FOSS in developing countries, the case of GRASS in Rwanda and Tanzania projects

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The lack of water is one of the most important problems in many African countries.

In the past this problem has been faced with the help of Developed Countries aids, carried out by means of many different help programs aimed to improve the number of water wells and acqueducts.

In the past this problem has been faced with emphasis on technical infrastructures, such as wells and pipelines without any care of the environmental issues

Advantages:

- initial water abundance
- agriculture improvement

Disadvantages:

- water salinity
- soil salinity
- loss of water potability
- loss of natural environment and agricultural areas.

This is a classical example of unsustainable development and the approach must be definitely changed

It is necessary to simultaneously:

- design well made water supply systems and structures;
- involve local people and communities at all levels:
  - project definition
  - infrastructure construction and management
  - environment and landscape management
  - software used in all these phases
- monitor environmental situation before and after the interventions taking into account ecological dynamics;

The use of suitable technologies and the application of technical solutions tailored to the local people ability are crucial and directly involve the software solutions to support water management designs and planning.

- the software used in the projects we present are mainly:

- software to design and test water supply systems
- GIS software to manage and control the water supply systems and to manage and monitor the areas

Free Data and software

These projects are carried out using free data and software

Advantages for developing countries

1. economic
2. no commercial politics or connections
3. knowledge acquisition

all this facts allow us to work to guarantee their autonomy and independence, that is their development

Documentation and education

It is important to underline that in developing countries the land knowledge is particularly difficult, often base cartography is not available or it is old and without metadata, while GIS and cartographic tools are unknown.

Often the Datum definition for available cartography is unknown

As it happened at the beginning of GIS history, in western countries, the lack of data can be the real bottleneck for GIS spreading

Apart from technical issues, land planning in developing countries is complicated by many problems like corruption, scarce law respect and political instability

However, sustainable planning cannot begin properly without a GIS, a base cartography and land use information.

It is particularly important to use local cartography in local professionals education in developing countries as they do not feel comfortable with data from areas they do not know.

In this work the use of GRASS and GFOSS in different projects in

- Rwanda
- Tanzania

The focus is on the potential of FOSS GIS for

- data management
- digital technologies spreading
- education of local people to approach problem solving with software use
- training local users for specific software

Problems and difficulties are also underlined.

Muhura district, Rwanda

Pemba Island, Tanzania

RWANDA:

Muhura district is interested by different projects carried out by the NGO Movimondo ”Movimento per la lotta contro la fame nel mondo” supported by DICA (Department of Civil and Environmental Engineering) to improve water sources.

In the 90's Rwanda was the interested by one of most bloody civil war ever and is still struggling to recover.

Civil war affected not only humans but also natural environment.

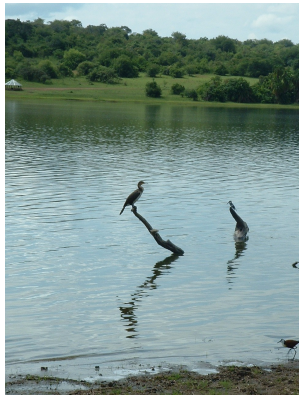
The construction of new wells and water supply system has been carried out with good results, but the management of the single sources or water supply system is now fundamental to maintain their efficiency.

Movimondo needed instruments to design, map and monitor wells and new water supply system and FOSS has been used to answer to their needs.

RWANDA: MUHURA ENVIRONMENT PROBLEMS

<u>high population density</u>		
land exploitation	agriculture excess of pastures deforestation	**desertification** **erosion** **biodiversity loss**
water management	hygiene (malaria) distance of villages from sources water supply networks	**management** **project** **planning**



Main goals of the work

- Create a system and a procedure to design and manage wells and water supply systems

- Optimize resources and reduce costs

- Education

- To use simple and easily replicable image analysis techniques to produce a land use map of the Muhura area

- To collect all the available cartography and create new multitemporal information useful to:

  - carry out the current project

  - analyse the land changes through the years

  - create a specific GIS tutorial for local technicians training.

