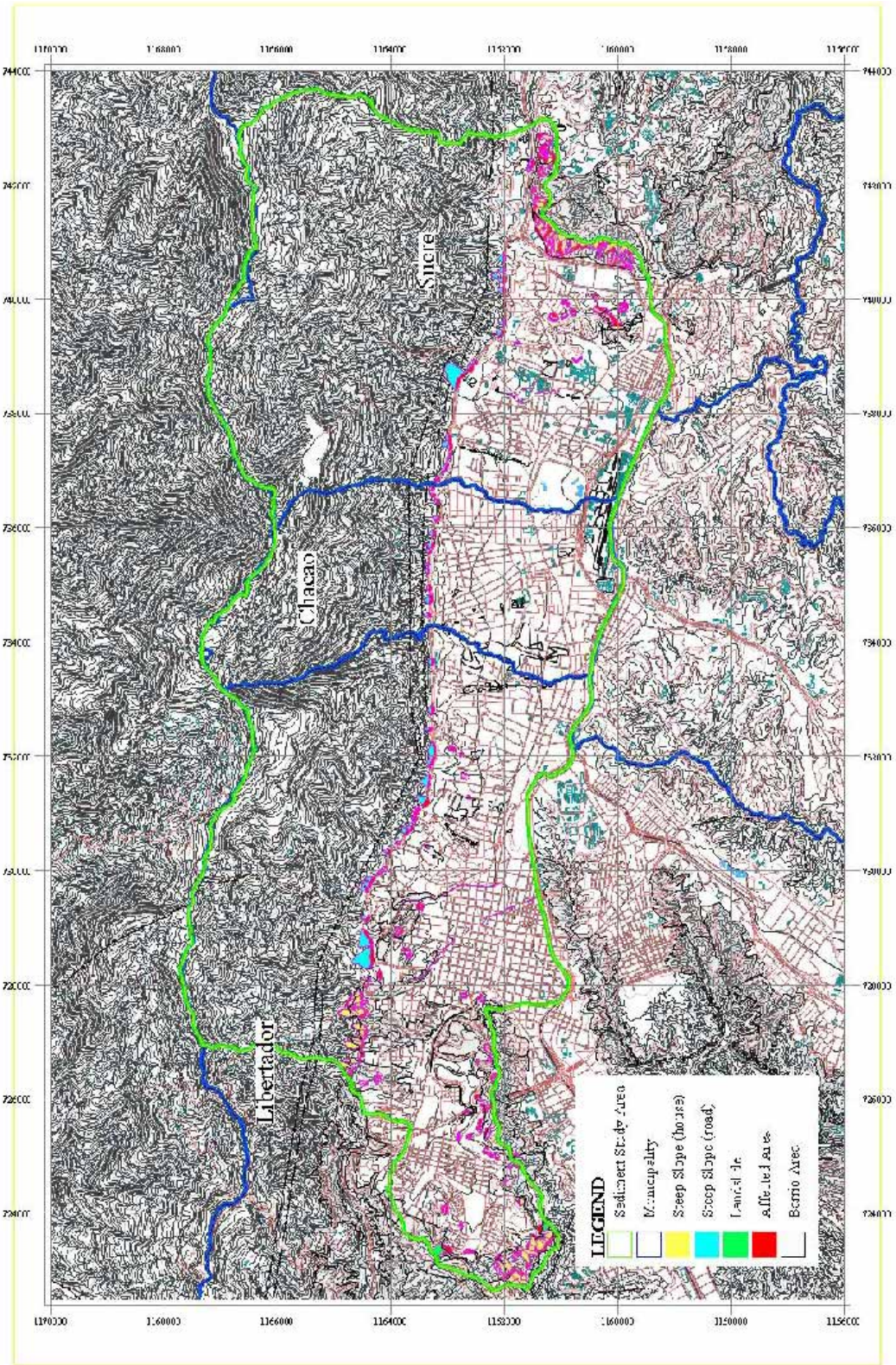


Figure 4.2.1 Hazard Map for Landslide and Steep Slope Failure (Whole Area)

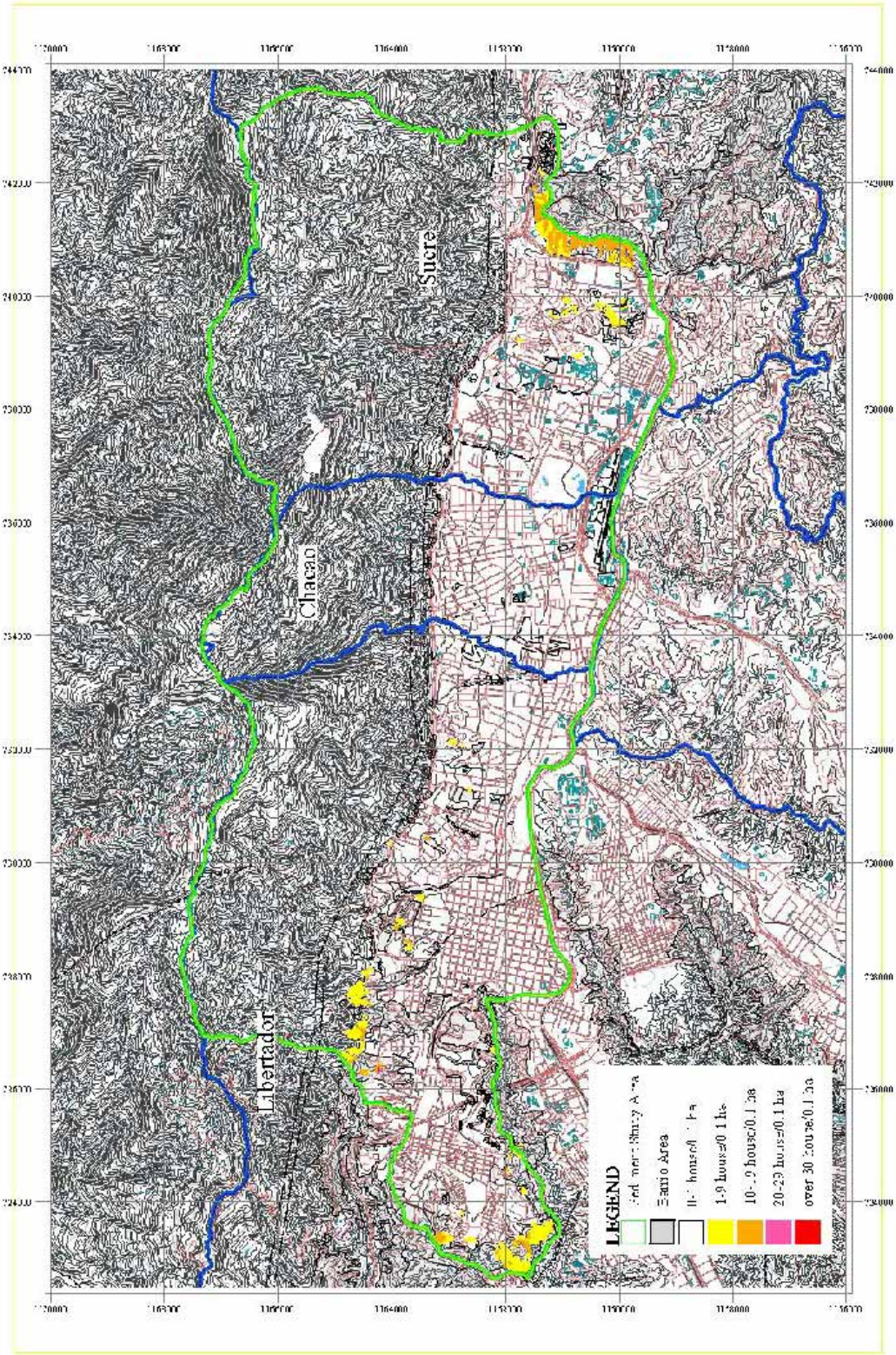


Figure 4.2.2 Risk Map for Landslide and Steep Slope Failure (Whole Area)

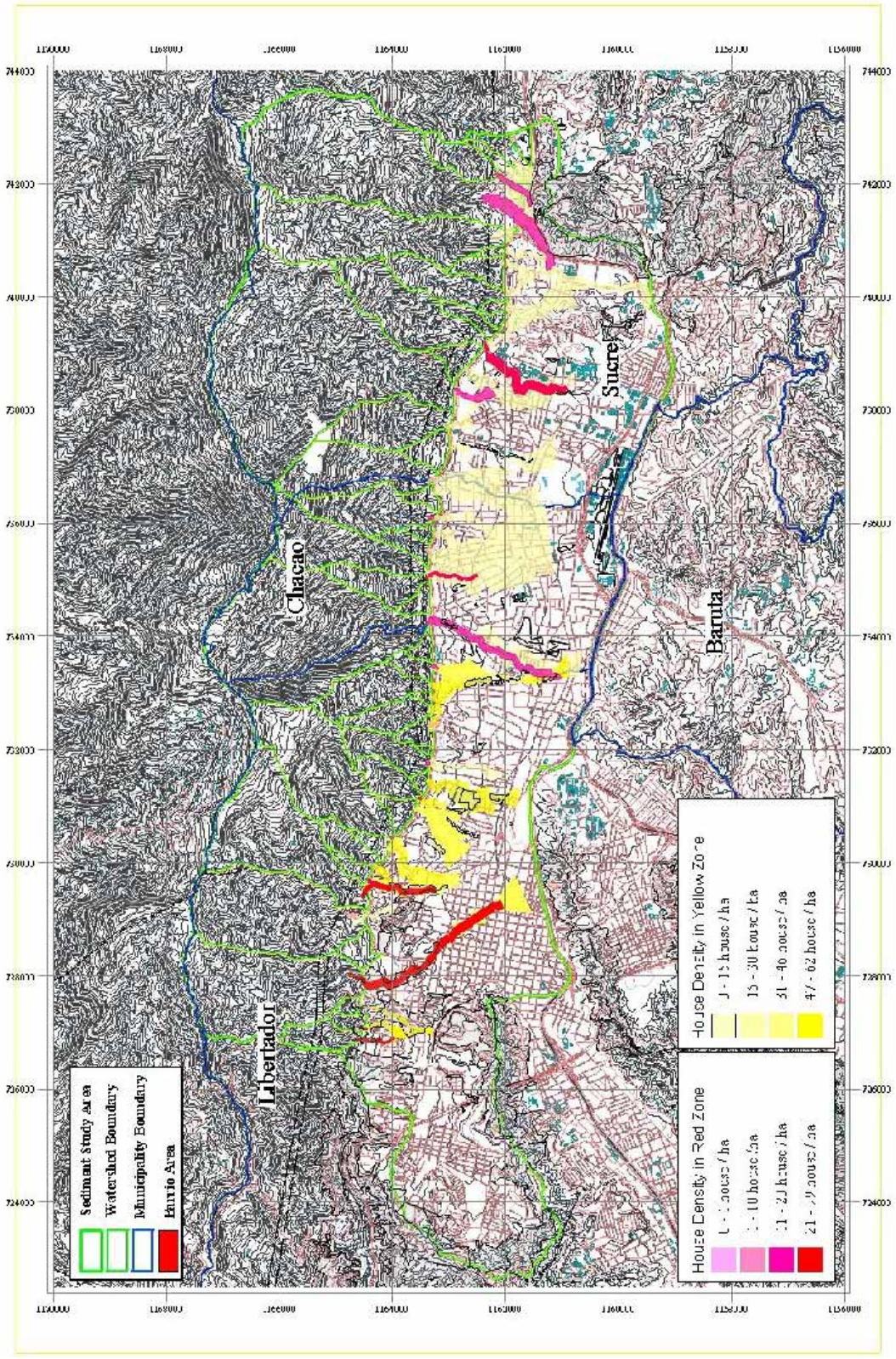


Figure 4.2.3 Risk Map for Debris Flow

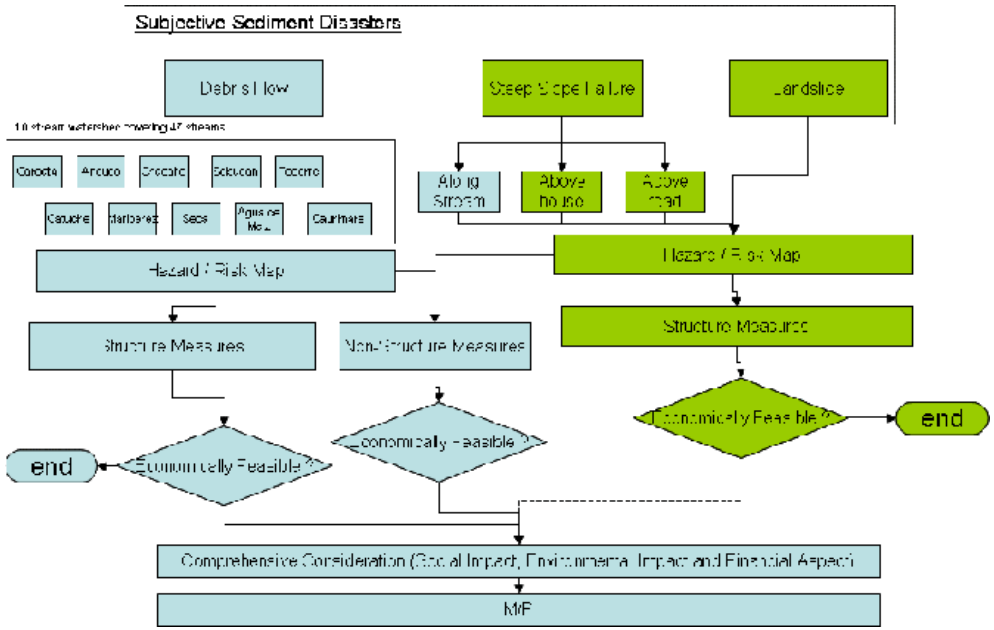


Figure 4.3.1 Principal Work Flow Diagram for Master Plan Formulation

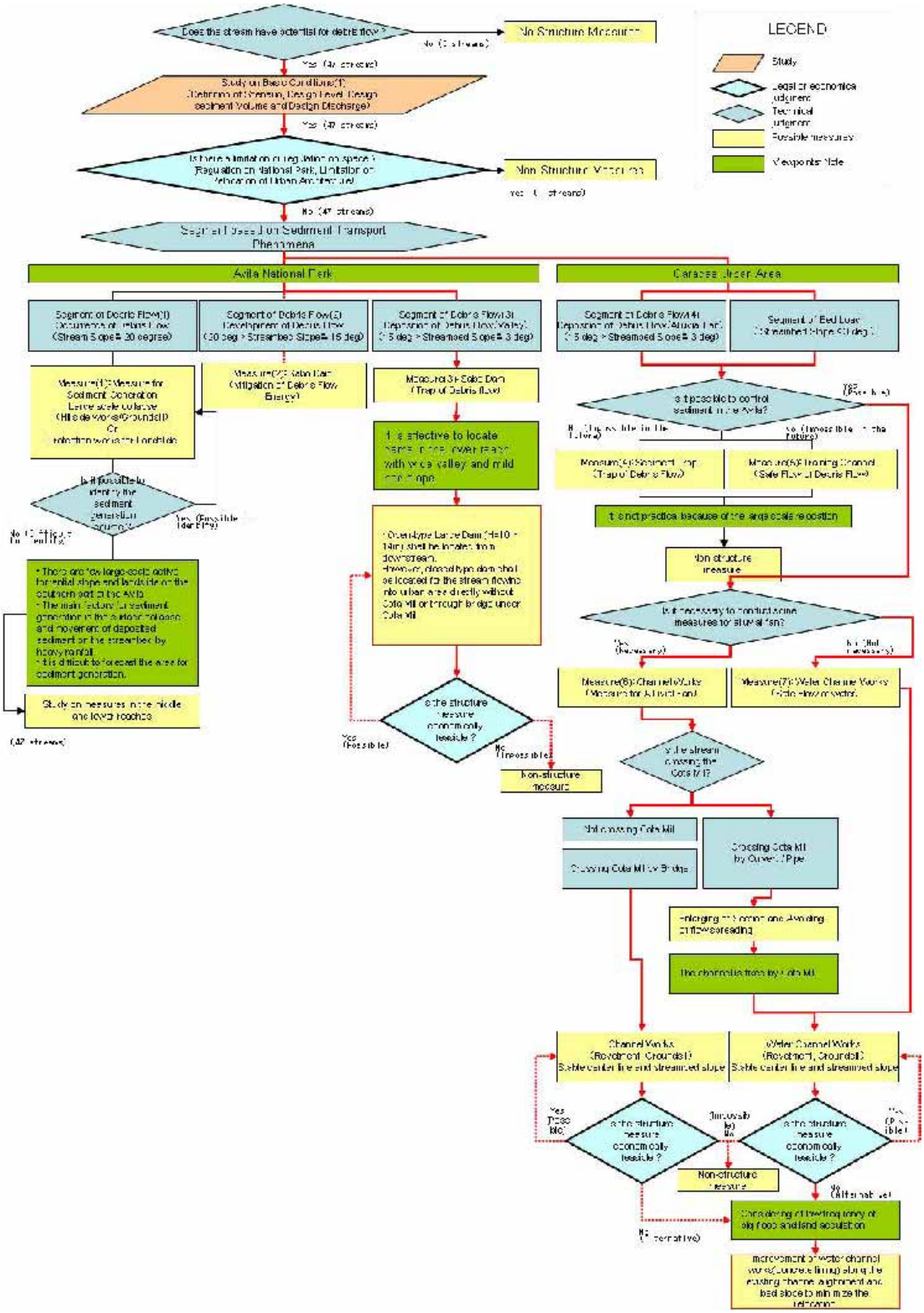
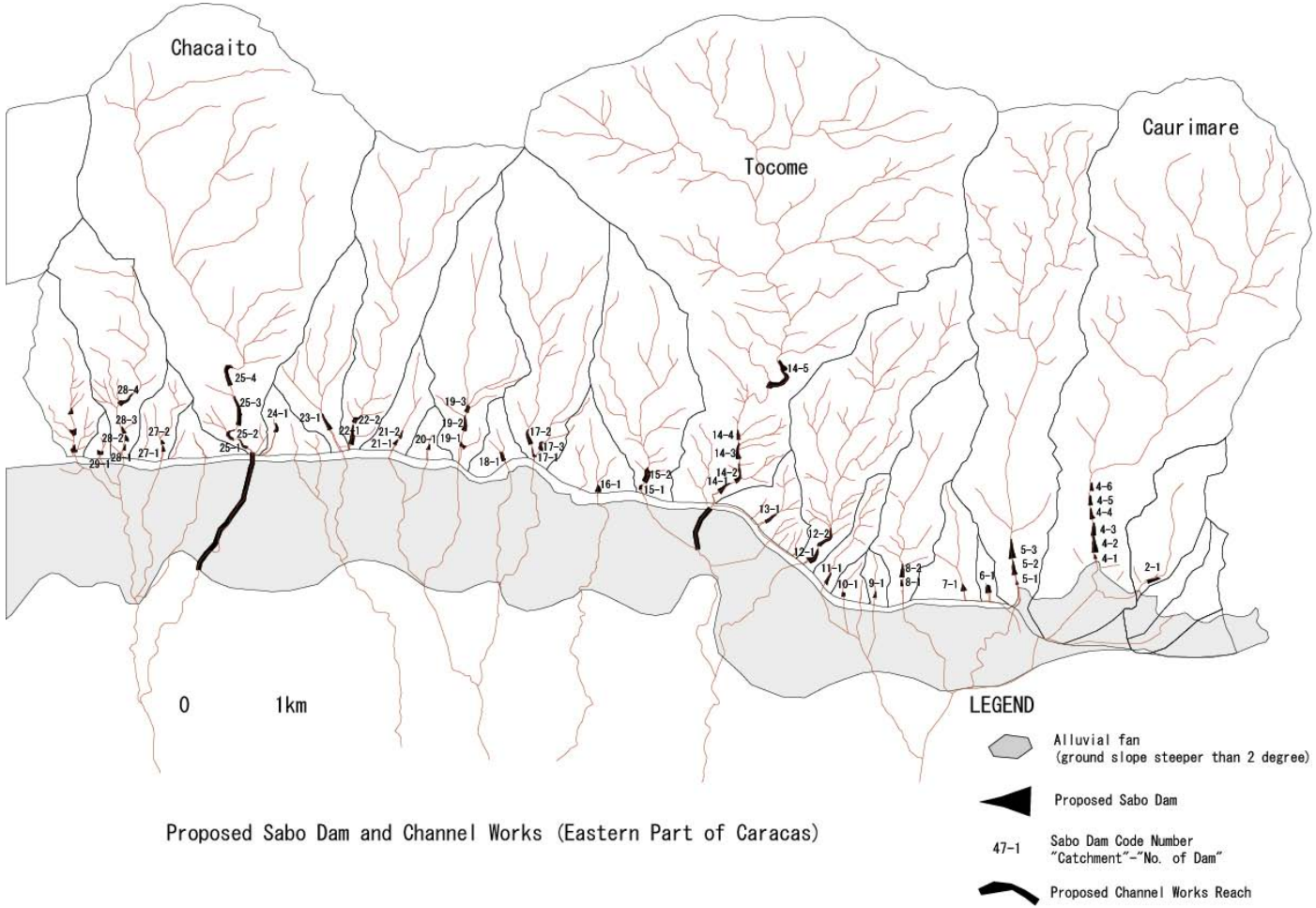


Figure 4.3.2 Work Flow Diagram for Structure Measures



Proposed Sabo Dam and Channel Works (Eastern Part of Caracas)

