chart

- The five final layouts, are titled and labeled. The legend , scale bar, and north arrow are also specified.
- The first layout which represents the whole rural community will be done to show more environmental features within the rural community.
- The table and the chart will be on the same layout.

c. Theme analyzed:

The themes of Ross Bethio boundary and the population/habitat were the most critical. In addition, the water, animal trail, and parks were used.

Fig 14: Exer4pb1a

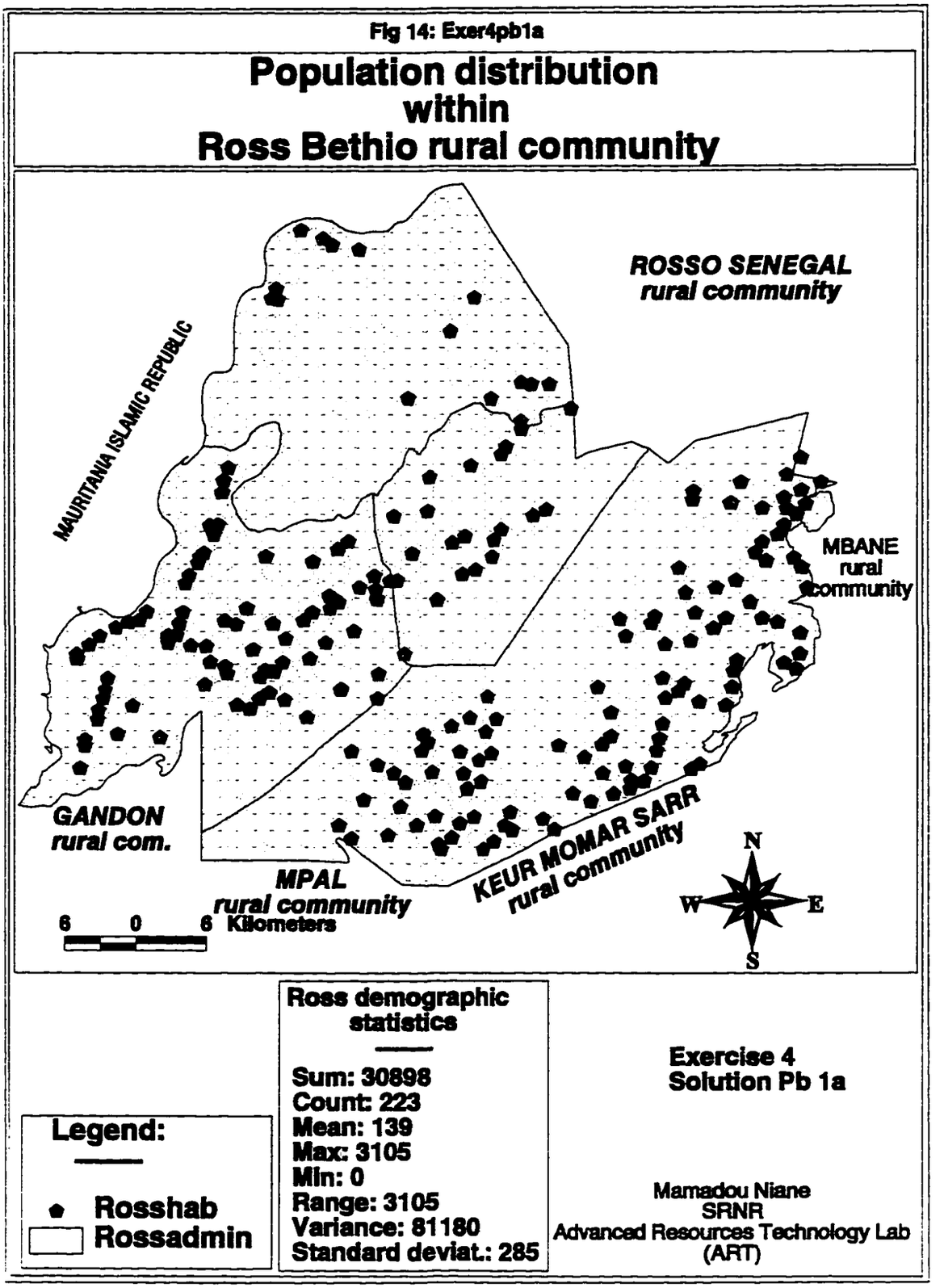
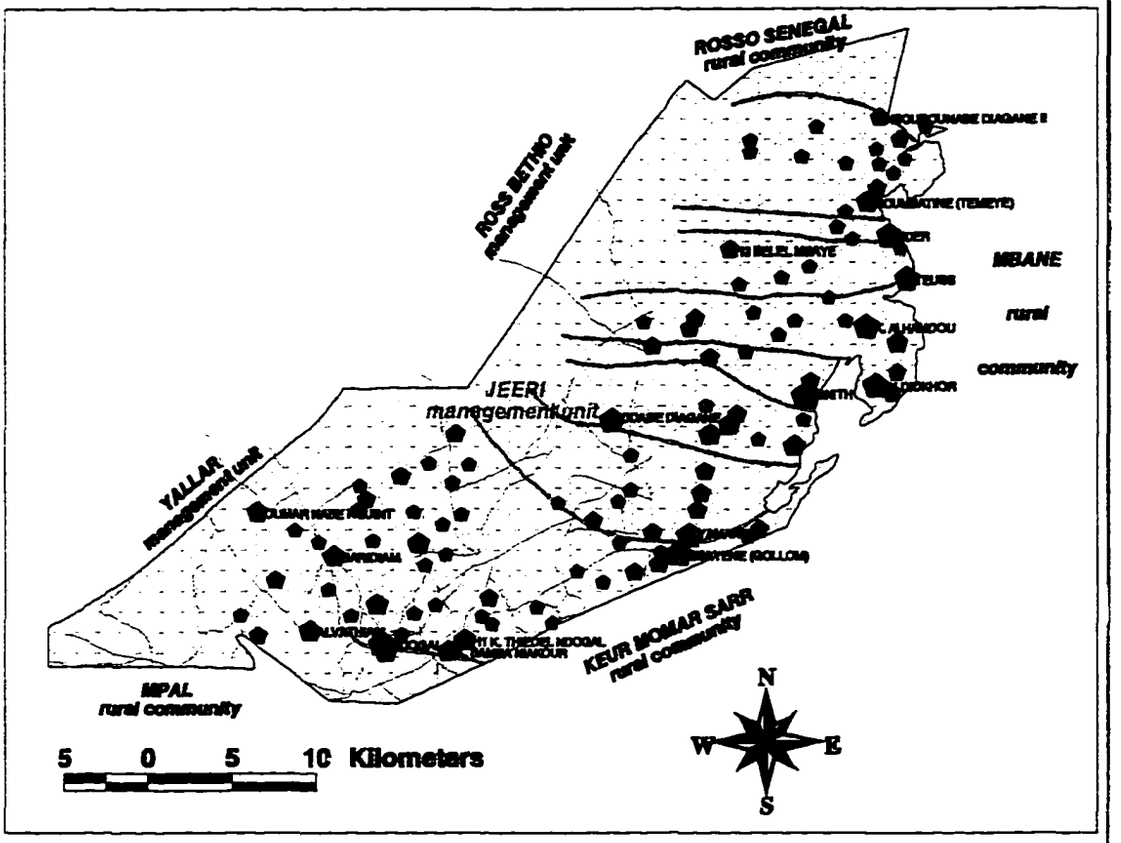