RWANDA:

Epanet software was used to design and verify new water supply systems and to map and manage existing water supply systems
GRASS has been used to

build an archive of the existing cartography

build a map of the water supply systems

build a map of the environmental changes, especially forest distribution, using multitemporal satellite information

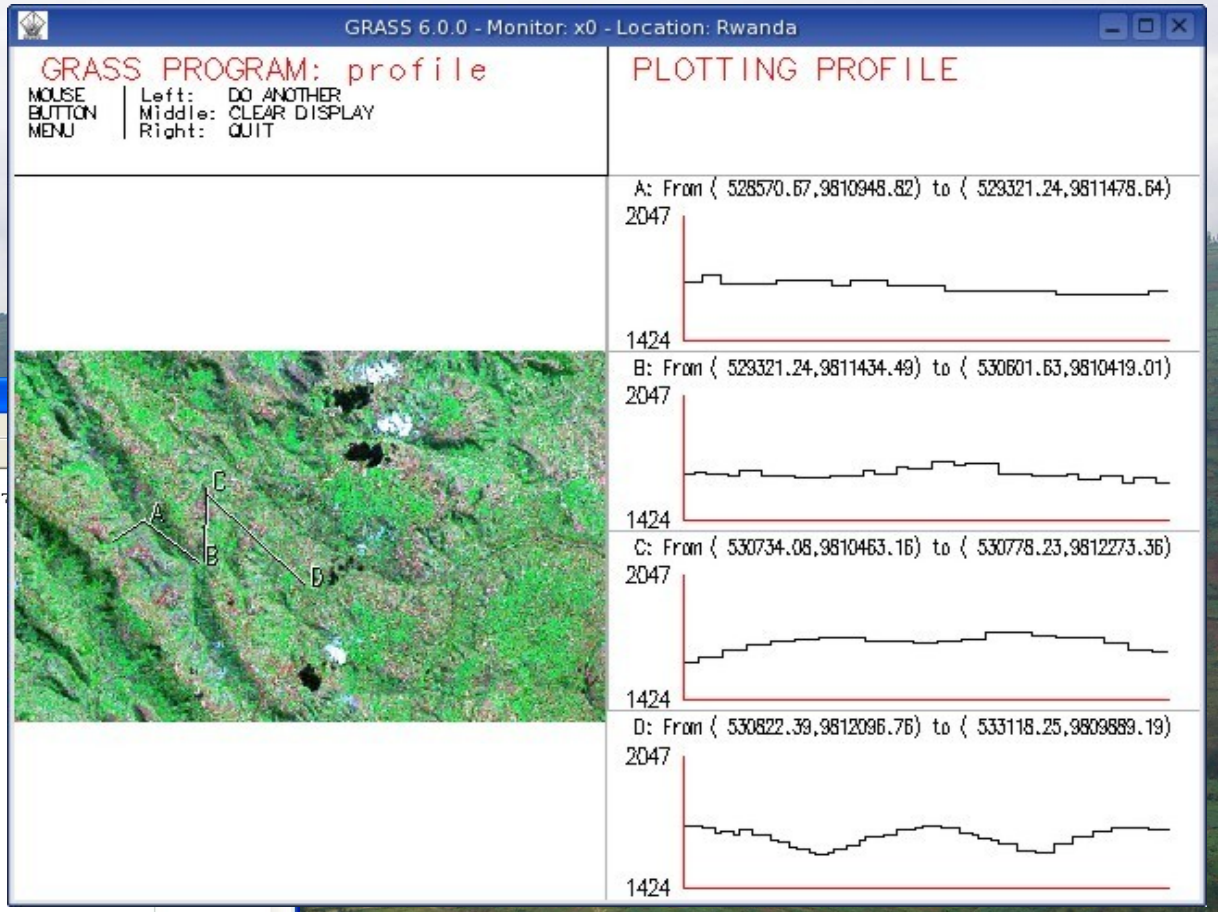
educate people to GIS using FOSS

In the long run the goal is to help Muhura district to carry out "sustainable planning" in which local people are directly involved

Many problems have been encountered to involve other people both in the university and in the NGOs to switch from proprietary software to FOSS. The resistance seems to be more at European level...

Rwanda 2004, photo by Enrico Selmi

GRASS and EPANET



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li=19 co=45 INS (CR+LF)

