

## 14. GIS Training for Data dissemination

### 14.1. Status of Phase 1 dataset

The Phase 1 project is a starting point of GIS in Cambodia for national level Master planning. The Phase 1 project data is accessible via MPWT to everybody. The Phase 2 project is underway to complete the rest of the country by March 2003 as an extension program of Phase 1. Data distribution conditions in the country at present (2001) are as follows:

Table 17 Phase 1 Data Distribution Status

*December 31, 2002*

Item Name	Donated Quantity by JICA	Distribution to Related Agency	Rest in MPWT	Distribution in %
1. Infrastructure Map - English	54000	15354	38646	28
- Khmer	18000	12641	5359	70
2. Land use Map	900	742	158	82
3. Landform Map	75	63	12	84
4. CD-ROM ARC/INFO	100	103	-3	103
5. CD-ROM Adobe Illustrator - English	100	92	8	92
- Khmer	100	45	55	45

*Prepared by Mao Phanarith*

The above result shows that making available to the public the data as suggested by JICA in the Phase1 project was promoted after the delivery of output. Also, the output that is invested by JICA shows that it was kept properly and was disseminated in the country for the urgent reconstruction of the Kingdom of Cambodia and its development.

However, the analysis of the above result shows some shortcomings in the distribution effort and the use of the CDs was limited because of the unavailability of appropriate software and instruction in the use of the digital data. Other reasons for the limited use of the data use could include the following:

-

(1) Low-level expertise on GIS knowledge and having to use special software such as Arc View to extract the specific data.

(2) Minimal information provided regarding the importance of GIS data and how such data might be applicable in their jobs.

(3) To date, only short workshops of one or two days have been organized. These presented the data capture and the out-put of project or out-put of analysis. but in such short time, how can the knowledge be accurately transferred to the users?

Thus an effort was made of MPWT to provide the training on Basic ArcView and Adobe Illustrator to use the GIS data to agencies concerned as well as to the users.

## **14.2. GIS Training Course**

JICA study team and MPWT agreed to organize a short training course on using GIS dataset by Arc View and Adobe software to the concerned agencies and users.

### **14.2.1. Objectives:**

- (1) Provide the basic knowledge of GIS and using of GIS DATA.
- (2) Basic of using Arc View & Adobe software to extract or create the need GIS data based on GIS BASE DATA .

#### **14.2.2. Training Topics**

The course is organized using human resources in the project such as the GIS expert, the mapping applicant, plus the existing equipment that was set up during Phase 1.

The proposed topic is mainly “The Techniques Used by ArcView and Adobe Illustrator.” After completed the training, a certificate was issued by the JICA study team to the trainee.

##### **(1) Training Topics for ArcView :**

- 1) Installation of ArcView and Extension
- 2) Data structure
- 3) Vector and raster data format
  - Vector data
  - Raster data
- 4) General information of ArcView
- 5) View document type
  - Displaying layer
  - Querying information
  - Labeling feature
- 6) Legend edition
  - Change data appearance
  - Customizing legend
- 7) Table document type
  - Data type (types of tables)
  - Sorting, selecting, querying information
  - Calculation table fields
  - Joining table
- 8) Getting basic statistical data from the spatial data
  - Getting summary
  - Getting statistical data
- 9) Layout document type
  - Creating a map
  - Customizing a layout
  - Adding map components

-Printing a map

- 10) Editing and updating of existing vector data in Arcview
- 11) Update the existing spatial data
- 12) Digitizing in Arcview
- 13) Preliminary remark to digitizing in Arview
- 14) Screen digitizing / vectorization
- 15) Import GPS/tabular data
- 16) Introduction to combination of spatial data
- 17) Clipping
- 18) Union
- 19) Intersection
- 20) Dissolving
- 21) Buffering
- 22) Introduction to the concept of map projection

(2) Adobe Illustrator Topics:

