numbers, which correspond to Questions 1 to 8 in Table 2.4-10. The vertical axis shows the ratio of each answer among the 30 participants in total.

In Figure 2.4-68, the longer the red and orange bars, the more dissatisfied the participants; the longer the yellow, green, and blue bars, the more satisfied the participants.

We received some specific comments stating that the course duration was too short and that the training was too fast. These comments corresponded well with the fact that the participants were relatively more dissatisfied with “length of the course” (Q1 in the questionnaire), “depth of each of the technical topic” (Q2), “speed of the course” (Q4), and “exercises during the courses” (Q7). We gathered that the participants wanted the courses to be longer, each of the technical topics to be discussed more deeply, and more exercises to be provided to them during the courses.

On the other hand, a relatively high percentage of participants were satisfied with the technical topics covered in the training. This may reveal the dilemma that, though the technical topics were interesting, they were provided with too short a duration in which they could master them.

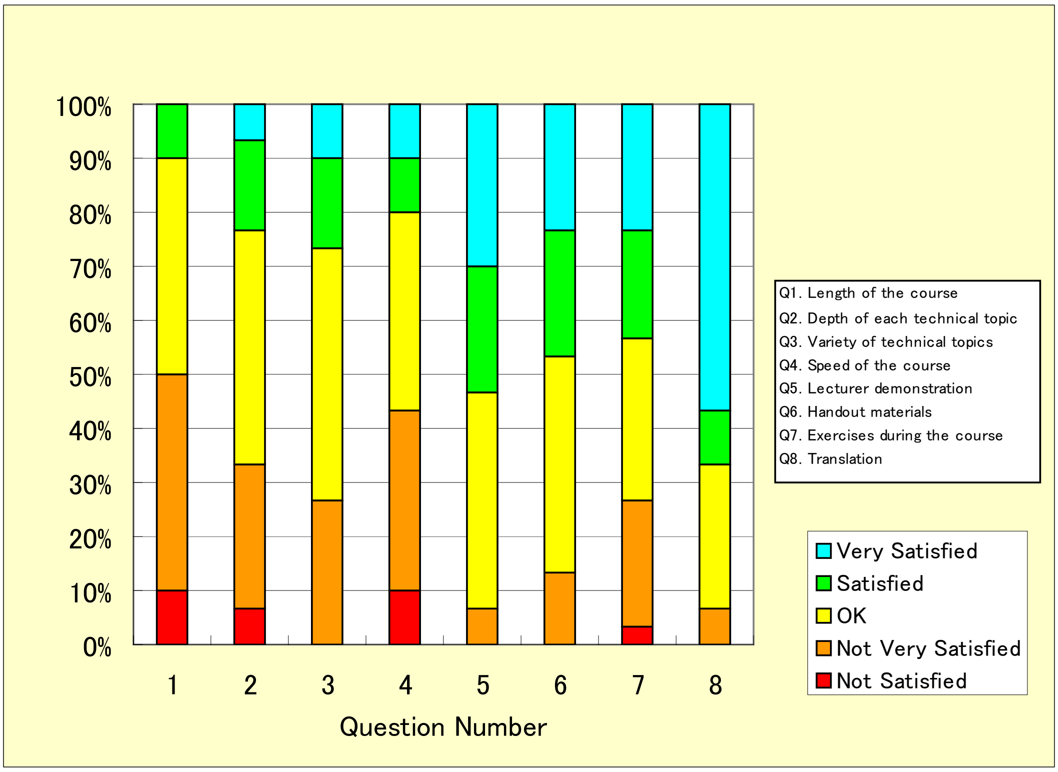

Figure 2.4-68 Technical Transfer Course Evaluation

The participants were highly satisfied with the demonstrations given by the lecturers in the courses, available handout materials, and Spanish interpretation provided during the courses.

In conclusion, the lessons given in the training and the performance of the lecturers enjoyed a high level of satisfaction but the participants thought that the training duration was too short and wanted to take time to learn technologies including more hands-on exercises. While a relatively high percentage of participants replied that the lessons progressed too fast, more than 30% of participants felt that the technical topics must be discussed more deeply. This fact indicates that the technological levels of participants have been polarized. The participants who were not very familiar with technical topics covered in the training had a difficulty to keep up with the lessons while those who had a certain level of experience and knowledge wanted the technical topics to be discussed more deeply.

To improve the level of satisfaction for all the participants, it will be necessary to group them by technical levels, provide different lessons for different levels, and give training in a longer duration. Realistically, however, it is difficult to implement this idea due to time and cost constraints of the project. Thus, we need to expect each of the IGN staff to learn the basic technologies in training and further improve their capabilities through their own efforts. Furthermore, we hope that the IGN staff members with different levels will share knowledge and experiences through their own efforts for an improvement of their overall capabilities.

(4) Self-evaluation of Participants

We requested the participants to evaluate themselves as well as the training by asking questions, how much they understand the content of training and whether they are confident of utilizing the content of training in their actual work. Figure 2.4-69 and Figure 2.4-70 show the results.

Figure 2.4-69 shows the result of the participant's self-evaluation of their understanding on a 1-to-5 scale: Not Well, Not Very Well, OK, Well, and Very Well. The vertical axis shows the number of respondents. This result shows that a majority of the participants thought that they understood the content of training in their self-evaluation.

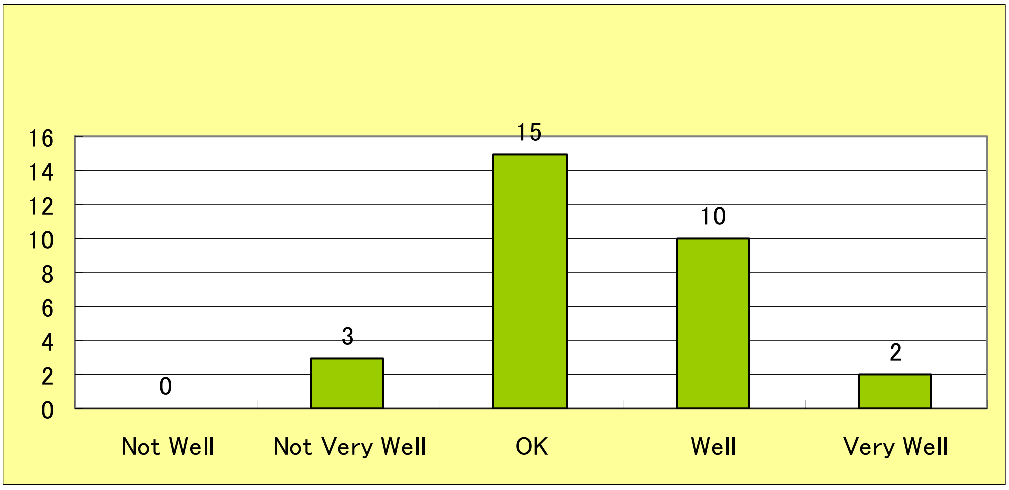

Figure 2.4-69 Self Evaluation by the participants [Your Level of UNDERSTANDING]

Figure 2.4-70 shows the result of the participant's self-evaluation of their confidence in utilizing what they learned in training for themselves on a 1-to-5 scale: Not Confident, Not Very Confident, OK, Confident, Very Confident. The participants who answered that they were "not very confident" or "not confident" added up to eight, accounting for more than one-forth of the total.

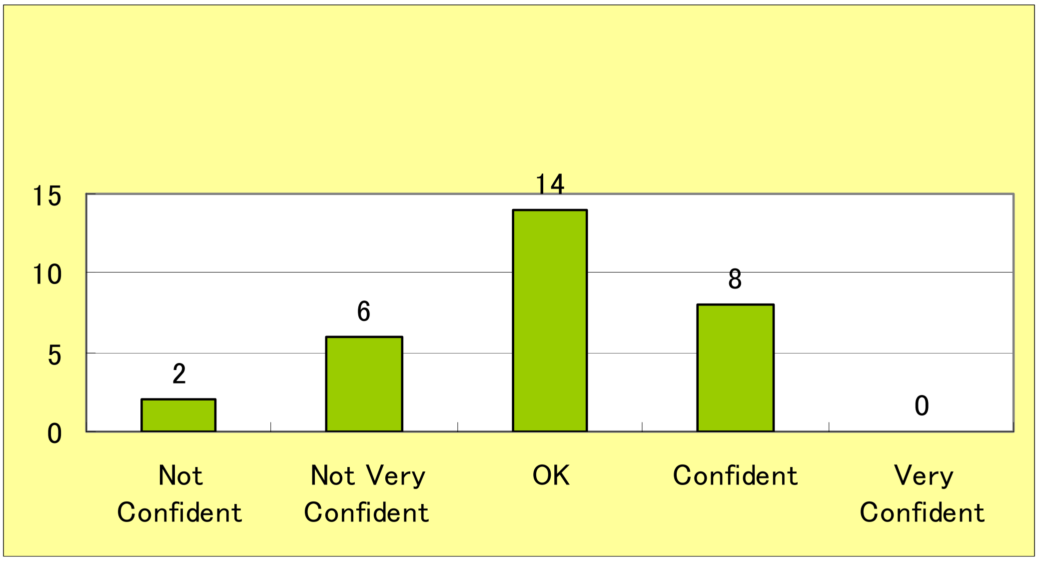

Figure 2.4-70 Self Evaluation by the participats [Your CONFIDENCE in carrying out the tasks you learnt from the trainings]

(5) Conclusion

The main purpose of technology transfer is to allow IGN, even after the end of the project, to persistently utilize equipment and software for themselves and apply and further develop the technologies that they learned in the Project.

It is thus very important for the Study Team to thoroughly examine the content of training, format of lectures, duration, and audience so that the each of the participants from the counterparts will be confident when utilizing what they have learnt in their actual work.

These results must be reflected in a technology transfer plan to be established in all the future projects.

2.5 Noteworthy background of the Study

2.5.1 Response of Each Counterpart Agency

This Study was carried out by the technical counterparts, IGN in charge of development of the national base map database, GIS, map printing and production of orthophoto maps; INSIVUMEH in charge of production of hazard maps; and SEGEPLAN, working to coordinate between the two agencies and the Study Team.

The three agencies were each implementing very different work, but they were working on the development and application of GIS data to meet their own individual objectives, including the activity of SNIG, and playing an important role within the Government of Guatemala.

Of the three agencies, IGN and INSIVUMEH, with the effective use of the results of the Study already in mind, are actively engaged not only in study activities based on cooperative work introducing a lot of OJT, but also in the technology transfer programs.

The main activities of these counterpart agencies with regard to the development of GIS and the database will be described below.

(1) IGN

IGN consists of 5 administrative divisions and 6 technical divisions. The work of these technical divisions will be described below. Of these divisions, the Information Division will be omitted because it is involved mainly in the construction of the information network within the office and in technical support for SNIG, which is somewhat different from the actual work of IGN.

Figure 2.5-1 The IGN Logo

1) Photogrammetry:

This Division is now constructing a digital database of the 1:10,000-scale topographic maps (expected to number 62 sheets in 2002) covering urban areas other than those covered by the orthophoto maps produced in this Study, using the 1:40,000-scale aerial photos (covering the East Area of Guatemala) provided by the US NIMA (National Imagery Mapping Agency) in 2000, and the 1:40,000- and 1:20,000-scale aerial photos taken and provided in the first and third years of this Study.

If the budget for the next year is acquired, new aerial photos to cover important areas and the blank area of 10,000km^2 in the above aerial photos will be taken, to further promote the above mapping project. If this additional program is implemented, 42 sheets of 1:10,000-scale orthophoto maps and 42 sheets of 1:10,000-scale topographic map database will be added.

2) Cartography:

IGN possesses 259 sheets of 1:50,000-scale national topographic maps as base maps covering the entire country. Of these, 22 sheets covering the North Area were digitized with French assistance in 1998, and 7 sheets covering the Metropolitan Area and its surrounding areas were also digitized independently by IGN at that time with technical guidance. In addition, 74 sheets covering the Southwest Area are due to be updated as a new database with the addition of modifications to show changes over the years.

The remaining 156 sheets are being digitized in the Cartography Division with the support of other Divisions, and the process of vectorizing contour line data is underway.

At the same time, this Division is taking the initiative with regard to the promotion of GIS and development of the database. It is also the leader in SNIG activities and is the driving force of GIS in Guatemala.

3) Geodesy:

The development and spread of the GPS applications have promoted a shift toward the world standard ellipsoid (WGS-84) in many countries. Guatemala is no exception to this, and is using the GPS equipment provided as study material by JICA to implement the resetting of first-order triangulation points.

There are a total of approximately 160 existing and new first-order triangulation points in Guatemala, and the work of marking and measuring the points has already been completed. Work is at present at the stage at which adjustment calculation of the observation network is of carried out.

4) Cadastral:

This Division's main task is to define administrative boundaries at the municipal level. In Guatemala, there are 22 Departments controlling 331 municipalities. Because of the impact of the long-running civil war, administrative boundaries remain undefined. Boundary definition is being carried out as a national project.

5) Geographical Information:

The main task of this Division is to create thematic maps of the whole country. The Division is responsible for the updating of existing thematic maps and the creation of new maps, for which it carries out detailed field surveys based on the topographic maps produced by the

Photogrammetry Division.

