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Title

Introducing Resource Information Techniques for the benefit of local communities: the FAO "Tonle Sap Project" practical experience (Siem Reap, Cambodia)

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Abstract

The FAO "Tonle Sap" project, based in Siem Reap (Angkor), Cambodia, is aimed at addressing natural resources management issues around the Tonle Sap lake, with a special concern for the degradation and loss of the forest habitat. Since the potential usefulness of the Resource Information Technologies had been realised by the project team, these tools have been introduced within the project to facilitate the integrated forest resources management by local communities. The paper will deliver a comprehensive view on the project's GIS background, current status and ongoing activities, and the prospects for the future. It aims at showing how such tools can be used into a mostly field-oriented project based at the provincial level. It will enhance the potential use of existing data sets, including applications such as ranking of current forest productivity, identification of target sites for community forestry activities, or detailed mapping of community forestry sites. It will elaborate further on the main objective of the GIS work, the establishment of *Natural Resource Data Bases*. Finally, considering GIS as a tool and not an objective in itself, it will elaborate on the future GIS strategy as the main challenge, *i.e.* the establishment of a *GIS based planning procedure*, which can be taken over by the provincial departments ; this is seen as the only possible way to ensure the sustainability of GIS and related resources assessment work beyond the duration of the project.

Contents

INTRODUCTION

The Food and Agriculture Organization of the United Nations (FAO), through its so-called "Tonle Sap Project" based in Siem Reap (Angkor), Cambodia, is one among few organizations currently involved in introducing and applying resource informations technologies in Cambodia so far, and perhaps the only one doing so outside the capital, Phnom Penh. Through its wish to include effectively the RS/GPS/GIS tools into its efforts to launch a participatory forest resource use planning and management, for the direct benefit of local communities, through its success and difficulties, it has gained a valuable experience on how these tools could indeed be introduced, step by step, and used within a mostly field-oriented project strictly located at the provincial level.

PROJECT'S OVERVIEW

The "Participatory Natural Resources Management for the Tonle Sap Region" project of the FAO was formulated in 1994 to address natural resources management issues around the Tonle Sap lake. It intended to focus on the degradation and loss of the inundated forest habitat, which is believed to be of essential importance for the maintenance of productive fisheries within the lake. The Siem Reap province was selected, and activities were implemented in one target district, Sotr Nikum.

Project activities mainly focussed on forestry and fisheries sectors ; three years of implementation result on a considerable amount of ecological and socioeconomic data gathered throughout the project's various activities. It also established trials and experiments on forestry, fisheries and other income generating activities, and laid the foundation for further development and expansion towards a sustainable management of the natural resources. A second phase has become operational since September 1998, with the Belgian Government funding it for another thirty months. The project's team is keen now to implement activities built upon what has been learnt from Phase 1, and to focus on natural resources management by local communities.

The Phase 2 overall development objective is therefore : "**Sustainable management of natural resources within the Tonle Sap basin through local community participation for the benefit of rural people and communities**". The project has now expanded its activities to three additional districts along the lakeshore of Siem Reap province, *i.e.* Siem Reap, Prasat Bakong and Puok districts ; the project's target area now covers 262,300 hectares and with a population of over 340,000.

The project's team does concentrate its activities on facilitation of communities to assume responsible, productive and sustainable management of local forest resources, both in the upland areas as well as in the inundated forest zone. Trained counterpart staff provided by the Provincial Departments of Forestry, Fisheries, Agronomy, Rural Development and Environment undertakes fieldwork. In addition to community resource management, the project implements supporting activities which include : seedling production, agroforestry development, horticulture nursery development, on-farm aquaculture development, wood energy conservation program, micro-irrigation systems for vegetable production, environmental education and extension, and a rural credit program to support local development and income generating activities primarily among community forestry management groups.

GIS BACKGROUND AND CURRENT STATUS

Initially, there was no GIS component in itself formulated in the Phase 1 project document. It is not known whether, back in 1994, the authors might not have been aware of GIS or did not consider the GIS tool as relevant and useful to fulfill the objectives of the project. However, GIS became eventually part of the activities and development of Phase 1, even though the important and preliminary step of assessing the relevance of installing and using GIS considering the scope of the project was never really made.