Fig 15: Exer4pb1b1

Jeeri management unit population distribution



Legend:

Jeeridemo.shp
- 0 - 42
- 43 - 114
- 115 - 231
- 232 - 387
- 388 - 1609

Jerriroad.shp
Jerritrail.shp
Jeeribnd.shp

demographic summary statistics

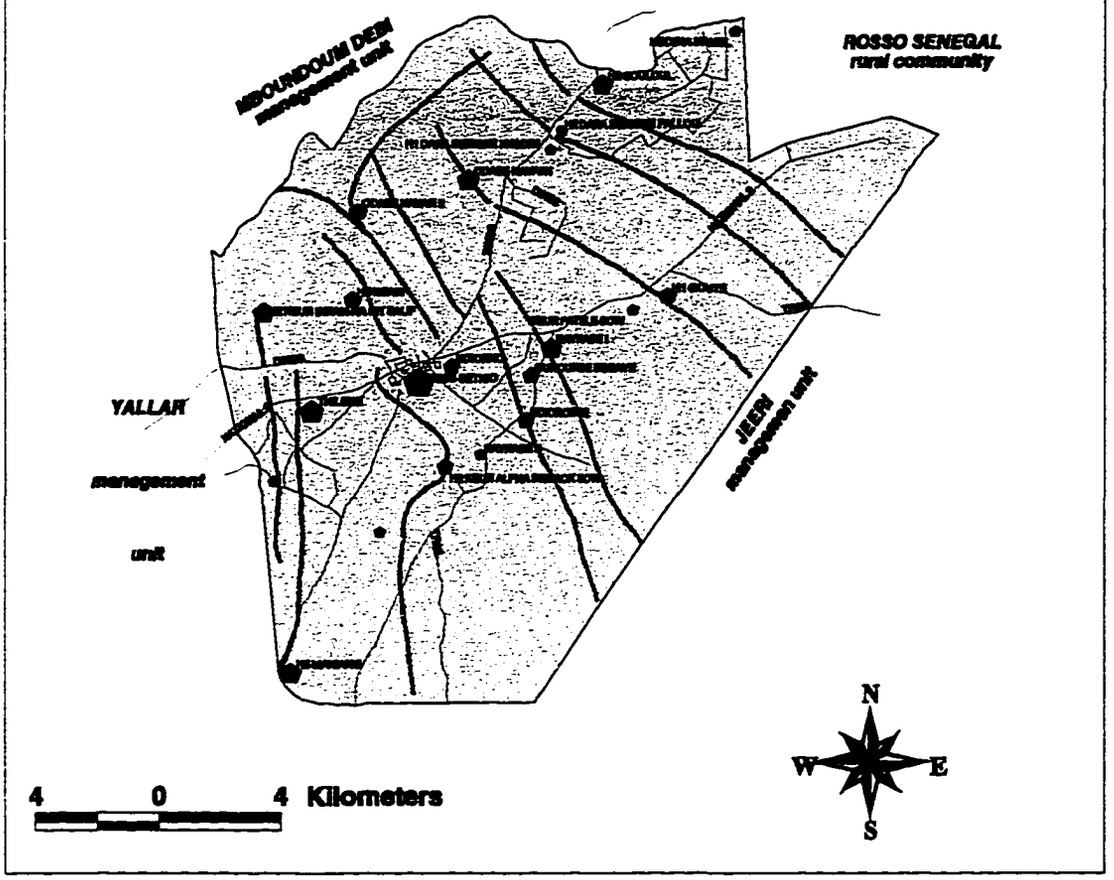
Sum: 8855
Count: 107
Mean: 83
Max: 1609
Mini: 0
Range: 1609
Variance: 29984
Standard deviation: 173