Figure 4.3.3 (1/2) Location of Sabo Dam

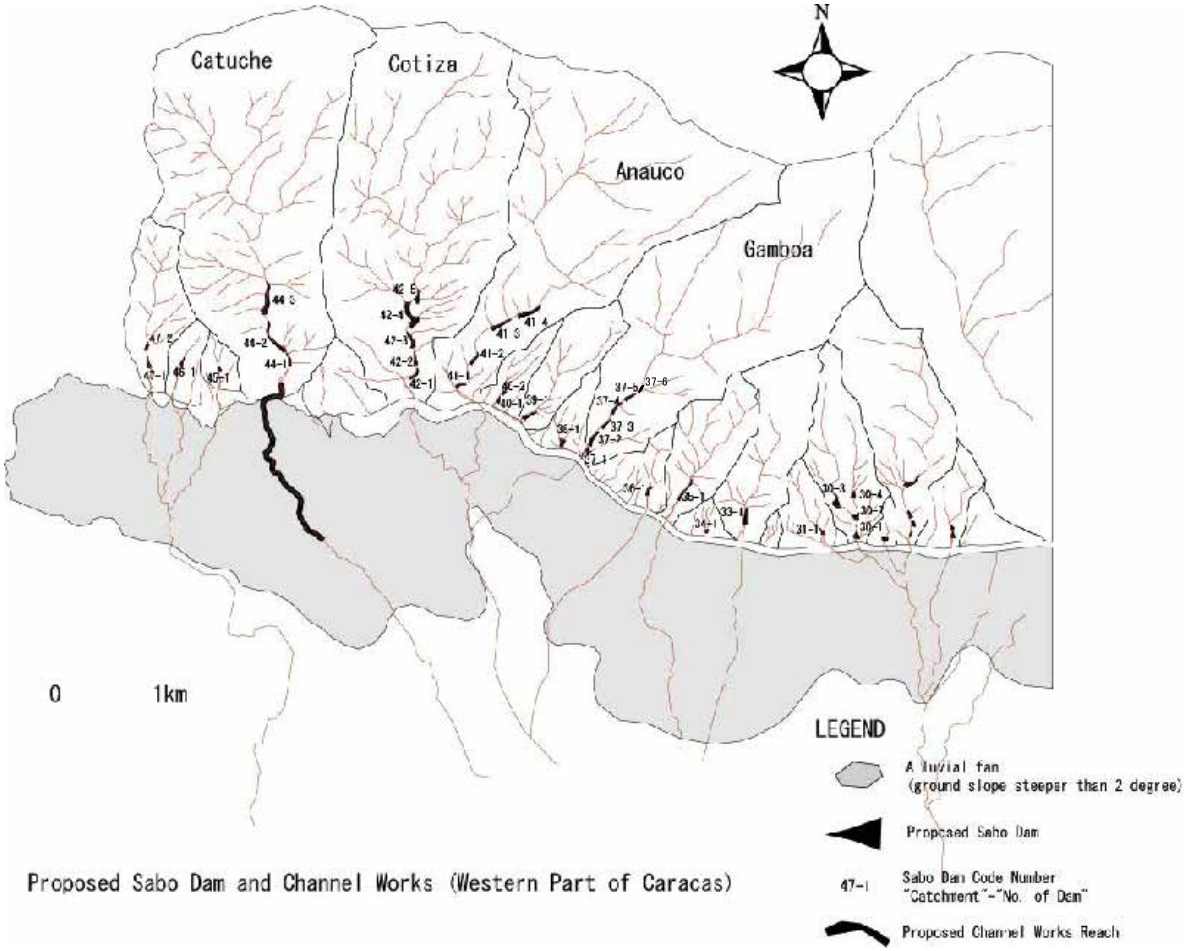


Figure 4.3.3 (2/2) Location of Sabo Dam

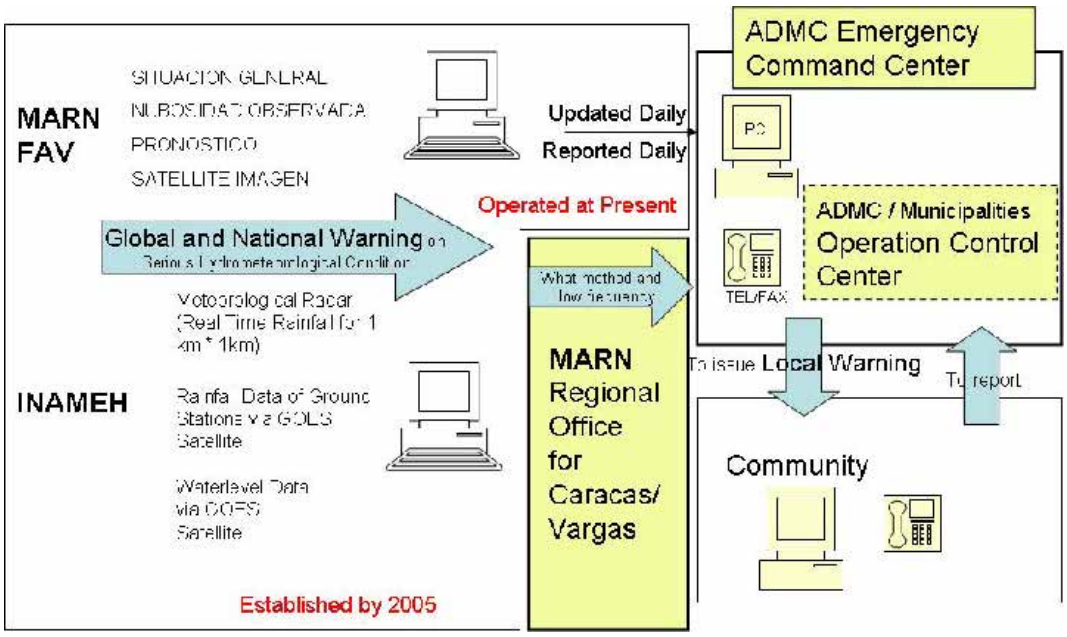


Figure 4.3.4 Position of MARN Regional Office in the Early Warning System for Caracas

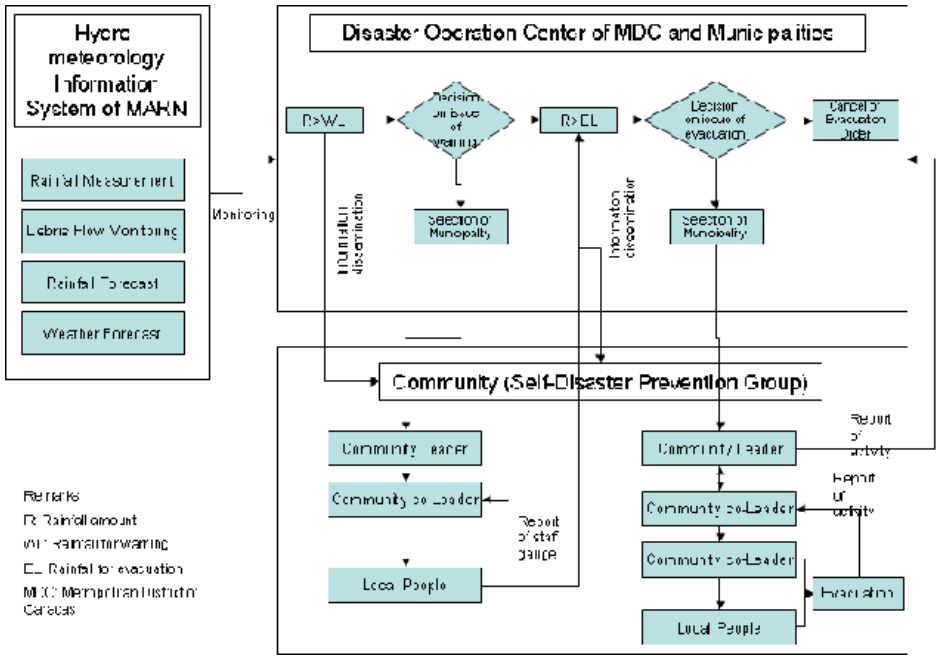


Figure 4.3.5 Proposed Information Transfer System for Early Warning and Evacuation in Caracas

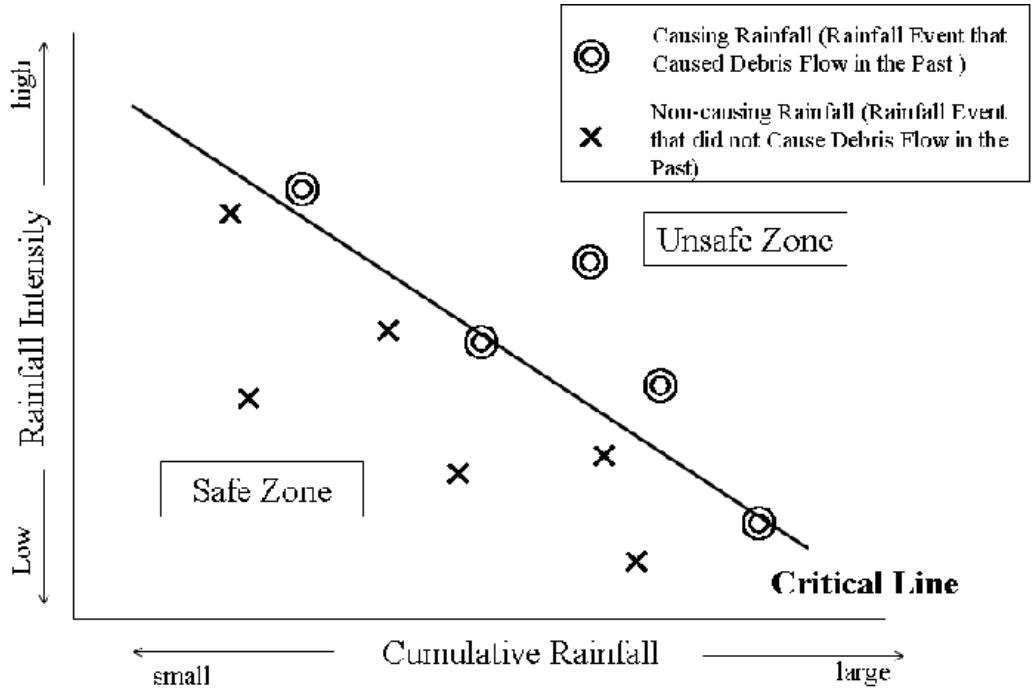


Figure 4.3.6 Concept of Critical Line

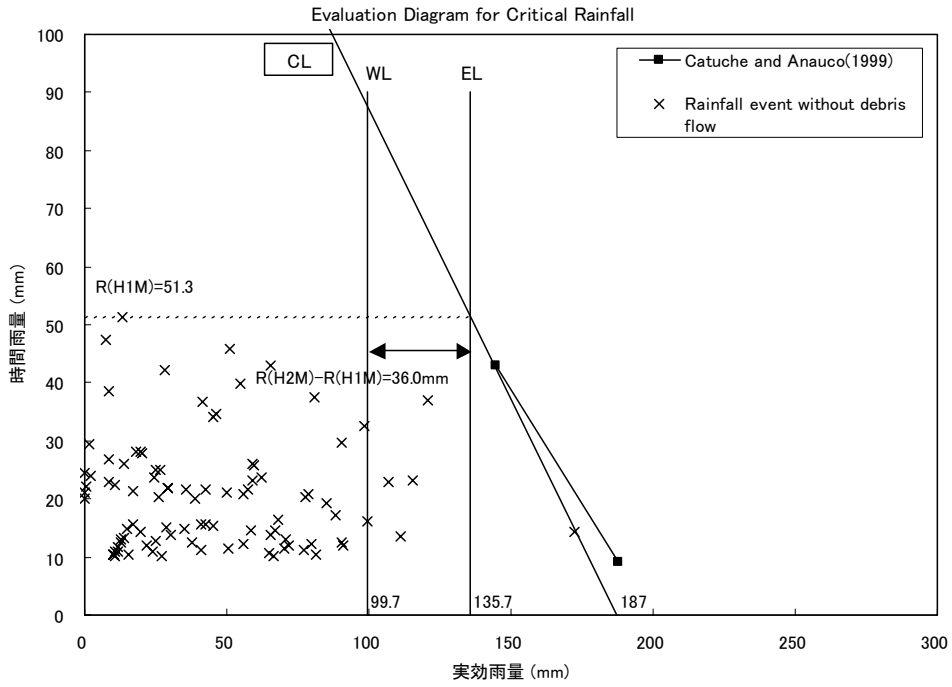


Figure 4.3.7 Warning Level and Evacuation Level for Caracas

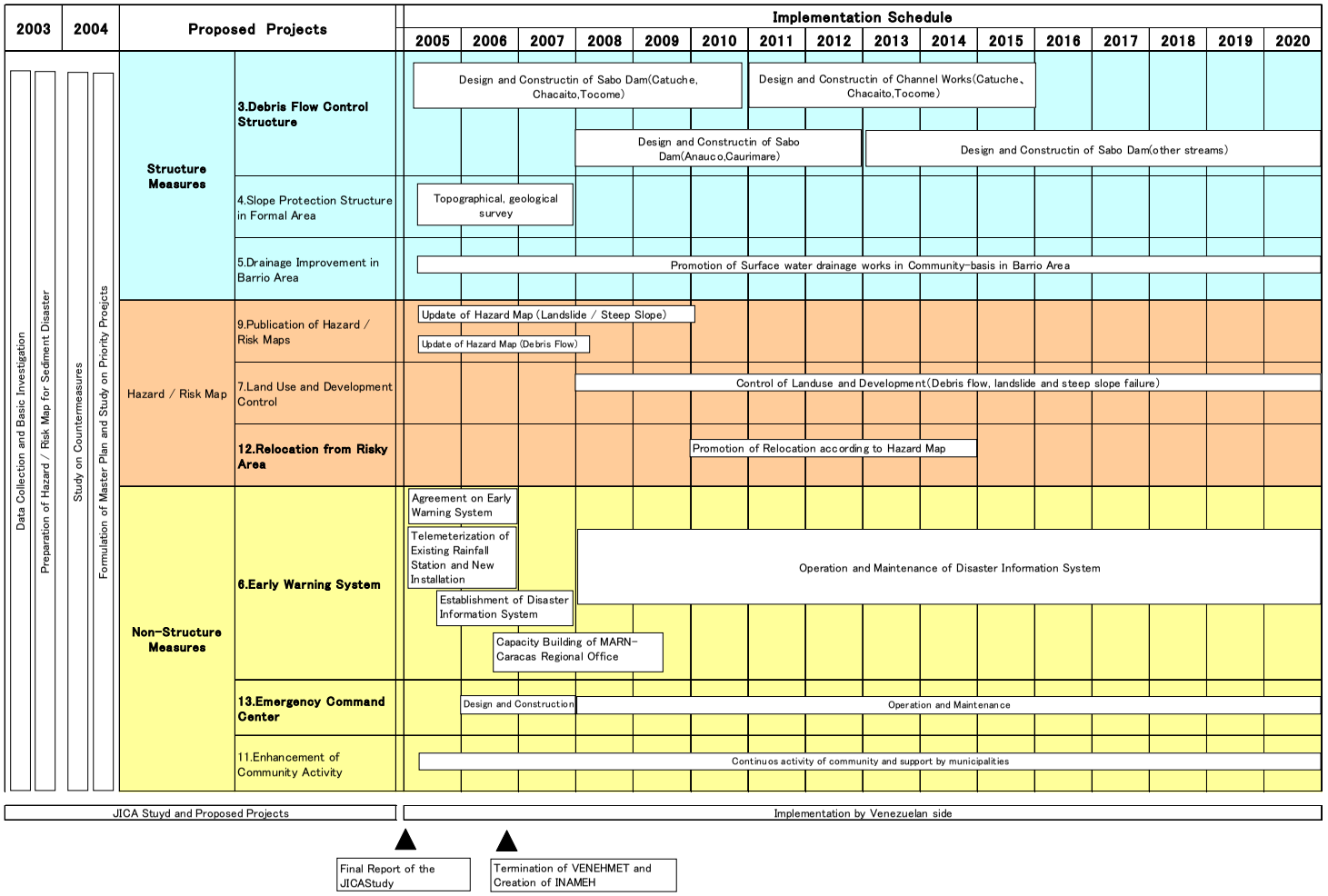


Figure 4.3.8 Implementation Schedule

CHAPTER 5

SOCIAL STUDIES

CHAPTER 5. SOCIAL STUDIES

5. 1 Legal and Institution Study

5. 1. 1. The Legal System Related to Disaster Mitigation and Preparedness

There are four levels on Venezuela's legal structure. At the top of the structure is the 1999 constitution is composed of 350 articles that cover far reaching aspects of government structure, peoples' rights, government obligations, and procedure. Under the constitution are the organic laws that set the framework for a particular subject area established in the constitution. At the same level are organic codes that formulate specific practices. The organic levels establish the guidelines for the ordinary laws that are found at the next level. The organic laws related to territorial management as most relevant to disaster management issues. Decrees with the force of law, which are statements of action taken by a particular government level, are also at the same level as ordinary laws. The bottom level is that of ordinances promulgated by the municipal councils.

Each lower level generally conforms to the laws or decrees made at a higher level. It is a hypothetical pyramidal system built in on the concept of concurrency. The legal structure of laws as it relates to disaster mitigation and preparedness is shown in Figure 5.1.1. The disaster prevention and response responsibility has been clearly decentralized in Venezuela. The Office of the Metropolitan Mayor pointed out that disaster declaration is in the hands of the city councils regardless of the actions of the national assembly.

5. 1. 2. The Structure of Laws Related to Citizen Safety and Disaster Management

There are many articles in the constitution, organic laws and ordinary law that relate to safety of the person, and the state responsibilities to address citizen security.

Additionally, the law that created the Metropolitan District of Caracas establishes certain governmental responsibilities including preservation of public order and the security of people and property; and civil protection and security and the preparation for emergency and disaster and providing services of the firefighters. In September 2003, the Alcaldia of the Metropolitan District council passed the Urban Guidelines Ordinance that establishes the responsibility for efforts in disaster prevention. These actions include: citizen education on subject of the disasters (Art. 74), Early warning systems and attention to mitigation measures (Art 75), information systems for disasters (Art. 76), and a general comment about disaster prevention, especially in barrio areas (Art. 77). On March 9, 2004, the same council issued a degree establishing a metropolitan disaster coordination committee for civil protection and administration of disasters which functions are:

- To plan, coordinate and develop activities with other governmental agencies and

- To provide and coordinate measures for prevention, education, and administration of disasters.

Thus, there is sufficient general basis for the departments and agencies of the metropolitan level to proceed with disaster mitigation and prevention activities on its most general form.

5. 1. 3. Institutional Arrangements

At the municipal levels, the civil protection agencies (institutos de protección civil) are located under a secretariat of citizen security, which usually also supervises the police and firefighters. In the national assembly there is pending legislation of a new law of risk management that could encompass citizen security as part of a broader concept of lowering risk to the people. To implement the existing laws there are many different agencies, ministries, and organizations that have partial responsibilities. A chart of these agencies and their relationship to the stages of the disaster management process is shown in Figure 5.1.2.

5. 1. 4. Inter Institutional Coordination

Better coordination will improve the institutional capacity for disaster mitigation and preparedness. Saving lives and lowering property loss is a function of the quality and quantity of coordination procedures among and between government units at any given time will result. The larger the disaster, the greater the number of governmental and nongovernmental are involved in emergency and disaster response at different times. This creates greater need for coordination.

Coordination takes three major forms: (1) within a an operating unit, such as a fire brigade, or a civil protection unit; (2) between units, such as fire brigades in different municipalities, and (3) between units that serve different levels of government.

Improving coordination is accomplished in two ways: strengthening informal and strengthening formal relations. Informal relations are improved more contact (face to face and in groups). For example joint training exercises that allow personnel to know their counterparts and the capacities of the counterparts in terms of disaster mitigation and preparedness helps in establishing the communication needed for coordination. Simply put, the different unit needs to spend more time with each other engaging in disaster simulation exercises, reverse role playing, and understanding the practices and cultural of counterpart units. Formal relations are achieved through adopting, signing, and entering into ordinances, service agreements and contracts.

The table below shows the strength of three types of coordination and improvement strategies.

COORDINATION FOR DISASTER MITIGATION & PREPARDNESS

	INFORMAL COORDINATION	FORMAL	SUGGESTED IMPROVEMENTS
HORIZONTAL Within Unit	Strong	Weak	Adopt ordinances for integration of effort
HORIZONAL Between Unit	Moderate	Weak	Use contracts, and formal service agreements, common model ordinances
VERTICAL Between Units	Weak	Weak	Use contracts, and formal service agreements, joint exercises, model ordinances

Ordinances for horizontal coordination are needed. They can be adopted at the level of the municipality. For example, each municipality needs to write their own risk analysis ordinance. The ordinance would require plan-parcial review of all environmental risk and this review would be conducted by a team from the engineering department, the urban planning department and the civil protection department. Ordinances can also require that the protection civil department at the municipal level establish along with the engineering and urban planning departments evacuation plans that are based in identifying and constructing life line roads.

Legal agreements can improve coordination. Legal agreements (convenios) between different units of government obligate them to provide certain services to each other. For example a metropolitan early warning system agreement can be written between the national environment ministry (MARN), the Alcade Mayor and the three municipal governments sharing a border with the Avila Mountain. This agreement would consist of services to collect information, and training to use the information once it is gathered.

There needs to be a series of mutual agreements (Acuerdo Mutuo) to provide support for specific activities. One needed activity is to develop and evacuation plan for three types of natural hazard events (sediment disaster and earthquake disaster). This mutual agreement will require coordination between at least four national ministries (MARN, MINFRA, SALUD, and INTERIORYJUSTICIA), the Alcade Mayor, and all municipalities.

The Metropolitan District of Caracas has a Proteccion Civil y Administration de Disastres (PCAD) Committee established by ordinance. It should be the main entity to manage the process and strengthen both horizontal and vertical coordination. Through the use of coordination many of the counter measures in the plan can be implemented if a general principle is followed.

5. 2 Rescue Operations / Medical Service

5. 2. 1. Overview of the Response Mechanisms and the Health Sector

In order to measure an emergency impact and provide an adequate response, 4 levels were formulated where the situation is controlled using:

- Some resources locally available.
- All the local resources.
- Resources of superior administrative levels.
- Resources at the national level.

At each level, in accordance to the Disasters Administration and Civil Protection National Organization Law, three types of organizations face an emergency situation. The first is provided by the police and firefighters corps as organizations of primary attendance. The organizations of secondary attendance are all the public or private institutions that are requested to collaborate because of their degree of specialization and/or resources. And finally, there are the supporting organizations that can provide information and resources for the two former groups of organizations, in order to manage the emergency jointly[1]

Organizations of secondary attendance include Red Cross, NGO's, groups of volunteers. And supporting organizations include Ministry of Health and Social Development: MSDS [initials in Spanish] and the Army.

The responsibility of metropolitan civil protection is to obtain and provide support of medicines, materials and equipments supplies required by the organizations of primary and secondary attention.[2]

The Civil Protection and Disasters Management system has a national, state and municipal level. This system coordinates the work of different public organizations in relation to civil protection issues.

The health sector is constituted by a private, a public, and a military sub-sector. The public formed by multiple institutions that operate not in an integrated but in a disorganized way because of the decentralization process. The MSDS is ruling the health sector and has the responsibility of the formulation, design, evaluation, control and monitoring of the policies, programs and plans, and being the municipality level the executive entity.

[1] Gaceta Oficial. Ley de la Organización Nacional de Protección Civil y Administración de Desastres. Noviembre 2001.
[2] Ibid

At present, there is identified a technical committee of emergencies and disasters working to elaborate the plan for emergencies and disasters of the MSDS that will be as guidelines in activities related with the risk management in this sector. On the other hand, in the military health department, due to the characteristics of its organization, contingency plans are demanded and to be put into practice periodically.