Satellite images

Landsat3, 20 august 1980, res 60 meters

Landsat5, 20 june 1984, res 30 meters

Landsat4, 22 december 1990, res 30 meters

Landsat7, 8 july 1999, res 30 meters

ASTER, 9 september 2005, res 15 meters

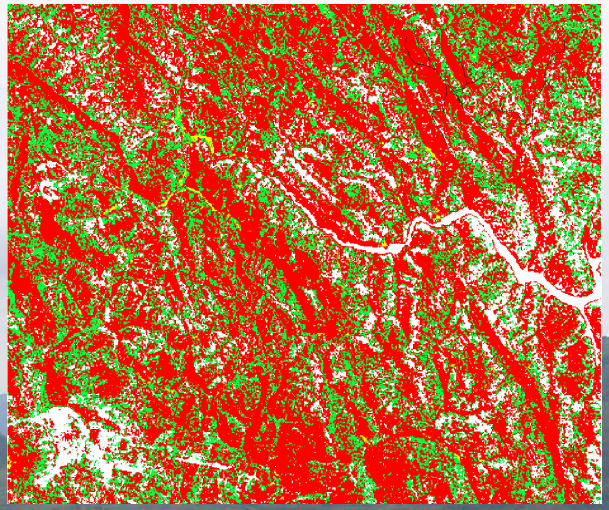
FAO (Africover)

Land use map
Geology map
Urban centre map
Roads map

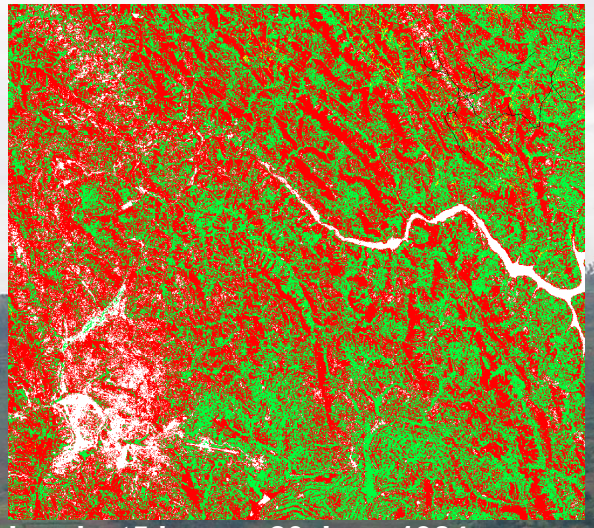
Topographic map

1987 by Belgium Institute Geografic Nationale with Rwanda Geografic Institute

Analysis of multitemporal changes for "**Banana trees**", "**Fields**", "**Forest**"