- 1) Installation of Adobe I.
  - 2) Adobe I. user guide for map preparation
  - 3) Introduction
  - 4) Adobe Tools
  - 5) Adobe Toolbox
- Layers Palette
  - Swatches palette
  - Brushes Palette
  - Colors Palette
  - Gradients Palette
  - Align Palette
  - Pathfinder Palette
  - Group / ungroup toolbox
  - Lock / unlock toolbox
  - Transform toolbox
  - Stroke toolbox

- Typing toolbox
- Paragraph
- 6) Map Symbolization
- 7) Map Preparation by area selected
- 8) Map Plotting

### 14.2.3. Schedule and Participants

Table 18 Training schedule

TERM	PERIOD	INSTITUTION
I	From 02-13 to Sept.02	CNMC, Faculty of Archeology
II	From 23 Sept to 4Oct.02	MPWT, Phnom Penh Port
III	From 14 - 25 to Oct.02	MIME, MLUPC, NGD, MOWRM
IV	1) From 25 to 11/26/2002	Public Works Provincial Office
V	From 2 -13 to Dec 02	MPWT, MRD, MDN, DFW, FD

### 14.2.4. Results

All participants from related agencies were invited to participate in all terms of the training. The following is the summary of total participants.

Table 19 Number of participants

TERM	PERIOD	PARTICIPANTS
I	From 02-13 to Sept.02	4
II	From 23 Sept to 4Oct.02	5
III	From 14 - 25 to Oct.02	14
IV	1) From 25 to 11/26/2002	17
V	From 2 -13 to Dec 02	18
Total		58

Therefore, in all of the terms of the training there were 58 participants from different agencies who began their training with little understanding and knowledge of GIS (such using ArcView and Adobe Illustrator to use and extract the existing GIS data for their study purpose).

The samples of map preparation by participants is as showed Fig.38,39.

Table 20: List of trainee at the training course

TERM	PERIOD	No	ATTENDANT Name	INSTITUTION	OTHERS	CONTACT TEL.
I	02-13 Sept.02	1	Kim Seiha	CNMC		012.885.177
		2	Sous Bunthan	CNMC		012.924.451
		3	Sakhon Bory	CNMC		011.974.059
		4	Thuy Chan Thouen	Faculty Archeology		011.951.397
		1	By Ban Villa	R.I.D		016.858.595
II	From 23 Sept. to 4 Oct.02	2	Ros Sovannarith			011.951.856
		3	Kang Phirith	HEC		012.850.197
		4	Long Hun			012.786.599
		5	Ly Sophak			012.899.116
		1	Tep Dararth	PP.Port		
		2	Mom Monireinsey	PP.Port		
		3	Tim Thol	PP.Port		
III	From 14 - 25 Oct.02	4	Lim Chandara	MIME		
		5	Meng Soktha			
		6	Keo Serey Pich	MOWRAW		016.861.729
		7	Sen Song	MLUPC		012.791.859
		8	Keo Roger	MLUPC		016.828.665
		9	Chea Narin	MIME		011.890.956
		10	Sun Socheat	MLUPC		011.974.723
		11	Nong Sareth	MIME		016.859.809
		12	Men Vouch Leang	NGD		012.924.913
		13	Koe Chenda Mony	NGD		011.939.801
		14	Pech Bunny	PP.Port		
IV	Provincial Officer	1	Ros Kim Thorn	Kampong Cham		012.977.987
	From 25 to	2	Chinh Kourng	Pursat		012.835.203
	26-Nov-02	3	Dit Serey Reatana	Siem Reap		012.917.915
		4	Lim Thea Tong	Kampot		
		5	Seng Vutha	Kampot		012.856.855
		3	Chea Sovan Thoun	Bantay Meanchay		016.876.363
		7	Saray Orm	Kampong Chnang		
		8	On Raksmeay	Kandal		012.864.574
		9	Ney Sona	Takeo		012.913.020
		10	Klot Sarem	Ratanakiri		011.935.282
		11	Nguon Khan	Svay Rieng		