* As a point of reference, this year the IGN Marketing Division sold a total of approximately 1,200 sheets of contact prints and enlargements, of which about 75% were photos printed from the negatives of the aerial photos taken and made available through this Study. This provides a clue as to whether there is a shortage of aerial photos and maps showing new information.

(2) INSIVUMEH

Like IGN, INSIVUMEH belongs to the Ministry of Communications, Infrastructure and Housing, and is made up of two divisions; one Division in charge of meteorological observation not including agricultural meteorological observation that is the province of the Ministry of Agriculture, Livestock and Foods (MAGA), the arrangement and analysis of observation results, and the dissemination of daily weather information,; and the Research Division.

Figure 2.5-2 The INSIVUMEH Logo

This agency is also responsible for disaster prevention services including a) the monitoring of earthquakes, volcanoes, weather and floodgates, b) the collection and organizing of information on natural disaster risks, c) the reconstruction of observation facilities that have suffered robbery, damage or disaster, and d) the collection and analysis of basic data for hazard maps.

At the present time INSIVUMEH consists of the General Affairs, Finance and International Cooperation Divisions, as well as three technical divisions. The services of these technical divisions will be outlined below.

1) Meteorological Services

This Division is in charge of meteorological observation (rainfall, air temperature, solar radiation, clouds, wind direction and velocity, humidity, subterranean temperature, etc.), and weather forecasts, as well as the digitization of old observation data, drought forecasting, aerial meteorology, etc.

2) Hydrological Service

The main tasks of this Division are the installation and maintenance of river water-level gauging stations (water-level observation network), water-level recording and data organization, and water quality measurement.

3) Geophysical Service

This Division is responsible for the establishment of a seismic monitoring network, seismic observation and analysis, visual observation of the Pacaya, Juego and Santiaguito volcanoes, observation and survey of volcanic earthquakes and ejecta, management of existing hazard maps, countermeasure against lahar of the Samalá River, landslide surveys, etc.

(3) SEGEPLAN

SEGEPLAN (Secretary for Planning and Programming of the Presidency), as indicated by its name, belongs to the President's Office. It is responsible for Guatemalan governmental planning and projects, and is the contact agency for cooperative projects with other countries and international organizations. One of its several organizations is Informatics, within which is a unit of the main undertaking of which is GIS.

Figure 2.5-3 The SEGEPLAN Logo

This GIS Unit handles the building of databases and the provision of analytical services in response to requests from within SEGEPLAN or from other institutes.

The Unit at present possesses two licenses for Arc/View and one license for Arc/Info, which it uses for its various activities. Working towards the common use of information, at the end of December 2002 the unit uploaded to its Website the various databases it has accumulated.

In this Study, SEGEPLAN is positioned in the role of coordinator between the counterpart bodies, i.e., the technical expert organizations IGN and INSIVUMEH, and the Study Team; but SEGEPLAN itself is also carrying out GIS-related work and is an important user of the results of this Study.

＊ The Existing Census as a Database and the New Census

① The 1994 census

<u>10th Guatemala Population Census 1994 (INE)</u>

The currently-available census was issued in March 1996 as the result of the Census (the 10th population census, 5th housing census) that was carried out by the Instituto National de Estadistica (INE) simultaneously throughout the Republic of Guatemala from April 17 to 30, 1994.

The 10th population census was carried out according to the "de jure" system (a system in which each citizen is registered where he or she resides, regardless of whether he or she is actually there at the time of the census). In other words, the census is the result of a population survey and registration at the geographical location where each resident was resident or intended to be resident as of April 17, 1994. The total population of Guatemala at this point in time in 1994 was 8,331,874, a yearly increase of approximately 2.5% from the population of 6,054,227 recorded in the 1981 census. Figure 2.5-4 shows the population density, based on data prepared by IGN, MAGA and INE.

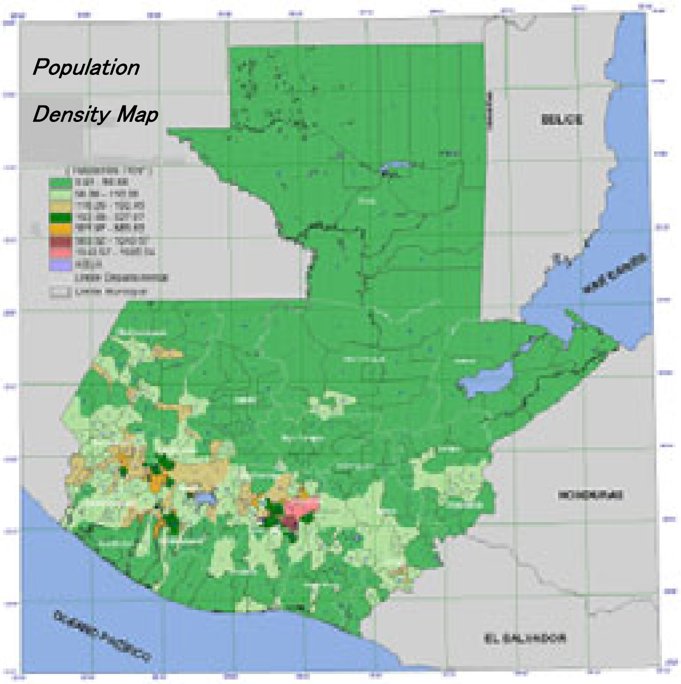

Figure 2.5-4 Population density map

② Census of projected increase in population by 2000

Estimate of Population at the Municipal Level in Guatemala 2000 – 2005 (INE)

The estimated increase in population at the basic Republic level is shown in 'Guatemala: Estimation and Projection of Population 1950 – 2050' (Estimaciones y Proyectiones de Población 1950 – 2050) that was drawn up as a joint project with the Centro Latinoamericano de Demografía (CELADE) of INE.

Based on this methodology, the data from the 1995 National Mother and Child Survey, the registrations of births and deaths 1981 – 1994 and the International Immigration Register were tempered with the results of the 1994 10th National Census to produce a forecast of population increase throughout the country for the years 2000 to 2005; and this was published in January 2001. The figures thus determined from the supposed average were deemed to have the highest degree of probability, were authorized by INE and CELADE, and thus came to be publicly announced as mentioned above.

Table 2.5-1 is a summary of the population forecast for 2000 – 2005, showing the population for each year by Department and its percentage of the national population. As is clear from this table, approximately 23% of the total population is concentrated in the metropolitan area; and it may be inferred that all of the problems common to developing countries, such as the rapid enlargement of the cities and the resulting delay in development of infrastructure are occurring.

Table 2.5-1 Estimation of population growth made by INE

Year / Department	2000	%	2001	%	2002	%	2003	%	2004	%	2005	%
GUATEMALA	2,578,520	22.65	2,654,203	22.73	2,732,081	22.79	2,812,253	22.86	2,894,770	22.94	2,979,746	23.01
EL PROGRESO	143,207	1.26	143,193	1.23	149,435	1.25	152,667	1.24	155,940	1.24	159,283	1.23
SACATEPEQUEZ	259,260	2.28	267,877	2.29	276,769	2.31	285,904	2.32	295,386	2.34	305,115	2.36
CHIMALTENANGO	427,585	3.76	437,649	3.75	449,134	3.75	460,292	3.74	471,750	3.74	483,487	3.73
ESCUINTLA	483,773	4.25	489,227	4.19	494,734	4.13	500,314	4.07	505,958	4.01	511,647	3.95
SANTA ROSA	319,810	2.81	325,479	2.79	331,249	2.76	337,117	2.74	343,035	2.72	349,076	2.70
SOLOLA	307,792	2.70	316,629	2.71	325,742	2.72	335,107	2.72	344,656	2.73	354,512	2.74
TOTONICAPAN	361,298	3.17	369,349	3.16	377,556	3.15	385,923	3.14	394,454	3.13	403,177	3.11
QUTZALTENANGO	678,307	5.96	694,590	5.95	711,241	5.93	728,324	5.92	745,832	5.91	763,706	5.90
SUCHITEPEQUEZ	403,589	3.54	411,638	3.52	419,787	3.50	428,090	3.48	436,494	3.46	445,105	3.44
RETALHULEU	241,927	2.12	245,875	2.11	249,886	2.08	253,964	2.06	258,077	2.04	262,244	2.02
SAN MARCOS	844,474	7.42	863,164	7.39	882,207	7.36	901,654	7.33	921,453	7.30	941,662	7.27
HUEHUETENANGO	879,989	7.73	906,033	7.76	932,855	7.78	960,450	7.81	988,850	7.83	1,018,120	7.86
QUICHE	588,824	5.17	602,383	5.16	616,286	5.14	630,497	5.13	645,054	5.11	659,934	5.10
BAJA VERAPAZ	203,428	1.79	207,781	1.78	212,201	1.77	216,712	1.76	221,302	1.75	225,989	1.74
ALTA VERAPAZ	814,300	7.15	848,340	7.26	883,713	7.37	920,544	7.48	958,847	7.60	998,714	7.71
PETEN	333,397	2.93	346,805	2.97	360,738	3.01	375,215	3.05	390,263	3.09	405,888	3.13
IZABEL	333,955	2.93	340,532	2.92	347,209	2.90	354,009	2.88	360,920	2.86	367,948	2.84
ZACAPA	212,805	1.87	217,927	1.87	223,188	1.86	228,545	1.86	234,041	1.85	239,657	1.85
CHIQUIMULA	313,151	2.75	320,979	2.75	328,979	2.74	337,188	2.74	345,558	2.74	354,126	2.73
JALAPA	270,043	2.37	277,486	2.38	285,118	2.38	292,944	2.38	300,960	2.38	309,185	2.39
JUTIAPA	385,905	3.39	391,272	3.35	396,692	3.31	402,175	3.27	407,701	3.23	413,285	3.19
Total	*11,385,339*	*100*	*11,678,411*	*100*	*11,986,800*	*100*	*12,299,888*	*100*	*12,621,301*	*100*	*12,951,606*	*100*
Year	***2000***	*%*	***2001***	*%*	***2002***	*%*	***2003***	*%*	***2004***	*%*	***2005***	*%*

③ The relationship between the population growth forecast census and the area covered by the Study

The area covered by the 1:50,000-scale digital national base maps to be produced in this Study is approximately 30,000km^2 (74 map sheets). Combined with the approximately

3,500km^2 (7 sheets) for the City of Guatemala and its surrounding areas that were prepared independently by IGN, the total area covered is equivalent to approximately 30% of the land area of Guatemala (108,889km^2.)

As shown in Table 2.5-2 below, the population of this area (33,500km^2) is approximately 8,664,964, accounting for approximately 72% of the total population of Guatemala (11,986,800).

Table 2.5-2 Estimated population within the study area

Estimated Population of the Area covered by 1:50,000-scale National Base Maps (74 sheets + 7 sheets by PAABANC), 2002

	DEPARTMENT	MUNICIPALITY	Total population of MUNICIPALITY	Percentage of Plotted Area	Population within Area	Total
1	GUATEMALA	17	2,732,081		2,704,258	2,704,258
2	EL PROGRESO	2	54,113		14,387	14,387
3	SACATEPEQUEZ	16	276,769		276,769	276,769
4	CHIMALTENANGO	16	449,134		384,362	384,362
5	ESCUINTLA	13	494,734		494,734	494,734
6	SANTA ROSA	13	323,179		295,385	295,385
7	SOLOLA	19	325,742		325,742	325,742
8	TOTONICAPAN	8	377,556		377,556	377,556
9	QUETZALTENANGO	24	711,241		711,241	711,241
10	SUCHITEPEQUEZ	20	419,787		419,787	419,787
11	RETALHULEU	9	249,886		249,886	249,886
12	SAN MARCOS	29	882,207		882,207	882,207
13	HUEHUETENANGO	23	723,414		626,509	626,509
14	QUICHE	13	402,021		338,337	338,337
15	CHIQUIMULA	4	77,526		35,281	35,281
16	JALAPA	6	270,942		143,052	143,052
17	JUTIAPA	17	396,692		385,471	385,471
	17 DEPARTMENT	249 MUNICIPALITY	9,167,024	95%	8,664,964	8,664,964
*1 Population figures and names of departments and municipalities are taken from the "Estimated Census of Population 2002".				(A)	Total population of working area =	***8,664,964***
*2 Each working area was overlaid with the corresponding demographic division map in order to roughly determine the percentage of the population in each area. Cities with low populations were omitted				(B)	Total population of Guatemala=	***11,986,800***
				(A)/(B)	% =	***72.3%***

Table 2.5-2 shows estimates of the number of people residing in the area covered by this Study and data possessed by the IGN. The table clarifies the relationship between the Municipalities (the statistical unit of the national census), their estimated populations and the maps produced in the Study and establishes a rough percentage; and on the basis of this calculates the population of each Department. The table also shows the ratio of the population of the study area to the population of Guatemala as a whole.