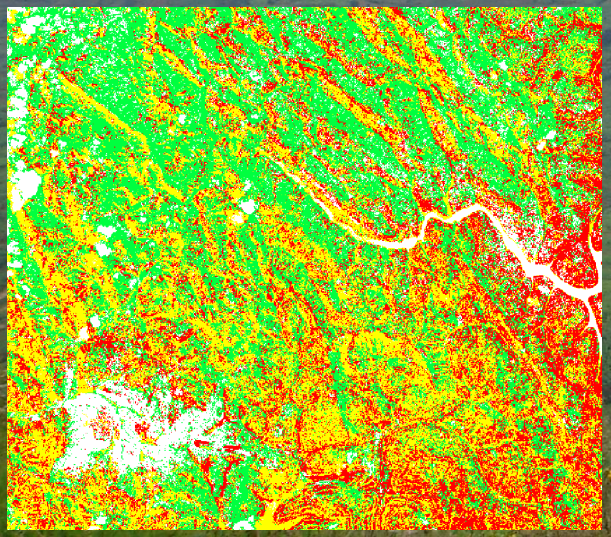


Landsat3 image, 20 August 1980

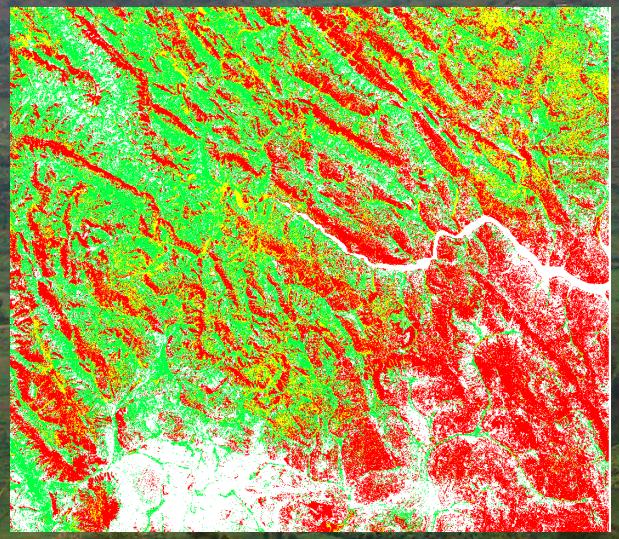


Landsat5 image, 20 June 1984

Banana
Fields
Forest

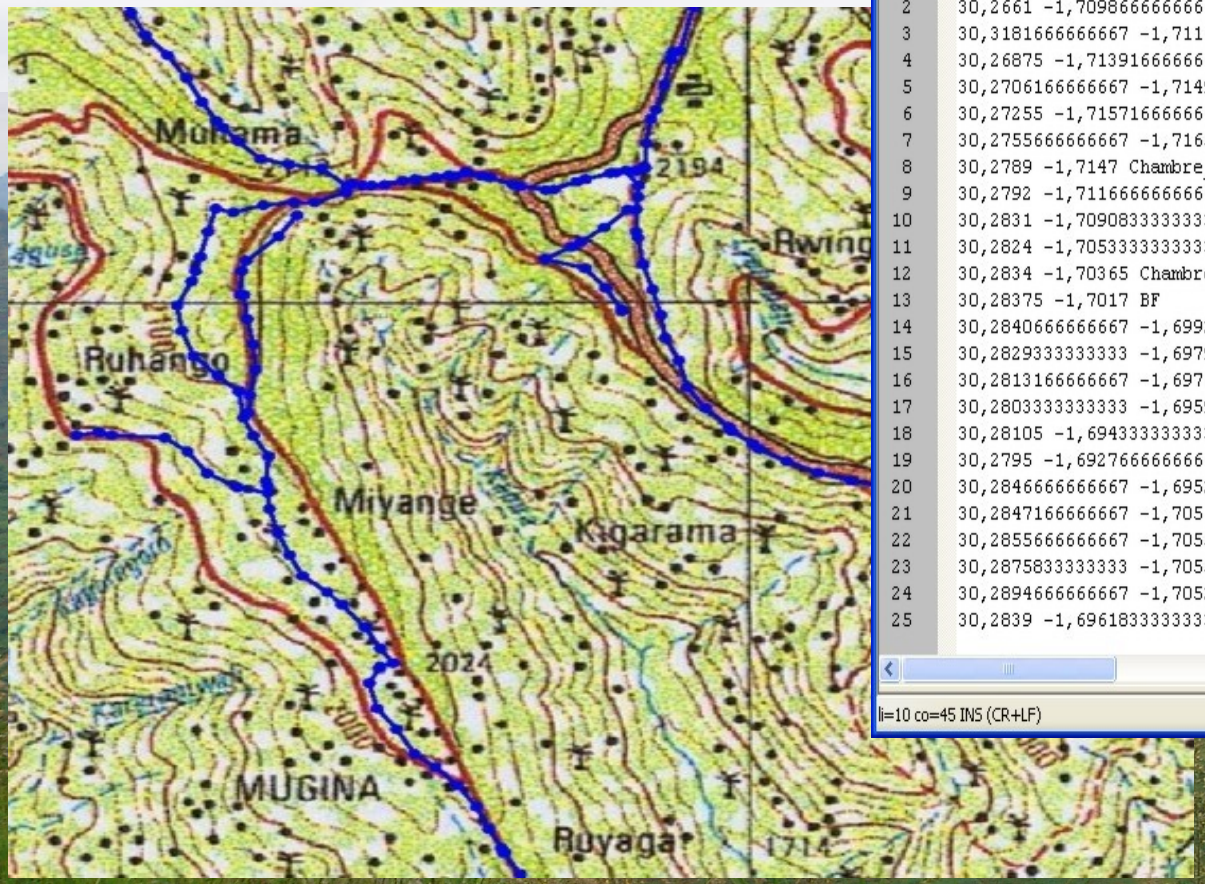


Landsat7, 8 July 1999



ASTER image, 9 September 2005

GPS



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li=10 co=45 INS (CR+LF)

TANZANIA:

Pemba Island is not far from the most famous Zanzibar Island, but for many different reasons it has not the same appeal for tourists.

Pemba has been repeatedly interested by severe cholera and other epidemic problems.

Chake-Chake in Pemba is interested by a project carried out by DICA (Department of Civil and Environmental Engineering), ISF (engineering without borders) and Fondazione De Carneri to monitor water quality.

Pemba has monsonic climate, low natural water reserves, had many forests both coastal (mangroves) and inland (esp. mango) that have been gradually destroyed both by local people and big companies.

TANZANIA: CHAKE-CHAKE ENVIRONMENT PROBLEMS

Inland forest destruction resulted in a wide desertification and reduced water availability.