5. 2. 2. Response Mechanisms and the Health Disaster Preparedness Program

(1) Planning and Technical Programs

1) Disaster Plans

a) Civil Protection

The CP has responsibility to obtain and provide support of medicines, materials and equipments supplies required by the organizations of primary and secondary attention in each level of the response (national, state or municipal) according to the impact of an emergency.[3] CP has to organize the response in each level and instances. But at present, from the national level to the municipal level there are no official documented plans.

b) Ministry of Health and Social Development

The Emergencies and Disasters Office of the Population Health Office has recently presented an emergency plan However, because of the decentralization process, most of the public hospitals are being administered by the ADMC while the MSDS has a ruling role, the emergency plan only considers a response of the medical institutions that are still under their administration or the ones that belong to the national government programs (Barrio Adentro, Popular Doctors´ Offices, Popular Clinics), without considering the major public hospitals administered by ADMC.

c) Hospitals

The hospitals only have emergency plans within their ordinary operating structure, which does not take in account situation of disaster event. There are not considered events in which the own hospital infrastructure is affected.

[3] Op cit. Gaceta Oficial

In May 2004, the MSDS gave instructions to the ADMC through a guideline to establish hospital emergency committees, which guideline includes some actions as part of a contingency plan and recommendation of the elaboration of hospitals for emergency evacuation drills.

2) Mass Casualty Management

a) Pre-hospital Activities

There are three main actors for the pre-hospital activities: Firefighters, Civil Protection, Groups of Volunteers and Community.

Firefighters

The fire brigade has a military-type organization structure, this guarantee a chain of command based on preparation and training with a fluid information system that enable planning to face disasters. Concerning the resources, this brigade has 25 rescue units and 40 fire trucks which would cover the needs for the next 5 years. As for firemen, the international average is 0.8-1 fireman/1,000 inhabitants, thus, we must have 5,000 firemen (2,300 firemen at present). Currently, according to the Fire Department, approximately 30% of the firefighters live outside Caracas. This means that in case of a disaster and if they are not in service, some time will pass until they arrive, which besides will depend on the good conditions of the roads to Caracas. As for the stations, according to the needs in Caracas, we have calculated 30 stations for the next 5 years (21 stations at present).

In relation to the ambulances, there is a deficit that is intended to be controlled with the unification of the service among fire department, public hospitals and CP. Since ADMC is in charge partially (central government is covering some liabilities) of the administration of most of the public hospitals, 21 ambulances are serving them.

Volunteers groups

There are groups of volunteers specialized in searching and rescue operations that are also trained to offer first aid and basic vital support. There are the approximately 90 groups of volunteers registered in the Metropolitan Civil Protection office.

Community

The immediate support of the community to help the victims in the event of disasters is empirical and it could be more efficient and effective by transferring the capacities of the more qualified actors.

b) Hospital Activities

Hospitals

Hospitals and ambulatories of the MSDS are located in Libertador. The major health centers are not equitably distributed and the effects of an earthquake would not be limited to only one municipality but would affect as a whole. At this moment, there is no information about the private heath facilities available.

Hospital network

The hospitals are not organized as a network for facing situations of disaster. Most of hospitals do not have disaster plans, and the supplies for emergencies are not considered.

Medical staff

The number of physicians is of 54,000 approximately in the whole Venezuelan territory and of 14,676 nurses.[4] It must not be considered just the medical personnel at the Caracas area but it is necessary to assure a good communication network to convoke the necessary personnel at the appropriate place as soon as possible.

Hospital facilities

Many hospitals are rather old and, many of them do not have ramps of access for evacuating the patients in litters, wheeling chairs, assuming that elevators could not be used for some emergencies.

Military

The military has the contingencies plan. They have personnel trained for evacuation, fire, communication, etc. They have identified the zones for the triage of the evacuees and areas to place additional beds on, separation of the patients according to the gravity of injury. The access is secured with the heliports and large peripheral zones which can be used in case of collapse of the infrastructure itself.

[4] La Salud en las Américas, edición de 1998, Volumen II, page 584

Municipalities

At the municipality level, there is an effort in Chacao. "Salud Chacao" is a program equipped with 4 ambulances and 2 vehicles to provide medical service to the neighbors and to attend any emergency in this area. They have 4 medical centers and one emergency room. In massive events, the Civil and Environment Protection Institute of Chacao activates the Risk Management Bureau in which are participating "Salud Chacao", the fire department, and the police. They have an agreement with private clinics to provide in case of emergency with 10 beds, including medical service for 48 hours free of charge.

5. 2. 3. Assuming Scenarios with the Existing Conditions

In the case of the 1967 scenario earthquake, it is estimated that out of 314,606 buildings and 2,740,381 inhabitants, there will be 10,020 heavily damaged buildings, 602 deaths and 4,306 injured people. The number of beds is enough but it is not clear whether it is possible to maintain the quality of medical service.

After an earthquake, it is possible that the small injuries, it means those that do not require admittance in a hospital, exceed the number of major injuries at a 10:1 rate.[5] In Caracas there are 8,876 beds[6] with the average occupation percentage of 53%,[7] which means that 4,170 beds would be available only in case no damage would occur in those hospitals.

The ambulatories (148, the majority in Libertador) can serve as triage and treatment centers for people with small injuries to avoid the saturation of hospital services.

The number of firemen is lower than optimal (2,300 present against 5,000 required) and some of them live outside Caracas. In the event of a disaster, where the vital communication lines are damaged, the number of victims is greater so that more firemen would be required but they would take more time to arrive. The CP coordination is really important because the participation of many other actors would be required, such as the Red Cross, the groups of volunteers, NGOs, etc.

Although the number of beds and personnel would cover the emergency needs in terms of quantity, it is not clear that the quality of service would meet the needs because there are external factors that would interfere with the response capacity.

[5] Op cit. SEAMAN, John
[6] www.msdm.gov.ve
[7] Ibid

In addition, communities do not have the capacity as the base of the pre-hospital response. Neither exist the appropriate number of firemen to link this first phase with the hospital response, nor the organization of the actors to face the disaster in a coordinated and integrated way.

5. 3 Education

5. 3. 1. Basic Policies for Education

Based on the analysis on the current situation of education for disaser management, the following policies are set.

- Existing education and training institutions must reach out to search and apply effective mechanisms of coordination to bridge the educational gaps in disaster prevention identified in this Study for all sectors of society in Caracas. Strenghtening and building upon local capacity, rather than creating new entities, helps to guarantee the stability and sustainability of the institutional and citizen's responsabilities on self protection.

- Disaster prevention inclsudes both short term education for optimal preparation towards unexpected events, and also mid and long term education and awareness efforts to reduce the existing conditions of risk affecting the majority of Caracas' population.

- Existing efforts and resources must be optimized. Multiplication of the current capacity for its continuation is a required strategy in all the disaster prevention education policies and programs.

5. 3. 2. Education Strategies

To achieve the policies described above, the strategies are formulated in sub-sectors: 1) higher and professional education, 2) basic, middle, and diversified education, 3) community education, and 4) governmental personnel education.

(1) Higher and professional education

The three subsets of programs are introduced, directed to a range of professionals related to buildings, policy decision making, disaster managers, professionals with emphasis in social components, and particularly professionals that form future teachers – educators of educators.

1) Sponsoring current initiatives of Disaster Manager Degrees
2) Development and refreshment programs for current academics, trainers, teachers and decision makers
    a) Updated applied teaching techniques:

b) Periodical city wide seminars:

c) Curricula revision:

3) Mainstreaming Disaster Prevention into Public Education Policies through Higher Education

(2) Basic, middle, and diversified education

Proposed programs include school program revisions, training programs for teachers, training guidebooks for teachers as well as for student handbooks. Procedures have to be discussed and formulated to set into place a task group for establishing communication among entities involved in the Metropolitan District School System.

1) Key school related entities coordination in public education
2) Disaster related training for teachers and students
3) Curricula revision and update
4) Risk prevention and disaster prevention joint approach by the related agencies

(3) Community Education

Effective educational policies set by the responsible agencies such as Protection Civil require adopting a Strategy to Promote Education for Public, Community Promoters and Trainers Multipliers in order to increase population coverage, particularly in the most risky areas identified in the present study. Educational strategies should stress raising awareness of the potential hazards and current risks; urging the population to be prepared, targeting distinct population groups; techniques on how to act before, during and after events; and last but not least, how to reduce risk.

Figure 5.3.1 illustrates the contents of each sub-components.

(4) Education for Government Personnel

The Education and Training Program specified as Community Programs in the previous section also applies for the personnel of Civil Protection, Figher Fighters and the counterparts participating during the discussions. The holistic approach explained previously in Figure 5.3.1 has to be included as well in the curricula of government workers related to disaster prevention. The institutional strengthening of education for disaster prevention requires careful building of a collaborative agenda. This can take various forms and setting different task groups by shared concerns or issues is a good way to keep the organizations involved. Some meetings can include discussions with university and technical institute's representatives.

Others meetings and/or task groups can discuss the formal school programs at municipal and ministry level education departments, to broaden the analysis and adoption of measures for education planning.

5. 3. 3. Public and Mass Media Dissemination

The production of information for public distribution shall adopt specific means: 1) Mass media spots for TV and radio announcements for raising awareness to the whole population, 2) Multimedia, such as setting up websites, topic specific videos or power point presentations for the use of community leaders to disseminate education within their neighborhoods, and 3) Community booklets with suggestions on activities, tools & resources, best practices and course announcements are among the most recommended written tools to raise awareness to broader public. Suggested topics are:

- Techniques to identify and reduce risk such as building rapid inspection, and simple tools to improve physical building conditions in barrios.

- Memory refreshing icons of past events (both for earthquake and sediment disasters) in most vulnerable areas or sites.

- Community-built risk maps placed in public places, with regularly updated plans.

5. 3. 4. Education Programs and Measures

In education sector, programs shown in Table 5.3.1 are propsed based on the following criteria and target population.

1) Criteria for Education Projects
   - Significance and urgency
   - Effective social impact
   - Sustainable capacity
   - Multiplying capacity
   - Broader coverage
   - Optimize existing structures

2) Target Population for Education Projects
   - Disaster Managers
   - Teachers and trainers of teachers and trainers
   - Risk reducer professions
   - Youth and children

- Community leaders, particularly women
- Institutional staff and decision makers

5. 4 People's Organization for Disaster Prevention

5. 4. 1. Element of Success

The preferred strategies from successful experiences in Caracas shows that keeping the organization ongoing and the unity of people, is the most effective way to deal with disasters. The elements for success proposed by the Successful Social Study to consider in disaster organization are summarized as follows:

- keep the memory of events in daily lives
- Include risk reduction in community development agenda
- Minimize institutional vulnerability by reducing dependency or waiting
- Minimize conditions of vulnerability is a long term process
- Organizational process needs to be continuous and innovative
- Good communication is a key aspect as well as motivation, positive attitude, and hope
- Key roles of leaders: recognition, credibility, legitimacy, confidence

5. 4. 2. Institutional Policies for People's Organization in Disaster Prevention

(1) Sectoral programs

Institutions with sectoral programs have sponsored the establishment of local legal entities (health, environment or housing). Other structured programs are directly sponsored by preparation entities (such as PC, Red Cross or Firefighters). Network coordination among neighbors, neighborhoods, community/institutions, and among institutions, have yielded outputs.

(2) Legal framework

At least seven distinct laws referring to community level preparation and organization were found.

Table 5.3.1 summarizes competencies for People's Organization in Venezuelan legislation. Local entity are legally bound to adopt measures and develop activities in citizen protection, disaster prevention and fund raising for emergencies.

1) Alcaldias

Specifically, the Municipal Law stresses the obligation for Alcaldias to attend and develop civil protection and citizens safety programs. At the same time, the recently created Local Councils of Public Planning (CLPP) are entitled to establish Security Plans, develop safe local urban plans and to establish an emergency fund for disasters.

2) Neighborhood association

Neighborhood associations are legally bounded to take care of people's security and protection, specifically to organize campaigns and practices for people's and asset's protection and safety.[8]

3) Citizens

Finally the citizens are bounded to develop self protection measures, to be prepared and to follow agencies commands during emergency time.

5. 4. 3. People's Organization Models Sponsored by Agencies

The study has identified the existence of several disaster preparedness models in the neighborhoods of Caracas. These are CAELs, Red Cross Community Preparation Program, Barrio Rehabilitation community based organizations such as Consorcios and Civil Association, Neighborhood Protection Committees, Municipal Protection Committees, and Rescue Volunteer Groups. The CAELs are models preferred by the Metropolitan District Authorities of Civil Protection, mostly present in Chacao Alcaldía sponsored by IPCA.

There are at least three preliminary sets of arrangements by which organizing tends to occur for disaster prevention, that is, top down, bottom up and horizontal approach, and third party intervention.

(1) Top Down approach[9]

The Law of Civil Protection establishes as one its goals, the creation of strategies directed to community preparation in order to guarantee the full use of potential of people, families and communities to face emergencies and disasters.[10] The steps recommended by Bomberos and Protección Civil for new groups or persons interested, are composed by a core of training contents referred to models and materials on specific.

[8] Reglamento Parcial No. 1. Asociaciones de Vecinos. Adjunto a la Ley Orgánica del Régimen Municipal No 4109, 1989.
[9] See "List of Manuals" Annex from Strategies for Disaster Prevention for Earthquakes Fundapris. Social Study Set 2004.
[10] National Organization of the Civil Protection and Disaster Administration Law, No 5557 13/112002 (Ley de Organización Nacional de la Protección Civil y Administración de Desastres)

The Metoropolitan Civil Protection Office has created Committees for the Actuation of Local Emergencies / known as CAELs –(a scheme originated from the Metropolitan Fire Department) as a community structure in charge of the tasks of prevention and preparation to face disasters in all their phases.[11]

(2) Bottom up and horizontal approaches.

Successful experience sharing are excellent tools that support information sharing and learning, with the advantage that language barriers, credibility and detailed examples on daily basis are available from first hand sources. Methodological strategies such as "farmer to farmer methodology", "training trainers", workshops for exchanging live experiences, to "community to community internships", are all methods utilized stemming from the basic concept that greater chances of replicability comes from community based experiences sharing processes. Communities benefiting from external support from Bomberos methodology are Anauco and La Trilla, in Libertador municipality, despite the fact that these communities do not use the name of CAELs as their true identity an identity.

(3) Third party intervention:

These are programs sponsored by agencies such as NGOs, national or international, religious or highly committed academic projects. Academic Agents doing field work can have the ability to transform technical information into proper material for communities.

5. 4. 4. Basic Policies

The goals to pursue with the people's organization is to provide tools, strengthen capacities and set procedures for citizens of Metropolitan District of Caracas to successfully protect their lives, families and assets in preparation for disaster events in Caracas.

The principles of people's organization include a bottom up approach, including 1) A community "motor" starts the initial work; 2) Networking and effective coordination among agents in communities as well as between disaster related institutions within municipal jurisdictions; 3) Exchange and sharing of resources; and 4). Strengthening capacity building and community building processes.

[11] Among the tasks of the CAELs it is mentioned gathering population data, identification of hazards, vulnerabilities and risks, the preparation of safe areas, drills and scenario building, support in preparation of actions during the response, such as evacuation of affected areas, and others. Martinez, W. Presentation on October 10, 2003.

5. 4. 5. Strategies

The following four strategies are proposed:

- Preparation of a Strategy for People's Organization in Disaster Prevention
- Disaster Preparation Program
- Disaster Prevention and Risk Reduction Policy Building
- Support Programs

5. 4. 6. People's Organization Program

The program is formulated as shown in Table 5.4.2 and 5.4.3, based on the following criteria:

(1) Principles for People's Organization Program

- Significance and urgency
- Bottom Up Capacity Building
- Optimizing existing resources
- Population coverage by diversity and particular needs
- Asset based: networking and capacity sharing
- Sustainability: Ability to create multiplying-effect over time

(2) Target for People's Organization Project

- Communities with greater building damage for Earthquake.
- Communities at risk in Sediment Disaster Scenario
- Most vulnerable social condition: (such as income and education level) as well as accessibility to support system

5. 5 Social Surveys

5. 5. 1. Social Survey in the Study

Since disaster is attributed to a combination of natural hazards and human systems (social structure and resources, dynamics of human behavior, etc.), it is important to integrate social aspects into the disaster prevention agenda. For this reason, JICA Study conducted three Social Surveys, which have individually specific objectives in accordance with strategy for community - based disaster management by empowering community autonomy and its ownership, which would reflect Disaster Prevention Plan of Metropolitan District of Caracas (See, Figure 5.5.1).

As primary step to investigation of pivotal factors of existing community of risk management, "Social Vulnerability Survey" and "Case Study of Successful Experiences of Social Risk Management" were conducted early in September 2003 for three months by sub contractors. First of all, Social Vulnerability Survey pursued existing social vulnerabilities and characteristics in 15 areas of Metropolitan District of Caracas. Secondary, Successful Case Study of Successful Experiences of Social Risk Management, specifically aimed at identifying key elements and capacity of community for better performance of risk management from past disaster experience in three local communities: Catuche, Anauco and La Floresta. As final Survey, "Pilot Study of Community - Based Disaster Management" was carried out in early July, 2004 for three months by sub contractors. The study were intended to function as selected feasibility study (F/S) subjects, 1) preparing early warning system and evacuation for debris flow, 2) promotion of reinforcement of risky buildings, and 3) promoting people to live away from risky area. In order to meet needs of JICA Study Team, participatory approach played extremely important role in the pilot study and five (5) communities were applied based on mentioned each F/S subjects considering urban and Barrio area to meet the study purpose.

5. 5. 2. Results of Social Vulnerability Survey

(1) The Setting and Objectives

Addressing disaster management, any type of vulnerability has roots in social-economic, political, and cultural aspects as well as physical aspects, under which complicated urbanization development of Caracas have appeared. The overall objective of the Survey is to identify different types of vulnerabilities that correspond with the urbanization process in Caracas, and thus includes human systems. For the Survey, the following points were specifically focused: 1) Socio-economic and livelihood characteristics, 2) Housing and building characteristics, and 3) Risk perception and behavior prior to disasters

(2) Classification of Social Vulnerability Zone

The survey area was classified into 15 zones in terms of urbanization process, type of land use, social class shown below.

	Name of the Zone or Unit	Decade developed	Predominant Land Use	Social Class
Urban Central Area				
1	Altamira –Los Palos Grandes- La Castellana	50-60	Residential	Medium-High
2	Campo Alegre – Country Club -San Bernardino-Los Chorros – La Florida – B.Campo	40-50	Residential	Medium- High
3	Casco Tradicionales – Casco Central – Prado de Maria – San Agustin – San José – Cementerio – Los Castaños – La Pastora	20-30	Residential - Commercial	Medium

	Name of the Zone or Unit	Decade developed	Predominant Land Use	Social Class
4	El Marqués – La California	60-70	Residential	Medium
5	El Recreo-Bello Monte – Los Caobos – Las Acacias – Los Rosales – Valle Abajo – Av. Victoria – Las Delicias – Sabana Grande – La Campiña	40-50	Residential	Medium
6	El Rosal-Sebucán-La Carlota – La Floresta	40-50	Residential	Medium-High
7	La Urbina - Montalbán	70-80	Residential	Medium
8	23 de Enero-Simón Rodriguez	50´s	Residential	Medium-Low
9	Caricuao - Valle – Coche	60-70	Residential	Medium
10	Santa Mónica – Colinas de Bello Monte - Vista Alegre – El Paraíso	50-60	Residential	Medium
11	Chacao - La Candelaria	20-40	Residential	Medium
	Slums (Barrios)			
12	Chapellín-Sarria	30-60	Residential	Low
13	La Vega		Residential	Medium-Low
14	Mariche		Residential	Low
	Suburb			
15	Macarao		Residential	Medio Bajo

(3) Summary of the Survey Result

Various social vulnerabilities exist in communities of the Metropolitan District of Caracas although the above analysis illustrated only one part of the Survey. The vulnerabilities are complex, fuzzy and not uniform, but they definitely affect people. The extent of social vulnerability varies from place to place. Although the vulnerable zones were identified, this doesn't mean the zones won't be fixed; they will have positional to improve the vulnerability to capacity by any kind of approach to tackle them in the future. And as seen in procedure for defining indicators, some biases are contained as a limitation. Therefore, the map needs to be used as output of quantitative results in correspondence with results of ethnography. In general, factors of vulnerability are considered as a negative part or problem. However, JICA Study Team is attempting to take advantage of social vulnerability factors as indicators of potentials to better the community, particularly for community based disaster management.

Findings on typical vulnerabilities are summarized below:

1) Cultural Vulnerability

- Knowledge from disaster experiences and awareness of risk through everyday life with disaster do not necessaryly direckt to risk management activity. And risk prepration knowlege seems to depend on types and frequendcy of happining risk or disaster. For example, local konwledge from experience of flooding or sediment disaster, the frequency tend to raise awariness for the preration in a way. However, earthquake disaster won't happned freqnenct in same area. Therfore, the past one time experince rarely situmilate enough preparation knowledge for another earthquake in particually comminity level.

- However, these factors could be improve by active social organization, solidarity, leader initiatives, knowledge through training in community, etc.
- Perception that it is somebody else's matter, which is distinct among higher social class and people with higher education.
- Belief that disaster won't occur since it has never happened so far.
- Attitude that taking action for preparedness and prevention is a separate issue from the great concern on disaster in barrios areas.
- Attitude that people only need to care about disaster after 5 years, and this is related to the issue of sustainability.

2) Socio-Organizational Vulnerability

- Lack of capable leader who can apply charismatic supervision
- Leaders and their approaches in communities are less integrated
- No agenda for disaster management in community
- Less consistent approach and method for disaster management
- Less interchange about disaster outside the community

3) Economic Vulnerability

- Lack of budgets for community disaster prevention work.
- Lack of access to essential preparedness resources including technology
- Economic conditions don't have practical influence on disaster management activities

4) Factors of institutional vulnerability

- Weak legal and normative regulations are counterproductive by duplicating roles among governmental organization
- Weakness or less effective institutional support from government
- Lack of institutional management in community
- Weak communication and collaboration work between community and government

5. 5. 3. Case Study of Successful Experiences of Social Risk Management

(1) The Setting and Objectives of the Study

Three communities (Catuche, Anauco and La Floresta) are well-known as precedents since they have worked for community-initiative risk management on disasters. The experience has proved their capability to cope with the disaster situation. The ultimate objective of the survey is:

- To identify elements which potentially could improve capacity for social risk management in the three pioneering communities in order to adapt the self-management systems to other communities.

(2) Findings

Obviously, each community is heterogametic possessing specific characteristics of reflecting backgrounds. However, this study attempted to clarify the common elements of successful experiences of disaster management in order to inquire way of dissemination to other community. Through investigation in the three communities, the following key elements and vulnerable elements in social risk management were identified.