In short, these statistical results show that over 70% of the total population of the country reside in the Study area, which is equal to 30% of the total national land area; this indicates that this is a very important area for production activities in Guatemala. The remaining 70% of the land is located in the northern part of Guatemala, and consists mainly of nature conservation areas covered in forestland, with some agriculture and stock raising. As a point of reference, the administrative organization of the country as a whole is made up of 32 Departments and 331 Municipalities, so it is obvious how large a proportion of this is represented by the 17 Departments and 249 Municipalities covered by the Study.

Figure 2.5-5 shows the present state of land use, in which a huge contrast between North and the South can be seen. This map is based on data created by the IGN and MAGA.

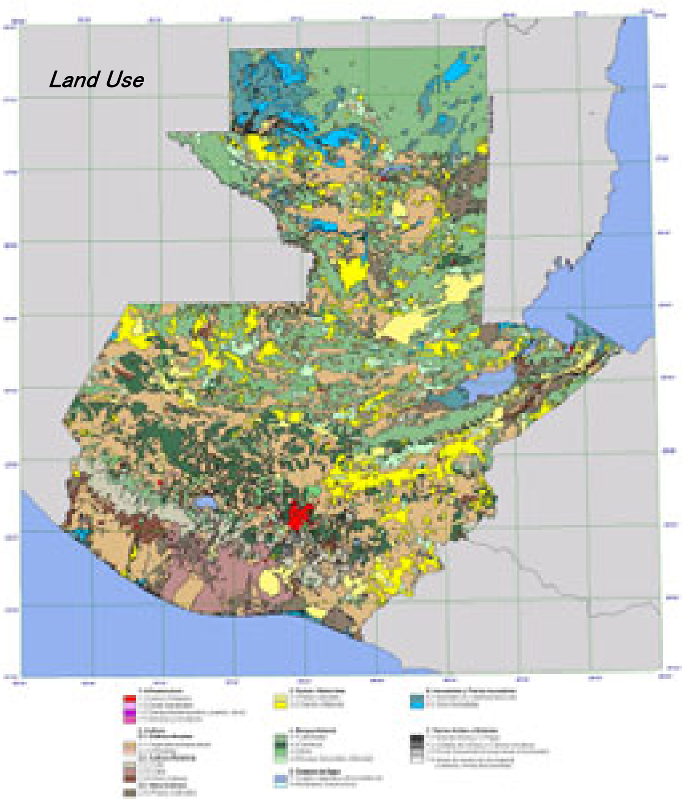

Figure 2.5-5 Present state of land use

④ National Census 2002

As has already been mentioned, the census currently available in Guatemala was carried out in 1994, and in order to know the present state of affairs we have to relay on the population growth forecast issued in 2001. In 1994, Guatemala was still in a state of civil war and the accuracy of the results of the census lack reliability compared with normal times. Backing up this fact, the Introduction to the 1994 Census states:

"The figures published in this document reflect the population and houses surveyed in the census. Therefore, those residents and houses omitted for various reasons (lack of reliability, refusal) are not included. In addition, 38 villages included in the Departments of Quiche, Baja Verapaz, Chimaltenango, Solola and Jutiapa are excluded, because the residents of those villages did not acknowledge the implementation of the national census."

This being the case, a new census for Guatemala (the 11th Population Census and the 6th Housing Census) was held over the period of November 24 to December 7, 2002 as originally planned. However, as the 4th Agricultural Census was implemented in May 2003, it is expected that the results of the new Census will be published in the latter half of 2003.

This Census was implemented with the support of the United Nations and the US Census Bureau. About 21,000 researchers were dispatched all over the country, and the total cost of the census came to a huge Q175,000,000 (about US$23,000,000).

2.5.2 Expectations of Guatemala for this Study

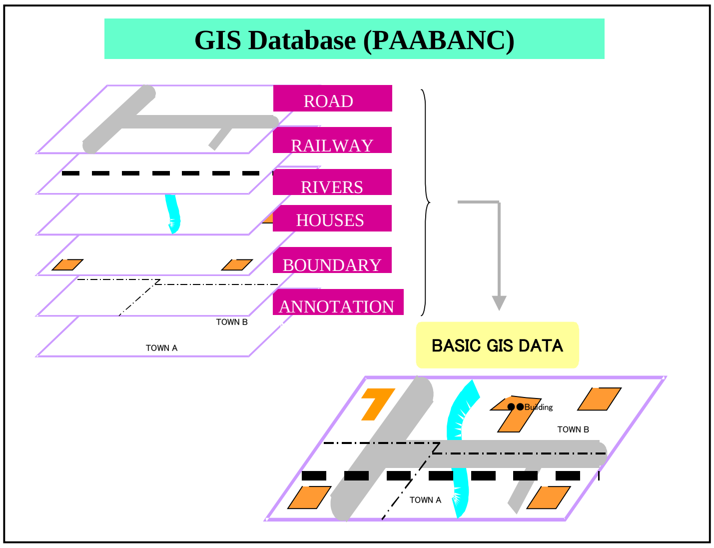

Figure 2.5-6 Overview of GIS

It was characteristic of this Study that in addition to the counterpart agency, consisting of three organizations; IGN (National Geographic Institute), INSIVUMEH (National Institute for Sismology, Volcanology, Meteorology and Hydrology) and SEGEPLAN (Secretary for Planning and Programming of the Presidency), other Guatemalan administrative agencies and research institutes also showed great interest in its results.

The growing application of GIS for work in many sectors is a worldwide trend, but in Guatemala GIS is, with the exception of a few bodies, still not widespread. As evidence of this, the only GIS database in existence in the country is a 1:250,000 scale (SUNIL *1) map covering the entire country and 7 or 8 1:50,000 scale map sheets (PAABANC *2) covering the capital and surrounding areas. Moreover, when they were digitized, none of the maps were revised to include the progressive changes occurring over the years, so that the discrepancies between actual conditions and the database were a constant problem in the application of the maps.

*1 SUNIL: Sistema Unificado de Información National

*2 PAABANC: Proyect de Asistencia A la Base National Cartográfica

Under these circumstances, the 1:50,000-scale national base map database covering the Southwest Area of Guatemala, the 1:10,000-scale digital orthophoto database and the hazard maps that will be obtained as a result of this Study will provide the latest information on topographic conditions and land use, as well as information relating to disaster risk forecasts, and are thus attracting close attention not only from the disaster-related agencies but also from many administrative agencies and research institutes.

Photo 2.5-1 Presentation given at the Vice Presidential Residence

In Guatemala, the National Geographical Information System (SNIG) has already been organized: IGN and SEGEPLAN have taken the leadership to promote the development of PAABANC and also develop and integrate the metadata showing the content of existing databases in Guatemala. They are also working to step by step to promote the building of a clearing house to take on the role of cataloguing data. In addition, they are holding regular conferences for the exchange of information and effective use of the databases.

There is no doubt that the promotion of the effective use of the results obtained from this Study, led by the counterpart agencies and the SNIG affiliated agencies, will bring out the maximum benefit of the results.

2.5.3 Recognition by the top levels of the state

(Presentation to the Vice President)

Photo 2.5-2 The Vice President (right) and the Japanese Ambassador (left)

A symbolic event showing the strong interest in GIS was the presentation of this Study made to the Vice President of Guatemala during the third-year work in Guatemala.

This event was made possible through the good offices of those concerned with this Study on the Japanese side (The Japanese Embassy in Guatemala and JICA), who realized that the results of GIS development and technology transfer in this Study would be important and effective in solving many of the problems faced by Guatemala.

On July 11, 2002, His Excellency Kagefumi Ueno, Ambassador extraordinary and plenipotentiary, and First Secretary Mr. Kiyofumi Ishii, (both of the Japanese Embassy to Guatemala), Mr. Masami Shukunobe, (General Manager of the JICA Guatemala Office) and four representatives of the Study Team were invited to the Vice Presidential Residence to explain the objectives and details of the Study and the technology transfer to be carried out in the process of implementation, as well as the various development projects and early implementation of disaster prevention programs that would be made possible through the effective use of the results of the Study. In addition, they discussed with the Vice President the concrete action to be taken by Guatemala in the future.

After these discussions, the Vice President requested the Japanese side to give the presentation once more for other governmental officers including Ministers and the directors of research institutes. It was apparent that, as the leaders of a country that faces the constant threat of natural disaster equal to or even greater than Japan, and faced with the need for the early restoration of the peace zone in the western part of the country, which has been devastated by 36 years of civil war, they strongly felt the urgency to take appropriate measures.

2.5.4 Importance of GIS for the country

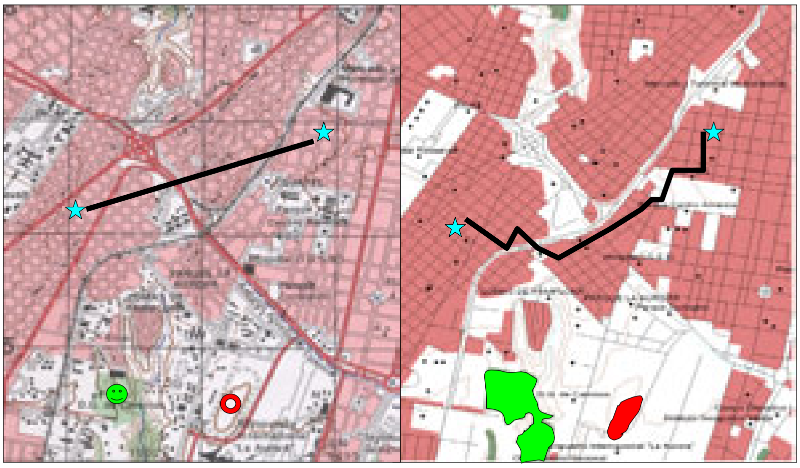

Figure 2.5-7 Difference between topographic map (left) and GIS database (right)

Being able to use the information processing technique known as GIS not only allows many elements to be used; implementation speed is markedly faster. This enhances the objectivity, transparency and accuracy in comparison to decisions and actions that rely on human subjectivity. In addition, the reduction in the amount of time and labor required leads to lower social costs.

As regards the national administration, there is great awareness of the huge role to be played by GIS, in terms of greater efficiency and speed in activities covering a wide range of spheres, from the accumulation and compilation of data on social conditions basic to the running of the country, such as the national census, land register and fixed property surveys, through the integration of data on various natural conditions (geology, topography, soil, etc.) with survey data on weather conditions, earthquakes, volcanoes etc., and hazard maps and the construction of a database, to the formulation of various development programs, environmental conservation, measures to deal with natural disaster, and the improvement of medical care, welfare and education, resulting in reduced costs and greater reliability.

In a Guatemala where the national leaders understand the importance of GIS and the SNIG has been set up by the related agencies, the effective, practical use of the results of this Study will promote various development programs, including redevelopment of the infrastructure in major cities and reconstruction of the peace zone, and will strengthen measures against all kinds of natural disaster.

＊ The History of SNIG and Its Present Activities

The Coordinating Commission for the Modernization of the Country’s Geographic Information System (CCMSIG) was established in May 1996, in response to many requests concerning the geographic information necessary to promote and assist public investment at the national, regional, provincial, municipal and village levels with regard to social, economic and natural matters. This organization was intended to reinforce, modernize and homogenize the national geographic information system, on the initiative of the Presidential Office of the Republic of Guatemala.

In May 1999, CCMSIG was renamed the "Inter-Institutional Unit for the National Geographic Information System Development Support (UNISNIG), and in January 2000 this was renamed SNIG. The goal of SNIG is to promote inter-agency consolidation, create geographic information through the formulation of standards and guidelines, and provide a basic system for the preparation of the national cadastral records and the receipt and administration of international assistance. The agencies and organizations participating in SNIG abide by the same framework, concept and technical specifications in carrying out their activities. The national cadastral record preparation project described here was one of the items agreed on in the Peace Accord entered into at the end of 1996.

Figure 2.5-8 Overview of SNIG

Figure 2.5-9 Logos of the organizations participating in SNIG

Since then, SNIG's efforts have steadily borne fruit, and international cooperation projects (with Canada, Sweden, France and Japan) in support of modernization have been implemented.

At the same time, various projects at the national level have also been implemented. Project SUNIL, to digitize the 1:250,000-scale topographic maps covering the entire country of Guatemala and develop the nation's first GIS database, was completed in October 2000. The activities of SNIG have also supported the concept of the National Infrastructure for Geospatial Data (INDE); and through the effective use of the Permanent Committee of Geospatial Data Infrastructure for the Americas (CP-IDEA) and the Global Infrastructure for Geospatial Data (GADI), SNIG has pushed forward developments and improvements both at the Central and South American level and at a global level.

At present, SNIG has formed 5 working groups (① Technology, ② Training, ③ Management, ④ Logistics and ⑤ Marketing) under the leadership of IGN and SEGEPLAN to promote its activities. The above diagrams give an overview of the organization of SNIG taken from a brochure on its activities and show the logos of the participating agencies and organizations. The agencies and organizations participating in SNIG as of November 2002 are listed in Table 2.5-3 below.

