Chapter 2 Results of the Study

2.1 Establishment of 1:50,000 Scale GIS Base Maps

2.1.1 Discussions on GIS specifications

(1) Discussions about production plan

1) Reconfirmation of the survey standards and work specifications

As a result of discussion with JICA study team and Government of Guatemala, the main items of the survey standards reconfirmed are as follows.

- Reference ellipsoid: WGS84 (a=6,378,137.0, f=1/298.257223563)
- Projection for topographic maps: Guatemala Transverse Mercator (GTM)
- Position of the datum: central meridian=90degree 30min longitude, latitude=equator
- Coordinate of the datum: X=0, Y=500,000m, scale factor: 0.9998
- Standard height: Mean Sea Level
- Transformation parameter from previous reference ellipsoid (Clarke1866) to new reference ellipsoid

  Shift (m) :X=64.9712323165, Y=193.5225720651, Z=58.3595349179

  Rotation（sec）:X=3.6404982054, Y=-0.4293259588, Z=2.3124451702

  Scale factor: 1.000018598593220

The study team prepared the work specifications necessary for ground control point survey, based on JICA overseas survey work specifications (for base maps). IGN and the study team discussed about this work specification and the Guatemalan survey work specifications.

2) Discussion and determination of symbols to be adopted

As a result of discussion with JICA study team and the Government of Guatemala about the specifications for topographic maps (neat lines, marginal information, color design, etc.), the following are the fixed / pending items and a list of provided information by IGN.

a) Fixed items of topographic map printing

- Printed maps, as a final product of this project, will follow NIMA style, the specifications for topographic maps that were created by Cartografia, IGN, (combination of IPGH style and DMA style), as much as possible.
- Four colors (black, blue, green, brown) will be used for printing. The sample color (in paste form) was provided by IGN, and the final product will conform to it.

- Data for printing will have registration ticks at the center and four corners in order to indicate the margin of neat lines.
- Data for printing will have registration ticks at the center and four corners in order to indicate the margin of a paper map.
- Fixed paper size for a printed map should be 57.5cm×73.66cm（22.5in×29.0in）.

b) List of information provided by IGN

- 4 sets of complete printed maps of the project area (74 map sheets). 6 map sheets (1861_Ⅱ、1862_Ⅳ、1958_Ⅲ、1961_Ⅳ、2157_Ⅲ、2258_Ⅰ) were out of stock, so the JICA study team made copies of the originals and substituted for them. One of 4 complete sets contain signature of the counterpart.
- NIMA Specifications of map legends (combination of IPGH and DMA style)
- IPGH Specifications of map legends
- DMA Specifications of map legends
- Layout example prepared by IGN on a clear mylar sheet using a map sheet of Oratorio (2158-1)

(2) Confirmation of National Base Map Symbols

The Study Team held discussions with IGN to confirm the detailed information necessary to proceed with the work on the symbols (including annotations) for the national base maps. The following main items were confirmed:

Photo 2.1-1 Meeting to confirm symbols

- Whether a symbol should be adopted or not
- Difference in definitions of similar symbols
- Whether a symbol is represented as a real shape or a symbolized shape
- Where its true position (origin) is if it is symbolized
- Standards for acquisition (minimum size, public use, etc. for representing symbols on maps)
- Whether an annotation is attached to a symbol or not. If attached, what annotation code is applied.

At the meeting between the Study Team and IGN, it was discussed and agreed to change the analog method of representing the symbols on the existing maps into the digital method to facilitate updating work at IGN in the future.

The discussion of symbols progressed based on an image of the final printed maps, but it was considered that most of the symbols would be output at the basic spatial information database stage. In this case, it was agreed with IGN that the symbols output from the database might be different from those on the printed maps; more precisely, polygon processing such as masking or hatching of vegetation areas in green was not implemented, but the outer circumference of the polygon and the symbol inside it were represented.

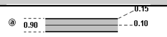
The results of the discussions were compiled as symbols for the national base maps, and were translated into Spanish and presented to IGN. (See Table 2.1-1 and Table 2.1-2, and Appendix.)

(3) Special Notes on Symbols

The discussions on symbols covered all items, most of which were related to representation of maps and work volume in data acquisition process as follows:

- As the volume of work involved in updating the data would be tremendous if each house symbol was rotated as on the existing maps, the symbol will not be rotated but positioned at right angles with X and Y axes.
- If a road passing through a populated area was blanked in white, a number of small polygons divided by road rims had to be created, which makes the updating work very complicated. Therefore, it was decided that each road would not be blanked in white, but that the judgment of a "densely housed area" would be indicated on a photo at IGN's responsibility.
- It was confirmed that the white blank areas on the existing maps were those with no vegetation, which could not be classified by means of symbols (grasslands, cultivated fields or unoccupied land).
- Contour lines would not be intermittently cut.