		12	Plong Pidor	Ratanakiri		012.651.723
		13	Som Sothea	Kampong Speu		012.911.700
		14	Yong Polen	Battambang		012.953.414
		15	Bin Hon	Kampong Thom		
		16	Soeur Phalkun	Prey Veng		
		17	Phan Mao	Kampong Thom		092.620.155
		1	Eng Polo	Dept.Forestry		012.912.245
		2	Ly Chanthy	MPWT		
		3	Chhea Bunvuth	MOWRAM		012.969.649
		4	Pich Sereyath	DOF		012.917.626
		5	Suos Borinsak	MRD		016.862.830
		6	Ma Nirith	MRD		
V	Agencies Ministry	7	Chey Chanthan	MRD		012.917.873
	From 2 -13 Dec 02	8	Ms.Vanh Sok Samphea	MPWT		016.811.858
		9	Pan Bun Eng	MRD		011.843.165
		10	Kep Kan	DN		011.752.378
		11	Pharun	DN		011.858.909
		12	Chheav Sok Khim	MPWT		016.852.176
		13	Douk Bo	MPWT		
		14	Vong Saththa	MPWT		
		15	Koy Ratanak Bandith	MPWT		012.891.638
		16	Yang Sophat	MOWRAM		012.757.386
		17	Hem Garavuth	DFW		012.916.864
		18	Mao Bora			