Table 2.5-3 SNIG Member List

No.	Abbreviated name of organization	Formal name of organization
1	IGN	Instituto Geográfico Nacional
2	SEGEPLAN	Secretaria de Planificación y Programación de la Presidencia
3	DGM	Departamento Geográfico Militar
4	UVG	Universidad del Valle de Guatemala
5	MEM	Ministerio de Energía y Minas
6	MINEDUC	Ministerio de Educación
7	INE	Instituto Nacional de Estadística
8	INAB	Instituto Nacional de Bosques
9	CONAP	Consejo Nacional de Areas Protegidas
10	MAGA	Ministerio de Agricultura, Ganadería y Alimentación
11	INSIVUMEH	Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología
12	FLACSO	Facultad Latinoamericana de Ciencias Sociales
13	FAUSAC	Facultad de Agronomía de la Universidad de San Carlos de Guatemala
14	INGUAT	Instituto Guatemalteco de Turismo
15	SEPREM	Secretaria Presidencial de la Mujer
16	SAE	Secretaria de Asuntos Estratégicos
17	DGAC	Dirección General de Aeronautica Civil
18	CONRED	Coordinadora Nacional para la Reducción de Desastres
19	Caminos	Dirección General de Caminos
20	EPQ	Empresa Portuaria Puerto Quetzal
21	MARN	Ministerio de Ambiente y Recursos Naturales

＊ SNIG : Sistema Nacional de Información Geográfica

＊ Use of GIS in the Project to Combat Chagas' Disease (JICA)

① Chagas' disease

At present, the Ministry of Public Health and Social Assistance of Guatemala is implementing a project to reduce Chagas' disease as part of the technical cooperation undertaken by the Government of Japan. Two JICA experts have been dispatched to work in tie-up with JOCV volunteers.

The reduviid bugs that are responsible for the disease are parasitic on humans and domestic animals, living on their blood and inhabiting adobe or thatched houses. Blood sucking alone does not cause infection; the pathogens exist in excrement and invade the body via a skin wound. Sometimes fatal in humans, this is a dangerous infectious disease. Depending on the species, from 100 to several thousand bugs may inhabit one house. If even one bug is found in a house, the house must be disinfected to ensure annihilation. The eradication of the disease in Uruguay and Chile has already been announced by the WHO, but in other Central and South American countries countermeasures are behind schedule.

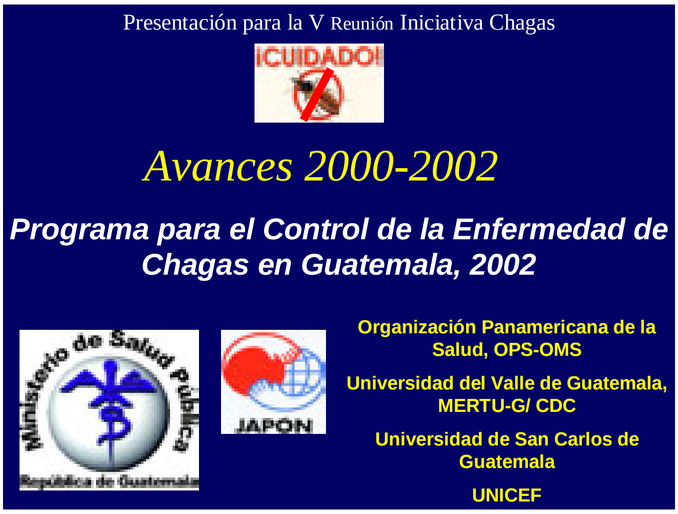

Figure 2.5-10 Overview of the Project to Combat Chagas' Disease

② Details of the implementation of projects using GIS

First of all staff members from the Department or municipality and JOCV volunteers visit the local area, conduct a detailed, house-to-house study and record what they find. Then as soon as the distribution of bugs in each municipality has been ascertained, spraying is carried out twice. While one spraying will wipe out all the adult bugs, the eggs survive, so that a second spraying has to be done after an appropriate interval.

This information on "distribution", "implementation of first and second spraying" and "distribution after spraying" is used to construct a database by province. The GIS is used to grasp an understanding of actual conditions and this is used as an indicator of the activities. However, because existing digital topographic map data is the low-scale (1:250,000) Guatemalan SUNIL, there are some limitations on the use of GIS at the Department level. A 1:50,000-scale database is essential for management at the municipality, where the information is more detailed , but at the present time there are only paper-based topographic maps to rely on. Here too, the early development of a 1:50,000-scale database is hoped for.

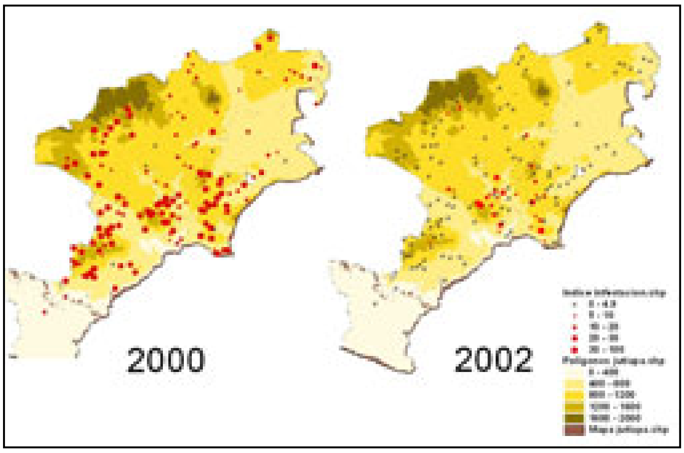

Figure 2.5-11 Distribution of the disease, drawn up using GIS

③ Future development

As it is presumed that the distribution of the reduviid bugs is at heights of from 400m to 1,800m, an analysis will be carried out combining satellite images, DEMs, meteorological data and census, to try defining the extensive range of distribution. Further, since Chagas' disease in Guatemala is prevalent in Chiquimula Province, appropriate measures will be necessary to collect data from the neighboring countries of Honduras and El Salvador. As described above, Chagas' disease is rampant throughout Central and South America, and it is clear that, as with anti-disaster measures, tie-ups with other countries are needed in order to cope with this problem at the regional level. If it becomes possible in the near future to operate GIS via Website, it is thought that these measures will become still more effective, leading to the improvement of health and welfare throughout Central America.

2.5.5 Database required for an early recovery of the Peace Zone

The Guatemalan civil war that broke out in 1960 lasted as long as 36 years until 1996 when a peace agreement was reached under the observation of the U.N.

The Study was undertaken initially because the country urgently needed a national land development, especially the "establishment of national base map" contributing thus to an early recovery of the "Peace Zone" impoverished in the civil war. With the disaster caused by Hurricane Mitch in 1998, with great damages to Guatemala as well as to other Central American countries, the Japanese Government decided to develop also the hazard maps in an emergency assistance project.

This civil war, the longest in the history of Central America, has destroyed completely the infrastructures in most of the concerned zone. In other words, roads, bridges, electricity, telecommunications, water supply and sewerage systems, and cultivated land became dysfunctional. Furthermore, disaster spared no medical, educational, or other facilities required for normal life of people living in this zone.

Under such circumstances, SEGEPLAN released the poverty maps in 2001 that accurately reflect the conditions of poverty in Guatemala. The maps also show the percentages and numbers of people in the categories of "general poverty" and "extreme poverty," respectively, indicating that many of these categories are concentrated in the Peace Zone. One typical example is San Macros Department, located in the Peace Zone in the western part of Guatemala.

The poverty maps constitute an example for utilizing the world's highest-level GIS, which is exceedingly valuable and indispensable for any national development. We would like to express our deep respect to those who participated in this publication under the assistance of the World Bank and UNDP; people concerned at SEGEPLAN (Secretariat of Planning and Presidency), INE (National Institute of Statistics), and Universidad Rafael Landívar (Rafael Landívar University).

However, the poverty maps, currently available, were produced based on the database of small-scale 1:250,000 maps and do not accurately represent the relationships between the detailed positions of cities, towns, villages, and settlements and the poverty levels.

The 1:50,000 national base maps and their databases that can be acquired from the Study shall cover only about 30% of the entire land of Guatemala and not all the Peace Zone. However, we may improve drastically their accuracy through statistical processing by combining the data on the developed area and the social condition data used to create the aforementioned poverty maps.

The poverty maps are very important for the implementation of the National Development Plan. The poverty maps, whose objective was not to create it, shall act as highly effective tools if they are used to implement the appropriate measures based on the facts revealed in the production process. The more accurate the tool, the more waste we would eliminate. The result will allow us to determine the appropriate distribution of public investment required for future recovery, content of investment, and identification of target areas, according to the objective criteria.

The alleviation of poverty, i.e., the recovery of the Peace Zone is not a simple problem that can be solved in the short term and a financial assistance alone will not be useful. Poverty would be wiped out in the future only if the governments (central and local) and local residents participate in continuous activities toward this goal and carry out their responsibilities.

In other words, it is essential to improve the standard of living until local residents are economically independent. To this end, we must understand the characteristics of the areas, identify the causes of poverty, and take appropriate measures. The GIS will be indispensable for this process.

The database of national base map created in the Study will lay the foundation for development. The full use of GIS will establish an accurate objective development plan without arbitrariness and the plan will be implemented with positive effects, if a database containing the natural conditions of the project areas (such as maps related to soil, headwater and water system, current road state, forest resources, and slope classification) and the social conditions including the latest census (population, households, incomes, and agriculture) are developed. The investments in the next phase must be made on electricity, telecommunications, water supply and sewerage systems, medical care, and education to further improve the standard of living.

Poverty is one of the main factors in the outbreak and infection of Chagas' disease, which is apparent in the reports of the project to combat infectious disease to which JICA provides assistance in Guatemala. Additionally, the vulnerability to natural disasters is closely related to poverty. In conclusion, it is not exaggerated to say that many of the social problems come from poverty.

With the specific case of early recovery of the Peace Zone being related to the poverty problem at its core, it will be difficult to achieve this goal by simply meeting the physical conditions.

The vulnerability against natural disasters and infectious diseases resulting from poverty cannot be considered separately from the Peace Zone.

Fortunately, various hazard maps have been developed from the Study and the hazard levels for various disasters have been defined. The review of land uses according to these data should be undertaken as early as possible.

On the other hand, the project to combat infectious disease (Chagas' disease) already uses GIS in its operations and the database accumulated so far (such as structures of houses in the

Study Area). These are great treasures. We think that a still more effective development promotion plan can be obtained if the results of different projects are brought together, integrated, and analyzed using GIS.

Currently, the Japanese Government is engaged in bilateral cooperation as well as extensive cooperation across several countries. Good examples are CEPREDENAC and CDERA related to disaster prevention. The Chagas' disease prevention project, though implemented country by country, has started in the neighboring countries, El Salvador and Honduras, and is taking now a form of extensive cooperation.

If we bring this concept into Guatemala, it is quite possible to carry out cooperation between projects. In other words, the Chagas' disease database, agricultural database developed by MAGA, Hazard Map database obtained in the Study, and the national base map database may be integrated and analyzed efficiently.

We understand that the basic data for this purpose were developed in the Study. With the current instability in economic climate in the world, it is an important task to avoid duplicated investments and we must promote information sharing.

The driving force in this case is the National System for GIS Information (SNIG) and the leader of this organization, SEGEPLAN, is expected to be actively involved in the future. Naturally, IGN and INSIVUMEH which develop important databases as their key business should continue their operations.

2.5.6 Holding of the GIS and hazard map seminar

On June 19 and 20, 2003, a technology transfer seminar was held, introducing the objective, background, products of the Study, and uses of the products, etc.

Photo 2.5-3 GIS and Hazard map Seminar (1)

This seminar was attended by about a total of 300 persons, including not only Guatemalan people but also seventeen guests from CEPREDENAC, as a joint organization for disaster prevention in Central America, organizations related to CDERA (Caribbean Disaster and Emergency Response Agency), and their member states.

On the first day of the seminar, a plenary meeting was held, attended by staff from many governmental ministries and agencies that understood and appreciated the importance of the Study and the wide range of its applications. As a representative of the Japanese Government, Mr. Kagefumi Ueno, the Ambassador Extraordinary and Plenipotentiary, attended the meeting himself and delivered an opening address. Mr. Flora Ramos, Minister of Ministry of Communications, Infrastructure and Housing, delivered a congratulatory address as a representative of the Guatemalan Government. Finally, the presentations by the domestic and international organizations followed.

Many of the speakers came from GIS or departments related to disaster prevention gave presentations demonstrating enthusiasm for future development, disaster prevention, and medical care and education in Guatemala, as well as comprehensive disaster prevention activities in the Central American region.

Photo 2.5-4 GIS and Hazard map Seminar (2)

We could listen to the presentation by the U.S. National Imagery & Mapping Agency (NIMA), which undertakes mostly the same support operations as the development of the national base map and GIS databases in the Study, and check about the avoidance of duplicated assistance and reciprocal cooperation.

On the second day, we focused on the technical know-how and held group seminars divided between GIS and Hazard Maps. This arrangement allowed us to discuss technologies in great details. Also, it is true that some engineers who were interested in both of these presentations complained that they had to choose from both items. It is a problem that remains to be solved in future seminars.

Holding a seminar will not solve all the pending problems but will allow knowing how the study results are, where they are available, and how they can be used.

The seminar was attended by the staff of the central government and guests from remote local governments, universities and other research institutes as well as assistance agencies from various countries and consisting of presentations by many of the participating organizations. In the seminar, participants were effectively and successfully instructed in a wide rage of applications of the GIS and hazard maps.