Table 2.1-1 Symbols for national base maps

NIMA No	PAABANC	No.	Name	Shape	Shape (dgn)	Remarks
202	RCA	39	Carreteras pavimentadas a:Dividida con separador			Se toma la línea central. No se cambia la representación incluso cuando pasa por las áreas urbanas.
203			b:Dos o más vías			Se toma la línea central. No se cambia la representación incluso cuando pasa por las áreas urbanas.
204			c:Una vía			Se toma la línea central. No se cambia la representación incluso cuando pasa por las áreas urbanas.

NIMA No. → Code number in accordance with NIMA. This was used in field surveys as a rule.

PAABANC → Code number in PAABANC

No. → Code number for IGN's work
Name → Item
Shape → Image on final printed map
Shape (dgn) → An example of representation in basic spatial information database (The design file for MicroStation is assumed here.)
Remarks → Remarks, acquisition standards, etc.

(4) Special Notes on Annotations

Discussions were held on items such as whether an annotation would be adopted or not, under what circumstances it would be used, and what font would be used, based on the list of annotations issued by the National Imagery and Mapping Agency (hereinafter referred to as NIMA). When placing annotations for topographic and planimetric features such as rivers, they were rotated not on a character-by-character base, but word by word.

Table 2.1-2 Annotations

Code	Pt.	Color	Font	Feature	Remarks	Example
90100	16	Black	UNIVERS BOLD COND.	First Class	Capital	LONDON
90200	12	Black	UNIVERS BOLD COND.	Second Class	Primera categoría Segunda categoría	MANNHEIM

code → Code number. If the point size is changed according to the object size, the last two digits represent the point size.
Pt. → Point size
Color → Color of an annotation
Font → Font type
Feature → Item
Remarks → Remarks and acquisition standards
Example → Example

(5) Discussions on detailed map symbols and others

Detailed discussions with IGN were made again on the problems that were pending in the discussions on symbols made in the process of "Discussions on GIS/printed map specifications, about OJT scope and investigation of existing conditions" and on the points that were not discussed in detail until new maps were produced. Especially, the following important points were noted in the memorandum and the technical note was exchanged with IGN (refer to the attached sheet):

- Final decision on font types and sizes
- Unclear points on map representation and on PAABANC, and problems related to the

both

- “Administrative boundary and name” data provided by IGN in 2001

In particular, regarding to the problem that the present form of the river along the national border was largely different from the national border data provided, IGN updated and submitted the data to the Study Team.

(6) Discussion about digitizing specifications

The study team reviewed and discussed the current specifications of printed maps and the data specifications used in the PAABANC project with IGN.

The data specifications for the 1/50,000 national base maps must cover practically all the items for representation, including the GIS database and printed map data. For this reason, the difference and the common points of both data were pointed out in the course of discussions.

With regard to PAABANC specifications, JICA study team confirmed the extensibility and information coverage and agreed to retain it as a GIS data specification for this project. With regard to map printing specifications, IGN requested to follow the current specifications.

As a result, the specifications for digitization of the 1/50,000 national base maps were created to have the layer structure and the attributes of each layer in common with the GIS database specifications as much as possible (See Appendix A-9). Data layers of features were designed with due consideration for the different representations between GIS database and printed map data. Line features (roads etc.) on topographic maps will be digitized as line objects. Area features (vegetation etc.) will be digitized as area objects. Topographic symbols on the paper maps will be digitized as points and linked to the legend library for symbolization.

(7) Discussions about printed map data specifications

Discussions were held about the database specifications in order to improve work efficiency by combining the workflow for creating GIS database with that of creating the printed map data, to maintain the integrity of database components and to reduce the work volume in revising temporal changes.

Followed by the discussions of digitization specifications, the study team redefined the current specifications for printed maps, reclassified the printed map data structure, and integrated duplicate topographic features.

Also, the representations of topographic features will be modified to utilize the digitization process, so that it will be possible to link many features to the legend library.

2.1.2 Investigation of existing conditions

(1) Investigation of existing conditions

The study team collected the following information and materials in addition to the previously collected information which were organized in the process of "Collection of information and materials" and "Explanation/discussions of Inception Report".

Items for investigation of existing conditions

1) Existing topographic maps

At IGN, the cartography department (cartografia) is responsible for maintenance and updating of maps, and respective divisions carry out printing and sales of maps. Among the 74 map sheets of 1/50,000 topographic maps (study area of this project), information is updated partially, such as urban areas, and some mountainous areas have not been updated for the last 20 years.

In the past, several foreign organizations supported Guatemala to create topographic maps. As a result, the consistency of map projection and legend style has been lost during this period of map production and in the organizations that produced them. With regard to map projection, two cases (NAD83 or WGS84) had been used respectively. With regard to map legends, the IPGH (Instituto Panamericano de Geografia e Historia) style had been adopted previously. Recently, the DMA (Defense Mapping Agency) style, which changed its name to NIMA (National Imagery and Mapping Agency) in 1996 after organizational integration, has been adopted. After discussions with IGN, the study team agreed that WGS84 (map projection) and NIMA style (map legend) should be adopted for the final products of this project.

Regarding to the condition of reproduction films, it became apparent that IGN does not maintain all of the negative films and some are missing. However, IGN keeps and updates element films (mask films) so that they can create negative films by combining them.