1) Key elements

- Leadership is ultimately the key element for community organization on risk management in terms of solidarity, innovative challenge, diplomacy and sustainability for community organization.
- Everyday life with disaster arouses awareness of risk but doesn't directly affect knowledge on disaster preparation. Additional actions such as contact with knowledge technicians or spontaneously attending training for risk management by community people themselves puts risk management into community agenda as priority. As a result, these actions strengthen community solidarity and improve the quality of risk management.
- Multiple approaches integrated by internal organizations (such as Neiborhood Association), intermediate organizations (such as Consortium), and external organizations (like ADMC, municipality, local and international NGOs) collaborate with stakeholders to enable risk management activities to function in sustainable way.

- The communities had completed risk maps and recognized evacuation routes, as part of their own early warning systems in the communities. In addition, they set up roles with high priority in the community's agenda.
- The reputation as a well-organized community for risk management increased the community's confidence, which leads to future influence on other communities.
- There was learning by doing and diffusion of good practices like the interrelationship of the case between Catuche and La Trilla. A practical method for diffusion of community risk management activity was "Learning from Neighbors, Catuche".

2) Vulnerable elements

- Not all individuals are interested in disaster and its prevention management. People are diverse.
- Cooperation with external organizations sometimes bring about dependency and limitation on community risk management in terms of motivation, innovation and finance promotion.
- Individual enthusiasm and participation for community risk management easily disappear without any personal attention.

(3) Summary

Throught the case study, it was foind out that any kinds of vulnerabilities exsit in, even these three precedent communites, accoompannying with good elements for risk management. In other words, vulnerability and key element for better risk management seem like opposite sides of the same coin but also have possibility to turn vulnerability into good points by appropriate understating of the causes of the vulnerability. People in Catuche have recognized the key role of having organizational management power in the hands of community. Complex but spontaneous communities have adapted better beliefs, attitudes, and knowledge for risk management through interaction between stakeholders as well as by taking advantage of frequent disaster experience.

5. 5. 4. Results of Pilot Study of Community – Based Disaster Management-Improvement of Early Waning System for Evacuation in 12 de Octubre and Los Chorros

Through all community based early warning management in the pilot community, following factors were come up for expecting capacity of for better community-based early warning management.

(1) Understanding Own Community's Risk and Vulnerability

Every community members have responsibility to know and understand the neighborhood risky environment and condition where could occur floods or landslides etc.

(2) Establishment of Community Resource Profile

Community resource profile such as identified stakeholders, the role of emergency situation and diplomacy roles such as negotiation to governmental organization to get more supports or cooperation with other community is ultimately necessary from the stage of preparation. Beside, *contact telephone trees* within the community is to enable effective any information of risk or evacuation flow in the community.

(3) Community Map

Including evacuation route, shelter locations, risk and vulnerability area, responsible persons with instructions or possessing key, and locations of community organizations (Neighborhood Association, CTU and others), Disability persons needed with help etc.

(4) Registration of Information System

Community's own initiative and actions are enormously important for any case of community-based disaster management. By technical supports from related organizations, the community should develop and update community information including own censes. These preparation would be useful to become the data base in case of disaster, for registration of human data such as insured and missing people causes by flooding or other disaster would be management by community people as preliminary actor.

In the end, brief strategy is summarized below. According to each step, main actor's responsibility are shown as ★.

Step	Items for Setting up Functional Community – Based-Early Warning System for Proper Action (CEWS)	Governmental Intuitions	Community	Intimidate Group with facilitator skills
1	Identification the necessity and efficiency of CEWS in the targeted community	★★★	★	★★
2	Identification of Existing Community Organizations and its development toward Community Organization for Early Waning System	★	★★	★★★
3	Empowerment of the Community Organization in a topics of Leadership, Consolidation, Communication and Negotiation skills, Sustainability, Autonomy etc for CEWS.	★★	★★★	★★
4	Building up Strategy for CEWS based on Investigation in depth.	★★	★★★	★★
5	Implementation of the Strategy from no 1 to 4) and How, ? Methodology? materials? training?	★★★	★★★	★★★

5. 5. 5. Results of Pilot Study of Community – Based Disaster Management –Strategy for Earthquake Disaster

For those with larger investment in homes are equivalent to larger property loss, therefore greater likelihood to invest in mitigation of value loss if proper education and awareness is in place. Less investment implies less economic capability, therefore less likelihood to invest out of their pocket in house reinforcement.

Through the pilot study of reinforcement program, obviously an integrated approach which includes multi factors in terms of economic decision, the value of human lives and its belief, are social contexts, institutional framework and education processes were aroused. For the thorough lessons for community's understanding toward reinforcement program, corroborated multi- stakeholders from various backgrounds not only technical engineers but also soft side of specialists like community communicators, economist, sociologist, psychologist are necessarily joined as a project team. This multidisciplinary approach would guarantees in a way to take first action for the implantation of effective and efficient reinforcement projects for community.

5. 5. 6. Results of Pilot Study of Community – Based Disaster Management – Strategy for Relocation of Community from Risky

(1) Institutional intervention

The difficulties that have had decisive effect in the success or failure of a policy, taking in consideration the experiences, in favor of the relocation and/or reinforcement housings programs of the urban neighborhoods consider several aspects:

- Formulation of policies relevant to administration of settlement of immigrants, how to treat with people living in the risky area, the provision of the right to live or land ownership to those living on the risky area.
- Establishment of the institutional arrangement for relocation of the community and implementation of the relocation projects, including budgeting
- People's participation in planning and design process of the relocation project. Otherwise, people will oppose the relocation plan.
- Transparency in use of finance for the project.
- Mutual trust between people and government is a prerequisite for the relocation project to start, otherwise the project would not be started.
- Sustainability of the project by political will (advocate) and continuity should be maintained in spite of government's changes.

(2) Professionals

- Professionals for technical support shall spend much time with the community and understand the community's dynamism and work on the project as a partner of the community.
- Professionals will respect the community's participation in the planning, design, and implementation stages, and as open as possible to the community.

(3) Conditions on which people would move out of the risky place where they live?

The following aspects shall be taken into account for the barrio people living on a risky land to move in a voluntary way, otherwise the project would not succeed.

- If their housings are relocated within the same area o r near the community.
- If they are fully aware of the risk when living in a high risk area for the presence of the river.

- If it improves their quality of life. To change their houses for another more decent that offers them bigger security, when being located in safer places, far from the river.
- If it improves the surrounding area where they live. To endow the area with suitable and sufficient services, to create or to design amusement areas, of recreation, sport, community spaces, educational areas, health services, among others.
- If they will have access to a house of their own. The inhabitants of Los Lanos, won't want to change houses of their own, for others that are leased, rented or given in accommodate.
- If the community participates in the design of the relocation proposal. The design of the preliminary proposal and the actions to be taken should be elaborated in permanent consultation with the community.
- They won't be relocated next to inhabitants of other barrios of different and unknown origin, the neighbours are not willing to take the risk of the future coexistence with these inhabitants.
- If the community has control of the financial elements that intervene in the investment, they are willing to become participants of the rational use and control of materials for the construction of the houses.

5. 5. 7. Conclusion of the Social Surveys

The technocratic approach for disaster prevention often used in many places have served mainly to disguise the root causes behind much of the vulnerability of particular society to natural phenomena regardless of earthquake or devastating rain. The approach only focusing on technical analysis or by way of trial of developing high techniques have easily failed to reach efficient disaster prevention for human lives. Therefore, JICA Study dared to integrate social surveys with three major components into technical aspects. A social vulnerability map based on key indexes was created as a first trial. The second social survey, a case study of successful communities of risk management enabled to identify key elements as community capacity in targeted communities and also ascertained the process of change from existing vulnerabilities to preferable capacity of disaster management in community. As the third, pilot study of community-based disaster management applied for three topics, early warning system, reinforcement of risky buildings and relocation. It achieved to establish strategies for the implementation regarding each topic in terms of community and institutions in participatory way, and produced manual for community on disaster management (Reference, Data Book). Through involvement of the pilot study, targeted communities were empowered toward autonomous disaster management expanding link with certain governmental agenizes support of intermediate group. After all, all process of the social surveys set efficient methodologies to strength community

for disaster management, which absolutely key elements for civil protections or related agencies to work with community. To sum up, the indispensable factors for diffusion of community-based disaster management over Caracas are 1) existence of functioning community organization, role of nationhood association, 2) With leader with trust and skills, and 3) Communication and Negotiation skills and 4) Intermediate group which bridge community and government.

As the last remarks, the social surveys contributed to 1) provide vulnerability information reflecting human society and action, and 2) develop community empowerment for disaster management, and 3) explore dissemination methods including education and training for community for disaster preparedness and mitigation.

Table 5.2.3 Hospitals from MSDS and Other Organisms in the Metropolitan Area of Caracas (Libertador, Baruta, Chacao, El Hatillo y Sucre)

Municipality	Hospitals[1]				Total
	Type I	Type II	Type III	Type IV	
Libertador	2	5	6	9	22
Baruta	-	-	-	-	-
Chacao	-	-	-	-	-
El Hatillo	-	-	-	-	-
Sucre	-	2	-	1	3
Total	2	7	6	10	**25**

Table 5.2.4 Ambulatories Placed in the Metropolitan Area of Caracas (Libertador, Baruta, Chacao, El Hatillo y Sucre)

Municipality	Ambulatories[2]
Libertador	120
Baruta	9
Chacao	1
El Hatillo	5
Sucre	13
Total	**148**

[1] Hospitals Type I are located in populations up to 20,000 inhabitants, with a demographic influence area up to 60,000 inh. They have between 20 and 50 beds and are organized to provide services in medicine, surgery, pediatrics, gynecology and obstetrics. Hospitals Type II are located in populations with more than 20,000 inh., with a demographic influence area up to 100,000 inh. They have between 50 and 150 beds and are organized to provide services of major complexities than the previous level. Hospitals Type III are located in populations with more than 60,000 inh., with a demographic influence area up to 400,000 inh. They have between 150 and 300 beds and are organized to provide services of major complexities than the previous level. Hospitals Type IV are located in populations with more than 100,000 inh., with a demographic influence area over 1,000,000 inh. They have more than 300 beds and are organized to provide services of major complexities than the previous level.

[2] An ambulatory is the first level of health service, and it does not have beds which constitute the main difference with a hospital.

Table 5.3.1 Education Programs and Measures

Program	Strategy	Target Population	Measure
1. Professional and High Education			
1. 1. Professional Program to Certify by Competence	Reinforce and complete professional skills for currently hired Protection Civil Staff and Managers	- Staff from Protection Civil offices (100-150) -300 persons survey interested in Disaster Management Careers	i. Certification Program Establishment ii. Establishment of Higher Technicians in Emergencies and Disasters Program
1.2. Refreshment Programs and Curricula Enhancement with risk reduction approach for university professional careers	1. Provide experiences to improve skills for professionals in charge of forming new professionals 2. Inclusion of Technical Courses and Topics into curriculum for key university professions	-Professionals -High Ed Teachers -Academics -Decision makers	i. Exchange programs, internships and national level seminars ii. Study, lobby and reform curricula in professional careers like engineering, architecture, social communication, medical and social work to include risk reduction approach
1.3. Mainstreaming disaster education in teachers education	Raise awareness and promote mainstreaming of disaster approach for future teachers	All University Institutes and Pedagogical Universities	i. Study and proposal for program revision and improvement
2. Primary, Middle and High School Education Programs			
2. 1. Inserting risk and disaster programs in official school curriculum	1. Methodological and topic training in risks and disasters 2. Agreements among MECD, FEDE, ADMC, Municipal Alcaldias	Teachers in most risky areas	i. Curriculum review and proposal ii. Institutional approval and engagement iii. Training modules for teachers (Pilot, implementation, review)
2.2. Education materials for teachers and students	Production of methodological tools for teachers and students for classroom, home and community	20,000 teachers 500,000 students in Study Area	i. Training materials for teachers and students
3. Community Education and Operational Training			
3.1.Community Education Strategy	Policy strategizing and establishment for Protection Civil and related agencies	All agents involved in disaster education, as well as community groups	i. Study, production and implementation of educational strategy
3.2. Training Courses for creating multipliers and community facilitators in communities	Establish permanent educational modules for community persons, leaders, and groups	28 parroquias community groups and institutions, starting with those located in most risky areas	i. Modules on Operational Techniques, Pedagogy, Leadership and Community Development, Planning.
4. Media Programs for Disaster Preparat. & Risk Reduction	Create and disseminate information to general public	All City Population	i. Production and distribution of multimedia educational programs ii. TV spots and radio programs

Source: JICA Study Team

Table 5.4.1 Responsibilities Pertinent to People's Organization in Venezuelan Legislation

Law and Organizations	Responsibility
Civil Protection Law	- Must design permanent preparation policies for people's self protection and reduction of vulnerability factors; - Promote and develop citizen self protection
Fire Department	- Design and execute prevention, mitigation and preparation for emergencies and function as advisors and promoters
Municipal Law	- Mandated to work on civil protection and citizen security
Neighborhood Associations	- Promote campaigns & programs for protection of people and assets
Local Councils for Public Planning	- Set local emergency fund; people & assets security plan
Citizenship (Citizen Security /PC Law)	- Participate in self protection; readiness if required civil support
Ministry of Health & Social Develop	- Sponsor community organizing for social development

Table 5.4.2 Outline of People's Organization Projects

Concepts/Components People's Organization for Disaster Prevention Concepts
Support to Civil Protection System • Organization of appropriate structures or networks in most vulnerable areas • Technical and Institutional Support • Community Preliminary Diagnostic • Identification of initial motors • Inter-institutional coordination • Capacity building and transference • Standardized training modules with specific methodologies and approaches according to characteristics of target population
Support to Civil Society • Support directly work with populations through social organizations • Identification of capacities in the organizations • Direct support for civil organizations inserting risk factors into their development plans • Identifying development needs and their relation with risk management • Sustaining disaster prevention over time by facilitation and multiplying effect
Holistic Perspective • Identifying external resources/assets available (institutional, local, community spheres) • Risk reduction screening for development projects • Community motivation • Community prevention and risk reduction indicators
Building Community Capacity • Methodological tools • Identification of community resources • Creating appropriate materials for community needs

Table 5.4.3 People's Organization Projects

Program	Target Population	Measure
1. 1. Design and Pilot Strategy for People's Organization in Metropolitan District	Municipal PC Institutes, communities in risky areas, social groups and training entities	1.1.1. Strategy building and institutional lobbying
		1.1.2. Pilot Project implement Peoples Organizing Strategy
1.2. Policy adoption	28 Parroquia Sectors, Alcaldias & Alcaldia Metropolitana	1.2.1. Institute & Community Workshops in Alcaldias Adopt Preparedness Strategy. Program revision, update
2. Disaster Preparation Program		
2.1 Disaster Preparation Program	Groups and population in most risky areas, expand to all study area	2.1.1. Program Development in Sector, Parroquia and Municipal units
		2.1.2. Emergency Plans, Drills & Preparation
		2.1.3. Community workshops and networking for periodical revision and upgrading
3. Disaster Prevention and Risk Reduction Policy Building		
3.1. Risk reduction lobbying, planning & policy adoption	Neighborhood associations, CLPPs, Alcaldia, community networks	3.1.1. Work sessions, Workshops Seminars, Lobbying for Risk Reduction Policy Development
		3.1.2. Community workshops & networking for policy building risk reduction
		3.1.3. Municipal Seminars on Disaster Prevention Policies
4. Support Programs		
4.1. Institutional strengthening	Sectors, Parroquia and Alcaldias	4.1.1. Policy Development Support Program
		4.1.2. Evaluation & Monitoring
		4.1.3. Supporting Materials & Tools
4.2. Community & Municipal Database		4.2.1. Inventory of Vulnerability and Assets
		4.2.2. Computer equipment, programs, training

LEGAL FRAMEWORK
(CIVIL PROTECTION AND DISASTER ADMINISTRATION)

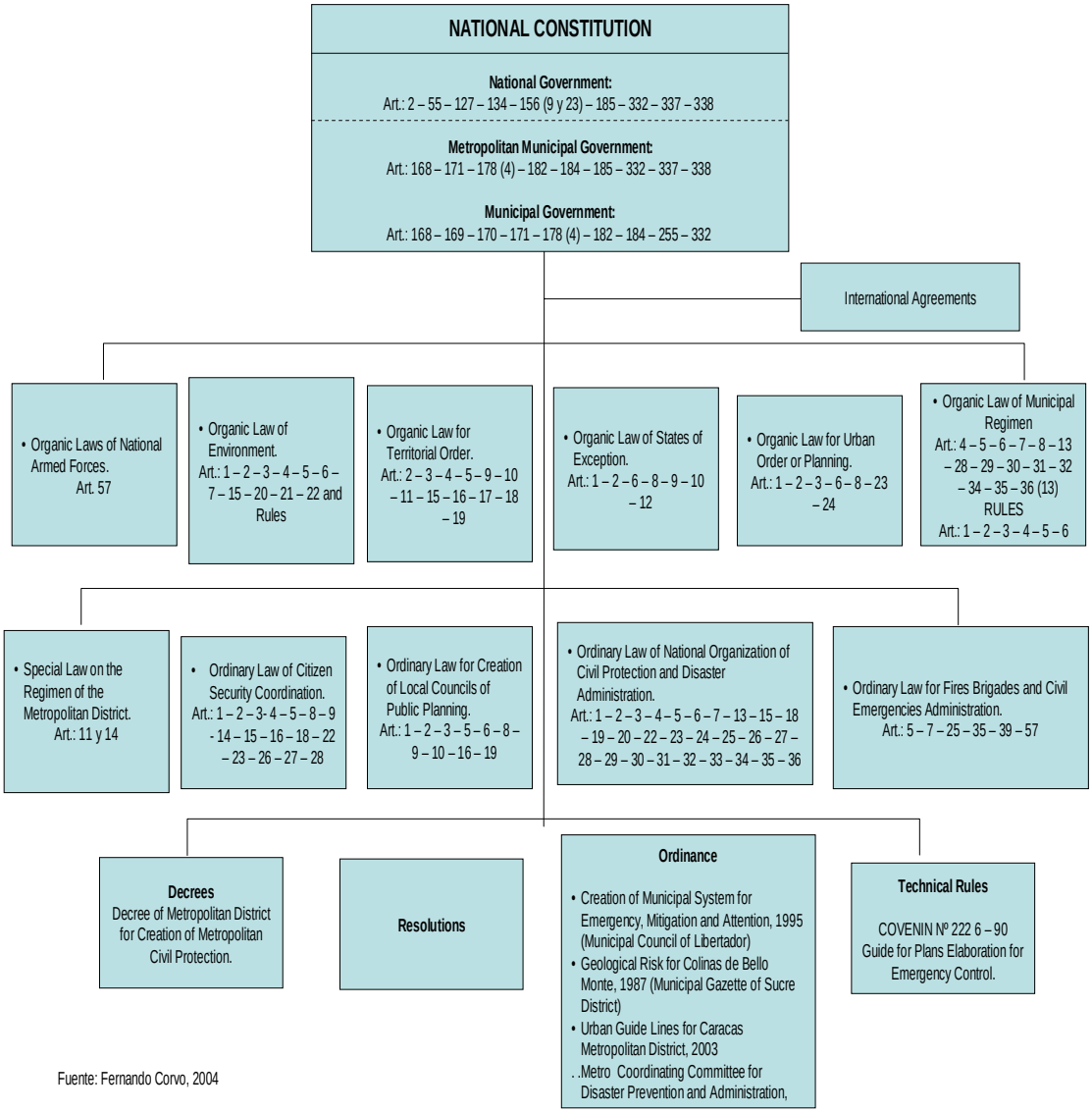
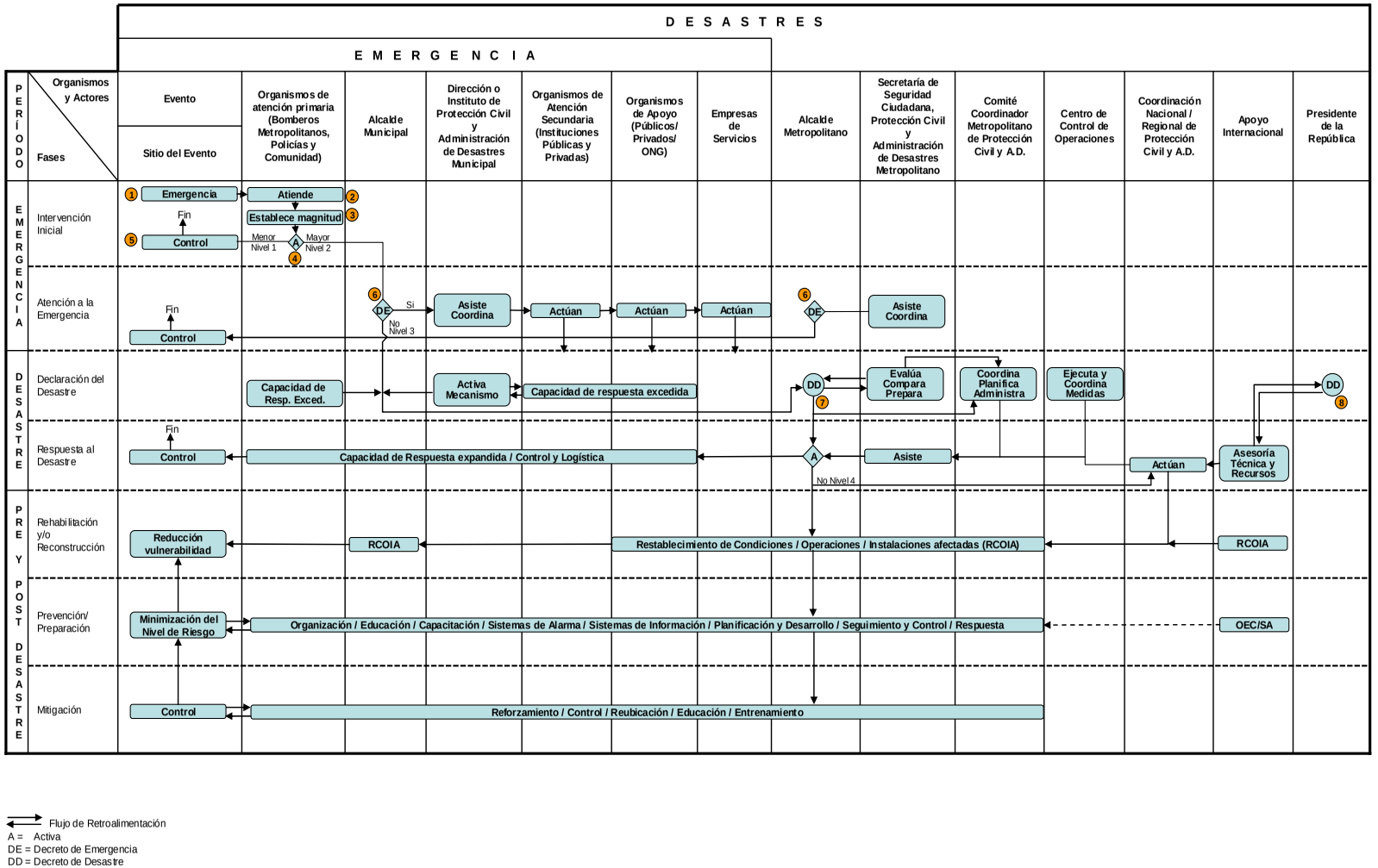