Exercise 4
Solution Pb1b1

Mamadou Niane
SRNR
Advanced Resources Technology Lab
(ART)

Fig 16: Exer4pb1b2

Ross Bethio management unit population distribution



Legend:

Rossbdemo
- 0 - 21
- 22 - 141
- 142 - 243
- 244 - 495
- 496 - 3105

Rossbroad.shp
Rossbtrail.shp
Rossbnd

Demographic summary statistics

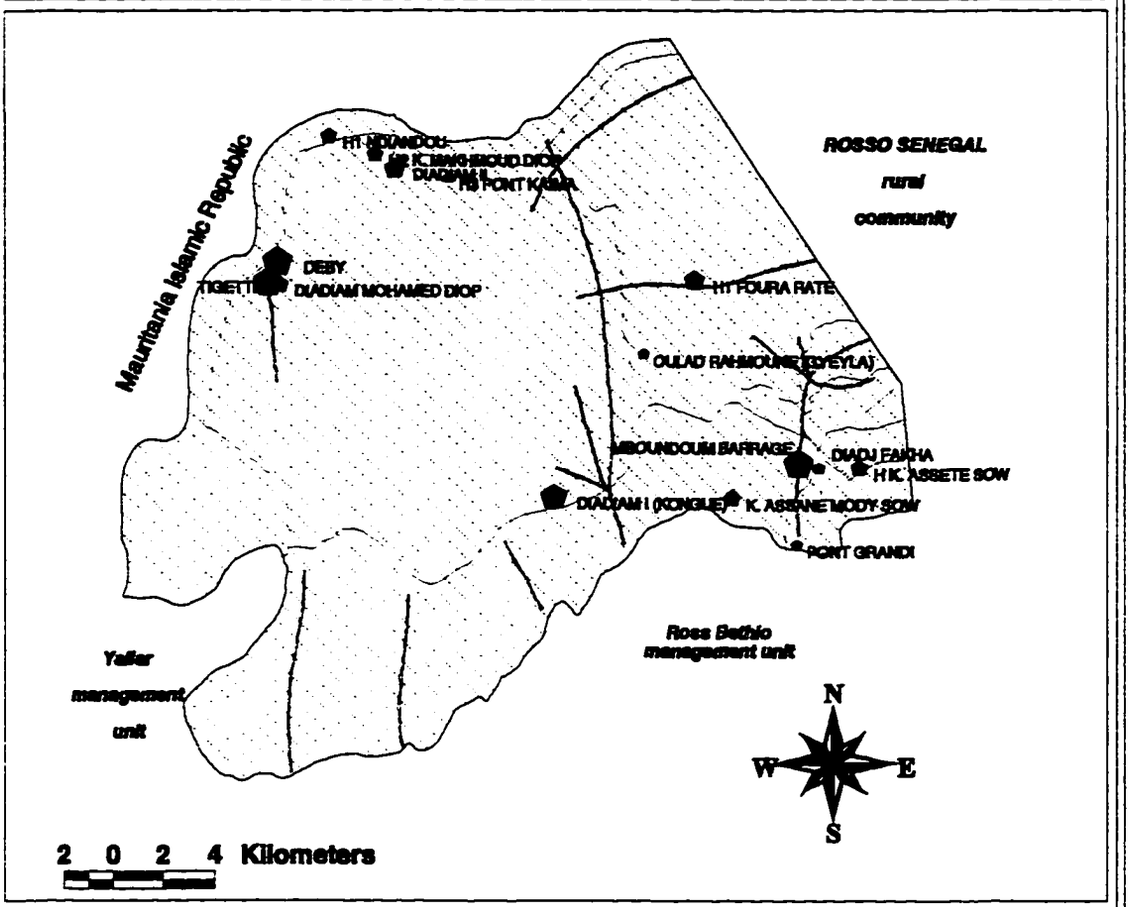
Sum: 5448
Count: 21
Mean: 259
Max: 3105
Min: 0
Range: 3105
Variance: 430319
Standard deviation: 662

Exercise 4
Solution Pb1b2

Mamadou Niane
SRNR
Advanced Resources Technology Lab
(ART)

Fig 17: Exer4pb1b3

Mboundoum management unit population distribution



Legend:

- Mbundroad.shp
- Mboundtrail.shp
- Mbuddemo
  - 0 - 8
  - 9 - 65
  - 66 - 176
  - 177 - 340
  - 341 - 1363
- Mbudbnd

Population statistics

Sum: 3756
Count: 15
Mean: 250
Max: 1363
Min: 0
Range: 1363
Variance: 160754
Standard deviation: 401

Exercise 4
Solution Pb 1b3

Mamadou Niane
SRNR
Advanced Resources Technology Lab
(ART)