2) Existing control point information

Recently at IGN, updating survey of control points is done by GPS, and there are 13 control points with coordinate value by WGS84. When updating survey of control points, three control points, ITRF (International Terrestrial Reference Frame of GPS Station), Quezaltenango, and Flores were used and the reliability is verified. Benchmarks cover all of the main roads in Guatemala. However the date of setting is as old as 1950's – 1970's, and some may be lost from road construction. IGN is working on recovering lost points, but the progress is not significant due to the inadequate budget.

3) Technical capability of the counterpart

<IGN>

Cartografia, the department in charge of GIS and printed map production, consists of Mr. Marcos Sutuc as a chief engineer, and 13 engineers. Detailed information (academic background and technical training history between 1997-2000) of each engineer is shown in Appendix (provided by Cartografia, IGN).

By reclassifying the contents of trainings into three categories (basic computer operation, analogue mapping, and GIS and digital mapping), the following figure, Figure 2.1-1, shows the number of technical training of the three categories that each engineer received between 1997-2000. In the figure, the letters a-n correspond to individual engineers, and numbers on vertical axis show the number of training. Blue indicates training related to basic computer operation (Windows, Office, DOS, etc.). Pink indicates analogue mapping (from photo interpretation to map updating). Green indicates GIS and digital mapping production (ArcInfo/ArcView operation, AML, TIN creation, Metadata creation, satellite image processing, etc.).

Almost all of the engineers have training experience for basic computer operation, as blue shows in Figure 2.1-1. Hence, when we think about technical transfers in GIS and digital mapping, it supports the fact that all have knowledge and experience of basic computer operation.

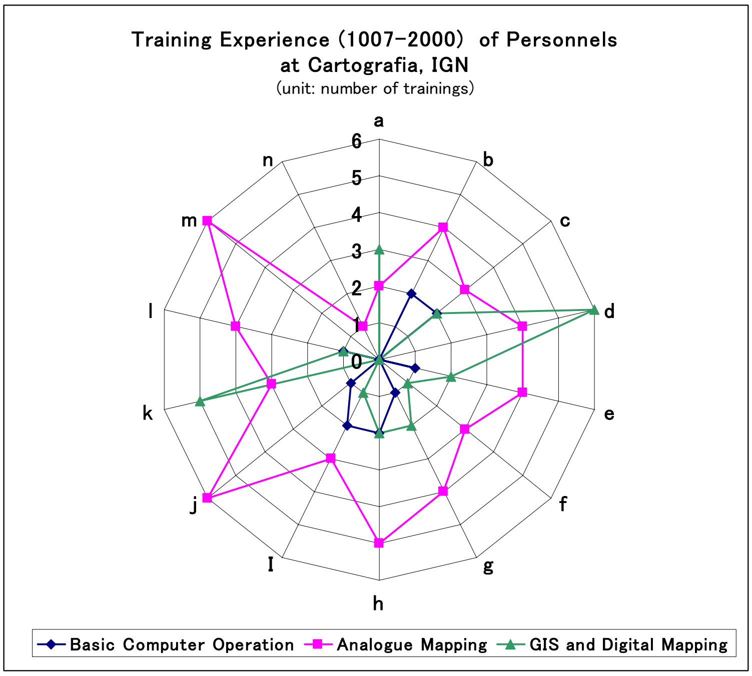


Figure 2.1-1 Training experience (1997-2000) of personnel at the department of Cartography, IGN

The pink line in the Figure 2.1-1 shows that generally most engineers have many training experiences in analogue mapping, which illustrates their high levels of knowledge and skills in mapping. However, only a few selected engineers have experience in GIS and digital mapping, as the green line in the Figure 2.1-1 shows. As a part of this project, it was crucial to provide analogue mapping engineers with adequate on-the-job-training and transform them into digital mapping specialists. Only after this, efficient management and maintenance of mapping data and effective GIS use can be achieved.

<INSIVUMEH>

Currently, INSIVUMEH does not own any kind of GIS or satellite image analysis software. However, the importance and significance of GIS and satellite image analysis are well recognized since several engineers have received technical training (Table 2.1-3). Based on their experiences, it is believed that the engineers have knowledge of GIS and are expecting technical transfer in analysis and simulation functions of GIS.

Table 2.1-3 Training experience of personnel at INSIVUMEH on GIS and satellite image analysis

Software Training	Number of people
ArcInfo 6 (vector GIS software)	1
Arc View 3.1 (vector GIS software)	2
Idrisi (raster/vector GIS software)	2
Erdas (raster GIS software)	1
ILS	3

4) Equipment and materials to be brought in by JICA and consultants

<IGN>

As mentioned earlier, IGN requires more engineers specialized in GIS and digital mapping and the existing engineers have to be more trained. However, IGN has no sufficient quantities and types of hardware and software..

♦ **Hardware**

Currently, IGN owns 44 computers and the Department of Information (Informatica) is in charge of management and maintenance of the computers and other related equipment. Detailed computer specifications are shown in Appendix (provided by Informatica, IGN). Among the 44 computers, only 17 are connected to IGN’s local area network (LAN), and sharing resources through the LAN is another issue yet to be solved. About half of the computers use Windows98 as a operating system, four at Cartografia use WindowsNT, and the rest use Windows95.