Figure 5.1.1 Legal Framework – Law Level

FLUJOGRAMA MULTISECTORIAL PARA EL MANEJO DE EMERGENCIAS Y DESASTRES EN EL DISTRITO METROPOLITANO DE CARACAS



Flujo de Retroalimentación
A = Activa
DE = Decreto de Emergencia
DD = Decreto de Desastre

Figure 5.1.2 Multi-Sectorial Flow Diagram For Disaster & Emergency Management

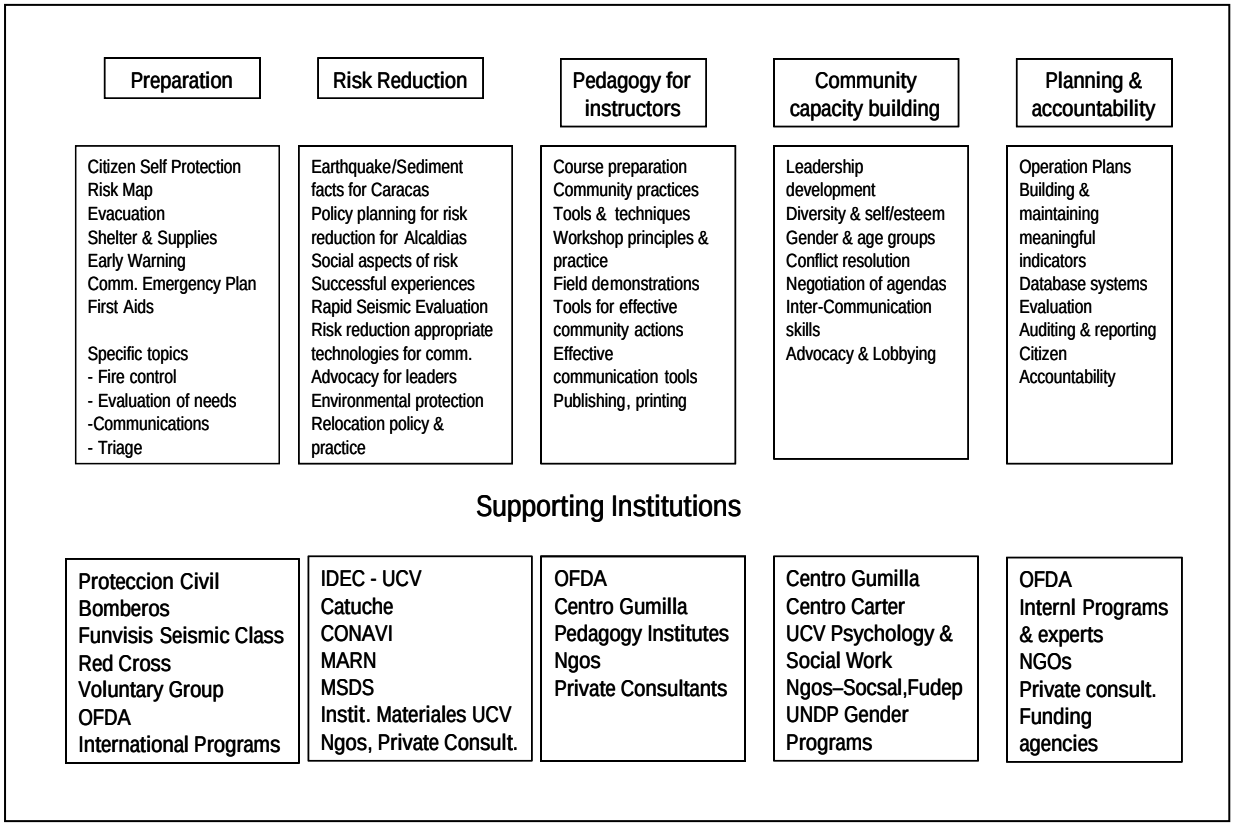


Figure 5.3.1 Holistic Approach to Community Training Program

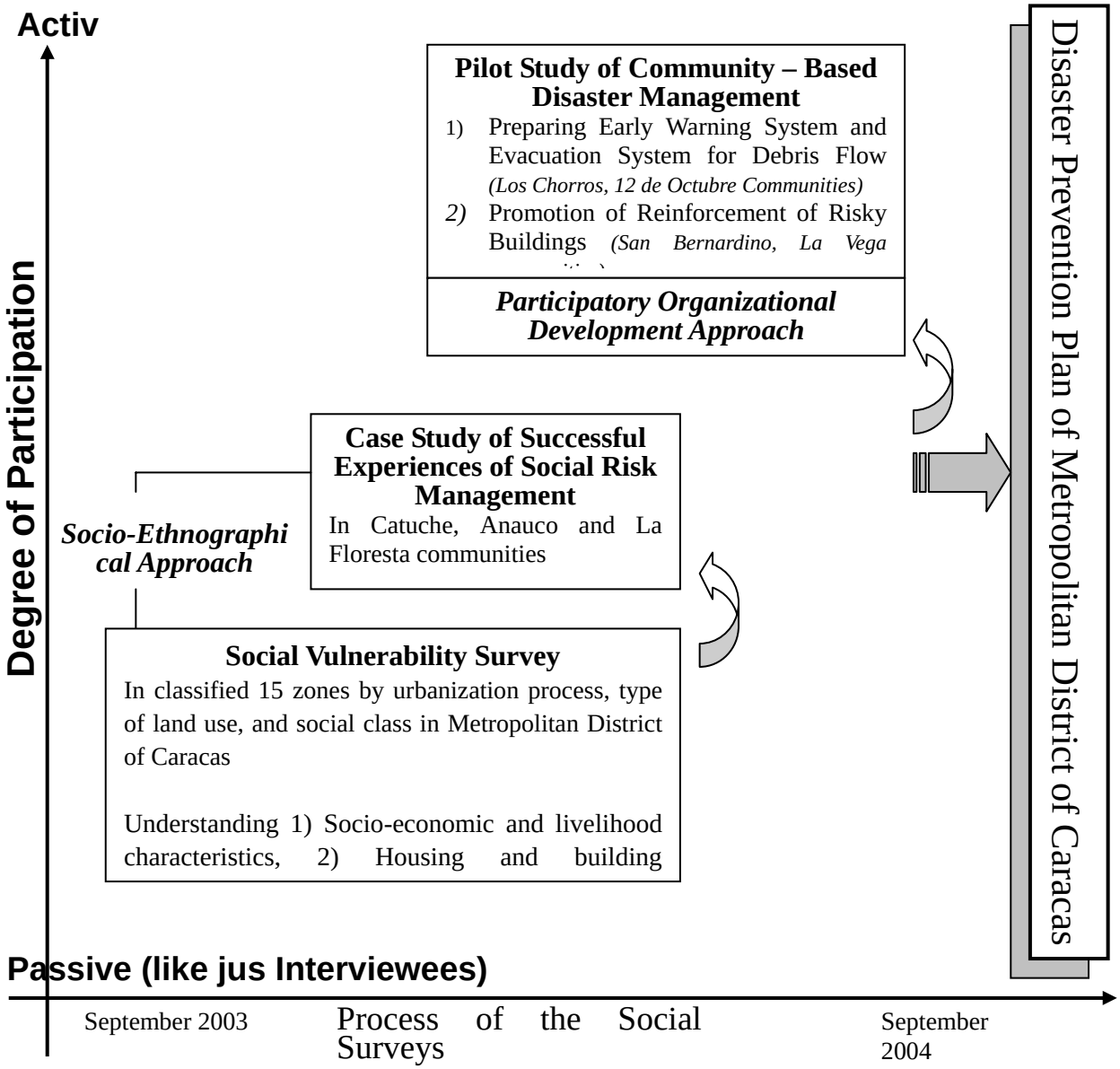


Figure 5.5.1 Process of the Social Surveys in the Study

CHAPTER 6

DISASTER SCENARIOS

CHAPTER 6. DISASTER SCENARIOS

6. 1 Proposal of Base Disaster Scenarios for Disaster Prevention Plan

6. 1. 1. Basic Concept of Disaster Scenario Selection

In order to make a disaster prevention basic plan, it is necessary to select disaster scenarios as the base for the plan. It must be noted again that the selected scenarios are just assumptions for the base of the plan and not predictions of disaster phenomena.

The selection of scenarios should be made based on the following criteria:

- The scenarios should be selected among simulated results by sound engineering considerations.
- The scenarios should be selected through a close discussion between engineers and planners.
- The scenarios should be selected according to the degree of importance of the target area.
- It is possible to consider plural number of scenarios according to the timeframe of the plan.

The simulation results of both earthquake disaster and sediment disaster were performed with all information available so far and with close cooperation of the top level academic body in each field in Venezuela: namely, the FUNVISIS and the Institute of Fluid Mechanics of Central University of Venezuela.

The importance of the Metropolitan District of Caracas is large because of its large population and large accumulation of assets and the function as the capital city of the country. Considering this importance of the target area, the conservativeness for preparation of the plan is justified.

The Study Team organized meetings with the Counterpart Team in order to discuss the matter and to select the disaster scenarios for making the basic disaster prevention plan at early stage of the Third Study in Venezuela. The disaster scenarios were selected as discussed below.

6. 1. 2. Earthquake Disaster

(1) Selection of Disaster Scenarios

From the viewpoint of the slip rate of the fault, the earthquakes from San Sebastian fault have the highest possibility, because they have the highest activities among other faults; La Victoria fault comes next, and then comes Avila. When magnitude of each scenario is considered, 1967 has higher possibility than 1812, because a smaller earthquake has higher possibility to occur than the ones with larger magnitude. The possibility of Hypothetical Avila Earthquake should be carefully interpreted, because the magnitude for this scenario is set to be the lower than

maximum probable magnitude for this fault, so that the return period of an earthquake with this magnitude size can be shorter.

An earthquake similar to 1967 is the scenario for the first priority and for short term planning, while those similar to 1812 should be achieved with longer time planning. The cases of 1878 earthquake and Avila Fault earthquake are treated as references.

(2) Result of Damage Estimation

The results of the damage estimation based on the scenario are summarized in Table 6.1.1.

(3) Hazard Maps and Risk Maps

The hazard maps and risk maps of earthquake disaster prevention are presented in Figs. 6.1.1 and 6.1.2. Fig.6.1.1 shows the distribution of earthquake motion intensity expressed in MMI. Fig. 6.1.2 shows the distribution of ratios of heavily damaged buildings in each micro zone.

6. 1. 3. Sediment Disaster

(1) Selection of Scenarios

According to the statistical analysis of the rainfall amount, the probability of one day rainfall during the 1999 December event in Caracas is once in hundred years. The debris flow phenomenon is the most serious one in the history. Considering the importance of the area, the disaster scenario of debris flow is proposed to take one hundred year daily rainfall amount, which would cause debris flow in the area.

(2) Result of Damage Estimation

Table 6.1.2 shows the damage estimation by the scenario debris flow with the return period of 100 years.

Table 6.1.3 shows the estimated number of houses in risky area of slope failure or landslides.

(3) Hazard Maps and Risk Maps

The debris flow hazard map is shown in Figure 6.1.3. The landslide/steep slope failure hazard map is show in Figure 6.1.4. The debris flow risk map and the landslide/steep slope failure risk map are shown in Figure 6.1.5 and 6.1.6 respectively. The risk maps classify the hazard area by house density and it is possible to estimate the damage in the area.

6. 2 Disaster Scenario and Social Capacity/Vulnerability

A social capacity/vulnerability map was created by using the result of the social vulnerability survey as shown in Figure 6.2.1. Digitalizing and developing social vulnerability index is still in the stage of research and there is no established methodology. In this Study, the social vulnerability map created is a first trial and it is necessary to study further on preparation methodology and the way to utilize it.

Comparison of Figs.6.1.2, 6.1.3, 6.1.4 and 6.2.1 shows that,

- The area of heavy earthquake damage coincides with socially vulnerable area, meaning that most vulnerable areas are exposed to high risk of earthquake disasters.
- The area of debris flow disaster overlie both socially vulnerable and less socially vulnerable areas.
- The area of slope failure and landslide disaster overlie socially vulnerable areas.

Therefore, it is necessary to watch the vulnerability of the society together with the physical risk in preparation of the disaster prevention plan.

6. 3 Disaster Management Administration/Legislation

The summary of the capacity and the vulnerability in terms of disaster management administration/ legislation in the Metropolitan District of Caracas is as follows:

- Civil Protection has a firm legislation background of “Law of The National Organization of Civil Protection and Administration of Disasters” as the core of the disaster management administration of the Metropolitan District of Caracas.
- Because of the short history of the law and the Civil Protection itself, national disaster prevention plans, guidelines for regional disaster prevention plan and disaster management regulations and related ordinances are lacking.
- According to the law, three stages of disaster management cycle (namely “preparation for emergency response”, “emergency response” and “rehabilitation”) are covered as the responsibility of the Civil Protection. However, the stage of “mitigation” is not mentioned nor well recognized as the responsibility of the Civil Protection.
- Various ministries such as Ministry of Interior and Justice, Ministry of Infrastructure, Ministry of Planning and Development and Ministry of Environment/Natural Resources are relevant national governmental organizations for mitigation measures.

6. 4 Problems for Disaster Prevention Plan

The problems for disaster prevention plan for the Metropolitan District of Caracas are summarized as follows:

- There is possibility of large scale earthquake disaster and sediment disaster in the area but mitigation measures are not being implemented to cope with the possible situation.
- According to the “Law of The National Organization of Civil Protection and Administration of Disasters”, the mitigation phase of the disaster mitigation management cycle is not well defined and the responsibility is not clear.
- “Law of The National Organization of Civil Protection and Administration of Disasters” defines the responsibility of the Civil Protection clearly but the regulations and the guidelines following the law are not ready and causing some confusion in application of the law.
- A large degree of social diversification is causing a large difference of social capacity /vulnerability in the area and there is a tendency that physical risk in earthquake distribution tends to coincide with the distribution of social vulnerability.

Therefore, the disaster prevention basic plan should take into account of the following concepts:

- The plan should be based on the scenarios simulated by scientific methodology.
- The definition of responsibilities for implementation of the mitigation projects is one of the key issues in plan preparation.
- The plan should be based on the spirit of the “Law of The National Organization of Civil Protection and Administration of Disasters” and the plan should be revised when the regulations and guidelines are prepared in future based on the law.
- The plan should take into account not only the physical risk distribution, but also the distribution of social capacity/vulnerability of the area to cope with disasters.

Table 6.1.1 Results of Damage Estimation

	1967 Earthquake	1812 Earthquake
Heavy Damage Buildings (no.)	10,000	32,000
Human Casualties (no.)	4,900	20,000
Bridge Collapses on Main Roads (no.)	0	15
Damage in Viaduct (place)	0.3	4.16
Water Supply Pipe Damage (Max. places / 250,000 m^2)	0.0	0.53
Telephone Line Damage (%)	0.07	0.25
Gas Station Leakage (%)	0.14	2.00

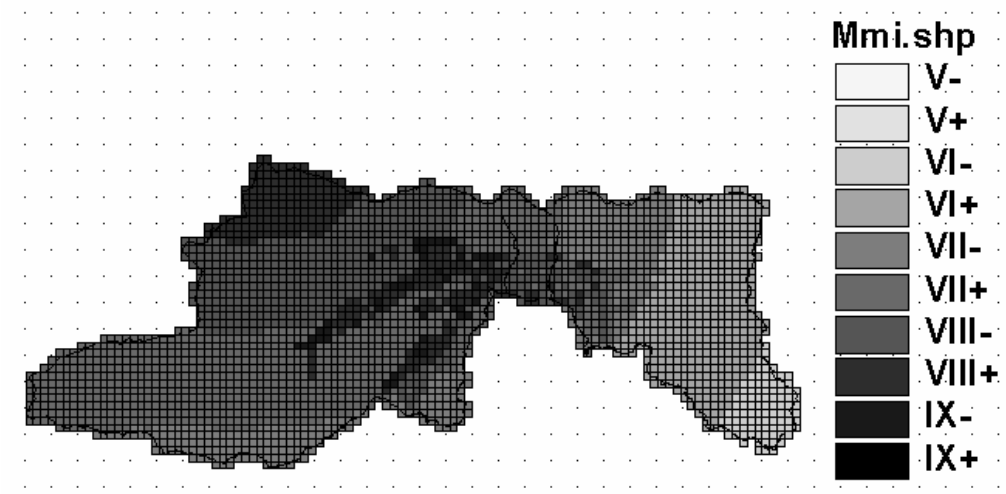
Table 6.1.2 Property in Yellow and Rd Zones of Debris Flow Disaster

	Yellow Zone		Red Zone	
	Area (km^2)	Estimated Affected Buildings (no.)	Area (km^2)	Estimated Affected Buildings (no.)
Urban Area	2.80	9,800	0.38	1,400
Barrio Area	0.32	4,500	0.11	1,300
Total	3.12	14,300	0.49	2,700

Table 6.1.3 Number of Buildings in Risky Area of Slope Failure or Landslide

	No. of houses on risky slopes	No. of houses in the affected area	Total
Slope Failure	6,800	5,500	12,300
Landslide	400	100	500

(**Estimated Seismic Intensity for the 1967 Earthquake)**



(Estimated Seismic Intensity for the 1812 Earthquake)