Re-forestation with non indigenous species has been carried out but resulted into further problems

Coastal forest destruction gave place to fish farming and salt mining and resulted in salt infiltration in fresh water sources

Agriculture areas produce pollutants whose concentration is probably very high near fresh water sources and reservoirs

Forest destruction and new agriculture practices resulted in rivers draining

Conversely, few areas interested by sustainable forest management are giving some first encouraging results.

Land use changes tied to natural environment devastation and water availability reduction are strongly connected.

Main goals of the work

- Create an archive of wells and water supply network data to manage them trying to reduce health risks

- Optimize resources and reduce costs

- Education

- Use simple and easily replicable image analysis techniques to produce a land use map of Chake-Chake district in Pemba

- Analyse land changes through the years trying to connect them to water and environmental problems

- To collect all the available cartography and create new multitemporal information useful both to carry out the project and to obtain local data for local people training.

TANZANIA

FOSS software can help to describe land use changes

Epanet software has been used to verify existing water supply system,
GRASS to map the area

GRASS helped to carry out a first investigation about land use changes tied to water availability problems

GRASS and QGIS have been used to map GPS points

GRASS and FOSS have been used as an aid to spread technical software in African areas (people showed great interest also in CAD and software to assist design)

Great helpfulness from local people to test FOSS as an alternative to proprietary software, while (again) perplexities came from some European Universities and NGOs staff.

TANZANIA

The possibility to use GRASS has been investigated also by means of direct contacts and courses given to selected personnel coming from Africa.

The direct contact has allowed the organization of courses tailored both in the choice of the right software solutions for the tasks at hand and in the choice of the lectures' topics.

A course in Italy has been attended by selected Tanzanian personnel whose task is to spread the knowledge of GIS and FOSS when back at home.

To involve local people the strategy was to decide together how to carry out the upgrading of the local Tanzanian computers, to provide the necessary hardware using dismissed but still working quality proof parts of computer of our faculty and to simulate the whole intervention, both hardware upgrading and software installation on a test machine in Italy.

The same has been done later in Tanzania using the computer selected to become the GIS server.

TANZANIA

This approach allowed us to develop a more profound awareness of the Tanzanian technicians base knowledge and abilities to tailor hardware and software solutions following their need and their requests.

Installing, uninstalling and installing again computer components in the test machine side by side with local African personnel is useful because while dealing with computer components we also learn how to solve problems together and to create a relation.

The “handcrafting” atmosphere which naturally bears when working together using hands near a small mountain of hardware components helps to develop a good relationship.

The choice to give them recycled components to upgrade their existing hardware instead of a whole new machine has born directly from these considerations.

TANZANIA

Those people have been taught also in Pemba by Italian GRASS skilled user

The participation of the people to education is fundamental to obtain the best result and to encourage them to try the solution of free software.

In this way FOSS experimentation is a choice and not an imposition and they may be able to compare it to commercial solutions and to test if FOSS can be a suitable alternative.

A set of Chake-Chake (Pemba) data was prepared specifically to train Tanzanian professionals.

TANZANIA

The need to tailor software solutions to special projects can be addressed also by means of special editions of GNU/Linux and GRASS Live DVDs and installation DVDs.

This kind of DVD can be created exactly with the applications needed by the African partners whose advices can be taken into account to transform the installation in something more familiar and addressing the most important issues they need.

Tailored installation DVD can also help to overtake the lack of Internet connection, a problem that often limits the spreading of FOSS in African countries.

In the case of Pemba, a live DVD has been used to give them last available versions of GRASS, QGIS, Open Office, and some other software following the indications of Pemba partners.

The live DVD has been used to install Linux in the hardware upgraded computer in Pemba.

CONCLUSIONS

In our experience, to improve FOSS use in developing countries we need to:

Convince European partners, more than the African ones, that FOSS is almost as good as proprietary software and it is better under many points of view

Involve African partners in all the phases of the FOSS introduction, from Hardware to Software choice and installation

Tailor solutions to their exigences as much as possible

Foster specifically tailored Live DVD production

Create specific datasets to train people on local areas data

Choose reliable partners, i.e. motivated partners

People are the key element of FOSS spreading so they must be individuated among those who have the basic skill to begin FOSS diffusion and, above all, they must find really useful to use FOSS, maybe in just one application, doesn't matter which one...

Underline the fact that they can use FOSS as an alternative to test its potential but they must not feel it as an imposition