Fig 18: Exerpb1b4

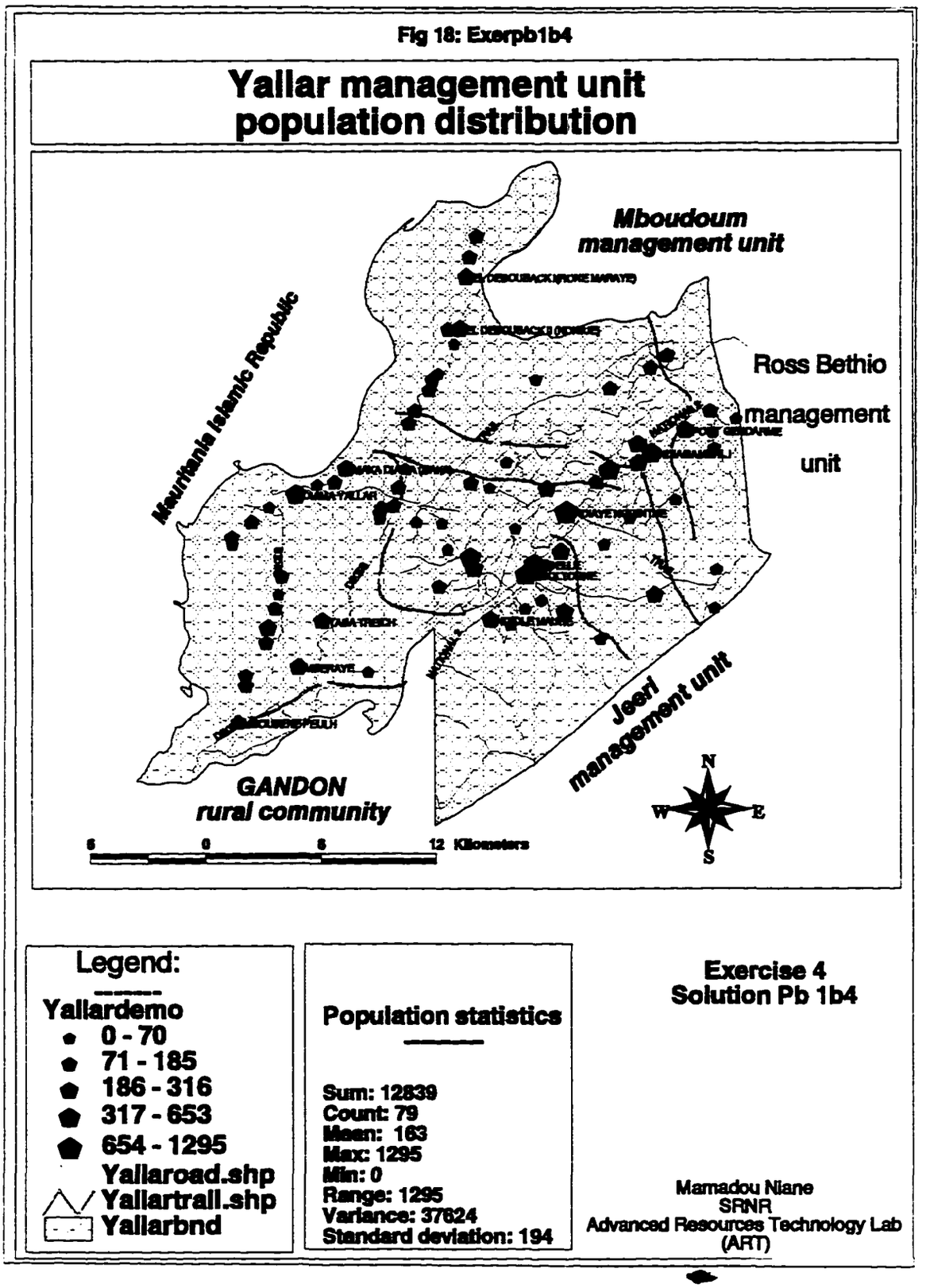


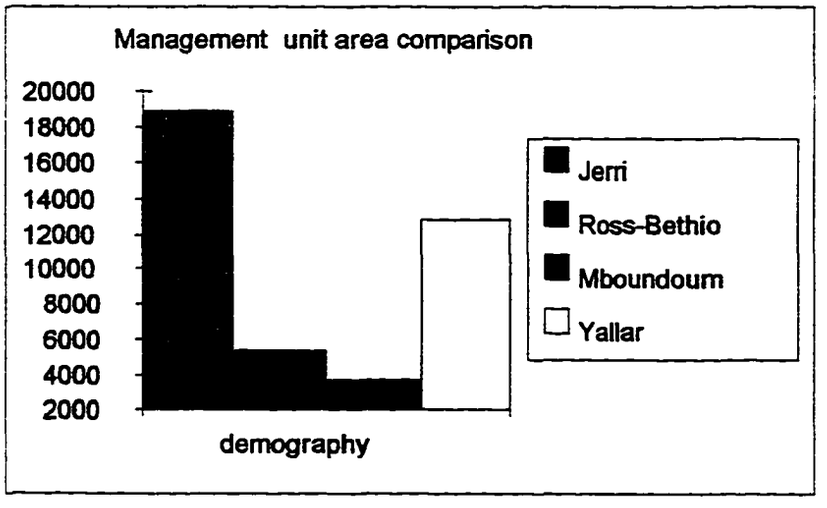
Table 2: Exer4pb1

Areas comparison between the four Ross Bethio management units

Table 2

Jerri	18855
Ross-Bethio	5448
Mboundoum	3756
Yallar	12839

Chart 2



2. Problem Two

This assignment will allow you to give to the local community of Ross Bethio the opportunity to focus on the areas where conflict can occur between different community components (ethnic groups) interacting in this environment. Based on their requirement, you will have to highlight a buffer of 1000 meters from any water sources which represent the potential conflict zone. You will also need to compute a 200 hundred meters buffer around the animal trail which represent the path reserved to animals only. However, it might be considered as a potential conflict area also. The overlap between conflict zone and trails will be considered as the safe path for livestock which need to go to drink at the water sources. You are required to add water sources, animal trails and human habitats on the final map. An optional analysis is to represent each ethnic group with a different symbol. I chose a red triangle to represent the Maure habitat who used to live under tents in the desert, green circle for the nomads who are livestock raisers, and the brown box which represents the traditional apartments of the wolof.

- Solution Problem 2

a. Results:

The solutions of problem 2 are displayed on the layouts of pages (p.112) with the following results:

- A map titled "***Potential range-agriculture problem within Ross Bethio rural community***" (**Exer4pb2**) is submitted.

- All themes necessary to make the solution of the problem clearer

are added.

To achieve the solutions, I went through a complicated process with alternate simple and advanced ARCVIEW analysis functions:

b.Steps to get the results:

After you start ARCVIEW, you will open the project **exercise 4** and create a new view where you will load the following theme from ross2: rosshab, rossadmin, rossntrail, and rossfwater. Do not forget the first step which is to set a projection and map unit in meters before any analysis.

b1 steps:

You are supposed to be more familiar with the material used and the advanced function for buffer zones. Therefore, within the next analysis you will follow the same procedures as in the advanced analysis of the previous problems.

- Therefore, using the advanced analysis function, you will compute distances around the animal trails and reclassify to a buffer of 200 meters (instead of 100 meters for pedagogical reason).

- You will use also the same advanced analysis function to create a 1000 meters buffer around water sources as conflict zone, between agricultural people and herders.

- Using map calculator you add the two buffer maps (200 meters around trails and 1000 meters around water sources)with the (+) operator. The resulting

map will show you the final conflict buffer map where the conflict zone reserved by the local community council for exclusive animal use (red) is highlighted.

- The last required operation is to add the Ross Bethio water sources and the administrative boundary to the map.

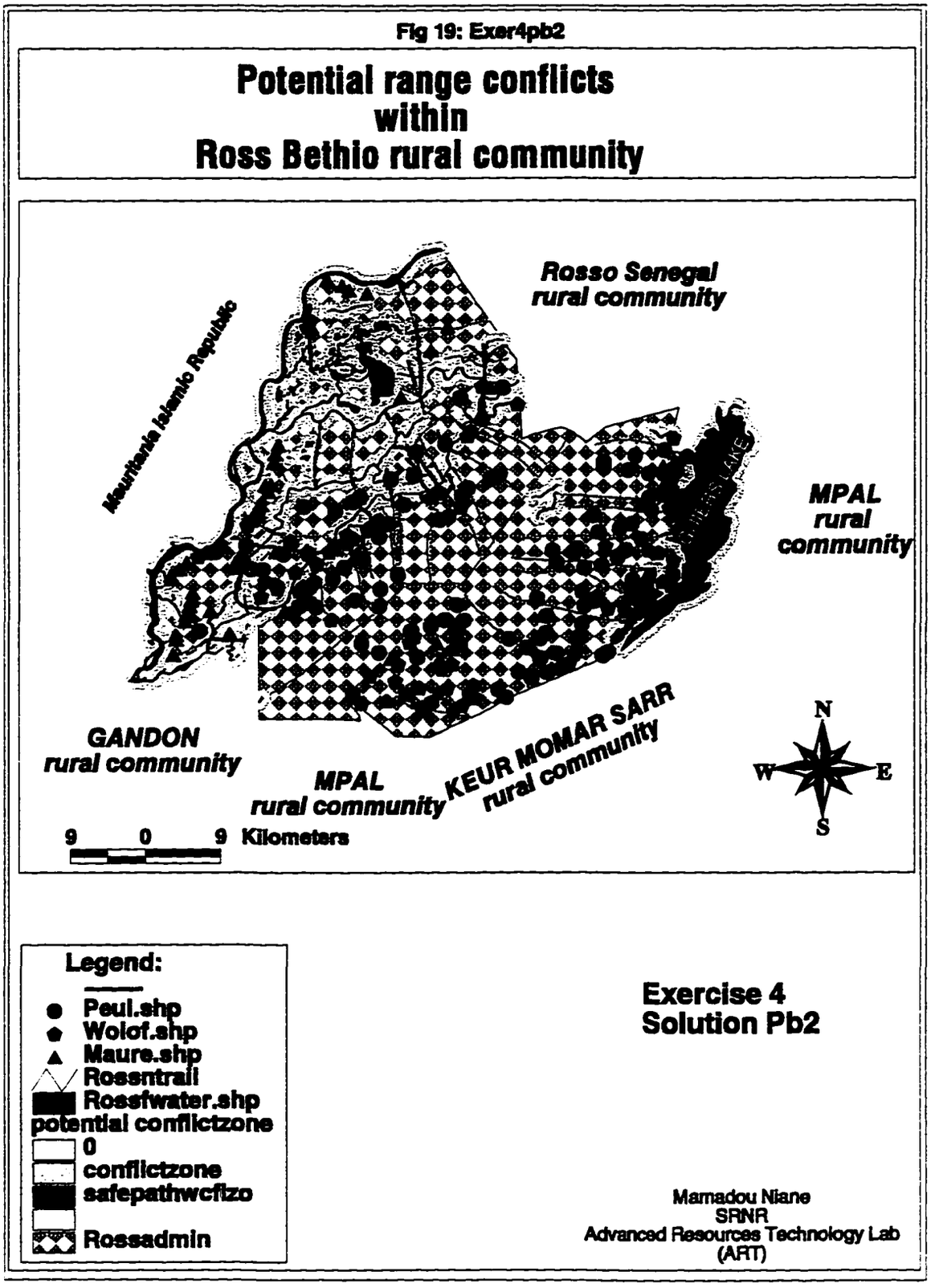
- The optional analysis will help to identify the distribution of the three major ethnic groups within that local community. Using the rossadmin and rosshab as the basic theme, you will extract each ethnic group using the query builder under theme proprieties. You will select the field **Ethnic_g** (double click) click on (=) and select one ethnic group name (double click) and hit OK. Then you can convert the selected villages to a new theme. After that you must give to each ethnic group a specific symbol which show their spatial distribution. Therefore the Maure, Wolof, and Peul are differentiated.