ArcInfo is installed in one of the best-equipped computers at IGN (Inventory Number. 073-050-54), HD 20GB / RAM128MB / CPU Pentium2 350Mhz and is used for GIS data production at Cartografia. However, in order to handle large image files for digitizing, it is essential to have more memory and a faster processor.

Also, the computer connected to the scanner and the plotter is not powerful enough to perform productive and efficient work. In fact, in the course of scanning topographic maps and producing raster image files during the 1st fieldwork in Guatemala, IGN and the study team were often troubled and the task was hindered by the shortage of computer memory. The current specification of the computer for the scanner and the plotter is HD9GB / RAM128MB / Pentium2 300Mhz, which is not capable of handling a large volume of raster data.

The specification for the computer to run ArcInfo version 8 (ESRI Inc.), the leading GIS software, is WinNT/2000, CPU above Pentium400Mhz, and RAM minimum 128MB (256MB recommended). Also, the required specification for DiAP (ISM Corp.), the leading digital mapping system, is WindowsNT and RAM minimum 256MB. However, as Appendix (provided by Informatica, IGN) shows, IGN owns 7 computers whose CPU is above Pentium400Mhz, but none of the 7 have memory more than 256MB (3 computers=128MB, others < 128MB). These conditions reveal that effective technical transfer and will not be achievable unless the study team brings adequate hardware and software during the course of on-the-job-training.

Recommendation: IGN, as an agency leading SNIG, should reinforce the analytical function to make the more effective use of the GIS.

- **Software**

Appendix (provided by Informatica, IGN) shows the list of software that IGN currently owns. Regarding the computers that have a LAN connection, GIS, CAD, and graphics software are installed and they seem to share the data and information via the network. On the other hand, on those computers without a network connection, Microsoft Office is the principal software component and it is mainly used for documentation and tabular calculation. At Cartografia, ArcInfo and ArcView are available, however digital mapping software is yet to be introduced. Hence there is high expectation that digital mapping software be made available by this project. In addition, the GIS software that is currently in use is not the latest version and short of modules for analysis. Considering the fact that IGN needs to proceed to the level of applied use of GIS and to strengthen analytical skills as a leading organization in SNIG, the latest version of GIS software and additional modules are clearly imperative.

Based on the investigation of current conditions at IGN, the necessary hardware and software are shown in Figure 2.1-2.

<INSIVUMEH>

INSIVUMEH owns 35 computers, and the specifications are shown in Appendix (originally provided by INSIVUMEH, partially modified by the study team). As is clearly seen, the equipment at INSIVUMEH are no better than those of IGN and far from sufficient specification for producing hazard maps and analysis by the use of GIS and orthophoto. Also, as Appendix (originally provided by INSIVUMEH, partially modified by the study team) shows, INSIVUMEH basically uses Microsoft Office and graphics software but not GIS software. With the expectation that GIS will be a powerful tool in hazard map creation and analysis, the study team strongly believes the following equipment are essential for INSIVUMEH (see Figure 2.1-3).