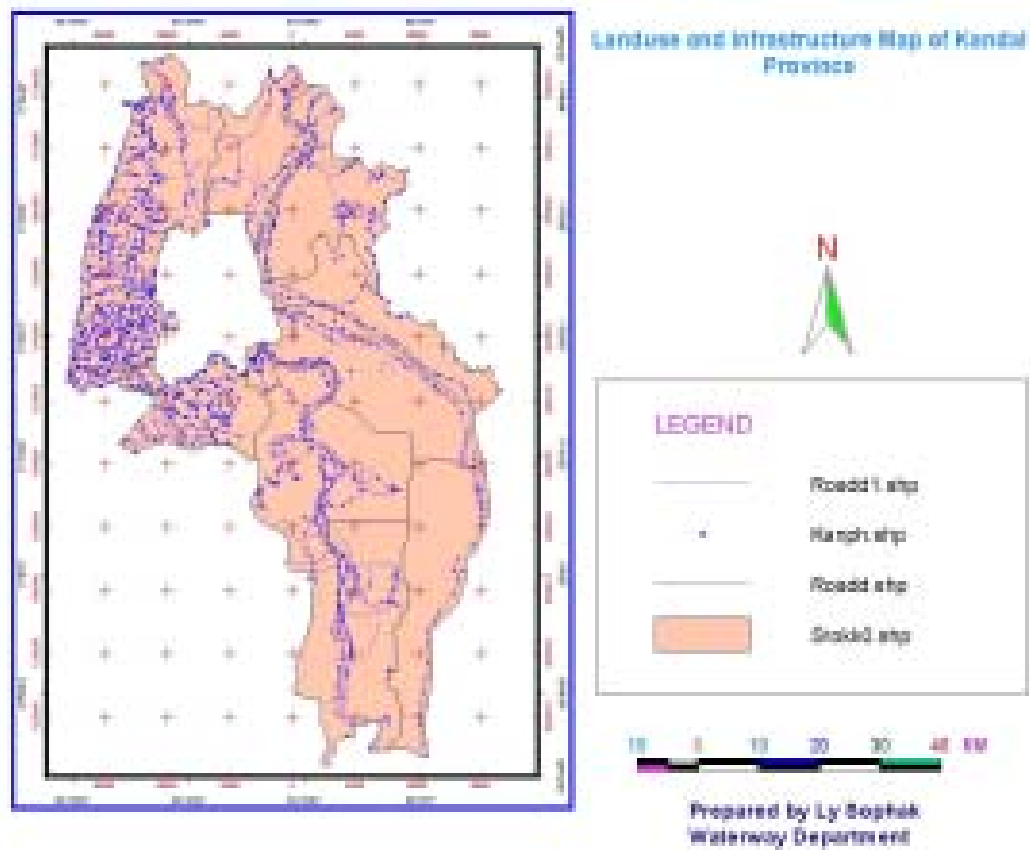


Figure 40: Training results-1



A map of the north-east of Ireland, showing county boundaries. Ten red dots are clustered in the central-eastern part of the map, indicating the locations of the study farms. The map is oriented with North at the top.



-107



**Figure 42: JICA Mission and Expert Participation and Activities of the Training Course**

#### **14.2.5. Request and comment from participants**

The recommendations given by the participants after the training, could be summarized as follows:

- (1) More terms should be added to the training, and the period of training should be lengthened.
- (2) Through the training the participants came to understand the important role of GIS data in development studies as well as the benefits of using GIS to support the study.
- (3) The Phase I data should be updated because of the emergence of new development features such as the location of primary schools, which were constructed after 1992. They are not presented on the map and GIS data.
- (4) The project office at MPWT should become a GIS center to support the GIS training as well as infrastructure mapping service to the Provincial Public Works Office as well as the user of GIS base data in Cambodia.

### **15. New Findings**

**Note; This chapter is reported to the study team from Dr. Heng Thung who is Technical adviser for the project**

In the process of mapping a country using new technology, such as remote sensing, many interesting discoveries are made of the environment, cultural heritage, and other subjects, which can be important in the present or at some future date. The list here is just a small number of activities and signatures that we quickly scanned, but which were outside the objectives of this project and should eventually be undertaken by the agency in charge or interested parties.

This is just a small sample of activities, which the available aerial photos, satellite imagery can produce. Some of these are important in the development and rehabilitation of the country, while others may have more academic value.

#### **15.1. Limestone Deposits**

Extensive subsurface limestone deposits were found along the northern and southern shore of Ton Le Sap Lake. Belts of sinkholes, cause by the solution of the

calcareous material, are visible through an area extending along both sides of the Ton Le Sap coastline, which have not been mapped, because they are covered by alluvial fans, laterite and other material. These were recognized by the large extend of sinkholes, which are definitely caused by the solution of the calcareous material.

This was also positive correlated with the few limestone deposits which were exposed in the area around and south of Battambang. These outcrops were surrounded by these sinkholes. In addition several boreholes in the area of sinkholes also extended into limestone rock on the bottom of the boreholes. The same phenomena occurred in area south of Phnom When where the limestone is being mined for the cement factory in the area. These outcrops were also surrounded by swarms of sinkholes.

There are no other rock occurrences with this typical drainage which disappear into the holes rather than flowing across the surface.