Figure 6.1.1 Hazard Map of Earthquake Disaster

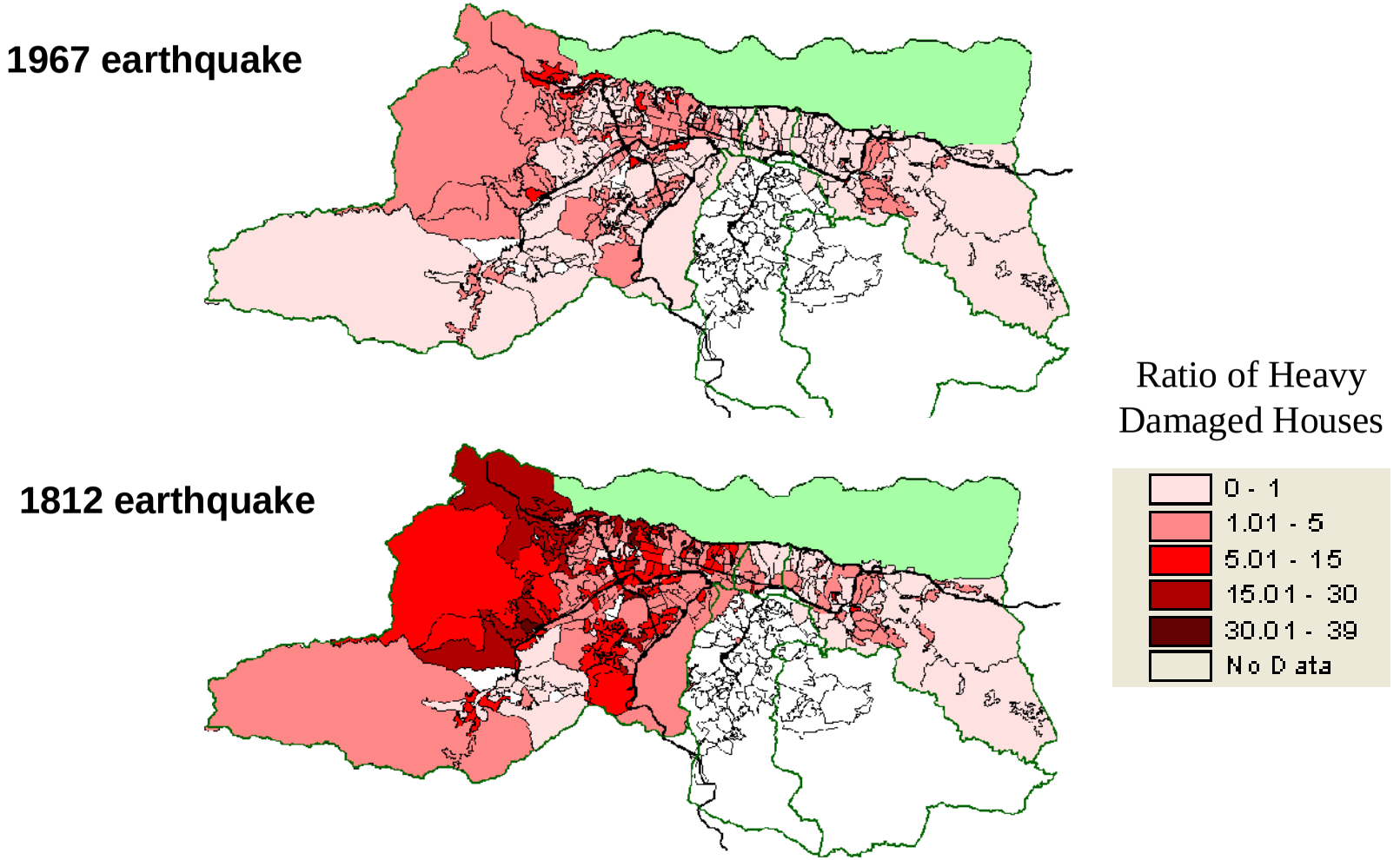


Figure 6.1.2 Risk Map of Earthquake Disaster

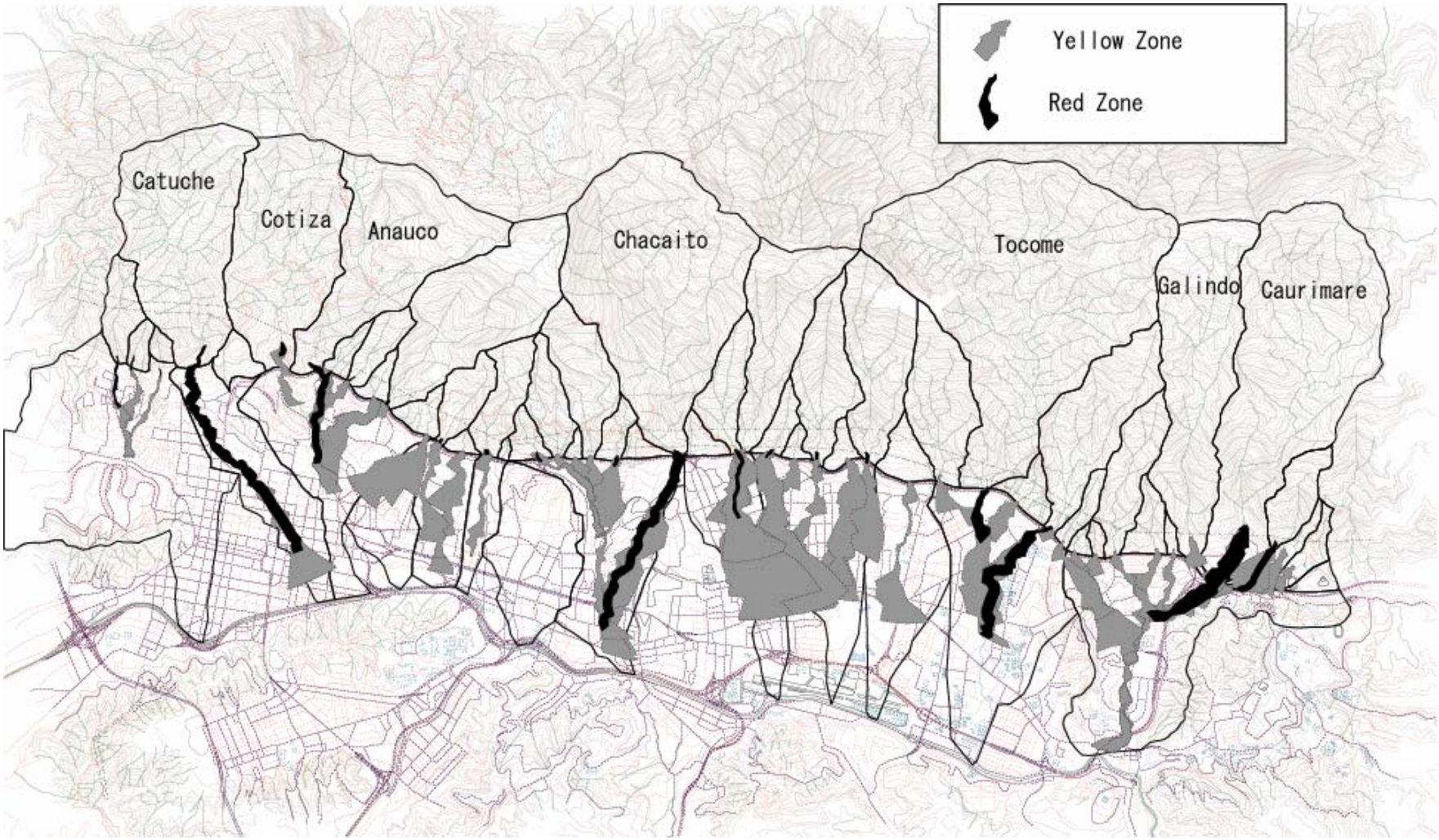


Figure 6.1.3 Hazard Map for Debris Flow Scenario

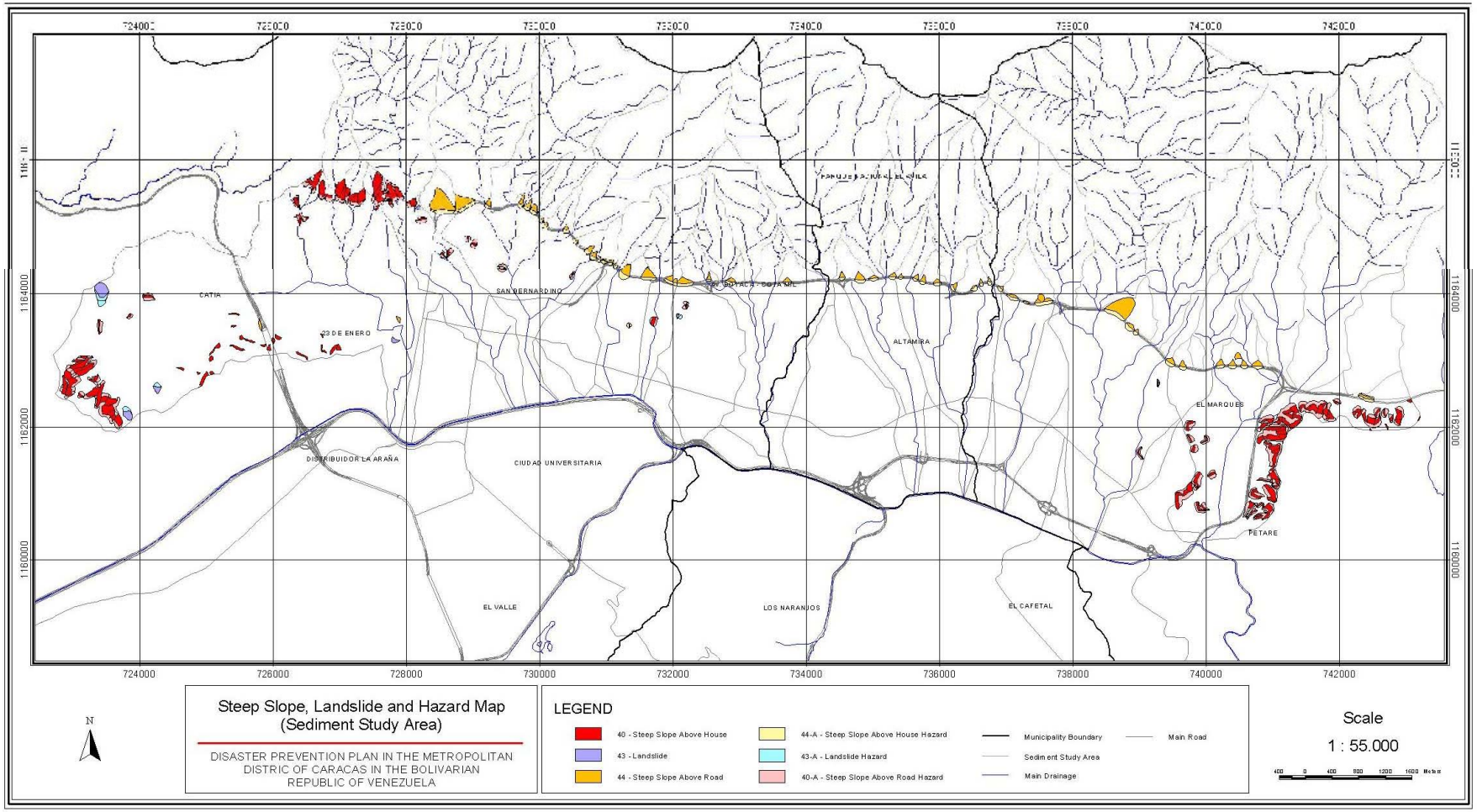


Figure 6.1.4 Hazard Map for Landslide and Steep Slope Failure

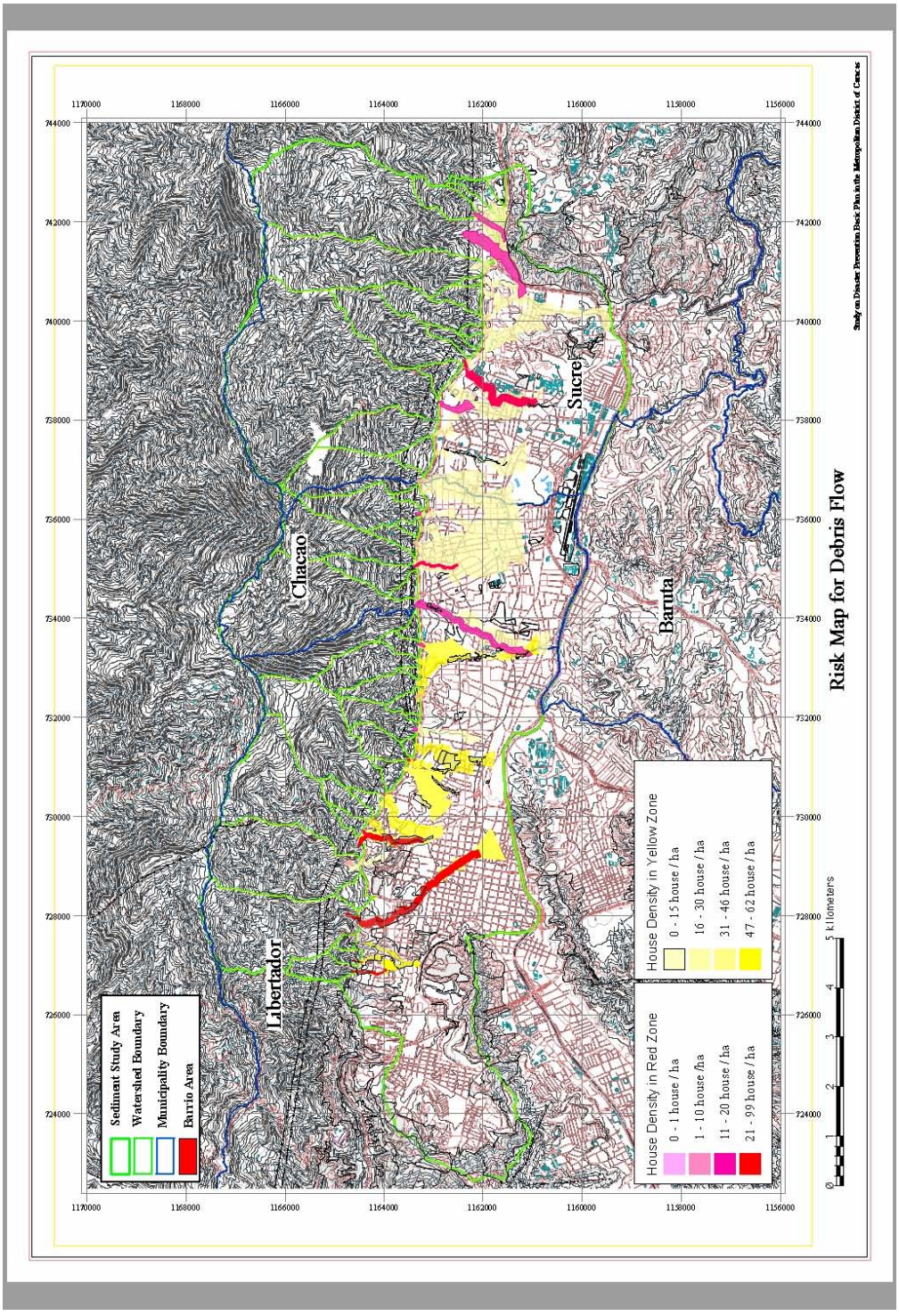


Figure 6.1.5 Risk Map for Debris Flow

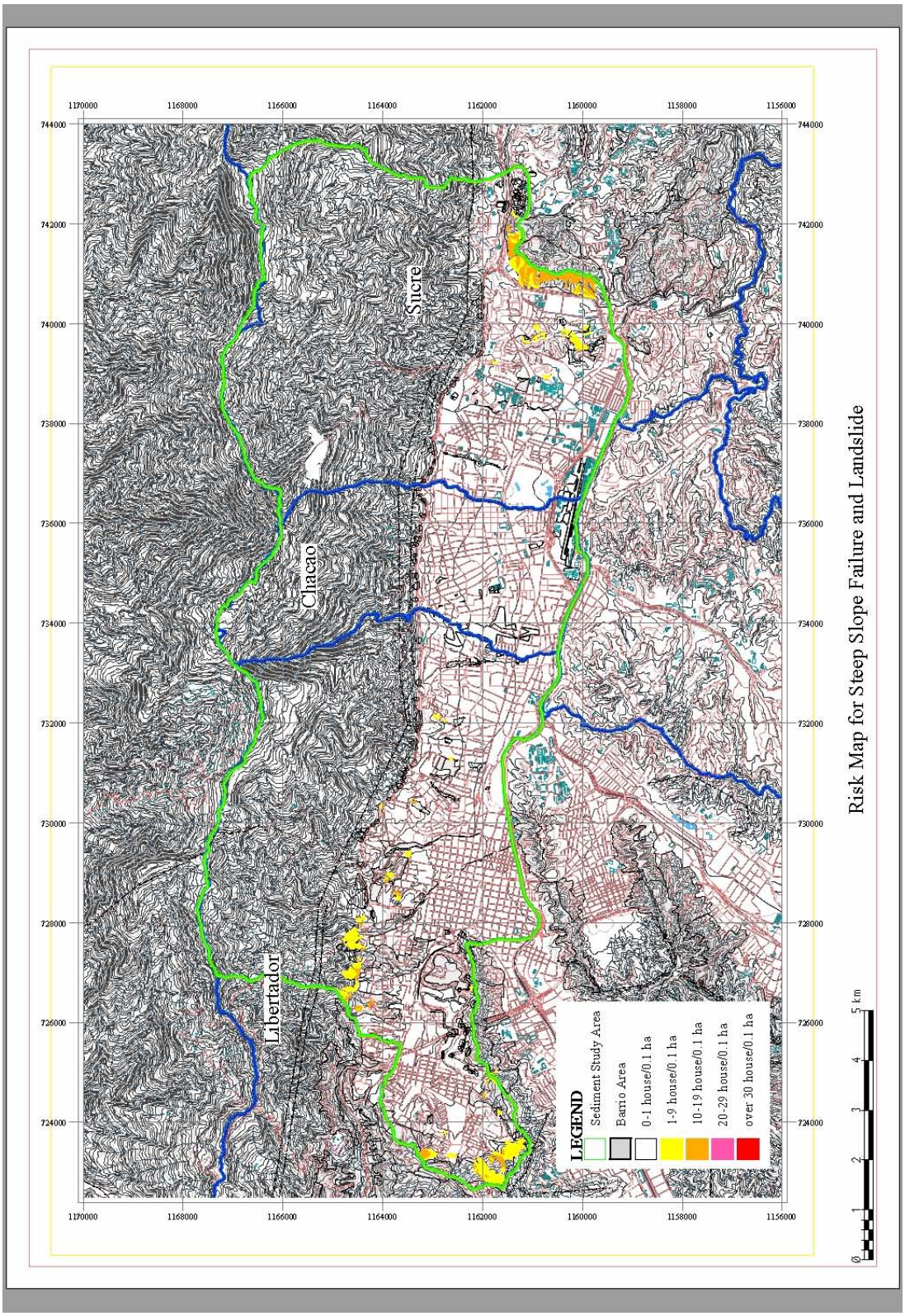


Figure 6.1.6 Risk Map for Steep Slope Failure and Landslide

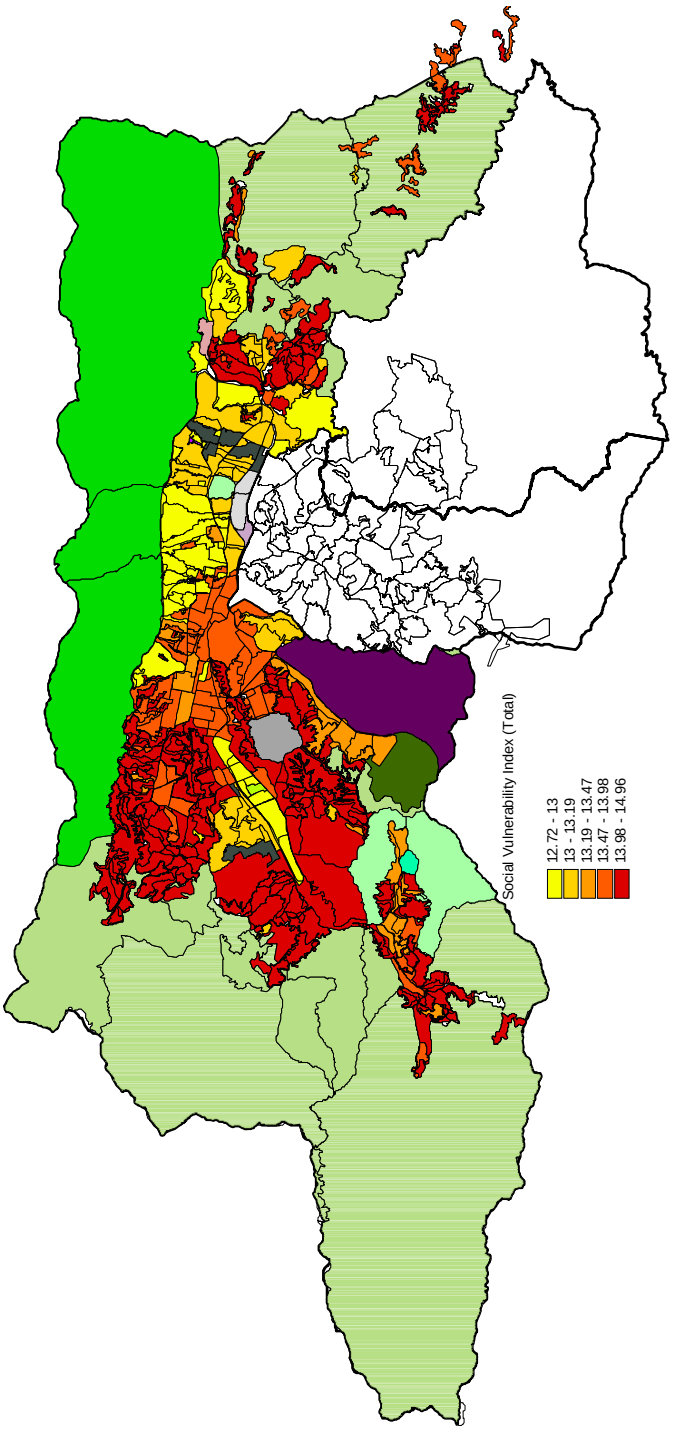


Figure 6.2.1 Social Capacity/Vulnerability Map

CHAPTER 7

PLANNING BASIS

CHAPTER 7. PLANNING BASIS

7. 1 Basis of the Plan

Targets of the plan (namely, area, year, protection, disaster types, scale of disasters and basic strategy of the plan) are defined in this section.

7. 1. 1. Target Area

The target area for the plan is the Study Area of this study. For earthquake disaster prevention plan, the three municipalities of Libertador, Chacao and Sucre are the target area for the plan. For sediment disaster prevention plan, the limited area along the 20 mountain streams are the target areas of the plan.

7. 1. 2. Target Year

The target year of the plan is 2020, 16 years after 2004. The plan should look at a foreseeable period and at the same time long enough into the future to make a complete plan covering the four stages of disaster management (namely, “mitigation”, “preparation for emergency”, “emergency response” and “rehabilitation”).

In order to make the plan more programmatic, it is a good idea to set the intermediate target year as the short term target. Dividing the whole 16 years of plan period into two parts, the first half will be for the short term targets and the whole plan period will be for the implementation of all the master plan projects.

Therefore, the target years of the plan will be defined as follows:

2012: the midterm target year to accomplish short term projects

2020: the final target year to accomplish all master plan projects

7. 1. 3. Targets for Protection

Generally in disaster prevention planning, there are three targets for protection. They are human lives (or human safety), property (or assets or stock), and functions (or activities or flow).

The Metropolitan District of Caracas is the most important city in Venezuela in the sense that it has the above three important targets to be safeguarded.

The Metropolitan District of Caracas has a population of 3.1 million, which is one-eighth of the total population of the country, and it is has the largest population among the various cities in the country.

The Metropolitan District of Caracas has the largest number of assets of buildings, infrastructures and lifelines to sustain the large number of people and the all human activities of the people, including political, economical, commercial, industrial, financial and cultural activities in the city. At the same time, the Metropolitan District of Caracas has important functions as the capital of the country. All the functions of legislation, justice and administration are concentrated in the city. The headquarters of the Central Bank of Venezuela is situated in Caracas. Various national museums and a national theater are distributed in the city.

Thus, the Metropolitan District of Caracas has all three targets for protection: namely, human lives, property and functions, with the most significant scale among all cities in the country.

Therefore, in the plan preparation, those three targets for protection are set and the goal are defined as follows:

1. To protect human lives
2. To protect properties
3. To protect functions of the capital city

7. 1. 4. Target Disaster Types

The type of the disasters dealt with in the plan are defined as “earthquake disaster” and “sediment disaster”. The “sediment disaster” is composed of “debris flow disaster” and “landslide/steep slope failure disaster”.

There will be other kinds of natural disasters relevant in the target area, such as flood disaster along the Guaire River or fire disaster in El Avila. However, considering the magnitude of the damage induced, earthquake disaster and sediment disaster will be the two main disaster types to be considered further.

7. 1. 5. Target Scale of Disasters

Due to the size of the Metropolitan District of Caracas, the target scale of disaster prevention should be large enough considering the amount of damage once a disaster occurs.

However, this plan with a planning period of 16 years, will not deal with a catastrophic disaster which may occur once in a thousand year period. Therefore, the target scale of disasters for the plan is in the order of 100 years to 500 years.

7. 1. 6. Basic Strategy of the Plan

Clear relationship between the protection targets and the plan

As the protection targets are defined as “human lives”, “properties” and “functions”, the plan should have clear relationship with those of targets. The relationship of the master plan projects with each protection target is clearly defined in the plan.

Four stages of disaster management cycle

In order to make a comprehensive disaster prevention plan, the Study will deal with the four stages of disaster management. However, the emphasis of the plan is placed on “mitigation” and “preparation for emergency”, while the stages of “emergency response” and “rehabilitation” are dealt with giving recommendations.

Structural and Non-structural measures

The plan is composed of structural and non-structural policies since disaster management is accomplished as a result of appropriate combination of both, especially when the financial resources are limited to invest in large scale structural measures for mitigation of disaster. In the study, after setting the target scale of disaster, an appropriate combination of structural and non-structural measures was sought in order to accomplish the objectives.

Consideration of social capacity and vulnerability

The plan considers not only physical risk of the problem but also social capacity/vulnerability of the target area. In the plan process, a physical risk map as a combination of natural hazard map and a human activity base map is created for both earthquake disaster and sediment disaster. The plan of structural measures and of non-structural measures are discussed through the analysis of those physical risk maps and social capacity/vulnerability maps.

Consideration of institutional framework

In order to make a workable plan, the institutional framework for the implementation of each policy is proposed based upon the discussion with the Counterpart Team, taking into account the local legal framework, historical background and existing institutional set up. Basically, the institutional framework is planed by applying existing institutional/organizational set up so that they will be able to take immediate action within the existing framework.

Consideration of Financial Sources

For the implementation of a plan, the financial background is necessary. Without financial support, no plan can be implemented. Therefore, the plan is being prepared with the possible financial sources to support each policy.

CHAPTER 8

DISASTER PREVENTION BASIC PLAN

CHAPTER 8. DISASTER PREVENTION BASIC PLAN

8. 1 General

The disaster prevention master plan was formulated for the three municipalities in the Metropolitan District of Caracas. The master plan is composed of twenty different projects, among which six major projects are selected in order to attain the two main objectives of the plan, namely “making a safer Caracas (mitigation)”, “acting effectively in emergency (preparation)” and “strengthening coordination between the government and the citizen (coordination)”. Recommendations were made for “emergency response plan” and “rehabilitation plan”.

8. 2 Structure of the Plan

The plan is composed of three parts: namely earthquake disaster prevention plan, sediment disaster prevention plan and common disaster prevention plan.

The earthquake disaster prevention plan is composed of a mitigation plan. The sediment disaster prevention plan is composed of a mitigation plan and a preparation plan. The common disaster prevention plan is composed of a common plan for earthquake disaster prevention and sediment disaster prevention in two stages of disaster management cycle, namely mitigation and preparation. Regarding emergency plan response and rehabilitation plan, recommendations were made based on the result of the study.