Some GIS-related activities took place during Phase 1. Arc/Info software was purchased and installed by the project in 1997. The designated Cambodian GIS counterpart received an extensive GIS training in AIT/Bangkok

in 1996, and some more hands-on practice on Remote Sensing in Phnom Penh. But unfortunately, for various reasons he could never get the chance to practice what he learnt. A 1-month GIS consultancy was made to the project in 1997. The consultant set up a GIS database. His end-of-mission report especially highlighted recommendations to prop up a successful GIS unit within the project. As Phase 1 was going on, mapping exercises using GIS were made, only by contracting an external agency based in Phnom Penh (IRIC). The main data produced were land use/land cover data sets based on aerial photos (1/25,000 and 1/15,000 scale of 1992, 1996) for the project's target area.

Finally, a GIS component was officially included in Phase 2 project document, including specific GIS-related expected outputs, recruitment of a GIS associate professional officer, and option for another GIS consultancy.

The computer availability and capacity, which was one among many key problems to develop GIS properly during Phase 1, has significantly improved with Phase 2. A new and adequate computer restricted to GIS and mapping purposes has been installed. A CD writer has been added to the hardware in order to make the **converted GIS maps into formats which can be read by non-GIS software** available to other project's computers. An A3-size printer has been purchased as well, in order to produce final printmaps of larger size. The project has decided to switch to ArcView, which is user-friendlier and gives the possibility to use our existing GIS database without much difficulty. The GIS APO and his counterpart have both acquired skills in Arc/Info and ArcView, including intensive training. A second GIS consultancy earlier this year has been of the utmost value for the project and has reshaped the entire work of the GIS Unit. GIS staff is now able to extensively **manage the GIS data base and the directory structure layout** and to perform to a fair extent various analysis operations, such as **calculate statistics for administrative or community forestry units** or **perform overlay procedures.** The associate professional officer in GIS and his Cambodian counterpart are now in the phase of practising their new technical skills in GIS and shaping their GIS work to be more useful for the project's activities. Nowadays, maps produced by the GIS Unit are exclusively made **using a computer-based approach.** The current GIS database has been largely expanded. A separate Cartography/GIS Unit has been set up within the project, in a specific office, in order to develop further mapping and GIS activities. Alike the project's Training and Documentation Centre, it intends to be accessible and useful to everyone from the project staff as well as from outside at the provincial level, such as the provincial departments, other UN agencies or other organizations based in Siem Reap.

Overview: Current Status of GIS and Mapping Materials

GIS Data

The GIS Unit currently holds a fair amount of GIS data gathered from outside agencies. These data sets include :

- administrative data (province, district, commune, village, protected areas)
- land cover data
- rivers and roads
- elevation data
- soils data

The GIS Unit has also created its own data, including

- Fishing Lots boundaries

- Community Forestry Sites boundaries

- Dikes location

Maps

A large number of maps were collected or purchased from other agencies in Cambodia. The majority of these maps are at small scales (1:250,000 and smaller), potentially useful only for macro level planning. Nearly all these maps are based on data sets that have also been included in the GIS data base. Beside, the main maps, which are extensively used, are the US toposheets (1/50,000) made in the 70's.

Aerial Photos

The GIS unit owns black and white aerial photos at 1:25,000 scale taken in 1992 and 1996 and at 1:15,000 scale of 1996 which cover parts of or the entire area where field activities are being implemented.

GPS

Two non-differential GPS navigation units linked to GPS software are extensively used in the field.

APPLICATIONS

GIS UNIT STRATEGIES

Beside the day-to-day work undertaken by the GIS Unit in various fields of activities, efforts are to be concentrated into applications directly usable for the project's main focus, community forestry ("CF").

Present focus - Community Forestry process

The short-term strategy of the GIS Unit at present is to make the existing GIS data sets and other resource information techniques as useful as possible while implementing the Community Forestry process.