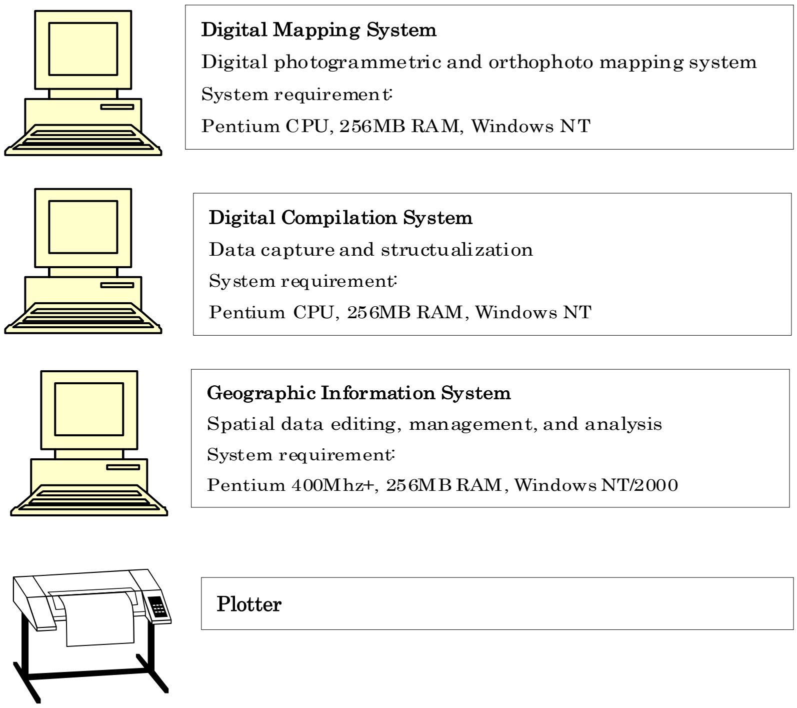


Figure 2.1-2 Necessary hardware and software for IGN

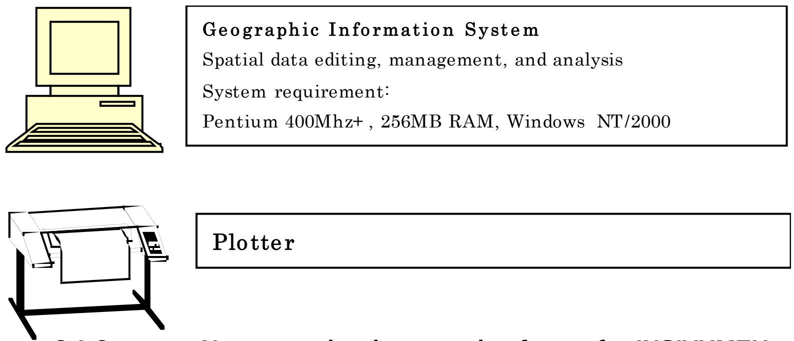


Figure 2.1-3 Necessary hardware and software for INSIVUMEH

5) Need for application of GIS

IGN has taken the responsibility of the SUNIL project that aims to create 1/250,000 GIS database for infrastructure development of the Peace Agreement area and hazard prevention planning. Also, with assistance from the French government, IGN established a 1/50,000 GIS database as a part of the “PAABANC” project between 1998 and 1999, which was a part of the SNIG activity. The GIS data specification was established and named after the project. In the PAABANC project, existing topographic maps were digitized, but temporal changes were not modified.

One of the most recent projects, which was conducted by USAID, produced a GIS database that is focused on hazard information in and around the central part of Guatemala. However USAID produced the database in the United States, and unfortunately no technical transfer has been performed in Guatemala.

Under these circumstances, the following are the underlying problems.

1) The GIS database created by the SUNIL project was the one covering the entire country at 1/250,000, however the scale was not suitable for detailed development and hazard prevention planning.
2) The GIS database created by the PAABANC project, a part of the SNIG activity, was the appropriate scale at 1/50,000 for detailed planning, however it only covered 10% of the country.
3) No project has ever considered the updating process, and technical transfer of it has never been done before.
4) Only PAABANC is capable of applied use of GIS for the future.
5) The technology transfer for production of digital data in consideration of updating of printed maps has not been implemented. In this project, the transfer of this technology was mandatory.

※ The volume of temporal changes will be surveyed in the process of “Photo interpretation/temporal change detection” during the second field survey.

(2) Survey of SNIG Members on GIS

The survey on GIS was made through a questionnaire to members of the ministries and agencies constituting the Sistema National de Informacion Geografica (hereinafter called “SNIG”) as shown in Table 2.1-4, and will be used to make recommendations for the effective use and future concept of GIS at the seminar to be held in 2003 under this Project.

The survey covered details of the ownership of hardware and software, views on the contents and applications of the database currently in preparation, and expectations regarding the future application of GIS. 14 of the 16 related ministries and agencies responded to the questionnaire. The results were summed up, arranged and analyzed as described below.

Table 2.1-4 Ministry/Agency belonging to SNIG (as of the Study)

	Ministry/Agency belonging to SNIG		Ministry/Agency belonging to SNIG
1	CONAP	9	INE
2	DGAG	10	INGUAT
3	DGM	11	INSIVUMEH
4	DGM-MEM	12	PRODETOTO
5	FIS	13	SEGEPLAN
6	FLACSO	14	UPE-MINEDEC
7	IGN	15	UPIE-MAGA
8	INAB	16	UVG

1) GIS-related Software

As an index for evaluating the efforts of the related ministries and agencies to implement GIS, firstly the number of licenses granted for GIS-related software was summed up. The licenses by software are shown in the graph in Figure 2.1-4 and those by agency are shown in Figure 2.1-5.

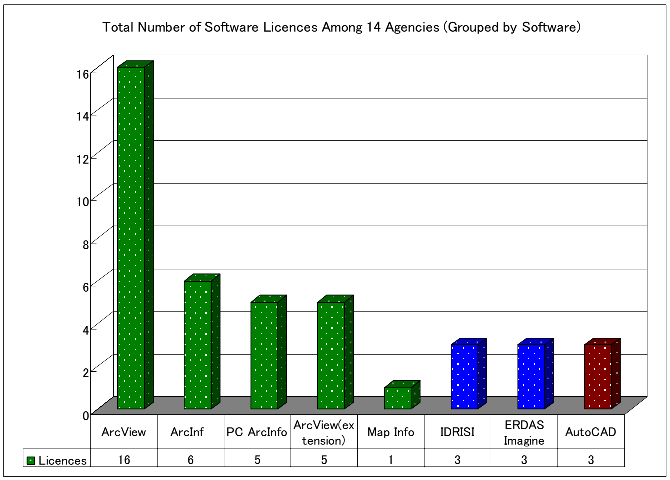


Figure 2.1-4 Total Number of Software Licences Among 14 Agencies (Grouped by Software)