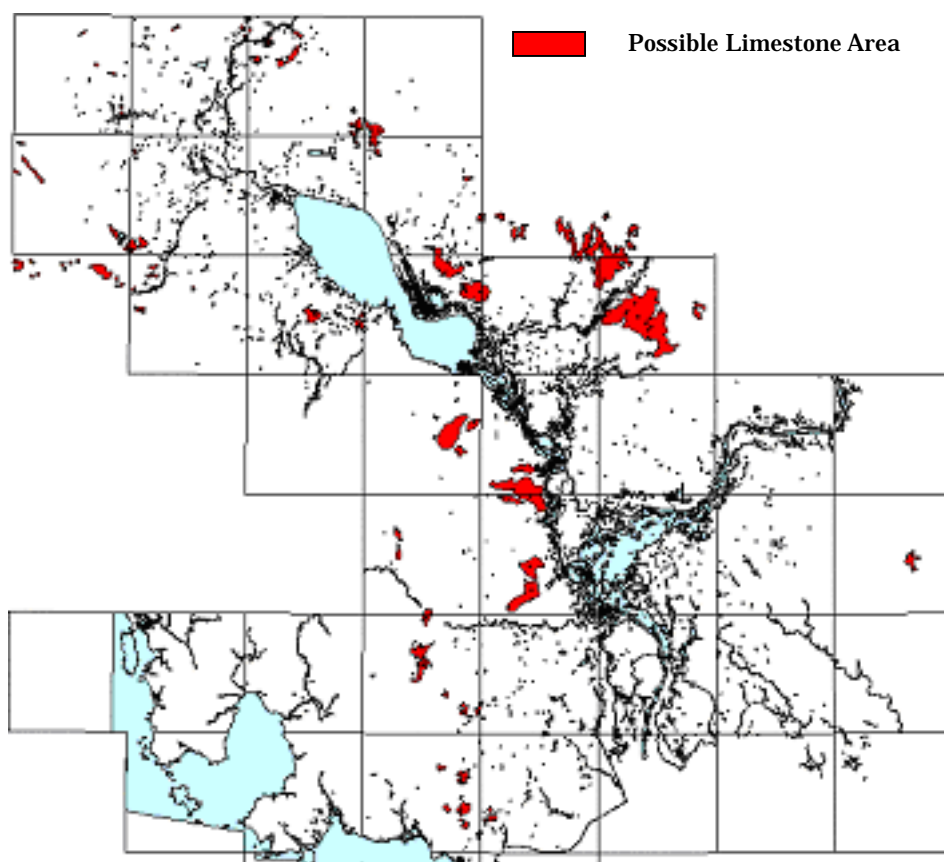


Figure 43 Possible Limestone area

### **15.2. Structural Patterns**

These joint planes can be easily tracked on the satellite imagery, and provide a good basis for a structural map of Cambodia, which has never been done as the satellite imagery was not available until recently.

### **15.3. Structural Dynamics**

The mapping of river diversions, and change of patterns can indicate the areas where geologic uplifts have taken place.

### **15.4. Erosion Patterns**

Large areas, especially east of the Mekong River show erosional features showing bedrock and indicating a period of heavy erosion, most likely caused by extensive deforestation in the past.

### **15.5. Deforestation**

It is possible to use satellite imagery to map the different deforestation activities, from the legal logging, to the slash-and-burn activities of the landless farmers. This system is fast and unbiased in its results.

### **15.6. Environmental Destruction**

Large areas of forest areas are subjected to slash-and-burn agriculture, and the extent and type of destruction can be documented to design preventive measures.

### **15.7. Archaeological Sites**

Many unknown sites are still to be discovered. Often these smaller ruins are not visible on the ground because of the fact that some of the signatures are a change in moisture content of the soil.

### **15.8. Ancient patterns**

The extent of agricultural land can be measured by mapping the land use for certain patterns, which often show through the present agricultural activities.

## 16. Final Outputs

Outputs and other information for the study are shown as below. The following outputs will be handed over to the agent who placed the order. However, the study team owns the copyright, all rights are reserved, and all data will be prohibited from citation or diversion.

Outputs and other information for the study are shown as below. Following outputs will be handed over to the agent who placed an order. However, the study team has a copyright, and the all data will be prohibited from citation or diversion.

Table 21 Final Output

Items	Quantity
(1) Reports of the study	
1) Inception Report	20 copies in English
2) Interim Report	20 copies in English
3) Draft final report	20 copies in English
4) Final report	
1.Main Report	50 copies each in English
2.Summary (English)	50 copies each in English
(2) Outputs	
1) Aerial photos	
1. Negative films of the aerial photos	1 set
2. Positive films of the aerial photos	1 set
3.Photo image files	1 set
4. Contact prints	2 set
5. Index map	1 set
2) Printing maps and data outputs	
1. Topographic maps	1000 copies each in English and Khmer
2. Land use maps	25 copies in English
3.Geology/Geomorphology (Landform) maps	25 copies in English
4.1/500,000 maps of the general use	1000 copies in khmer
5.Films for printing	1 set
3) Digital data	
1.ArcInfo coverage & Illustrator files (CD-ROM)	100 set
2.The data for Internet home page	1 set
4) Textbooks for workshops 1~3	50 copies for each workshop