The most important task of databases such as topographical and hazard maps, and orthophotomaps is not to create them but to effectively use them. The seminar gave many of the participants useful clues to how the digital databases, much different from paper maps, can be used efficiently in Guatemala in the future.

While many people in the world misunderstand GIS as a tool to be used only for engineering such as "land development" and "construction," SEGEPLAN showed in the seminar how GIS can be actually used in a plan for proper placement of medical and educational facilities and an actual medical project, i.e., the Chagas' disease prevention project. This allowed the participants to draw new inspirations.

Photo 2.5-5 GIS and Hazard map Seminar (3)

The examples of GIS being actually used were more popular than any presentation made by the Study Team, which might have been well-conceived but one-sided, and are likely to attract increasingly more inquiries from many fields. We have suggested that people who are interested in GIS should visit the Web site of SEGEPLAN at www.segeplan.gob.gt to learn more about it.

The counterpart organizations for the Study included IGN related to mapping and GIS, INSIVUMEH related to hazard maps, and SEGEPLAN related to coordination between various organizations. However, SEGEPLAN including the GIS department that developed the aforementioned poverty maps is actually a technical counterpart, which generously provided assistance to many of our operations including the setup of a Web site on the seminar. We would like to thank them for their efforts.

Chapter 3 Project Evaluations, Results and Recommendations for Future Activities

3.1 Project Evaluation

A systematic and objective assessment was made in order to provide highly reliable and useful information to be utilized in the decision-making processes of both the donor and recipient countries. The project evaluation is summed up as shown below.

3.1.1 Overall Goals and Project Purposes

Though we have not analyzed the outline of the project using the Project Design Matrix (PDM), we may define the project purposes and overall goals as follows:

(1) Project purposes

- Establishing the foundation of 1:50,000-scale national base maps for GIS
- Producing hazard maps in relation to earthquakes, volcanoes, landslides, and floods
- Transferring the technologies and know-how related to these hazards

(2) Overall goals

- Allowing the counterpart organizations to further develop the products of the project for themselves
- Commercializing the technologies to pave the way for self-supporting activities
- Sharing databases to cut budgets of the national government and effectively use data for the National Development Plan
- Providing and sharing data with assistance programs, NGOs, etc. to build mutually supportive relationships
- Consequently bringing about stability to the people's livelihood, enhancement of social infrastructures, and improvement of their living standard
- Also promoting people's understanding of disaster prevention

3.1.2 Five-item evaluation

The five-item evaluation assesses an entire project from a comprehensive perspective with focuses on project purposes and overall goals.

(1) Relevance
(2) Effectiveness
(3) Efficiency
(4) Impact
(5) Sustainability

This evaluation method verifies whether the project must be implemented, i.e., "validity of the project," and what kind of effects the project had on beneficiaries, whether the project was effective in terms of effective use of resources, whether the implementation of the project has long-term indirect or ripple effects, and whether there are lasting effects once the project was completed.

3.1.3 Evaluation results

(1) Relevance

The Government of Guatemala facing many tasks including securing of resettlement areas for refugees in the vast Peace Zone and redevelopment of infrastructures, defined the "disaster prevention" as an urgent task in the process of promoting national land development. The hazard maps must be developed urgently in order to establish disaster prevention plans while the national base maps containing up-to-date information are required for the development plans. The Government of Guatemala declared the policy of "establishing base maps for GIS" which is predicated on the update and extensive use of the base maps. The government also established the Inter-ministry Liaison Conference (hereinafter "SNIG") and is thus preparing for setting up organizations for sharing of information and utilization of GIS.

The Project is aimed mainly at the development of 1:50,000-scale national base maps for GIS GIS as well as hazard maps in relation to earthquakes, volcanoes, landslides, and floods and transfer of related technologies and know-how, all of which are consistent with the needs of the counterpart organizations and the Government of Guatemala and people. In conclusion, the Project has high relevance.

(2) Effectiveness

All of the following three project purposes were attained as initially planned:

- Establishing the foundation of 1:50,000-scale national base maps for GIS
- Producing hazard maps in relation to earthquakes, volcanoes, landslides, and floods
- Transferring the technologies and know-how related to these hazards

The products of the Study, 1:50,000-scale national base maps for GIS and hazard maps, were completed with accuracy. Furthermore, the technology transfer particularly contributed to the accomplishment of the project purposes. The technology transfer was provided in relation to digital mapping, GIS, and creation of printed map data. The training was attended by a total of 88 participants from both the counterpart organizations, who became capable of carrying out continued activities on their own as beneficiaries. In conclusion, the Project achieved significant effects on propagation and continuation of technologies.

(3) Efficiency

The following lists the input.

- Japan: 15 members of the Study Team
  Equipment for study (for IGN): digital plotter, film scanners, printers, digital compilator, plotters, and sets of hardware and software for GIS
  (for INSIVUMEH): Sets of hardware, software, and plotters for GIS
  (common use): GPSs and PCs for base line analysis
- Guatemala: About 100 persons from counterparts (collaboration), 88 persons from counterparts (technology transfer), a total of two project offices (in IGN and INSIVUMEH)

The input from Japan and Guatemala was necessary and sufficient in terms of types, period, quality, and quantity to accomplish results.

Normally, we can judge whether the input costs are adequate by comparing them with other similar projects. However, there is no other project that can be compared with the Study because the latter is special and consists of two segments, production of base maps/GIS databases and production of hazard maps. The relevance of the Project is beyond doubt if we judge it based on the values that have been obtained from the past projects.

(4) Impact

The following six overall goals cannot be easily assessed in terms of the effects of the project because, at the moment, no specific evaluation indexes have been established. We hope that follow-up research will be conducted on them in the future.

- Allowing the counterpart organizations to further develop the products of the project for themselves
- Commercializing the technologies to pave the way for self-supporting activities
- Sharing databases to cut budgets of the national government and effectively use data for the National Development Plan
- Providing and sharing data with assistance programs, NGOs, etc. to build mutually supportive relationships
- Consequently bringing about stability in people's livelihood, enhancement of social infrastructures, and improvement of their living standard
- Also promoting people's understanding of disaster prevention

However, some specific activities are being observed concerning "positive impacts" which were not expected initially.

The ripple effects are significant. For example, IGN started digitizing 1:50,000-scale national base maps for GIS for an area not covered in the Study on its own (continued activities using the equipment used for the Study) and promoting supply of data to the project to combat Chagas' disease implemented by JICA and to SNIG.

(5) Sustainability

As described above, IGN is carrying out continued activities on its own to digitize 1:50,000-scale national base maps for GIS for an area not covered in the Study using the equipment used for the Study. Specifically, IGN secured a budget for new aerial photographic surveying on the northeastern area, next to the Study Area, and already completed shooting photographs on 10,000km^2, clearly demonstrating the enthusiasm of this organization.

From these facts, we are confident that the sustainability has reached a fully satisfying level.

3.2 Conclusion

The Study has accomplished the initial purposes although it is a complex and special project consisting of two segments; establishment of national base maps/GIS databases and hazard maps.

We understand that this result was achieved due to the understanding of the Guatemalan government about the method of implementing the project, which focused not only on project products but also on technology transfer, and thanks to the enthusiasm and efforts made by both the Japanese and Guatemalan staff members.

In the final year, we held two seminars, one of which was attended by 18 guests related to GIS and disaster prevention in the Central America and Caribbean areas. We are confident that the seminar, thus disseminating information on the circumstances of the Study as well as what the products are and how they can be effectively utilized, will serve as a signpost for the future disaster prevention in the Central America and Caribbean areas including Guatemala.

3.3 Future development of transferred technologies

3.3.1 Digital plotting/compilation

The equipment to conduct the digital photogrammetric survey was introduced to IGN and the technology transfer for producing the products using the equipment was furnished three times. For effective use of these equipment and technology, three points that the staff of Photogrammetry Division should cope with on their own initiative are:

(1) Training of engineers

(2) Increase of production

(3) Higher production efficiency

The practical methods of coping with these issues are recommended as follows:

(1) Training of engineers

The “VirtuoZo” that was introduced in this project will be operated only by a limited number of operators because one set of equipment is available. So it is difficult to train many engineers. In the digital photogrammetry, it is very important to acquire not only the knowledge on photogrammetry but also on information processing. It will take very much time to train engineers for both types of knowledge. To solve this problem, it is recommended that the staff members acquire a part of and take partial charge of the technology.

The workers engaged in analog plotting are the specialists in photogrammetry and young engineers are relatively familiar with PC operation. For instance, the vector data acquisition process can be undertaken by plotting engineers and the orthophoto image production process by young engineers familiar with PC operation. The work is shared by both types of engineers, but if they are grouped, both types of engineers can complement their knowledge mutually, thereby ensuring their deepened understanding of the technology.

It is desirable that the engineers engaged in compilation undertake the compilation of plotted data. Unlike the analog method, however, the data subject to compilation is thoroughly reflected on the final product in mapping based on digital data, eliminating the drafting process that had been so far. Therefore, the engineers in charge of compilation need the knowledge on cartography and printed maps. Sometimes, they are required to operate Adobe Illustrator. Individual engineers have to acquire not only the knowledge on compilation but also on such peripheral technology as needed.

(2) Increase of production

If a large volume of data should be acquired in the future, one set of VirtuoZo PC may result in a situation that it cannot deal with such large volume of data. The work in shifts or the introduction of a new digital photogrammetry system can be considered as a solution, but it is recommended to make the effective use of the existing analog plotter (Photo 3.3-1) as a realistic solution.

In practice, the acquisition of 3D vector data (Figure 3.3-1) has to be performed in connecting an encoder to the analog plotter. In addition of increase of production, the advantages of using the analog plotter are that two times of digitization can be avoided in comparison with digitization of analog maps, and that 3D data with high utility for designing is available. Another secondary advantage is that the engineers of analog plotter can be shifted smoothly to the work with the digital photogrammetry system. The shift from the analog plotter to the digital photogrammetry system will be drastic, but the use of the analog plotter with encoder will bring the same effect as an intermediate analyzing plotter (Photo 3.3-2) and ensure the engineers to empirically recognize the significance of categorizing planimetric features into layers and acquiring them as data.

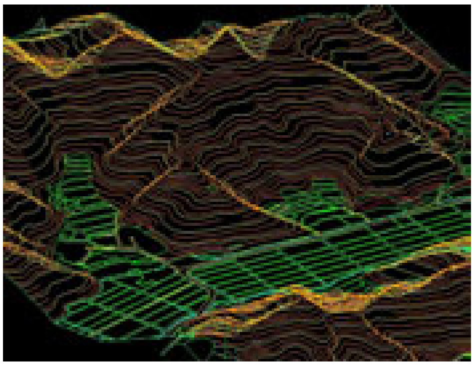

Figure 3.3-1 3D vector data

Photo 3.3-1 Analog plotter installed in Photogrammetry Division

Photo 3.3-2 Analyzing plotter

(3) Higher production efficiency

For map production with high efficiency, it is most important to conduct the process control in a complete manner. This is the same case in the digital process as well as in the analog process. However, the digital photogrammetry is a work that the staff members have not experienced, so that they have to determine the efficiency in each step. They have to calculate the efficiency of any small work step and accumulate the performance data.

For higher work efficiency, the work should not be promoted within Photogrammetry Division. The work to use the data acquired in photogrammetry for GIS will apparently increase in the future. In such case, the work process should not be completed within Photogrammetry Division, but it is desirable to search for any method with the highest efficiency and plan the work processes in considering the future processes. In digitalizing the photogrammetry work, the barriers among divisions will be gradually lower. Especially, there are many technologies that are overlapped with Cartography Division. It is necessary to increase the opportunity of discussions between both Divisions in order to reduce the discrepancies between data specifications required by Cartography Division and those provided by Photogrammetry Division. It is the most desirable way that the staff members of both Divisions are exchanged even for a certain period.

3.3.2 Database/GIS Technology

(1) Software compatibility problem and fund raising for costs for version-up

While this project is implemented, the version of ARCINFO (ESRI Corp.) was upgraded three times. The latest version improved the Coverage that had been the conventional leading data format and limited it to the support of the new type of data format called GeoDatabase with no downward compatibility. The policy of ESRI was to convert the data from the conventional Coverage into GeoDatabase. This means that the latest version of ArcGIS could not edit the Coverage, but can only allow browsing or converting the data into a new type of data. The change of policy was not foreseeable when starting the project and it imposed a heavy burden on the long-term users of the software.

IGN has a license for the old version of ARCINFO Workstation 4 as well as the license granted by the JICA team, and they are using these licenses for the current services such as data creation and editing. Therefore, it is not realistic to use the license granted by JICA team for ArcGIS, if the effective use of the property that IGN has developed so far is taken into account.

However, the external pressure on the version upgrading will increase in a few years and it is evident that IGN must change the data format into the new one sooner or later. It is thus necessary to access the cost of upgrade of the existing application under the license and data conversion, and to plan the future work. It is also necessary to make the profit profile to raise the fund for the required cost from the equipment, technology, products and others provided in this project.