In Supporting Report S1, an example of a regional disaster prevention plan taking the case of the Metropolitan District of Caracas by using a similar format as a regional disaster prevention plan in Japan.

8. 3 Organization Plan

Based on the discussion between the JICA Study Team and the Venezuelan counterpart team, the responsibility definition was made for all the twenty master plan projects. This responsibility definition should be discussed further especially between the Metropolitan Government and the National Government. The master plan projects are listed in Table 8.2.1. Table 8.3.1 shows the proposed responsibilities of related agencies.

8. 4 Main Objectives and Major Projects of the Plan

In order to protect human lives, properties and functions of the city, three main objectives were defined in the plan as;

1st main objective: Making a safer Caracas (mitigation),

2nd main objective: Acting effectively in emergency (preparation for emergency response), and

3rd main objective: Strengthening of coordination between the government and the citizens.

The first objective is to implement mitigation measures in order to make Caracas safer and the second objective is to implement preparation measures for effective emergency response. The third objective is to enhance good coordination.

In order to attain those three objectives, various projects were proposed, among which seven major projects were defined.

They are

For “Making a safer Caracas”

Major Project 1: Seismic reinforcement of buildings

Major Project2: Seismic reinforcement of bridges

Major Project3: Debris flow control structures

Major Project4: Resettlement of People in Risky Area

For “Acting effectively in emergency”

Major Project5: Early warning and evacuation for debris flow disaster prevention

Major Project6: Emergency command center

For “Strengthening coordination between the government and the citizens”

Major Project 7: Strengthening community activities

8. 5 Master Plan Projects

The master plan projects are listed in Table 8.2.1. The relationship of the master plan projects is described in Figure 8.5.1. Each project is described below according to the classification according to disaster types.

8. 6 Earthquake Disaster Prevention Plan

8. 6. 1. Mitigation Plan for Earthquake Disaster Prevention

Seismic Reinforcement of Buildings (Project No.1)

Reinforcement of buildings is not a perfect method, but it is a very effective for disaster mitigation. As it is technically possible to analyze the strength of structures against anticipated intensity of earthquake, once the design force or design criteria become clear, it is possible to design reinforcement of buildings. However, reinforcement of buildings involves not only technical matters, but also financial and institutional matters.

The Technical Code promoted by the Venezuelan Foundation for Seismic Research (FUNVISIS) and the Fund for Quality Certification and Normalization of the Ministry of Production and Commerce (FONDONORMA), is legally supported by the Law of Technical Normative and Quality Control (art 10 and 14) and is clear about the recommendations that must be followed for the seismic resistance of buildings.

This code establishes on its chapter 12, the regulation that applied to the buildings that have been constructed before the year 2001 (year on which the code was revised and approved). On this matter, the application scenario defined on Chapter 12-2 says:

"National, regional or municipal authorities, as is proceeded and determined by laws, will determinate the ways to guarantee the evaluation, improvement or demolition of any of the existing buildings that do not follow the recommendations of this code. This normative also applies to the construction that are not supported by engineering projects" Nevertheless the apparent utility of this legal tool could have for a seismic reinforcement program, there have never been an institutional program, apart of some research activities developed for academic research groups on seismic reinforcement of building as a matter of public security.

The common problem founded is that, nevertheless those normative are good enough to define what must be done in every case, there is no institutional structure to supervise the implantation of the normative. In other words, what must be solved is who and how will control the implementation of the rule and not the existence or the quality of the normative.

The Study Team proposed that the Ministry of Housing, the FUNVI of ADMC and the engineers office of the municipalities to be in charge of the project.

The Ministry of Housing should make the national policy of seismic reinforcement and ADMC should make the policy on barrio house reinforcement. While the municipality should implement the project in urban area, the project in barrio area should be promoted by the Ministry of Housing.

Seismic Reinforcement of Bridges (Project No.2)

According to the simulation of 1967 earthquake, no damage is simulated for the 115 bridges on main roads in the study area. No damage is simulated in water supply pipelines or telephone cable networks. This shows that the infrastructures and lifelines are comparatively safe against 1967 scale earthquake in Caracas.

However, in the case of 1812 earthquake, the simulation shows that 17 out of 115 bridges on the main roads in the study area may fall down because of deflection of piers. In the same cases, around four piers of the elevated highways have risk of destruction .

The bridge reinforcement plan was prepared based on the simulation results and priority was placed according to the degree of importance from the viewpoint of function of the main road network.

In this plan, the rehabilitation of the Viaduct No.1 on the Caracas-La Guaire highway is not included since the information of the work is not available. However, the rehabilitation work of the structure is urgent and important as the highway is the umbilical cord between Caracas and the international airport and the sea port.

(Institutional Considerations)

Bridges in the metropolitan districts cross roadways controlled by three different levels of government. When the bridges are located on autopistas, the Minister of Infrastructure shall reinforce and maintain the bridges. Assistance in design of reinforcement efforts can be provided by public entities such the Institute for Materials and Structural Models at UCV and the Center for Materials Technology at the Institute for Engineering.

8. 7 Sediment Disaster Prevention Plan

8. 7. 1. Mitigation Plan for Sediment Disaster Prevention

Debris Flow Control Structures (Project No. 3)

Since the total investment cost is large when the design scale of the structures has the same scale of the scenario debris flow (return period of 100 years), the short term plan with a smaller scale (return period of 25 years for sabo structures and 10 years for water flow channels) was prepared. The target year of the short term plan is 2012.

This project will give benefit to the people living in the risky areas along the mountain streams. The total umber of people who receive benefit is estimated as 19,000. The summary of the project is tabulated in Table 8.7.1.

(Institutional Aspect)

Ministry of Environment and Natural Resources (MARN) through Vice Minister for Water, General Office of Environmental Works, Office of Environmental Engineering related to water resources that are in charge of developing, executing and maintaining hydrologic projects at the national level.

Slope Protection Structures (Project No.4)

It was concluded that such slope protection structures are feasible only when the value of the protection target is high enough compared with the cost of protection structures.

Therefore, it is included in the master plan as one of the structural projects and more detailed investigation was recommended to assess the feasibility of each risky slope for 13 places for house protection and 50 places for road protection.

Ministry of Infrastructure will be in charge of protection works to safeguard main road and the Engineering Office of municipality government will be responsible for slope protection works to protect buildings.

Drainage Improvement in Barrios (Project No.5)

Observing the poor drainage condition in the barrio area, it was proposed to improve it in order to improve the stability of the slopes where many barrio houses are located.

The faculty of Architecture and Urbanization, the Central University of Venezuela, has been studying the drainage problem of barrio area and proposing low cost improving method.

This proposal is included in this master plan so that further study and implementation of the project should be promoted.

The Ministry of Housing will be responsible for drainage improvement of barrios as a part of barrio environment improvement scheme.

8. 7. 2. Preparation Plan for Sediment Disaster Prevention

Resettlement of People in Risky Area (Project No.6)

Living away from risk of disaster is the best way to prevent disaster-caused damage. However, it is difficult to move all the people living in risky areas in Caracas. Among the relocation of the houses in risky areas, in this project, houses in the river channel are covered. Around 1,000 houses (around 7,000persons) located in the mountain stream channel, which are highly risky in debris flow damage.

This relocation operation shall be a voluntary one after publication of hazard/risk maps, education of people and community activity promotion at that area.

The constitution and the organic municipal law require, for relocation, the obligation of the state to expropriate occupied lands. When there is an expropriation of private lands and buildings the value of both is paid to the occupants by the state. When public lands and buildings are expropriated, only the value of the buildings is to be repaid.

New relocation sites should be located in areas where adequate public services can be provided and are in job expansion areas of the metropolitan district.

Municipality shall be required to keep all high risk areas as open space (or off-limit area), with no new uses permitted.

Early Warning and Evacuation for Debris Flow Disaster Prevention (Project No.7)

As the preparation measures for sediment disaster prevention, early warning system was proposed composed of “rainfall monitoring”, “debris flow monitoring”, “analysis of information”, “transfer of information”, “decision making for alert”, “alert dispatching” and “evacuation by the alert”.

A draft agreement was prepared in order to establish an institutional framework for the early warning and evacuation for debris flow disaster prevention. (Chapter 4)

8. 8 Common Disaster Prevention Measures

8. 8. 1. Common Mitigation Plan

Land Use and Development Control in the Risky Area (Project No.8)

According to the simulation result of 1967 earthquake and 1812 earthquake, the distribution of building damage was concentrated in north-western part of the study area since both cases have epicenters in the northwest of Caracas. However, this does not mean that east part or south part of the city is safe from any earthquake disaster. The simulation results of 1878 earthquake case shows high intensity of vibration in the southern part of the city, and the Avila fault earthquake case shows high intensity vibration distribute from east to west. It can be said that the Study area is equally risky to

earthquakes. It is not recommended to identify a safer part of the area in terms of earthquakes or to modify the configuration of the city.

On the other hand, topographic differences influence the damage to buildings. As applied in the Study, it is reasonable to assume that houses on slopes are more physically vulnerable than houses on a flat plains if the basic structures are the same.

The simulation results shows that 90 % of all the buildings heavily damaged by both 1967 and 1812 earthquakes are in barrio areas and around 40% of the houses in barrio area are located on slopes with gradients larger than 20 degrees. Therefore, the most vulnerable houses are the houses in barrio areas, especially those built on the slopes.

It is best to live away from risk from the beginning, and so living away from risky area should be the fundamental policy in the area. However, it is not realistic to plan to relocate all the barrio houses in risky area as the millions of people have to be relocated.

In order to avoid any further increase of number of houses and people living in risky areas, it is absolutely necessary to regulate housing development in risky areas, in this case on slopes. In the formal area, the municipal authority should regulate land development of any kind in risky areas identified in the hazard maps and risk maps prepared in the Study.

For barrio areas, where formal regulation cannot be applied, there should be some measures to stop the development of new barrio areas from the viewpoint of disaster management.

It is estimated that population increase between 2001 and 2020 is 0.8 million, among which, half would belong to barrio and would go to live in a risky area without any restriction policy. By implementing the strict policy of land use and development control, it is possible to reduce the number of people in risky area by 0.4 million.

Development of Open Space (Project No.9)

Development of open spaces in the area are proposed from threes view points as (1) Barrio area, (2) Area redevelopment in urban area lacking open space, and (3) Reserved open spaces for shelters.

Publication of Hazard Maps and Risk Maps (Project No.10)

By publishing hazard maps and risk map, awareness of people on disaster management will be enhanced and promotion of mitigation measures will be accelerated. The information on risky areas will discourage people to buy and live in a house in risky areas and automatically discourage new housing developments in risky areas. This method of using hazard maps and risk maps may bring

about arguments from the viewpoint of real estate market. The discussion should be continued in Venezuelan side.

Education of People (Project No.11)

In order to mobilize people to avoid risk and mitigate hazard, education of people is the most important program. Formal education on disaster prevention is being carried out at a higher educational level but on the elementary school level and high school level, not much effort is being made. It is necessary to launch a program so that disaster management is included in the elementary school level as well as high school level of formal education.

Education through community is more important than formal education in the sense that the education is more locally characterized and more practical for the specific community.

The first step of education for mitigation measures is to give people knowledge on disasters, for example utilizing hazard maps and risk maps. The proposed mitigation measures in this plan such as "reinforcement buildings" and "land use regulation in risky area" must be promoted by education through formal or community education.

Strengthening of Community Activities For Disaster Prevention (Project No.12)

In order to promote mitigation measures such as reinforcement of buildings, strong community unity is required.

8. 8. 2. Common Preparation Plan

Emergency Command Centre (Project No.13)

An emergency command center is proposed as one of the preparation measures. The functions and the facilities of the center is described below. This project involves not only building construction, but also setting up of disaster management information system, planning of emergency response drills, emergency response training and institutional coordination operations.

Center Function: To coordinate all of the emergency and assistance recourses, and provide logistic support during a disaster event. Coordination means using available resources to accomplish a common task.

Center Users: Caracas Metropolitan District and the Municipal Civil Protection Office.

Education of People (Project No.11)

In order to prepare for good emergency response it is absolutely necessary to educate and train people to be involved in the operation. The education program will include alert system, alert information dissemination, evacuation operation, rescue operation, first aid and sheltering.

Integrated drill for emergency response will be a part of the practical education for the people as a preparation measure.

Strengthening of Community Activities For Disaster Prevention (Project No.12)

For early warning and evacuation operation as well as for rescue operation, strong community activity is the most important factor for the success.

During a large disaster when the formal rescue operation by governmental agencies are occupied by a limited portion of the victims, neighbors who constitute the community are the ones who can really rescue people.

Evacuation operation after getting alert of debris flow or slope failure is practical only when the community has solidarity and a leader who dispatches the evacuation order and has credibility as a leader of the community.

These kind of solidarity and credibility can be forged through strong daily activity of the community and promotion of it will be the key issue for disaster preparation.

Publication of Hazard Maps and Risk Maps (Project No.10)

The hazard maps and risk maps can be a crucial tool in the case of emergency response operation. If the information on risky areas and resources such as open spaces or schools are well disseminated through publication of hazard maps and risk maps, it will help the people to move effectively to escape from such risky areas.

Development of Disaster Information System (Project No. 14)

The disaster information system is a complete data base for disaster management. The system can be used in all four stages of disaster management, namely “mitigation”, “preparation”, “emergency response” and “rehabilitation”.

The data base shall be stored at the Information Technology Department of ADMC and the related organizations, as members of the consortium, will be able to access to the data base through internet.

The consortium will be formed based on the agreement, which will state the obligations and the privileges of the members. All the members have to update and maintain all the information related to disaster management provided by them.

One of the main users is the Civil Protection of ADMC at the Emergency Command Center, which will act as the command center in case of emergency.

Stockpiling of Food, Water, and Goods (Project No.15)

Through the disaster scenario of earthquake and sediment disaster, the number of refugees were simulated. In the case of 1967 earthquake case, around 70,000 people will lose their houses and become disaster refugees. The stockpiling of required food, water and goods are estimated and planned for storage.

Emergency Transportation Network (Project No. 16)

In the case of 1967 earthquake scenario, a total of 10,020 heavily damaged building will produce about 912,000 tons of debris, or some 701,000 m3 of debris. Part of such debris will block the road access. Also objects fallen off from buildings will block roads.

Emergency road network will be propagated by the committee to the municipalities and organizations responsible for primary emergency responses (rescue and medical operation), in order to respond effectively to the emergency situation in case of earthquake.

Important facilities related to disaster management should be prioritized who respond to the emergency situations. To connect them efficiently in emergency situation, emergency road networks within the Metropolitan Caracas will be established, and be recognized by the committee, and organizations responsible for primary emergency responses (rescue and medical operation and other related organizations).

Evacuation Plan and Evacuation Drills (Project No. 17)

Based on the 1967 earthquake scenario, 10,000 houses will be heavily damaged. These people have to be evacuated first to safe place and then sheltered. A total of around 70,000 people should be evacuated and sheltered. Those refugees are concentrated in barrio areas which are with very limited open space and thereby difficult to evacuate and access to rescue.

Evacuation plan shall include the following items:

- Identification of area needing evacuation
- Estimated number of evacuees

- Evacuation place, facilities, and logistics of necessary things
- Evacuation routes
- Evacuation procedure
- Evacuation map preparation, distribution and public relations
- Evacuation drill (simulation exercise)

Rescue Operation Plan (Project No. 18)

Based on the simulation result of 1967 earthquake, it is proposed to study the rescue operation plan.

Medical Treatment Plan (Project No. 19)

To organize necessary ambulatories as the first line of medical response and hospitals to cover the necessities, assuming at least 1967 scenario where there would be 4,510 injured persons and from this number, 451 persons would need to be hospitalized. At present, there is no plan to prepare the medical response in case of disaster in Caracas.

Mental Care and Support Skills in Disaster Prevention (Project No. 20)

The role of mental care, psychological and counseling to affected people is extremely crucial by shown from previous disasters experiences like Vargas(Debris flow in Venezuela), Hanshi-Awaji (Earthquake in Japan), and Bam (earthquake in Iran) as well as physical recovery from disaster damage. Therefore, in this project, specialists of mental care, psychological and counseling for disaster from different background are nurtured with specific skills particularly for rehabilitation stage from disaster. As preparation stage of disaster management, mental care training programs targeted disaster recovery are provided, and through these project, the specialists are expected to work as professional team.

8. 8. 3. Recommendation for Emergency Response

As there is no written emergency response plan for disaster prevention, the plan should be formulated as soon as possible and to be included in the basic plan.

The emergency response plan should include the following items;

(1) Organization for Emergency Response Plan without Early Warning

The organization set up to cope with a disaster without early warning such as earthquake disasters should be defined clearly.

(2) Organization for Emergency Response Plan with Early Warning

The organization set up to cope with a disaster with early warning such as debris flow disasters should be defined clearly as discussed in the agreement among the related agencies.

(3) Collection and Transformation of Information on Damage

In order to act effectively for rescue operation, it is necessary to collect accurate information rapidly and transform it to a correct place. As the emergency command center is the center for all command in an emergency, the information should be accumulated there.

(4) Collaboration with Related Agencies

Good collaboration with national government and other local governments is a must for ADMC during emergency response. It is recommended to make a prior agreement between ADMC and the national government as well as between ADMC and the other local government for collaboration actions.

(5) Early Warning, Evacuation and Rescue Operation

The responsibilities of related organizations such as the Civil Protection, Fire Fighters, Hospitals, Red Cross and etc. should be defined clearly. Here the Civil Protection should stick to the role of planning and coordination while the Fire Fighters should do the field operation work clearly defined in the law.

(6) Transportation

There should be a way to collect information of damage on transportation network such as roads and subways. Emergency network plan should be formulated to cope with the situation taking into account the priority of transportation.

(7) Accommodation

Accommodation plan should include setting up of refugee camps and utilization of vacant public apartment for temporary accommodation for disaster refugees.

(8) Provision of Necessary goods

Collection and distribution policy of food, water and necessary goods should be included in the plan.

(9) Debris Treatment

Debris treatment, such as building debris, garbage and human waste should be treated in order and role definition should be clearly described in the plan.

(10) Reception of Foreign Aid

The Secretary of International Cooperation of ADMC should be responsible for receiving aid from foreign countries.

(11) Lifeline

All the private and the public organizations in charge of lifelines such as water, gas, electricity, telephone and so on should response in emergency in order to assess the damage on the lifelines and take required actions for quick recovery. They should have their own plan of emergency response.

(12) Security

Security is one of the most important issue during emergency operation in order to realize effective action such as evacuation. The police of ADMC as well as each municipality should be responsible for security during emergency.

(13) Recovery of Infrastructures

The relevant ministries should response in emergency in order to assess the damage on the infrastructure and take required actions. Each ministry should have their own plan for monitoring and recovery after disasters.

8. 8. 4. Recommendations for Rehabilitation

The rehabilitation plan should include such items as;

(1) Reconstruction of houses

Promotion of reconstruction of houses should be stated as the responsibility of the national as well as the local governments.

(2) Collection of donations

A committee is recommended to be formed in order to discuss the methodology how to receive, distribute and utilize donations collected from in and out of the country.

(3) Redevelopment plan of risky area

It is an essential part of the rehabilitation plan to refrain people from coming back to the risky area again after the disaster is over. In order to realize the policy, it is necessary for the government to act accordingly in time.

The process should be as follows;

1) designation of disaster area

   The government should designate a disaster area where people should not come back to live on because of the risk of disaster in future.

2) acquisition of the land by the government

   The government should compensate the land owners of the designated disaster area and acquire the land in order to avoid people to come back.

3) redevelopment plan

   After acquiring the risky land, the government should make a redevelopment plan of the area. Basically, the place should be used as a park or a conservation area.

4) legislation of prohibition of resettlement of people in the same risky area

   The government should establish a law or decree specifying the place and prohibit resettlement of people in the place. Collaboration with the community surrounding the place and the collaboration with the police is indispensable to enforce the policy.

8. 9 Project Cost

The project cost is listed in Table 8.9.1. The total cost of all the project will be around US$2.8 billion and the largest portion of it is for reinforcement of buildings. The next largest item is construction of debris flow control facilities. It means that structural mitigation measures in both earthquake disaster prevention and sediment disaster prevention share the largest proportion of the project cost. The project cost for non-structural measures is comparatively small.

8. 10 Effect of Master Plan Projects

The effect of the proposed master plan projects are summarized as follows;

- Even 1967 scale earthquake attacks the area, the number of buildings collapse will be reduced from 10,000 to 1,300. And the number of casualties will be reduced from 4,900 to 400.

- Even 1812 scale earthquake attacks the area, the number of buildings collapse will be reduced from 32,000 to 5,300. And the number of casualties will be reduced from 20,000 to 2,300.

- Even 1812 scale earthquake attacks the area, no serious damage will be generated on the bridges of the main road while without project, the road transportation is interrupted around Arana and other places of main road.

- Even with rainfall with the scale of one in hundred years occurs and debris flow happens in the mountain streams, the flow will be contained in the Sabo dams and the improved channels, causing any damage along the streams, while without the projects, 2,700buildings damaged and as many as19,000 people are injured or die.

- Even with a large amount of rainfall of any scale and debris flow happens in the mountain streams, people along the streams will be able to evacuate before the event and no casualties are generated.

- By implementing the relocation of 1,000 families in risky area along the mountain stream to a safer place, their lives and properties will be saved by the project, without which their lives and properties are in danger.

- By implementing the land use plan and land use regulation referring the hazard maps at present, it can be save the lives and properties of the people by the projects, without which they might migrate into the risky area and expose their lives and properties in risk in future. The number of people who get this benefit will be 400,000 by the year 2020.

8. 11 Implementation Program

Implementation program was prepared for the master plan projects. Fig.8.11.1 shows the implementation schedule of all the projects.

8. 12 Selection of Priority Projects

8. 12. 1. Selection Criteria

The criteria for the selection of priority project(s) are listed as follows:

- Significance
- Urgency

- Immediate consequences
- Technical feasibility
- Economic feasibility
- The result of initial environmental examination
- Prospect of financial sources
- Social necessity
- Intention of counterpart

Because of the constraints of the study period and the study budget, it is necessary to select two projects for the feasibility study in this JICA Study.

As there are two disaster types involved in the study, it will be appropriate to select one project from earthquake disaster prevention and another from sediment disaster prevention.

8. 12. 2. Selection of the Priority Project for Earthquake Disaster Prevention

The simulation result of the two scenario earthquakes suggest that a large number of casualties will be brought about by building collapse

As the first goal of the plan is to protect human lives from the disaster, a project contributing to it will be the priority project.

Building reinforcement will be the almost only probable way in order to attain the first goal of the plan, to protect human lives.