## 17. Conclusion

As the second phase of the study is finished, the two-phased project, which was started in 1996, has been completed. The geographic information database, which covers all the land in Cambodia, has been completed. Technology transfer, through the course of the study, enabled the establishment of the MPWT Mapping Center and the technological self-reliance of engineers within the counterpart agency. MPWT Mapping Center grew to become a hub of GIS technology, education and training in Cambodia.

The geographic information database contains not only topographic mapping data but also geology and land use data. The study's long-term contribution was aimed at helping national-level planning, and without land use and geology information, such planning would not be possible. Data and information on socio-economic infrastructure, topography, and land use will help planners and decision makers in preparing national-level plans and programs. And, at the same time, public policies prepared from unbiased data and information would guarantee their accountability to the public. GIS technology, with scientific methodology, would enable the fast preparation and dissemination of planning information. The potential of social responsibility in the basic database prepared in the study is considered very high.

The end of the study, however, is only a beginning. After the study, it will be the counterpart agency or the government of Cambodia that will go beyond the scope of the study. Already, the data source used to produce spatial information for Phase 1 is ten years old. Therefore, it is a new challenge of the concerned agencies, including MPWT, to update the database and to provide results of database analyses, not raw data, to decision makers.

Now, the digital database system has been development. Compared with the initial costs borne by Japanese assistance, the costs of updating are significantly small. By acquiring and interpreting aerial photographs and satellite images available in other projects in Cambodia, and with the digital mapping and GIS technology of the MPWT Mapping Center, the counterpart is now technologically ready to update its own database. Logistics support, however, would be necessary to execute the field identification work.

The latest technology introduced in Phase 2 has improved the technical capabilities of the counterpart personnel; however, technologies on analyses and application development were not fully transferred because the scope of work did not fully cover the aspects. Talented GIS engineers shall be trained in the field of data analyses and application development.

After the Phase 2 Study, a new challenge evolved. Early updating of the Phase 1 database and upgrading facilities and equipment are a few examples of what is required to arrange a proper environment for GIS project implementation. Arranging and establishing a systematic financial scheme of international organizations, redistributing of government expenditures, or generating revenues from sales of maps in both paper and digital media would solve some of the challenging issues on financing GIS projects.

The counterpart agency, MPWT Mapping Center, has invited technical users and provided GIS training. It is our hope to continue such GIS education and training to fully utilize the national GIS basic data developed through Japan's ODA. In this respect, successful technology transfer during the study has highly contributed to the technological self-reliance of Cambodia. Currently, there is no other GIS training organization, within the government sector, with the facilities, equipment and technical capabilities of the MPWT Mapping Center.

Through education and training, the promotion of dissemination and the use of geographic data shall be promoted with the goal being the restoration and development of the land of Cambodia by each sector. The MPWT Mapping Center is capable of handling these tasks. The continuous development of the study as a national project will lead development and planning on a national level and the creation of electronic governments.



## **18. Recommendations**

### **18.1. Recommendations for continuing operations**

#### **18.1.1. Introduction**

The GIS database establishment project for the Kingdom of Cambodia has been completed. It consisted of the Phase 1 area and the recently finished Phase 2. This last area consists of the main forested area along the border with Thailand and the area east of the Mekong River. The spatial data has not been consistent between the two areas, because of the fact that Phase 1 of the project used 1992 aerial photographs. These are now ten years old, and accordingly data is outdated, because the major change in land use, settlements and roads took place after that date when many of the people returned to the land from across the border. Thus, there were many new villages and roads constructed since then. This central area of Phase 1 needs to be updated as soon as possible to make The Data of Phase 1 and 2 much more compatible to use for major planning purposes. In the meantime only limited use of the GIS-data sets have been used for rehabilitation projects of the Kingdom. It is primarily caused by the lack of time as the project had to concentrate all these years in the creation of the GIS database.