- The three ethnic groups will be added to the final layout where rosshab will be off.

b2 layouts

- The final layout has besides the title, legend, north arrow, label, and the assignment number, all the information necessary for easy understanding.

Fig 19: Exer4pb2



3. Problem Three

This problem will be for you a review of some of the simple and advanced queries you have already learned. We assume that you know the functions you will have to use to do the analysis. Therefore, we will not supply the detailed process that you can find in the previous problems.

In this analysis the local community council is waiting from you to do a realistic analysis of the local community. Therefore, they want you to allocate 300 meters wide to trails, and 600 meter buffer from any Peul to animals. At the same time the distribution of the ethnic groups will show which ethnic group really interact the most and may be in conflict.

- Solution Problem 3

a. Results:

The solution of problem three is displayed on the layout of page(116) with the following results:

- A map titled "***Ross-Bethio ethnic group distribution toward natural resources: a scene of potential conflict***"(**Exer4pb3**)

The map represent the different ethnic groups whose original distribution were linked with their ancient activities. We can see that the Wolof are around water and fishery and the Peul are on the land where they keep their cattle which come near the water only for drink. Because of the buffer of new agricultural land some conflicts are happening mainly between those two groups.

The area given for animal use only by the local community council of Ross Bethio is represented with the 200 meters buffer around animal trails and 600 meters around Peul habitats.

b.Steps to get the results:

After starting ARCVIEW, you will open **exercise 4** and load on a new theme the following themes: rosshab, rossntrail, rossadmin, and rossfwater. You will set the world projection and meters map unit.

b1 steps:

- You may use the three ethnic groups themes made with the exercise four problem one: Peul. Wolof and Maure.
- Using the advanced analysis function, you will compute distances around the animal trails and make a 200 meter (instead of 100 meters for pedagogical reason) buffer.
- You will use the same function to create a 600 meter buffer around Peul habitats.
- You will add the administrative boundary (rossadmin), and water sources themes (rossfwater) to the final map.