The results by software show that the number of licenses for ESRI's ArcView, which is noted for its operability, functionality, and popularity, is extremely high. In addition, it is clear that software with a variety of advanced functional and processing capabilities, such as ArcInfo, the PC version of ArcInfo (PCArcInfo) and MapInfo, is also used. This survey data shows that not only ArcView basic GIS software but also various types of GIS software are selectively used according to the

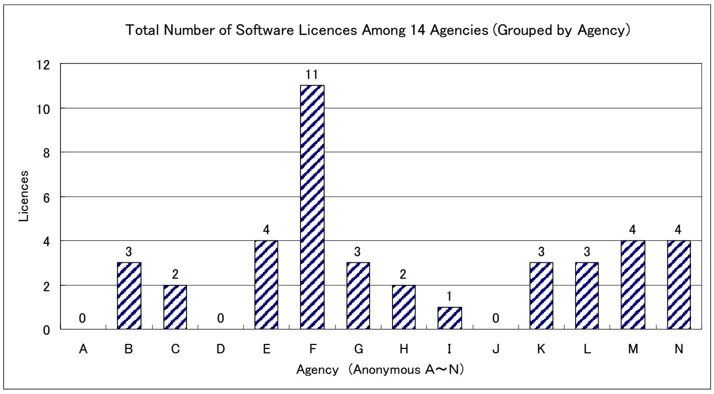


Figure 2.1-5 Number of Software Licences Among 14 Agencies (Grouped by Agency)

organization’s purpose by the related agencies.

Some agencies have a license for image analysis software which handles satellite image data and orthophoto images, and are making positive use of it to combine vector-type GIS with raster-type GIS. This survey was limited to “GIS-related software licenses”, so details of the CAD software licenses in use are not known. However, AutoCAD appeared in the responses. If such CAD software were included in the survey, the use of CAD software at other agencies could be confirmed.

Even if the agencies with an extremely large number of software licenses are excluded, the data on licenses at the 14 agencies shown in Figure 2.1-5 shows that most of the agencies have more than one license. It is natural, considering their main services, that some agencies have a particularly large number of licenses, but it is assumed that other agencies also use GIS as a tool and that the number of licenses they have is sufficient for their services. There were some agencies with no GIS software at all, but they had undergone outside training in GIS. Taking into account the content of the responses, it can be judged that the level of understanding and the technical potential of these agencies are high.

2) Participation in Training in GIS-related Software

The survey on participation in GIS-related training was based only on the experience of one official at each related agency. (See Table 2.1-5) 6 of the 14 agencies gave no response to this question. However, 5 of these 6 agencies own GIS-related software. It is presumed that officials at the agencies can use the GIS software in their work even if they have not personally participated in such training.

The types of training that figured in the responses are categorized into 3 types: training courses for individual types of software by software development companies such as ESRI and ERDAS, seminars held by universities and research institutes (in Mexico, Argentina and Guatemala), and seminars held by GIS promotion organizations (such as SNIG). This survey shows that officials have actively participated in a diverse range of training courses with a variety of sponsors, venues and purposes. Underlying this positive participation in training, there is clearly the fact that these agencies are making positive efforts to introduce and use GIS.

Table 2.1-5 Training Participation of Each Organization

Agency	Training Participation
A	1
B	no answer
C	several times
D	no answer
E	4
F	no answer
G	5
H	no answer
I	1
J	4
K	8
L	1
M	no answer
N	no answer

3) Purposes of Use of Topographic Map Database

In addition to the survey on the implementation of GIS at each related agency, a survey was also conducted of officials' views on application of the topographic map database (GIS data), orthophoto maps and hazard maps that would be the products resulting from this Project. The survey results were compiled in graphs. The applications of the topographic map database, orthophotos and hazard maps are shown in Figure 2.1-6, Figure 2.1-7 and Figure 2.1-8 respectively.

<Analysis of Figure 2.1-6>

Questions on possible applications of the GIS database of 1/50,000-scale topographic maps produced in accordance with PAABANC specifications in this Project were asked to the related agencies. The total number of the agencies that responded is shown on the vertical axis.