(2) Problems and recommendations for GIS technology transfer

As described above, not only the software operation but also a wide range of knowledge on GIS is required for the personnel engaged in GIS. As seen from the character and conduct of IGN engineers, they were simply studying the software operation, but their understanding of the conceptual items was insufficient. It seems that they could process the data in the same environment, but probably would fail in a different environment. The organization of the personnel in charge of processing in practice and that of other personnel are not planned in the proper manner and many engineers seem to receive training because they just have an opportunity. In this situation, the technology that they can acquire would not develop further and the opportunity of the engineers with a necessity to be trained for the technology may be lost. It is strongly recommended that the responsibility of each engineer to participate in technology transfer training be defined to enhance his motivation in the technology transfer.

3.3.3 Digital printing

The present problems and solutions concerning the digital printing work and the recommendations for the future development will be described below.

(1) Film outputs

In general, the files created on Illustrator in the digital printing process are outputted as printing film outputs through an image setter, from which reproduction blocks were made and put on a printing press machine. In short, if the reproduction film outputs were not applied to press, it would be meaningless to create maps on Illustrator, apart from the proofreading inspection on the color prints outputted from a printer.

The Printing Division of IGN possesses no image setter and uses the conventional analog printing method at present. If they purchase an image setter, this problem would be solved, but it is difficult due to the present high cost. (For reference: The costs required for an image setter used by a middle-size printing company in Japan are: 8 million yen or more for image setter; 20 million yen or more if a higher precision of color reproduction blocks is required; the running cost consists of the material expenses of 300,000 yen or more per month and the maintenance cost of about 200,000 yen per year, and the personnel cost for dedicated operators. Since this machine is specified for A3 outputs, the cost of a machine for map reproduction blocks will be much higher.)

Therefore, the film outputs must be subcontracted to a company. At present, one company in the private sector possesses an image setter in Guatemala, to which IGN had requested for quotation, but the quoted price had not meet their budget. So they had given up this plan. No other source of an image setter has been grasped in Guatemala so far.

In the digital printing environment, it is unnecessary to bring in a large volume of block copy manuscripts attained, but the delivery of manuscripts for reproduction film outputs is completed if a diskette recoding the data is sent to the output side. In this regard, there would be no problem if the film output work were subcontracted to any company in a country outside Guatemala such as Mexico. In any case, there is an urgent necessity to find a business partner who can cooperate with IGN in the film output work.

(2) Hardware

With the background that the digital printing (hereinafter DTP) development had been promoted using Macintosh of Apple Inc., Macintosh is still superior to Windows in terms of

DTP environment even if the DTP-related software on Windows is prepared. In fact, in the case of film output from an image setter, most of the manuscripts are provided after they are converted into files in the Macintosh format. Therefore, it is desirable to prepare the environment that allows the Macintosh OS-based hardware to be used effectively as a platform for final data reception.

(3) Software

The lecture on AdobeIllustrator was undertaken for the technology transfer to Guatemala. This graphic software is also provided with the function for importing photo images. Single-page maps, namely map sheets can be printed on this software, but it is recommended to acquire the operation of the following software:

- Image processing software (AdobePhotoshop provided)

  This software is capable of freely processing and compiling photo data imported from a scanner. The software can perform various types of processing such as clipping, composite, partial retouch, contrast adjustment and color adjustment. For the color- proof samples of the “Hazard Map” provided in the fifth field survey, this software was used to perform the contrast adjustment for printing of orthophoto data arranged on AdobeIllustrator.

- Page layout software (typically, QuarkXpress or PageMaker available)

  Single-page maps can be finally processed on AdobeIllustrator, but it is more effective to use the page layout software when creating the data for multi-page maps of an atlas type. If attaching a volume of map data, text data and photo data to each sheet completes the map sheets, it would be possible to compile an atlas.

Thanks to the use of the above software, the range of available products will be more expanded.

(4) Effective use of existing data (GIS database)

The map production processes have already been digitalized. In other words, it is more suitable to process digital data in all the processes than to proceed with the analog production. For this purpose, the GIS database is available. This matter is important for this technology transfer project.

(5) Social contribution by digital maps

Digital map data can be disclosed to the public on Internet and only changing its layout for distribution to citizens can easily produce the map representing evacuation routes in case of a disaster. The production and sale of atlas-type maps may create new opportunity of businesses and the valuable data should be made available to the public.

The present problems and solutions and the recommendations for the future development in the digital printing project have been described above. In any way, it is necessary for Guatemala to establish a method for producing digital printing maps independently through repeated try and error efforts.

3.3.4 Current tasks in IGN and INSIVUMEH and proposals for the future

It is commonly said that any organization is expected to constantly grow. In particular, a modern organization with an operational setup based on the electronic technologies should grow at a speed not comparable to any other in the past.

The main operations of the two organizations, i.e., development of topographical maps and GIS databases and development of hazard maps will be fully digital in a few years. In other words, the organizations must switch to an operation type based on electronic technologies.

There are three immediate tasks for the two organizations in order to catch up with the progress of these basic technologies, and they are (1)developing human resources, (2) investing in equipment, and (3) securing budgets.

These are the major requirements of which an organization must always consider.

In the Study, JICA provided equipment toward this goal and undertaken technology transfer required to make the most of the equipment. Namely, equipment and operation technologies minimally required for digitization remain with IGN and INSIVUMEH.

For a new expansion in the future, it is essential that the organizations maintain and manage this equipment and further educate their engineers. They will be thus able to maintain and manage the products of the Study, complete digital databases that cover the entire country at an early date, and even develop large-scale topographical maps of urban areas, now suffering from many problems. For these tasks, we would suggest the following proposals as specific examples:

(1) Developing human resources

1) Fostering experts

- It is required to foster experts as early as possible, based on the original operations of GIS such as structuralizing and using databases.
- Since this requirement depends on the utilization of software in many cases, offer the experts as many opportunities to participate in external seminars as possible.

2) Fostering routine workers

- Reassign engineers who were in charge of editing and scribing, to digital mapping and construction of its database.
- This operation is not only aimed at digitizing data but also figuring out minute errors that could be ignored on analog maps.
- Since people who understand the original meaning of topographical maps are the right

persons for the operation, skilled engineers can be assigned.

(2) Investing in equipment:

1) Maintaining and upgrading main equipment

- As described earlier, it is required to support new hardware and software in order to deal with the current rapid evolution of equipment (both hardware and software).
- At the same time, the introduction of new equipment must be also considered.

2) Maintaining and upgrading peripheral equipment

- Not only the equipment to be used for mapping and GIS but also its peripheral devices must be considered.
- The major items are input-output devices for databases and faster intranets in government office buildings. Since the equipment is normally required to handle increasing amount of data as it evolves, saving, moving, and using the data will be more difficult year by year unless the equipment is upgraded.

3) Maintaining and upgrading equipment donated by JICA

- As described in Paragraph 2-1, the equipment donated for this Study should be maintained and upgraded.
- The software and hardware must be upgraded to the latest version at least once every year. Leaving the software and hardware as they are for three or four years will make their functionality so obsolete, impeding thus to exchange data with or distribute data to other organizations.
- It is necessary to maintain and upgrade the equipment in order to develop national databases on your own in the future.

(3) Securing budgets

1) Budgets for maintaining and upgrading equipment

- As described earlier, the equipment (both hardware and software) is rapidly evolving. To deal with the evolution, you need to secure budgets so that you can support hardware and software in their newer versions.
- At the same time, it is necessary to keep track of new equipment and its necessity and to examine whether it needs to be introduced.

2) Revenue sources

- So far, the sales performance of maps has been managed inside IGN. However, when the Study is completed, the organization will be able to sell products that were not available before (such as GIS and orthophotomaps and the databases), increasing thus the sales.
- We propose that IGN assure part of the sales every year as budgets for the aforementioned maintenance and management.
- These revenue sources will prove useful as budgets for maintenance and management of the existing databases and as stepping stones to the next stage of development.

3.3.5 Examination of hazard map application methods and disaster prevention reinforcement

The residents in Guatemala, having experienced disasters due to Hurricane Mitch, have a high awareness for disaster prevention. In the field survey and interviews undertaken in 2001 and 2002, we felt that the residents are quite interested in disaster hazards. However, as time passes by or the residents move to live somewhere else, the experiences and interests on disasters will fade and the places flooded by Hurricane Mitch will be gradually forgotten. Then the disaster maps and hazard maps will allow people to review the hazards of a region.

The disaster maps and hazard maps created in the Study will be useful to develop land use plans, restricting land uses, and making evacuation plans. In particular, the urban planning and rural and agricultural planning sections are recommended to make the most of the hazard maps.

Municipalities, communities, and residents must be informed without using special terminology but easy-to-understand words assisted by public relation tools (such as posters, pamphlets, and signboards).

(1) Enlightenment for local governments and residents

1) For local government

The JICA Study Team explained about hazard maps to be created in the Project in a seminar on June 19 and 20 in 2003 for the local administrative organizations. Since the local administrative organizations, unlike national organizations, are not always staffed by disaster prevention specialists, the engineers at INSIVUMEH and other organizations should explain about disasters and hazard maps to the local administrative organizations in the future as required.

There is a limit to the structure-based countermeasures against a destructive natural phenomenon that will cause a disaster. They will not yield so many results in terms of cost efficiency. In particular, it is rather impossible to construct protective works over the nearly countless landslide hazard slopes. It is also just impossible to build large-scale banks to prevent floods on the rivers on the Pacific Ocean, which are close to their natural state.

On the other hand, the hazard maps may be used to mitigate disasters by not living and avoiding sophisticated land uses in places with high hazard, for example. Even people who have no choice but to live in places with high disaster hazards can evacuate to a safe location early only if a hazard map informs them of such a place in advance. Through the investigation, we learned that some people remained in houses to protect their household effects and lost their lives. When a disaster strikes, lives of people must take precedence over their belongings.

In some cases, development of farmland causes the vegetation in mountainous areas to be lost to promote the occurrence of floods and debris flows. The catchment area management concerns many fields such as environmental conservation, sustainable use of natural resources, and disaster prevention. For rivers with large catchment areas, forest conservation in the upper reaches will deter floods in the lower reaches. To implement such wide-area disaster prevention measures, the agencies in the local and national government must get together and coordinate with each other.

2) For communities and residents

It is highly probable that many among the general public do not know that the house in which they live or the farmland that they cultivate is located in hazardous areas and thus damages are worsened in case of disaster.

Therefore, it is important that the hazard maps created in the Study will be delivered or explained to communities and residents through national agencies or local administrative organizations so that people are aware of hazardous areas. It is recommended that, in a community not closely united, the leaders and caretakers be given a proper training to strengthen the organization.

It is an effective means of alleviating damages due to disasters to supply disaster prevention information to residents. Concerning part of volcanic eruption disasters, landslides due to rain, and floods, a phenomenon that causes a disaster may be noticed in advance. In particular, a hazard map has significant effects.

Since it is both very difficult and unrealistic at this date to relocate people living in hazardous areas, it is necessary to inform them of the danger of living in the current locations using the hazard maps. Furthermore, the inflow of new residents into hazardous areas should be prevented by taking an administrative measure to prohibit new dwellings in these areas.

To enhance the effects of hazard maps, it is necessary that the engineers of INSIVUMEH explain the hazard maps to residents using easy-to-understand words. It is also necessary that the hazard maps be explained in the field to the illiterates and people who have few chances of seeing the maps.

3) Evacuation planning using hazard maps

Not a few hazards in Guatemala have disaster causes that make evacuation difficult. The collapse of buildings due to unexpected earthquakes causes serious damages to people without giving them time for evacuation. Large-scale floods on rivers on the Pacific coast and fall of volcanic ashes are also wide-area disasters in which any evacuation is difficult. However, an early evacuation is extremely effective against flowage hazards among the landslides due to earthquakes and torrential rains and volcanic disasters. CONRED undertook an evacuation drill in villages around Pacaya Volcano. If a hazard map that informs the lapse of time is utilized in such a case, an evacuation drill based on an eruption disaster scenario will be possible.

(2) Example of Satiaguito volcano and Samala river

As an example of the use of hazard maps, we propose in this section the concept of disaster prevention using hazard maps in the Santiaguito volcano and the Samala river basin area. The utilization of hazard maps, involving many policy issues, must be thoroughly examined by national agencies. The example described in this section is illustrative only.