Overview: Community Forestry development strategy

The goal of community forestry is to reduce natural resource degradation and loss by placing resource control and responsibility under local communities who have traditionally utilized the resources, and to assist these communities to achieve productive and sustainable resource management which meets local needs while stimulating community development.

The project assists interested communities with obtaining recognized rights for management and utilization of locally accessible resources. Land tenure does not change, just resource tenure is transferred to the local community upon approval of their community forest management regulations. All products and revenue from the resource belongs to the community for their utilization / distribution as defined in their regulations.

The approach adopted is one of facilitation to assist local community members to articulate what they want, what they see as their problems, what are the options and opportunities, and to help them reaching a consensus on how to proceed.

The process now follows different steps :

Site identification
Case Study
Observation/Assessment
Discussion
Workshop
Mapping
Identification of interest group
Selection of representatives of interest group/
Membership registration/Forest committee set up
Regulation / Boundary demarcation
Community forest management plan
Implementation of management plan

It has to be mentioned as a foreword that the project is keen to strictly follow a participatory approach in the entire process ; any GIS output is a considerable *plus* to implement this process, not an alternative for management. The GIS Unit prepares technical maps using Remote Sensing data, GPS, ground checking and GIS, to be discussed with the local people. Whenever needed, participatory sketch maps are still be made on the spot, often using the materials prepared by the GIS Unit as a base map. The participatory sketch map tool is mostly left to the project's community forestry staff experienced with this kind of technique.

Present GIS Unit involvement

Two operations performed by the GIS Unit have a direct impact on implementing the CF process.

1- Process aerial photo

Staffs can process existing aerial photos, *i.e*. scanning, importing into GIS and geo-referencing them. This is of great benefit to the project's community forestry activities, since the original photos can be enlarged from 1:25,000 to 1:5,000 scale with simple and inexpensive means. The enlargements can be taken to the field and be used in discussions with villagers, *e.g*. when identifying boundaries of potential community forestry sites. It has been proven as the best tool to visualise the area, whereas a topographic sheet or a land cover map is rather meaningless for local people.

2- Import data from GPS surveys into GIS

GPS data from the GPS receivers used by the project field staff can be downloaded into the computer and then imported into GIS. This has already been widely practised for numerous community forestry sites, as well as for other features such as about a hundred illegal dikes, which were surveyed earlier.

As any position on the ground read from a GPS receiver can be identified on the photo, the combination of these two tools, aerial photos and GPS, put together into GIS, is of great benefit for the project. By developing their use, the GIS Unit is directly involved in **detailed mapping of Community Forestry Sites**. Once an area has been identified and confirmed as potential community forestry site, draft maps showing the CF area boundaries are prepared. It basically consists in spotting the different features which might serve as physical boundaries (such as rivers or roads), and collecting GPS points all along parts where no physical boundaries can be identified. A draft of the potential area limits is presented to the user group representatives during the discussion and workshop steps. When it is all agreed, the map is finalised and printed out to be included in the official CF agreement to be signed.

CF area limits demarcation is made by using inexpensive means, such as tightening wooden poles to the tallest trees in the flooded forest, or planting recognizable tree species seedlings in the upland area. Field check is made by the GIS Unit using GPS to detect any change in the limits of the CF area. Demarcation poles position on the ground is read from GPS receiver ; later the GPS navigation tool will help relocate them if needed.

For the more advanced CF sites, the project is now reaching the step of community forest management plan. Additional large-scale maps dividing the CF area into compartments for different forest management strategies are required as well. These maps, based on scanned aerial photos, bring into discussion the forest management options ; they often enhance the traditional knowledge of the local communities on the CF area. The locals take final decisions, in full respect of the participatory approach ; the area is divided into different blocks (per forest product) and sub-blocks (per village), and GPS measurement during demarcation is made if requested by the CF staff.

Future GIS involvement

In 1998, it was decided to target new community forestry sites based on the degree of utilization, and to work first with those sites which are under the heaviest pressure, *i.e,* those which may be lost unless immediate action is taken. To this end, the project conducted a *resource assessment* in all districts for long-term natural resource management planning.