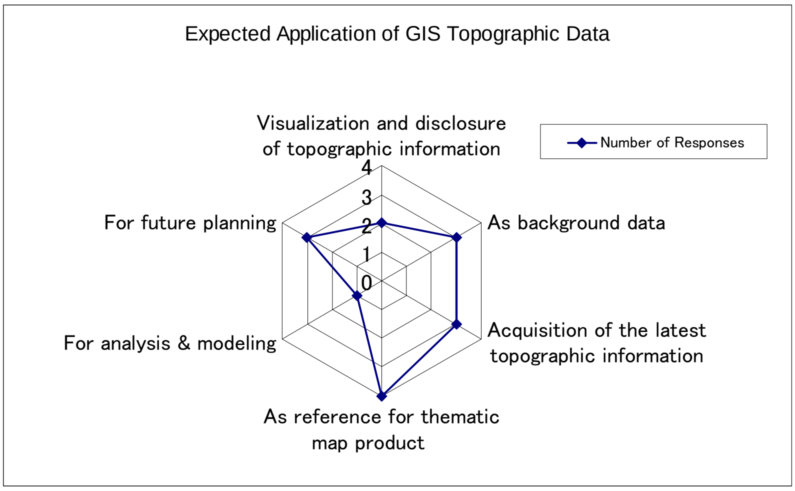


Figure 2.1-6 Purposes of Use of Topographic Map Database

The highest response was that the GIS database was useful for preparation of the thematic maps that constitute one of the main services of the agencies. This means that GIS is incorporated in their daily work. It was made clear that the topographic map database was highly evaluated as the latest information source because it covered the latest topographic information plotted from aerial photos. The agencies mentioned many applications that take advantage of the display functions of GIS and they hoped that the GIS database would be used as visualization tool of topographic information and basic maps for thematic maps. There were few answers on its use for analysis and modeling, but this may have been due to the fact that the topographic information alone was acknowledged as insufficient for analysis or that recognition of GIS as an analytical tool had not been established.

<Analysis of Figure 2.1-7>

It was clear that orthophoto maps on a larger scale (1/10,000 scale) than the topographic maps (1/50,000 scale) were highly anticipated as reference materials for various services because detailed topographic information could be grasped from these maps. There were some agencies that answered that they had never used orthophoto maps. This means that the level of recognition of orthophoto maps is lower than ordinary topographic GIS data. It is therefore considered necessary to promote understanding and use of orthophoto maps among the related agencies through this Project.

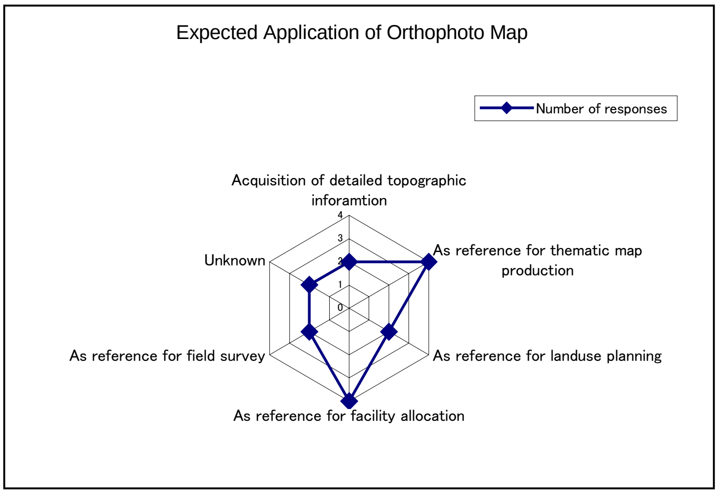


Figure 2.1-7 Purposes of Use of Orthophoto Map

<Analysis of Figure 2.1-8>

There were two frequent responses regarding applications of hazard maps: that some agencies would use hazard information in making decisions, and that some agencies would use hazard maps for the services and operations which they provide. In addition, some answers indicated that the hazard maps would be used for emergency operations, quick and efficient disclosure of information, and for planning countermeasures in the event of an emergency.

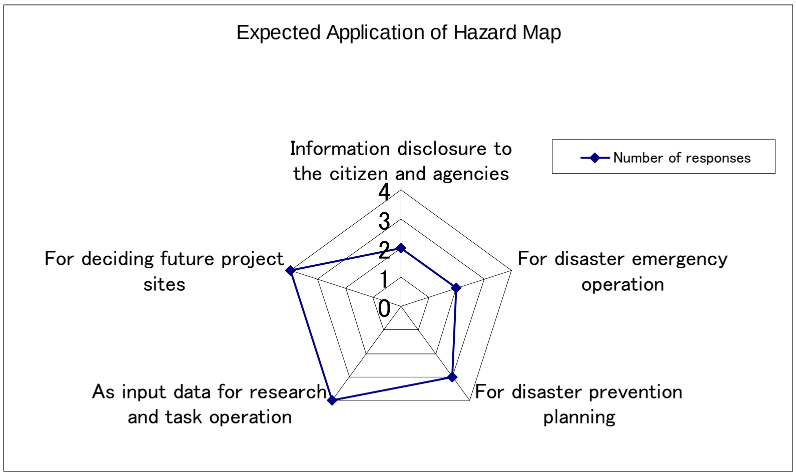
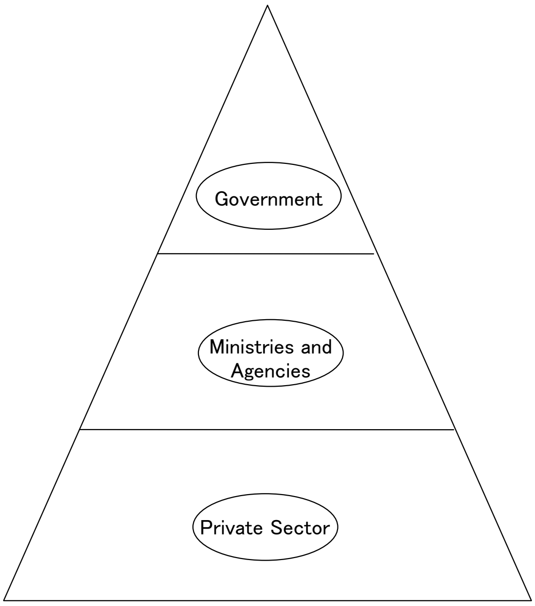