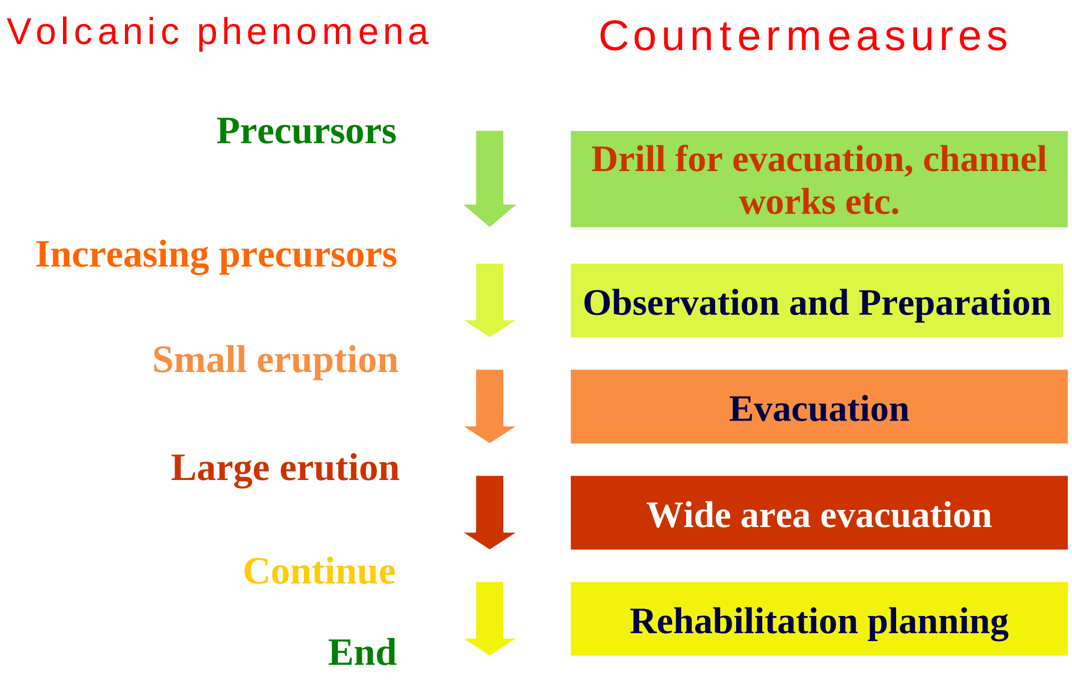

Figure 3.3-2 Sequence of volcanic phenomena and countermeasures

In Figure 3.3-2, the items on the left show changes in volcanic activity. The following scenario is assumed, although not all the volcanic phenomena occur this way.

① Precursors such as earthquakes or volcanic tremors occur.

② Earthquakes increase and/or the seismic center rises toward the ground surface.

③ Minor Vulcanian eruptions occur.

④ Sub-Plinian or full-fledged Plinian eruptions occur, followed by outflows of lava.

⑤ The active state continues for a while.

⑥ The volcanic phenomenon comes to an end.

Accordingly, the following countermeasures should be taken: During the inactive or precursor phase, preparations are made for a disaster through the holding of evacuation drills and/or the carrying out of river improvements. If precursor phenomena intensify, INSIVUMEH will intensify observation and the municipality and its residents will start preparing for evacuation. If a minor eruption occurs, residents will start to evacuate, beginning from the high-risk regions. If a major eruption occurs, wide-area countermeasures covering perhaps an entire department will be necessary. If, later, a major disaster should occur due to a major eruption, a recovery plan will be drawn up and implemented. This sequence of events is called the disaster scenario.

First, let us explain the concept of river improvement, something that can be done as things stand during a relatively inactive state. To the north of San Felipe, upstream from the junction with the Samala river is an area where debris from the Santiaguito volcano accumulates. It is necessary to build landslide prevention facilities there so that as much debris as possible is accumulated here. Waters merging with the Samala River makes the area from San Felipe to San Sebastian an area where debris is transported by the water, and where lateral erosion occurs. The water from the mainstream Samala River transports the debris coming out from Nimá II, and meanders erode the farmland beside the river. Here, bank protection works are needed to prevent lateral erosion.

The area downstream from San Sebastian constitutes a section of sedimentation and inundation. The sedimentation is causing the riverbed to rise significantly and the risk of flooding and lahars is rapidly becoming stronger over a wide area. In this section, in addition to river embankments, embankments and dredging to protect the towns and villages from lahars are also necessary.

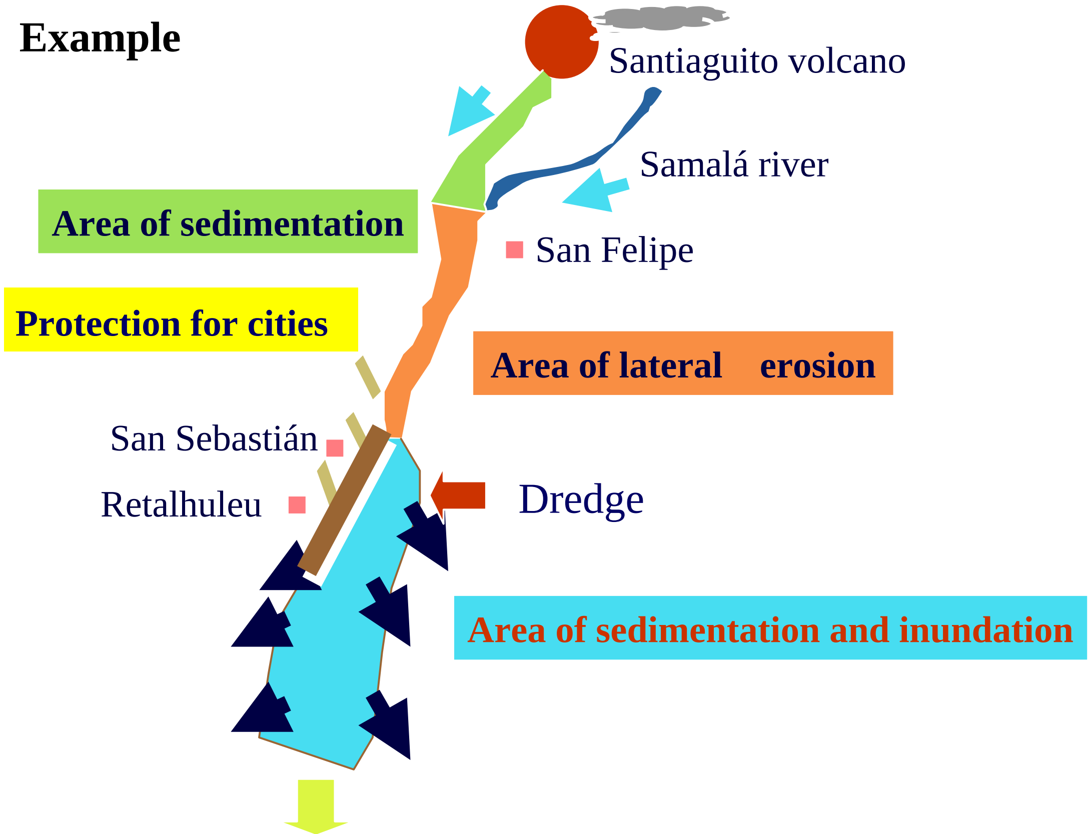

Figure 3.3-3 Countermeasures for Samala river channel

Next, we propose evacuation measures using hazard maps for volcanic disasters and flooding. Evacuation is essential to protect people from volcanic disasters and flooding. Based on the hazard maps, the following hazard zones, evacuation areas and evacuation phases were considered.

The areas of highest risk are the cinder risk areas and the lahar and flooding areas, where attention must be paid both to volcanic activity and downpours in the catchment area. These are the areas from which evacuation must start, and are designated as primary evacuation areas.

If signs of increased volcanic activity are observed, people living in areas at risk from pyroclastic flows, pyroclastic surges and debris avalanches must evacuate from them. Therefore, these areas are designated as secondary evacuation areas.

If the volcanic activity has become even more intense and a major eruption seems likely, people living in the areas marked on the hazard maps as areas at risk from fluid debris avalanches must evacuate from them.. These areas are designated as tertiary evacuation areas.

Figure 3.3-4 shows a proposal for evacuation areas based on the hazard maps.

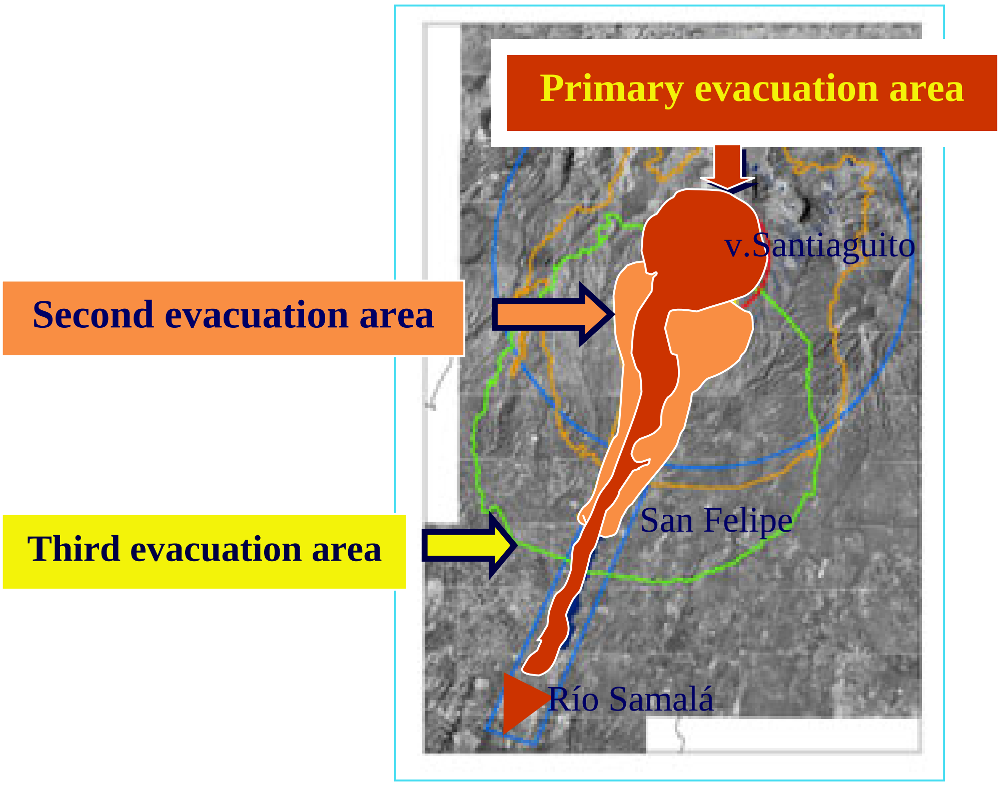

Figure 3.3-4 Evacuation areas based on hazard maps

Next, we propose land use restrictions using hazard maps. Restrictions on use of land are effective in minimizing damage in the long term. However, coordination with residents and land owners is not easy. Coordination may take time and, in some cases, result in a failure to reach an agreement.

The primary evacuation areas designated in Figure 3.3-4 are so dangerous that it is not appropriate to build houses in them, or use them as farmland. The secondary evacuation areas are at risk from pyroclastic flows and blasts, and the construction of houses or buildings should be restricted. However, it is possible to use it as farmland, where relatively less damage can be expected to occur in the event of an eruption. The tertiary evacuation areas may be used for houses and farmlands, but evacuation sites and roads must be provided for.

What I have described is a proposal made on the basis of the hazard maps created by the JICA Study Team. When countermeasures against disasters actually come to be considered, there are many problems that will need to be solved, including a consideration of construction methods, costs, the procurement of land, persuasion of residents and on disaster-prevention education.

3.4 Recommendations for project implementation of the disaster prevention plan formulation

3.4.1 Types of disaster prevention plans

Schemes for disaster prevention can be classified into three types:
(1) Extensive disaster prevention scheme in which neighboring countries cooperate with each other across borders, (2) National disaster prevention scheme in which one country plans and implements disaster prevention measures, and (3) Local disaster prevention scheme in which municipalities take the lead while promoting understanding and cooperation of local residents.

These types of schemes, with different scales, must operate in their own levels and interact with each other so that these entities can organically link up and achieve the main objective of "protecting people and their properties against natural disasters."

The following sections describe the representative tasks that these schemes are expected to play.

(1) Extensive disaster prevention (disaster prevention measures for a region across countries)

<Roles of organizations related to extensive disaster prevention>

- Exchange information and share experiences to alleviate damages that people in Central America may suffer due to natural disasters.
- Collect, process, and analyze scientific data across countries and integrate the results to prepare for extensive disasters.
- Provide citizens with education for emergency measures and create an international cooperation network.

Specifically,

* Holding courses, seminars, and expert programs
* Establishing scholarships for receiving technical training
* Collecting contributions
* Setting up common observation stations in the region
* Establishing economic and technical liaisons

(2) National disaster prevention (Disaster prevention measures for a country)

To protect people and their properties against damages caused by natural disasters, the national government needs to create systems including the basic disaster prevention policies, overall coordination of measures related to disaster prevention, and plans related to emergency measures during disasters.

<Roles of the government>

- Collection of information
- Emergency measures for disasters
- Emergency transport
- Procurement and supply of food and other necessities
- Evacuation accommodation activities
- Acceptance of support
- Disaster prevention drills in which local governments and residents work together
- Other (preparation of laws and regulations in terms of disaster prevention including, for example, priority aid to the vulnerable at the time of disasters)

(3) Local disaster prevention (disaster prevention measures for a locality)

To minimize damages caused by natural disasters, it is important to prepare for such disasters so that each citizen can protect himself. To this end, citizens must have accurate knowledge on disasters, develop a better understanding of the situation, and make preparations including checking the locations of evacuation sites and stockpiling water and food.