Therefore, the recommendations will try to address these needs so that the work conducted by JICA Project is not going to be wasted but used for the original purpose of the rehabilitation and reconstruction of the Kingdom of Cambodia. The updating is a small investment, because MPWT have now the database and the existing capability at the operation room. Also upgrade of equipment is needed for the data maintenance.

#### **18.1.2. Recommendation for MPWT (Main counterpart)**

- (1) Data distribution to Government agency concerned
  - 1) MPWT should investigate the demand of Government agencies concerned, NGO and International Assisting organization to send a questionnaire, which includes all the results of Phase 1 and Phase 2.

- 2) MPWT should collect the questionnaire, and make a distribution plan of the project results based on their demand, then MPWT should inform a distribution plan and delivery as a free of charge to Government agency concerned.
  - 3) MPWT should deliver the materials of aerial photography (except one (1) set of contact print) to Cambodia National Mekong committee (CNMC), which has enough facility for additional printing in Cambodia.
  - 4) MPWT should delivery all the printing maps (except set of maps necessary for MPWT) to National Geographic Department (NGD) which is responsible agency for Topographic mapping activity in Cambodia including the rest of Phase1 printing maps
- (2) Institutional enhancement for Mapping Center of the Research Center
- 1) MPWT should make an institutional enhancement for the Mapping Center as a core counterpart unit for JICA project that started from 1996.
  - 2) MPWT should specify the role and responsibility of the Mapping center in Sub-degree of Ministry to reinforce the organization for maintaining and updating GIS database.
  - 3) MPWT should allocate the budget to Mapping Center of Research Center for maintaining and updating GIS database..
  - 4) MPWT should give permission to mange income (from data selling) and expenditures to maintain the dataset under the control of a foreign expert.
- (3) Opening of Data distribution to public
- 1) Working group
- MPWT should organize a working group to discuss about the opening of data to public. Working group should consist of the participated agency in the project such as Geography Department, Geology Department, Ministry of agriculture, and Cambodia National Mekong Committee.

They should also discuss data sharing, how to develop a future GIS activity for National rehabilitation and development plan.

2) By-product

It is worthwhile to introduce not only the final product but also by-products, such as satellite images. If it seems to attract the interest of any users, such information should be available to the public also.

3) Pricing policy

Working group should discuss a charging system for data handling while selling to general users. There should be use self-sustaining program and charged to the users same as charged by MRC.

(4) Continuation of GIS training course

MPWT should continue the GIS training course not only for inside staff also related agency concerned. The staff of mapping center should be core group for the training program

(5) Data maintenance

- 1) Infrastructure data should be updated on a regular basis using new aerial photographs and or by the field verification. Especially, Central area of Phase 1 needs to be updated as soon as possible, because of the fact that Phase 1 of the project used 1992 aerial photographs. After that date, many of the people returned to the land from across the border resulting the major change in land use, settlements and roads. Thus, there were many new villages and roads constructed since then.

- 2) Land use data should be updated every five years for the whole country. As the detailed data has been generated using aerial photography, the five-year updating should be conducted using satellite imagery, which is detailed enough for such purpose. However, the Phase 1 area should be immediately updated as the time gap between Phase 1 and Phase 2 is too large for GIS correlation.
- 3) Landform data should continuously be updated, as most of the information is underground. This additional mapping should be conducted by the Geology Department, who are provided with a full set of aerial photos and imagery of the project areas. These are such studies as structural mapping, detailed geology mapping, and locating economic mineral resources, etc

(6) Maintaining a website

The website should be kept up-to-date so that users can refer to it to find the latest information on the GIS data of Cambodia.