Figure 2.1-8 Purposes of Use of Hazard Map

4) Demands to Government, Ministry/Agency and Private Sector

The responses on the current efforts of the related agencies regarding the GIS database and applications of the data being created at present were arranged. And the expectations of the officials in charge of GIS in the related agencies toward the government, ministry/agency and private sector levels were compiled. (See Table 2.1-6) Of the total responses, 22 directed their expectations at the government, 19 at the related ministries and agencies, and 10 at the private sector. Most of the expectations were directed at the government, ministries and agencies.

Individually, the expectations directed at the government are characterized by the demand for strong initiatives in establishing legislation and special corporations. In addition, government and ministry/agency levels are required to enhance their ability for coordination in order to strengthen their relationship with the related agencies. As the survey was conducted of SNIG member agencies, their positive attitude toward promoting the use of GIS in mutual cooperation at governmental level was apparent. Demands at ministry/agency level included items such as improvement and expansion of hardware and software and training of human resources.



Expectation for Government	Number of responses
Developing Legal Framework (SNIG institutionalization)	7
Coordination Capability	6
Gaining Understanding of GIS	5
Enhanced Organizational Structure	2
Fundraise	2

Expectation for Ministries/Agencies	Number of responses
Emphasizing Close Coordination	7
Personnel Training	3
Renewal of GIS Software/Hardware	2
Data Development	2
Fundraise	1
Nothing	4

Expectation for Privator Sector	Number of responses
Positive Participation	3
Information Disclosure	2
Distributing Information	1
Personnel Training	1
Nothing	3

Table 2.1-6 Expectation for the government, ministries/agencies, and private sector

5) Results of Analysis

As the target of the survey was SNIG member agencies, their positive attitude to implementing GIS in their actual work was highlighted. The expectations of a database as the product of the Project were so high that the Study Team was fully convinced that a wide range of applications will be found for the database after it is completed. In addition, it is expected that their firm attitude toward promoting the development and positive use of the GIS database in mutual cooperation at government level will become a role model for other developing countries that desire to introduce GIS.

In the future, the Study Team will be required to accurately monitor the changes in hardware and software that are progressing at high speed and present on the best solutions for GIS database, system, and methodology when this Study be completed.

It will therefore be important to make recommendations not only on effective application technology for the GIS database obtained in this Study, but also on the hardware configuration to realize the application technology. In addition, it will be necessary to examine the Internet-based GIS to ensure effective use of the GIS database not only within Guatemala but also to expand it to neighboring countries in Central America.

2.1.3 Aerial Photography

(1) Local Sub-contract

1) Selecting the local sub-contractor

Based on previous experiences in Central/South America, the study team examined local sub-contractors' capability and feasibility of this project. As a result, the study team selected three preliminary sub-contractors.

To the selected sub-contractors, the study team presented the Tender Notice, flight index, flight plan (coordinates of starting/ending point, planned length, photographing altitude), and aerial photography specification and requested them to hand in quotes for the contract price

2) Assessing and contracting

The study team received a proposal and a quotation from the three selected sub-contractors on December 27th, 2000.

The proposals, prices, possessed equipment, technical capability and experience of the sub-contractors were evaluated for selection and the sub-contract was awarded to a selected sub-contractor following the approval by JICA. Then, the aerial photography work was started.

3) Process and criteria of selection

The study team compared the three sub-contractors from the point of experience, technical skills, equipment, advantage, and quoted price.

For experience, the three did not differ much. However, FINNMAP showed several advantages such as availability of the latest camera system and GPS navigation system, the possibility to use two aircrafts, and the lowest quoted contract price. Therefore the study team got approval from JICA and started shooting aerial photographs.

(2) Specifications and products of photography

1) Specifications of aerial photography

- Aerial camera: Leica RC30 Camera + Leica PAV30 gyromount + GPS (for photo coordinate measurement and navigation) + FMC (Forward Motion Compensation)
- Aerial photo: Focal length: f = 15 cm , Picture plane size: 23 x 23 cm , Scale: 1/20,000 and 1/40,000 , Overlap: 60% on average / Side lap: 30% on average

2) Products of photography

Table 2.1-7 shows the aerial photograph index map. The study team took 1,740 sheets aerial photographs by 1/20,000 scale, and 1,409 sheets aerial photographs by 1/40,000 scale.

3) Annotation of aerial photograph films

The study team and the Government of Guatemala discussed about the annotation of the aerial photograph films. As the study team suggested, a film annotation form as shown below was used.

JICA-IGN	GUATEMALA	1:20,000	C09 - 01	01/01/30	10:20:45

Figure 2.1-9 Flight Index (1/20,000 and 1/40,000)