However in reality, communities are approaching the project for assistance and demand is exceeding current staffing levels. Demand was easily created first by holding discussions with commune chiefs at district meetings, which feeds back to the villages and starts the whole process. The project is now receiving direct requests from villages asking for assistance.

The CF process starts by the site identification step, which so far considers only the following criteria for selecting suitable sites to initiate community forestry :

- interest and assistance request from a local community ;
- idealistically, area with an existing local forest management system ;
- area with no serious disputes (land ownership claims, encroachment, military presence) ;
- forest resource users belonging to the same community.

The GIS Unit could provide a valuable input in this early stage as well, in the near future. It would consist in two main tasks :

1- Ranking of Current Forest Productivity

One could use the land cover data sets mapped from the 1:25,000 scale aerial photos (1992, 1996) in order to get a better overall picture of available forest resources at the district level. The classification scheme of these data sets in its original form does not provide this picture. However, one could re-group the various interpretation classes according to their current productivity (*e.g*. (*simplified*) Evergreen Forest > Deciduous Forest > Woodland > Shrubland). This may require some field activities in order to get a better idea of how classes like Woodland or Shrubland actually look like on the ground. The forest inventory information previously collected during Phase 1 may also be used in this context. The output would be maps showing the current forest productivity rather than the land cover with intangible classes like *Bushland and Trees of Low Density*. A map simply showing a *productivity ranking* (*e.g*. very high – high – medium – low – very low) would provide valuable insights compared to what is available at present.

2- Identification of Potential Target Sites for Community Forestry Activities

The information on current forest productivity generated in the previous step could then be used to help identifying potential target sites for community forestry activities. Considering the project's life span, one would therefore logically focus on activities in those areas that can be expected to provide maximum benefit to the target population, and which would serve as pilot sites for further action. Such areas would have to be identified through a structured selection procedure, combining information on areas of current forest productivity with information on *population density* and *population distribution*, which is available in the commune and village data sets (1998). Other valuable information such as *forest products demand and supply* have to be considered as well ; the project-made natural resource assessment at the commune level (1998) would be a primary source of information.

Note : This procedure can of course only be used to help identifying *potential* target sites, at the first step of the CF process. It has to be followed by thorough case studies by the Community Forestry team, checking on the ground whether an area is available for community forestry management at all.

That step leads naturally towards the GIS Unit broader objective : building the Natural Resources Database.

Future objective - Natural Resource dB

One of the key final outputs of the project is to produce *District action plans.* Logically, the main objective of the GIS work stated in the Phase 2 project's document, is to establish *Natural Resource Data Bases*. This is further specified by the Objective Verifiable Indicator *Detailed natural resource data bases compiled for each district and accessible under GIS*. Moreover, other Objective Verifiable Indicators are directly or indirectly related to GIS, including :

- *Number of communes and villages mapped for resource supply / demand*
- *Environmental profiles prepared and accessible under GIS for the project's 4 districts*
- *GIS data base for 6 districts*
- *Data base on fuelwood consumption for the various consumptive activities and options to decrease consumption evaluated*
- *Data on Fish Pond Location and Characteristics*

In order to achieve this objective, the preliminary step is, for the project team together with staff from the provincial Forestry and Fisheries Departments, to refine the information requirements for planning and implementing of forestry and fisheries activities at the district or commune level.

The main task of the GIS Unit will be then to further elaborate the components and contents of the *Natural Resource Data Bases*. This data base has to be built comprehensively, considering the following information layers :

- land cover
- forest productivity (growth rates, timber production, fuelwood production)
- land utilisation (private, through communes, others)

- land status (protected)
- soils
- hydrography and irrigation
- transportation and accessibility
- population
- supply and demand of forest and fisheries products

It is obvious that, of the data sets included so far in the GIS data base, data derived from sources at scales below 1:50,000 will not be suitable for the intended purpose, which is planning at district or even commune level. Therefore, a limited number of the project's current GIS data can be of much use for planning and analysis purposes at district and commune level. These are:

- District, commune and village data
- Land Cover derived from aerial photos
- Rivers
- Roads

The other data sets could only be used at the macro level planning, *e.g*. at provincial level.

Other sources of information are therefore to be found.