### **18.1.3. Recommendation for NGD (cooperation agency)**

(1) Updating and Maintaining the Topographic Map Data

NGD, with its responsibility, should update and maintain the Topographic map data on regular basis, especially the Phase 1 data is already outdated. Because the Aerial photos used for Phase 1 data were acquired in 1992.

(2) Map sales

NGD should set up a map sales division as a responsibility agency of topographic mapping activity for the user. A sales price should be set up appropriately after a pricing study at Public Market in Town that they are selling a old topographic maps.

Also consigning the printed maps to a bookshop in town shall be considered as one of the ways project data can be made accessible to the public.

(3) Request of Leveling Data from MRC

MRC is carrying out 2<sup>nd</sup> order leveling along the National route 5 and 6 from Nov.2002 to 2003 for WUP-FIN project. After completion of the project, NGD should request for the data and description sheet of the Bench Mark.

**18.2. Recommendations for the future plan of GIS activity in Cambodia**

It is proposed to create a GIS Coordination Center, which will eventually undertake the coordination, management and dissemination of the GIS data to all users. It will also become the training and assistance center to ensure the utilization of these data for planning, development and implementation programs through a training and assistance to all agencies on a sustainable way.

The program should be discussed by the working group and have the following phases:

1. Preparatory phase
2. Organizational phase
3. Operational phase

**18.2.1. Preparatory phase.**

During this phase, the foundation of a GIS coordination centre should be planned. So that it can have the proper program to operate. These tasks are mainly in preparation for the full operation of a GIS coordinating centre. Following action shall be implemented.

- (1) Make a total inventory of all the data and equipment at the Mapping Center in MPWT: including CDs and hard copy maps.
- (2) Distribute and prepare a questionnaire of all personnel involved in GIS activities and remote sensing
- (3) Making a meta-database to corporate with the Mekong River Commission Secretariat and GIS taskforce.
- (4) Prepare the flight indexes of all aerial photographs, including scale, type (color, B&W, etc.), year of flight, and sponsor.
- (5) Prepare an inventory of satellite imagery held by projects in Cambodia and list them by satellite origin, type of data, and scale, quality and potential of reproduction.
- (6) Prepare inventory of access to supplier of satellite imagery and prices.
- (7) Make a program to inventory all projects, which require map support. This inventory will have a GIS database, which will identify not only the type of project, the agency implementing it, but also the outline of the geographic so that overlaps of activities can be observed. The GIS program would then be able to assist these projects to coordinate their effort to prevent overlaps
- (8) Design the organizational structure of a GIS Center:
  - 1) Administrative location of the GC.
  - 2) Personnel requirements and sources.
  - 3) Facility requirements.
  - 4) Equipment requirements.
- (9) Conduct research on applications in support of activities of other agencies.

#### **18.2.2. Organizational Phase.**

It is recommended to follow the following procedure

- (1) Prepare the program for a GIS Coordination Center.
- (2) Order equipment.
- (3) Reorganize personnel Mapping Center staff core, and new staff from the list of experts and technicians
- (4) Arrival of expert(s) assigned from Japan.
- (5) Starting to organize the operation.
- (6) Training in GIS operation and maintenance of data.
- (7) Assist in GIS application of the user agencies.
- (8) Setting up procedure for updating and correcting data returned from users.
- (9) Continue to conduct digitizing work of the updated data.
- (10) Setting up dissemination procedure.
- (11) Maintaining the GIS network.

### **18.2.3. Operational phase**

- (1) Training of staff of other agencies on using GIS for evaluation, planning and implementation of specific projects of the various agencies.
- (2) Coordinate the correction and updating new data and inputs from other agencies. Such as the case when new aerial photos or satellite imagery are acquired.
- (3) Finalize the operational procedures.
- (4) Set up a coordinating agency, using the network as base.
- (5) Develop a sustainable program for the proposed GIS center. This is concerned with the financing of the operation of the GIS activities after the end of the donor support.