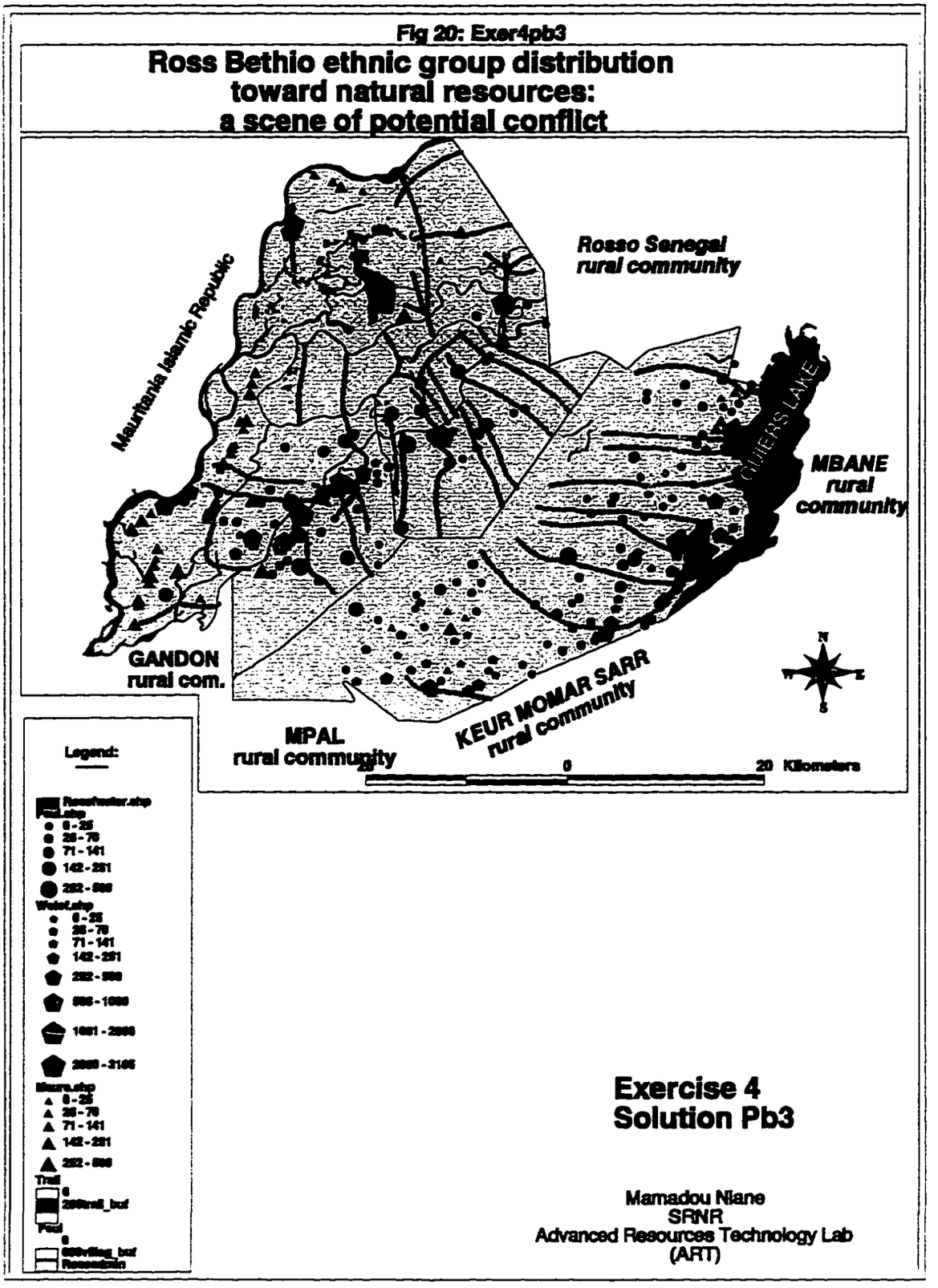
b2 layouts

- The final layout has besides the title, legend, north arrow, label, and the assignment number, all the information necessary for an easy understanding.

c. Theme analyzed:

The three problems of exercise four required the following themes: the demography / habitat (rosshab), the animal trails (rossntrail), the water sources (rossfwater), and the Ross Bethio administrative boundary (rossadmin).

Fig 20: Exer4pb3



VI - DISCUSSION:

This chapter will discuss some of the issues involved in this work. The major issues are the quality of the database (accuracy, precision , consistency) and the methodological, pedagogical, and managerial issues.

A)- DATABASE QUALITY:

The fact that the data came from three different sources, with different projections, different software and different operating systems, make the problem of their use very critical. The data I received came from PC ARC/INFO (CSE), and MAPINFO (SAED), and the data I created myself were from UNIX ARC/INFO. However, whether the data are from PC or UNIX systems, ARCVIEW will recognize them and allow their analysis. On the contrary, the data from MAPINFO, which were in MIF file, needed to be converted into ARCVIEW shape file.

This database may not be the most accurate we may develop, however our goal is to design and develop instructional material. Then, later we will improve the quality by doing more research.

B)- METHODOLOGICAL ISSUES:

As I said before, the availability of any data at the level of rural local communities may be the most important factor for a better management of the natural resources. The necessities which were discussed for years is now adopted by governments in Africa and

particularly in Senegal where the local communities have now more power for natural resources allocation or management.

After years of observation the political authorities failed to have success with the guided policies. Therefore, politicians and scholars believe now that success of sustainable development and environmental protection are better off if the local people realize that the resources are their property as a community. This might be done only if the political and management power come back to them, and this is what was done.

However, to make the change reality, we need to have data which can fit the area of concern. Unfortunately, the data usually available are very coarse scale, or in text file in a language which to everybody is able to read or understand. Indeed, The people who lead the local community, and who generally do not speak French, have more ability to manipulate maps than to manipulate a French document.

The focus on a rural local community is an important methodological element for a better use of research money housed in national and international agencies without being used by people who are most in need. Therefore, our work tries with this local community example, to demonstrate that it is possible to develop successfully that kind of data.

The previous tutorial gave us the opportunity to reach the objectives we defined before. Using ARCVIEW GIS we conducted spatial analysis with the local database of the Ross-Bethio rural community. The problem we solved focused mainly on natural resources management by a local community institution. Therefore, the methodological objective was reached, because we succeeded to focus the spatial analysis within the

boundary of a local community region. However, for the pedagogical objective, even if we reached our goal we need to setup the boundary of its use.

C)- PEDAGOGICAL ISSUES:

It is very important to know what the tutorial is or is not. The tutorial is not a self taught one designed to teach the basics of ARCVIEW or its step by step process. To use this tutorial, the users need to know ARCVIEW or learn it as part of the tutorial.. Therefore, the instructor is free to imagine how to introduce the GIS package to the potential users. The tutorial is developed for instructor use, therefore, they can adjust the level of difficulties at the level of their student knowledge.

Through this series of analyses the student will deal with almost all fundamental questions that this particular rural community face. In addition, the level of difficulties allow the student to practice either simple or advanced ARCVIEW functions. Therefore, the exercises cover from statistical to spatial queries.