<Roles of a local government>

- Meticulous disaster prevention measures

  Cooperate with the locality to create appropriate prevention and self-defense measures for the sake of the vulnerable at the time of disasters such as senior citizens. Provide support to increase houses and facilities more resistant to natural disasters.

- Development of networks for distributing emergency information

  Develop measures for distributing emergency information and provide without fail information including opening of evacuation sites and evacuation orders to citizens. Provide means of cooperation between towns and villages or with neighboring cities.

- Enhancement of stockpiling and facilities related to disaster prevention

  Properly place facilities for quick responses and disaster prevention centers with a stockpiling function. Review evacuation sites and enhance the resistance of the first aid centers and public facilities to natural disasters.

- Enhancement of autonomous disaster prevention organizations

Aim at reinforcing the autonomous disaster prevention through disaster prevention seminars, disaster prevention drills, etc.

* Provide citizens with information using disaster prevention maps and hazard maps.
* Support the development of autonomous disaster prevention organizations and hold disaster prevention seminars.
* Distribute articles for autonomous disaster prevention.

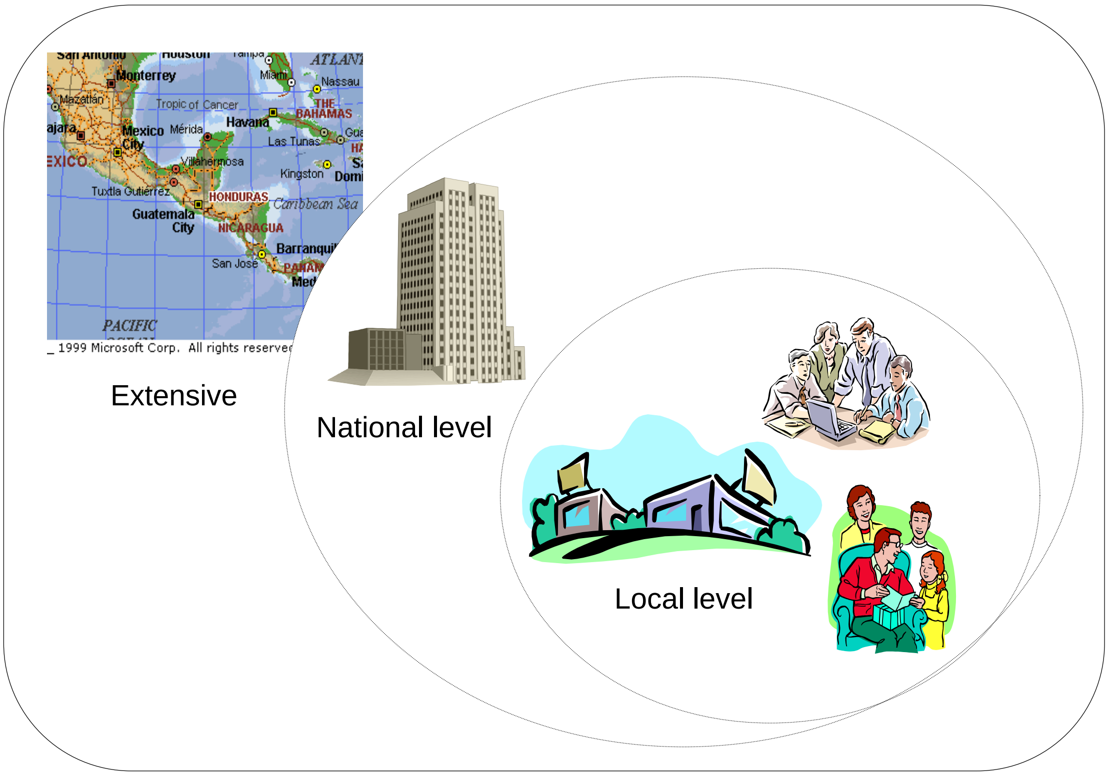

Figure 3.4-1 Disaster prevention schemes

3.4.2 Local disaster prevention and use of hazard maps

Table 3.4-1 Achievements of the Project related to hazard maps

Earthquakes：Guatemala City (1:50,000 scale), Quetzaltenango, Mazatenango, Escuintla, and Puerto Barrios (1:20,000 scale)
Volcanos： Santiaguito, Cerro Quemada and Pacaya volcanoes (1:25,000 scale) , Tacana volcano (1:50,000 scale)
Landslides：Guatemala City, Quetzaltenango and Antigua (1:25,000 scale) ,
Slope classification map for Northwest region (El Quiche, Huehuetenango, San Marcos) and Central region (Sacatepequez, Chimaltenango, Solola) (1:50,000 scale)
Floods：Samala Basin, Acome Basin, Achiguate Basin and Maria Linda Basin (1:25,000 scale)

The first step to local disaster prevention is to identify the location and nature of disaster hazards. The use of hazard maps is essential for this purpose.

A hazard map is a map showing specifically where and how target disasters are likely to occur.

For an efficient use of the hazard maps created in the Project, the "enhancement of local disaster prevention", directly connected to protection of citizens and their properties, represents the most importance of the aforementioned three levels of disaster prevention schemes.

This is based on the concept that disaster prevention can be promoted only if the local residents are well aware of disaster hazard locations and what to do when a disaster occurs.

Generally, a hazard map can be created in three steps, namely:

① Creating a map for experts through study, ② Creating a map for public administration based on the ① map, and ③ Creating an easy-to-understand map for education of residents based on the ② map and then distributing it to the residents.

The Project created four types of hazard maps, namely those for volcanoes, earthquakes, landslides, and floods. These are considered to be ① maps for experts, created in the first phase. In the future, it is important that INSIVUMEH, CONRED, and the local governments cooperate with each other to create ② maps for public administration, which the local governments can use to implement local disaster mitigation plans and measures and, ③ easy-to-understand disaster mitigation maps for education of residents, that allow the residents to understand the locations and nature of disaster hazards and take appropriate action when a disaster occurs. These maps need to be developed promptly.

INSIVUMEH is in charge of storing, processing, and analyzing scientific data while CONRED is in charge of emergency action and measures. While the cooperation of these two organizations is important, we recommend to continue creating and using hazard maps in cooperation with IGN that create topographical map and GIS databases, to be used as the foundation of map information, and with SNIG, a liaison and coordination agency for GIS in Guatemala.

3.4.3 Enhancement of functionality of the emergency action and measures organization

CONRED is in charge of emergency action and measures and assumes the role of national disaster prevention in one of the aforementioned schemes. On the other hand, some local governments and other organizations are not provided with sufficient systems or accumulated knowledge for local disaster prevention, in which case CONRED takes the initiative on their behalf, to act as a key organization in local disaster prevention in Guatemala in the future.

The tasks of CONRED include the aforementioned items listed as the disaster prevention measures for the country and for a locality.

To enhance the disaster prevention measures for the country, it is necessary to focus on the following items:

- ♦ Creating frameworks for sustainable development of disaster prevention measures:
  - Legal framework
  - Securing budgets
  - Definition of responsibilities to be shared among related organizations
- ♦ Making preparations at normal times:

  Collect and analyze data on natural and social conditions in preparation for influences from disasters.
- ♦ Securing the governing function:

  The scale of damages caused by natural disasters will expand under the influence of social conditions and human behaviors. Thus, make preparations so that the governing function will be efficient when a disaster occurs.
- ♦ Protecting people and their properties:

  Deal with the problems concerning supply and replenishment of goods and the social infrastructure required for them to protect people and their properties.
- ♦ Enhancing the socio-economic systems

  Since the fragility of social infrastructures leads directly to the vulnerability in case of disasters, it is indispensable to strengthen the socio-economic system in order to minimize damages.

On the other hand, we suggest to select a model area and to undertake a project so that the disaster prevention for the locality can be implemented normally.

Select a model area from the areas on which hazard maps were created in the Project and have CONRED create a local disaster prevention plan as an example using hazard maps. Furthermore, CONRED should work with a local government to carry out educational activities for residents in the target area.

It is important that CONRED cooperates with and instructs other local governments based on this implementation example, in order to actively implement the disaster prevention measures in the local level.

In conclusion of "Proposals for disaster prevention," we recommend that Guatemala launch at an early date the next project, "Community Disaster Management Project." CONRED shall be an implementing agency for this project with collaboration from Western countries and Japan, a country with a history of many disasters. Of course, the implementation shall be built upon all the products and technologies acquired in the Study.

MINUTES OF MEETING
FOR
THE DRAFT FINAL REPORT
OF
THE STUDY
FOR
ESTABLISHMENT OF BASE MAPS AND HAZARD MAPS FOR GIS
IN
THE REPUBLIC OF GUATEMALA

AGREED UPON BETWEEN

NATIONAL GEOGRAPHICAL INSTITUTE (IGN)

AND

NATIONAL INSTITUTE FOR
SEISMOLOGY, VOLCANOLOGY, METEOROLOGY, AND HYDROLOGY (INSIVUMEH)

AND

SECRETARIAT OF PLANNING AND PROGRAMMING FOR THE PRESIDENCY (SEGEPLAN)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GUATEMALA CITY
October 28. 2003

Axel Conrado Pellecer Meza
Director General
National Geographical Institute (IGN)

Kazuo Furukata
Leader
JICA Study Team
Japan International Cooperation Agency (JICA)

Eddy Hardie Sánchez Benett
Director General
National Institute for Seismology, Volcanology, Meteorology, and Hydrology (INSIVUMEH)

Jorge Mario Calville
Subsecretary of International Cooperation
Secretariat of Planning and Programming for the Presidency (SEGEPLAN)

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Study Team to Guatemala for the implementation of the 6th (final) phase of the Study for Establishment of Base Maps and Hazard Maps for GIS in The Republic of Guatemala (hereinafter referred to as "the Study") from October 14 to November 3, 2003, in compliance with the Scope of Work for the Study, which was agreed upon by the National Geographic Institute (hereinafter referred to as "IGN"), the National Institute for Seismology, Volcanology, Meteorology, and Hydrology (hereinafter referred to as "INSIVUMEH"), the Secretariat of Planning and Programming for Presidency (hereinafter referred to as "SEGEPLAN") and JICA on August 17, 2000.

The Study Team held a series of discussions with officials from IGN, INSIVUMEH and SEGEPLAN to present and explain the Draft Final Report.
The attendance list is attached as Appendix 1.

The main items which have been agreed upon by both sides are as follows:

1. Draft Final Report

The Guatemalan side agreed upon the Draft Final Report prepared by the Study Team. After returning to Japan, the Study Team will complete the Final Report, incorporating the comments and requests for change submitted by the respective agencies.

2. Release of the Final Report and products of the project to the public

The 1:50,000-scale national base maps, GIS databases and various types of hazard maps shall be provided to the government agencies, universities and research organizations in Guatemala without charge under the conditions of each of the participant institutions (IGN, INSIVUMEH, SEGEPLAN) of the study. The products will also be provided without charge for technical cooperation projects implemented by the Japanese government in the future if a request is made through the appropriate procedure. As for other requests made by the private sector in Guatemala and by international aid organizations, all products will be provided at a cost.

3. Request for the provision of equipment and software

The Guatemala side (IGN, INSIVUMEH) made a request to the Study Team for the provision of the equipment used for the technology transfer and actual data compilation to the respective agencies. The Study Team promised to convey this request to the JICA headquarters in Tokyo.

Appendix I

List of attendance

IGN

Axel Conrado Pellecer Meza

General Director

Mario Raúl Ocheita Rivas

Sub Director General

Mario Gerardo Fernández Hernández

Project Advisor

Giovanni Lara

Director Advisor

Mauricio Tavico Leguarca

Geographic Study Division Chief

Ronal Vinicio Robles Pereira

Geodesy Division Chief

Jorge Enrique Mansilla González

Photogrammetry Division Chief

Marcos Osmondo Sutuc Carrillo

Cartography Division Chief

Victor Hugo Mansilla Castellanos

Cadastral Division Chief

INSIVUMEH

Eddy Hardie Sánchez Benett

General Director

Enrique Molina

Geophysical Investigation and Services Units Leader

Fulgencio Garavito

Climatic Investigation and Services Units Leader

Otoniel Matías

In charge of Volcanology

Manuel Mota

Geophysical Investigation and Services Units

Pedro Augusto Tax

In charge of Hidrology

Luis Santos Galindo

In charge of Hidrology

SEGEPLAN

Juan Antonio Flores

Deputy Director of Bilateral International Cooperation

Ricardo Miyares

Coordinator of GIS Unit

Telma Leticia Ramírez de la Rosa

Consultant of International Cooperation

Study Team

Kazuo Furukata

Leader

Satoru Tsukamoto

Sub-leader / Disaster prevention plan

Daisaku Kiyota

GIS / Structuralization Supervision

Noboru Fukushima

Digital Compilation Supervision

Hiroyoshi Ishikawa

Flood Disaster Survey

Valerio Gutiérrez

Landslide Disaster Survey

Midori Oishi

Interpreter

OBSERVER

CONRED

Billy Pineda

Chief of the GIS unit

José Perreti

Assistant of Risk Management unit

JICA Guatemala Office

Antonio Ovalle

Cooperation Advisor

JICA Headquarter

Kenji Chujyo

Technical Advisor of JICA Headquarter