The baseline information generated by the project's own surveys (*e.g.* the forest inventory work) throughout Phase 1 has to be reviewed and screened ; valuable data have to be compiled in a comprehensive way to make them useful for the project as additional GIS data sets. Moreover, the resource assessment survey would be another valuable source of information for that purpose. This would require that the information collected be put into a structured (tabular) format prior to importing it into GIS. The GIS unit is now able to **integrate tabular data into GIS analysis.** Importing tabular (descriptive) data, *e.g.* prepared in EXCEL, into GIS will give a strong impetus to build the database ; it will allow the GIS Unit to integrate various additional data into the GIS database *e.g*. RRA or PRA data which have been collected by the project or by other agencies.

More information, which could be regarded as essential, might be already available from other existing sources at the provincial level, such as UNDP-CARERE, ACF, ILO, APSARA… Instead of re-surveying features that have already been surveyed by others, exchange of *meta-information* (information about information) within a provincial GIS user group would avoid the duplication of work already done by others. In addition, a wealth of information might be available from agencies at the central level in Phnom Penh, such as DoG, DFW, MoE, IRIC, JICA/PASCO, OXFAM, WFP or MRC ; a question mark, however, will remain on data and information sharing.

Once the situation of information request is clear, and the availability of such information has become transparent, the GIS team will be able to make a sound assessment of what additional data have to be *generated* in order to achieve the project's main GIS objective : the *Natural Resource Data Base.*

However, it has to be kept in mind that the human resources of the present GIS team are very limited.

It should therefore be considered to establish a *GIS based planning procedure* by the example of 1 or 2 districts instead, which has to be thoroughly tested. Establishing a *planning procedure* might serve the project and the provincial Forestry and Fisheries Departments better than establishing a *full coverage GIS data base* for all districts, the usefulness of which can possibly not be tested under local conditions because too much time is spent putting it together. Nobody might possibly be able to use, maintain and update such a database without external assistance, therefore it might become outdated soon after the project ends.

CONCLUSION

The prospects of using GIS within a field-oriented project are large, as are the difficulties one would face installing and using a GIS unit at a provincial level without much facilities.

On the short-term basis, the project's focus on community forestry development on behalf of both the local communities and provincial authorities in Siem Reap is very encouraging. Provincial and district staff is gaining hands-on experience with community resource management in the upland forests as well as in the inundated forests of the fisheries domain. Community forest management should prove to be a productive and viable resource management approach that conserves bio-diversity and protects the environment, while stimulating local community development**.** Regarding resource information technologies, the GIS Unit is making its best, though as a pioneer, to prove that these tools can be successfully apply at the very field-level, for the direct benefit of the local communities.

On the long-term basis, the project's objective of drafting district action plans, which would include natural resource use planning, is a tremendous challenge. How to correctly assess available forest land and resource, how to design appropriate forest land and resource management programme ? The GIS Unit should naturally take the lead in attempting to answer these questions… But, surprisingly perhaps, the main difficulty facing the GIS Unit in contributing to achieve this objective might not be technical constraints, such as the lack of reliable, up-to-date, adequate or accurate geographic information, or human resources limitation. The GIS Unit will succeed first if the various components of the project and outsiders at the provincial level, such as Forestry or Fisheries Departments officials, are truly convinced by the usefulness of the resource information techniques for their ground level activities planning and implementation. Idealistically, the GIS Unit has to run as a two-heads component : the *GIS specialist* who handles the information availability and can lead the procedure, and the *map theme specialist,* with his own specific knowledge and request of information. By then only, the GIS Unit will be able to give technical advice on whether and how these requirements can be satisfied based on the existing information, and if not, what additional information would have to be compiled. Its very existence and lasting will then be justified as a *technical service unit* at the provincial level rather than a project activity that runs on its own.

Being able to succeed in these objectives would truly mean having an efficient GIS Unit as the key-tool for both

- facilitating the integrated natural resources management by communities at the local level, and
- contributing to give natural resources use planning options to decision-makers at higher level.

That is what the project's GIS Unit aims at achieving by the year 2001, which is not a long way ahead.

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