According to the knowledge you have of ARCVIEW or the features you have available with the original package (e.g. spatial analysis extension), you can perform simple or advanced function to reach your solution. I want to make clear that even without the advanced extension I used you can still perform the analysis with very similar results.

D)- MANAGEMENT ISSUES:

Technically, we are demonstrating that the database will allow managers to solve community problems. That means that independent of the possible error on these data, there is no doubt of the usefulness of the approach developed within the problem / answer we adopted.

VII - CONCLUSION:

This thesis represents a great opportunity for learning and consolidation, but also is a modest contribution which can help to improve the use of computer based technology for a better management of natural resources in Senegal.

My conviction was based on the three important elements:

- The experience I had with Ross Bethio local community whose **database model** was developed and used with the **Tutorials** which try to solve some of the problems they face in their environment.
- The new focus that the government has, which is to give all the power of development and resource management to the local communities.
- And the belief that it is a necessity to adapt and focus instruction over local areas to solve real problems and make the international cooperation more useful.

The Ross Bethio local community model is the pretext which allowed me to make real my dream. Therefore, we developed databases from three sources whose primary goal was not to design data which fit for the test of our problems. Therefore, the SAED and CSE data were analyzed to fit the standards of the local community. However, the data we developed from the local community during our stay at the Saint Louis Agricultural Research Center (ISRA Saint Louis) fit perfectly the standards of the local community because the terrain was done with the whole community for years and was definitively adopted during the 1994 local development planning process (Le Developpement Local a Ross Bethio, March 1994).

The problems we had to address were translated within the tutorial exercises by a series of problems. Therefore, we tried to raise large and crucial varieties of questions which will interest the local community council for the management of their resources.

A)-MAJOR INTERESTS:

The major question at the end of this work is; what is the meaning of this work in the Senegalese context? This work has a large variety of real applicability:

1.The rural community scale:

As I said the basic administrative unit in Senegal is the Rural Community, and we have more than three hundred of them. According to the administrative political reform, the local community council has the power to manage all resources within their territory. Therefore, the model we developed will help all other local community to duplicate it based on their own realities, because the acquisition of the information used to develop the database was witnessed by the local community council from raw data to the production of the final results (maps). Therefore, if my results were displayed today on maps they do not need a guide to navigate through them like photographs. So, the results are usable right now even if they will need improvement from my point of view.

2.Methodological problem:

The focus at the rural community scale is intended to prove to researchers and developers that in order to make our research or investment useful we need to focus them on resources which have interested owners and managers who also have the power to decide. The rural community council meets the requirements because it is held

responsible for land resources allocation and the management of all problems within the boundary of their local community.

The reality of this problem can be seen with all hard copy maps produced for the country. Even if they have very important information like soil quality, soil capability etc. (SEDAGRI 1970) you cannot find nowhere maps which focus on the local community problems. Therefore, during the Ross Bethio planning processes, I extracted information from original maps, and assembled them into a new format which matches the local community. The manual work took almost two years for a result of hard copy maps which means that their reproduction was problematic. Today the capability of virtual data (maps) production will improve tremendously the possibility of map production and the capability for easy information update which is very important in a very fast changing environment.

3. The pedagogical problem:

The old manual way to visualize information on map is becoming too slow compared to all the challenges the environment faces. Even if some major problems like "resolution", "accuracy", "precision", and "many types of errors" are still a concern in digital mapping on the one hand , on the other hand computer based mapping offers faster processing, duplication, and easy update. The new technologic advances with the rapid development of Geographic Information Systems; the use of computer based mapping is wide spread, but teaching is almost only in developed countries. In addition, in most of the cases, the databases used are from the developed countries. The only popular databases developed which focus on Africa, and regions like the Dirol plain in

Mauritania, are remotely-sensed data based images which are usually analyzed with IDRISI raster package (United Nations Institute for Training and Research).

The use of Ross Bethio database used with ARCVIEW GIS has the dual advantages of offering training with a local database and flexibility of manipulation with ARCVIEW GIS features which allow GRID and VECTOR data structure analysis. It is known that in a GIS environment, the data are the most expensive part, however, in many developing countries lots of data are available but the software packages which allow the data to be digestible and useful even if they exist is still a specialist problem. Therefore, the demand of more service from the market is a lot higher than the capability of supply by the different institutions.

VIII - APPENDIX

Data sources:

Centre de Suivie Ecologique (CSE): The Ecological Survey Center provide us with a set of PC ARC/INFO coverages that we listed under the data acquisition chapter. Not published

Societe National D'Amenagement et D'Exploitation des Terres du Delta, des Vallees du Fleuve Senegal et de la Faleme(SAED): They supply us with the irrigation components data in Map/Info exportable file that we listed under the acquisition chapter. Not published

Tutorial Database: The coverages are stored in a disk with a readme file.

IX - REFERENCES:

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Niane, Mamadou. Octobre 1992: Typology dynamicque de l'Amenagement: Facteurs physiques, institutionnels, et contraintes a l'amenagement: Le cas de la community rural de Ross-Bethio. Memoire de diplome d'etude approfondies en geographie. Universite Cheikh A. Diop Dakar

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USAID-DAT 1985 Cartographie et Teledetection des ressources naturelles de la Republic du Senegal. Ministere de l' Interieur de la Republique du Senegal.