Referring to the criteria for the selection, “building reinforcement” policy satisfies the criterion of “significance”, “urgency”, “immediate consequence”, “less impact on environment”, social necessity (protection of lives)”. The items of “technical feasibility”, “economic feasibility” and “financial sources” are interrelated. The issue is whether it is possible to find a good reinforcement methodology, which is technically feasible and at the same time with low cost so that finance is easier.

Therefore, in the feasibility study stage, the main focus of the study will be to identify the most appropriate method of reinforcement of buildings to accomplish the purpose.

8. 12. 3. Selection of the Priority Project for Sediment Disaster Prevention

In the case of sediment disaster, as stated in the disaster scenario, symptom phenomena exists which can be detected and utilized to dispatch an evacuation alert. Considering the first goal of the plan, protection of human lives, candidates for priority projects in mitigation and preparation stages have been figured out. Representing the mitigation measures, construction of sediment control structures

including sabo dams is proposed as a candidate of priority project. Representing the preparation measures, early warning system is proposed as another candidate of priority project.

The two alternatives of priority projects were compared in Table 8.12.1. Discussion was made between the JICA Study Team and the counterpart team on the selection of the priority project from the two alternatives, and it was finally decided to choose “early warning system” as one of the priority project for feasibility study.

This does not mean that “sediment control structure” has less priority. “Sediment control structures” and “early warning and evacuation” are both important in two different stages of disaster management cycle: namely “mitigation” and “preparation for emergency response”. In this study, “early warning and evacuation” is selected only for study purpose.

Table 8.2.1 Proposed Master Plan Projects

No.	Project rename	Disaster Type	Measure Type	description of the project
1	Seismic reinforcement of buildings	Earthquake	Structure	180,000 buildings shall be reinforced based on 2001 building code and other criteria
2	Seismic reinforcement of bridges	Earthquake	Structure	17 bridges and 400 piers shall be reinforced against 1812 earthquake
3	Debris flow control structures	Sediment	Structure	84 Sabo Dams and 22 km of channel improvement for 1/100 year debris flow
4	Slope protection structures	Sediment	Structure	identification of risky slopes and to implement slope protection works
5	Drainage improvement in barrios	Sediment	Structure	improvement of drainage in barrio area in order to reduce the risk of steep slope failure and landslide
6	Resettlement of people in risky area	Sediment	Non-Structure	1,000 houses along the mountain streams to be relocated
7	Early waning and evacuation for debris flow disaster prevention	Sediment	Non-Structure	early warning and evacuation system for debris flow disaster prevention
8	Land use and development control in risky area	Common	Non-Structure	to control future land use in order not to increase the population and properties in risky area
9	Development of open space	Common	Non-Structure	development of open spaces as disaster prevention resources
10	Publication of hazard maps and risk maps	Common	Non-Structure	publication of hazard maps/risk maps
11	Education of people	Common	Non-Structure	promotion of education for disaster prevention in high, middle and primary level institution as well as through media
12	Strengthening of community activity for disaster prevention	Common	Non-Structure	promotion of community activity for disaster prevention especially in the field of "early warning and evacuation" and "reinforcement of buildings".
13	Emergency command center	Common	Structure/Non-Structure	anti-seismic structure equipped with disaster information system and communication system
14	Development of emergency information system	Common	Non-Structure	information system composed of database, computers with software
15	Stockpiling of food, water and goods	Common	Non-Structure	stockpiling of food, water based on the 1967 earthquake scenario
16	Emergency transportation network	Common	Non-Structure	road network plan to connect important buildings after 1967 scale earthquake
17	Evacuation plan and evacuation drills	Common	Non-Structure	evacuation plan after 1967 scale earthquake, evacuation drill plan
18	Rescue operation plan	Common	Non-Structure	rescue operation plan including institutional framework, equipments and community activities
19	Medical treatment plan	Common	Non-Structure	medical treatment plan based on the number of injured people in 1967 earthquake scenario
20	Mental care and support skills in disaster situation	Common	Non-Structure	implementation of mental care training

Table 8.3.1 Responsibility Definition for Master Plan Projects (1/2)

No.	Project Name	National Government	Metropolitan Government	Municipality Government
1	Seismic Reinforcement of Buildings	Ministry of Housing, FUNVISIS	FUNVI	Engineering Office
2	Seismic Reinforcement of Bridges	Ministry of Infrastructure	-	-
3	Debris Flow Control Structures	Ministry of Environment and Natural Resources	-	-
4	Slope Protection Structures	Ministry of Infrastructure	-	Engineering Office
5	Drainage Improvement in Barrios	Ministry of Housing	-	-
6	Resettlement of People in Risky Area	Ministry of Planning and Development	Urban Planning/Environment	Engineering Office
7	Early Warning and Evacuation for Debris Flow Disaster Prevention	Ministry of Environment and Natural Resources	Civil Protection	Civil Protection
8	Land Use and Development Control in the Risky Area	Ministry of Planning and Development	Urban Planning/Environment	Engineering Office
9	Development of Open Space	Civil Protection	Civil Protection, Urban Planning/Environment	Civil Protection
10	Publication of Hazard Maps and Risk Maps	Civil Protection	Civil Protection	Civil Protection

Table 8.3.1 Responsibility Definition for Master Plan Projects (2/2)

No.	Project Name	National Government	Metropolitan Government	Municipal Government
11	Education of People	Civil Protection	Civil Protection	Civil Protection
12	Strengthening of Community Activities For Disaster Prevention	Civil Protection	Civil Protection	Civil Protection
13	Emergency Command Center	-	Civil Protection	Civil Protection
14	Development of Disaster Information System	Civil Protection	Civil Protection	Civil Protection
15	Stockpiling of Food, Water, and Goods	Civil Protection	Civil Protection	Civil Protection
16	Emergency Transportation Network	Ministry of Infrastructure	Civil Protection	-
17	Evacuation Plan and Evcuation Drills	Civil Protection	Civil Protection	Civil Protection
18	Rescue Operation Plan	Civil Protection	Civil Protection	Civil Protection
19	Medical Treatment Plan	Ministry of Health	Secretary of Health	-
20	Mental Care and Support Skills in Disaster Prevention	Ministry of Health	Secretary of Health	-

Table 8.7.1 Summary of Debris Flow Control Structures

Phase	I	II
Term of the Plan	Short Term Plan	Long Tem Plan
Target Year	2012	2020
Design Rainfall Return Period	25 years for sabo structures 10 years for water channel	100 years
Number of sabo dams	81	84
Total length of debris flow channel	3,250 m	3,250 m
Total length of water flow channel	19,348 m	7,998 m
Construction Cost (million US$)	108	141

Table 8.10.1 Cost of Master Plan Projects

No.	Project rename	Cost (MUSD)
1	Seismic reinforcement of buildings	2,581
2	Seismic reinforcement of bridges	11
3	Debris flow control structures	141
4	Slope protection structures	–
5	Drainage improvement in barrios	–
6	Resettlement of people in risky area	49
7	Early waning and evacuation for debris flow disaster prevention	1
8	Land use and development control in risky area	–
9	Development of open space	–
10	Publication of hazard maps and risk maps	–
11	Education of people	17
12	Strengthening of community activity for disaster prevention	6
13	Emergency command center	3
14	Development of emergency information system	5
15	Stockpiling of food, water and goods	–
16	Emergency transportation network	–
17	Evacuation plan and evacuation drills	–
18	Rescue operation plan	–
19	Medical treatment plan	–
20	Mental care and support skills in disaster situation	–
	Total	2,815

Table 8.13.1 Comparison of Two Projects for Selection of Priority Project

Project	**Sabo structures**	**Early warning system**
Disaster management stage	mitigation	Preparation for emergency response
Benefit	save the lives and the properties regardless of the behavior of the people	save the lives depending upon the behavior of the people
Environmental impact(natural)	impact on El Avila National Park is comparatively large	impact on El Avila National Park is comparatively small
Environmental impact(social)	impact of resettlement on people along the channel	no impact of resettlement on people along the channel
Cost	US$100-200 million depending upon the design scale	US$1-5 million depending upon the system grade
Finance	finance of the central government or International Institutions are required	finance of the Metropolitan government can finance the amount
Proposed Implementing agency	Ministry of Infrastructure or Ministry of Environment and Natural Resources	Ministry of Environment and Natural Resources, Civil Protection, Fire Fighters, Community
Collaboration of agencies	Collaboration for Implementation is necessary among financial source, implementing agency, maintenance agency and environmental impact assessment agency.	Collaboration of operation agencies is absolutely necessary. Especially, vertical coordination among central government, Alcaldia government, municipal government and community is necessary.
Technology	civil engineering	information technology
Examples in Venezuela	examples in Vargas	examples in Maracay and in Catuche community

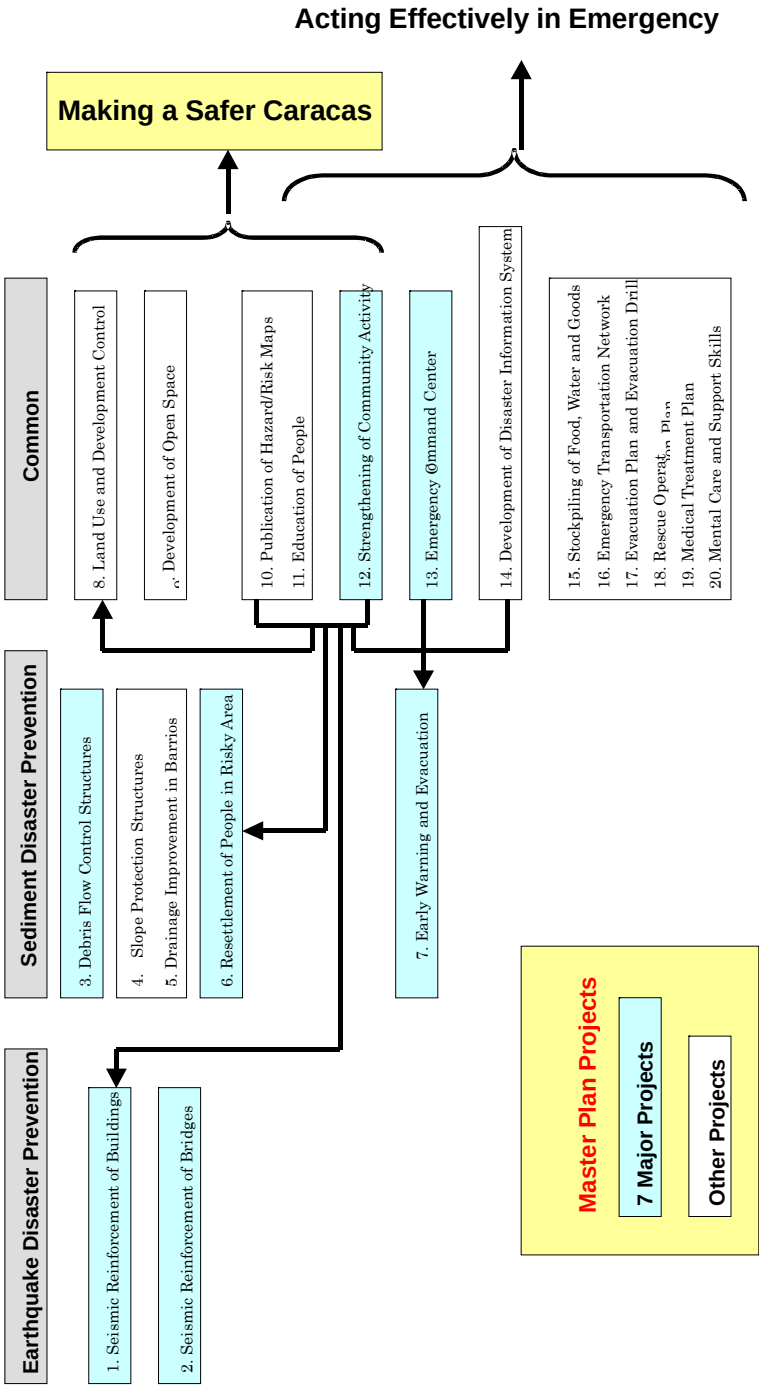


Figure 8.5.1 Relationship of Master Plan Projects

No.	Project rename	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Seismic reinforcement of buildings																
2	Seismic reinforcement of bridges																
3	Debris flow control structures																
4	Slope protection structures																
5	Drainage improvement in barrios																
6	Resettlement of people in risky area																
7	Early waning and evacuation for debris flow disaster prevention																
8	Land use and development control in risky area																
9	Development of open space																
10	Publication of hazard maps and risk maps																
11	Education of people																
12	Strengthening of community activity for disaster prevention																
13	Emergency command center																
14	Development of emergency information system																
15	Stockpiling of food, water and goods																
16	Emergency transportation network																
17	Evacuation plan and evacuation drills																
18	Rescue operation plan																
19	Medical treatment plan																
20	Mental care and support skills in disaster situation																

Figure 8.12.1 Implementation Schedule of Master Plan Projects

CHAPTER 9

EVALUATION OF MASTER PLAN

CHAPTER 9. EVALUATION OF MASTER PLAN

9. 1 General

The Study Team has proposed various projects that comprise the master plan to achieve the goals of the basic plan: namely, 1) protection of human life, 2) protection of property, and 3) maintenance of urban function, by reducing the risk caused by the natural disasters.

In this chapter, the master plan as a whole is evaluated in various apects for justification of the plan.

9. 1. 1. Evaluation Criteria

For evaluation of the master plan, the following criteria are set:

Economic aspect: In economic aspect, the master plan is evaluated in terms of cost and benefit. The secondary goal of the master plan is to protect property, and the third goal is to protect urban functions, and whose damage reduction is counted in economic aspect.

Financial aspect: The maste plan is evaluated in the total prject cost and budget size of the implementing agencies.

Social aspect: The primary goals is to protect human damage. In social aspect, the master plan is evaluated in how much the master plan as a whole contribute to reduction of human casualty.

Technical aspect: This will evaluate if the master plan can be conducted by local techinology level.

Environmental aspect: Project that include physical works may give impact on environment of the influence area of the master plan. This includes social impact on the residents of the project site, such as expropriation of land and relocation of people for the master plan.

9. 1. 2. Summary of Master Plan Projects

Table 9.1.1 summarizes the expected effect and costs of the master plan projects.

9. 1. 3. Summary of Master Plan Project Evaluation

Table 9.1.2 shows summarized feature of each master plan ptoject in each evaluation criteria.

9. 2 Evaluation Results

This section describes the master plan as a whole in each evaluation criteria.

9. 2. 1. Economic Aspect

It is difficult to make the economic evaluation of the whole master plan. The project of seismic reinforcement of buildings, which occupies 90% of the whole master plan, was evaluated. The benefit was calculated as the damage reduction (including direct damage, indirect damage and human damage) and the cost was calculated as the reinforcement cost including engineering cost. The value of the benefit and the cost is almost equal.

9. 2. 2. Financial Aspect

Total cost for the master plan is about 2.8 billion US$, more than 90% of which is that for reinforcement of buildings, US$ 2.58 billion followed by Debris flow control structure project, US$ 141 million (5 %), and resettlement of people from the risky area, US$ 49 million (1.7%). The total cost of the master plan is five times larger that the annual budget of the Metropolitan District of Caracas in 2003, around US$600 million. Even dividing them by 16, the number of years for the master plan period from 2005 to 2020, the average annual cost is around US$ 176 million. This is still around 30 % of the AMDC's annual budget. Accordingly the Metropolitan Government of Caracas cannot afford to finance all the projects. However, not all the projects should be shouldered by AMDC. Some projects such as reinforcement of buildings, and bridge reinforcement should be financed not only by the Metropolitan government, but also by other financial sources.

For example, the cost for the reinforcement of buildings which accounts for more than 90 % of the total cost should not be shouldered 100% by the public sector. The principle of building reinforcement financing will be by the building owners regardless whether it is public or private. However, for reinforcement of buildings, the financial burden for public and private sectors has not decided yet. The Metropolitan Government can fulfill the duty of protection of citizen by promoting building reinforcement in some way or another. In the case of bridge reinforcement of important highways, the beneficiary of the project is not only the Metropolitan Government but also the central government of the republic as these projects are important to protect the functions of the capital city.

Therefore, the cost of the master plan projects should be compared with the total budget of the central government as well as budget of AMDC as beneficiaries are not only the AMDC but also the entire country.

The budget of the country is about US$ 26 billion (2003), MIFRA's budget is US$ 1.9 billion (2003), and newly established Ministry of Housing has US$ 625 million (2004). The average annual cost for the master plan, around 176 MUS$ is around 0.7% of the annual budget of the country (2003) and 9% of the MINFRA's budget, and 2.8% of Ministry of Housing budget (2004).

In financial aspect, the most critical is determination of the appropriate proportion among the governmental agencies, and amount of subsidy or other incentives to private sector and individual people by the government to promote the master plan projects.

9. 2. 3. Social Aspect

The plan targeting to protect the human life and combination of all the proposed projects will significantly reduce the number of human casualties in both earthquake disaster cases and sediment disaster cases.

For example, among the master plan projects, the reinforcement of buildings alone would reduce the number of human casualties from 4,900 to 400 in the case of the 1967 earthquake scenario. Debris flow control, including sabo dam and river channel work, will protect 19,000 people in the sediment study area from a debris flows. Likewise, with the implementation of the early warning system, the same 19,000 people would evacuate from a debris flows. Furthermore, rescue and medial operation related projects, evacuation related projects are expected to save more people's life. With relocation project, some 7,000 people are expected not to suffer from sediment disaster. Land use and future development control will protect around 400 thousand potential barrio people from the risk.

As described above, the master plan projects will contribute considerably t in social aspect. Thus, the master plan is justified from social point of view.

9. 2. 4. Technical Aspect

Two projects of "building reinforcement" and "early warning system were thought to technically difficult among the master plan projects before the feasibility study about the technical aspects of the two projects. However, even the two projects have been judged technically feasible with the local technology level.

It is not difficult to inspect, design and implement the building reinforcement of engineering buildings with proper engineering design and construction. However, a large proportion of the buildings subject to reinforcement is in barrio area, where buildings are constructed without any design drawings, or constructed in a non-engineering way, which was thought to lead to technical difficulty in their reinforcement. To study the technical aspect of reinforcement of barrio houses, the JICA Study Team conducted a breaking test of four models of real barrio houses: that is, 1) a house without

reinforcement, 2) a house with reinforcement of grade beam, 3) a house with reinforcement of grade beam and brick wall, and 4) a house with reinforcement of grade beam and concrete block wall. These houses were built with prevailing, ordinary construction method for barrio houses. The results of the test show that it is feasible to reinforce barrio houses with the prevailing local construction technologies. With reinforcement by the grade beam (model 1) improve the strength of the barrio house by 40 %. And the results of the test clearly shows that barrio houses can be reinforced by conventional technique used in construction of ordinary barrio houses.

"Early warning" is a very sophisticated technique dealing with various information and technical judgment. Large-scale meteorological information as well as local information is essential for rainfall amount observation. Prediction of debris flow phenomenon or slope failure phenomena requires accumulation of data on rainfall amount and debris flow phenomena. MARN has experience of early warning system outside the Study Area and it is likely that they can apply that to the study area. And as for the information collection and analysis, based on the preliminary threshold rainfall amount the JICA study team has established, MARN can advance the system accumulating the additional data and modifying the analytical model. In respect to communities who are at the other end of the communication of the early warning system, they have proved themselves to be effective in the early warning system through the pilot study at communities.

9. 2. 5. Environmental Aspect

(1) Initial Environmental Examination (IEE) of the master plan projects

1) Screening

The master plan projects were screened according to the screening checklist of JICA's guidelines. Table 9.2.1 presents the summary of the screening of the master plan projects.

2) Scoping

The scoping is focused on the sub-project of sediment control structures. The following summarized the IEE on sediment control structure.

This project will induce relatively insignificant adverse impacts as compared with the sediment disaster control project of closed type sabo dams that significantly change sedimentation patterns in the downstream of the river. Unstable living environment is considerably stabilized by embankment. Improved landscape of the river surroundings will further improve the living environment. Several possible adverse impacts were, nevertheless, identified in the construction and operation phase of the project. The

major potential project impacts include the possibility of relocations of people, ecological impacts by anticipated changes in water quality by the structural measures in thel Ávila National Park and temporary traffic disruption in neighborhood.

Venezuelan expropriation law has some gaps with the spirit behind the JICA's new Guidelines, thereby some of the potential beneficiaries that live in barrio areas will necessarily be worse-off with the project implementation. This adverse impact will last long directly to the livelihood of the population, resulting in hardship and impoverishment unless appropriate measures are carefully planned and carried out. Accordingly, to minimize such adverse impact on the livelihood of the affected people, a project specific guideline needs to be developed by undertaking social survey.

The project of sabo dam construction will affect the natural environment of El Avila, which is a national park and well-preserved area. Discussions have been held on the issue with the Office of National Parks, a part of Ministry of Environment and Natural Resources. According to the discussion, by taking proper legal procedures and taking careful management in design, construction process and in maintenance stage of the project, it is possible to proceed with the project. Table 9.2.2 shows the environment impact in sediment control projects.

(2) Social Impact

In the master plan, resettlement project of people from risky area is proposed.

In this project, it is necessary to let them understand their risks so that they will resettle voluntarily. And according to the social survey with a barrio community in the topic of relocation, resettlement plan shall be formulated with the people in a participatory way so that they will feel the ownership of the plan and the part of the plan that is a key to the relocation project implementation.

9. 3 Overall Evaluation of Master Plan

The evaluation of the master plan is summarized as follows:

(1) Economic — It is rather difficult to conduct economic evaluation of the entire master plan. According to the economic evaluation of the reinforcement of buildings, which occupies more than 90% of the total cost of the master plan, cost is equivalent to the benefit.

(2) Financial — Total cost of the master plan accounts for around 3% of GDP of the country,

about 10% of the national budget. Taking into account the importance of the capital city in various aspects, it is worthwhile to invest in the master plan projects.

(3) Social — In the scenario cases of earthquake and sediment disasters, damage estimated are a total of 5,000 human death and injury in the 1967 earthquake scenario, and 20,000 human death and injury in the 1812 earthquake scenario, and human life and property of some 20,000 people in the sediment scenario of the rain of a 100 year return period. With the master plan projects, such damage are estimated to be reduced by one order in the earthquake scenario cases, and damage in the sediment disaster is likely to be minimized. Thus, effect on social aspect of the master plan is huge.

(4) Technical — All the master plan projects are feasible with the local technology.

(5) Environmental — Sabo dam, within the debris flow control project, is to be constructed in national park, the Avila. MARN has already admitted this structure in the national park on the condition that the dam will be designed and constructed taking into account natural environment.

In sum, master plan is justified by its large positive effect on reduction of damage caused by the disaster scenario for both earthquake and sediment disasters.

Table 9.1.1 Summary of Master Plan Projects (1/2)

No.	Project	Outline	Expected effect	Cost
1	Reinforcement of buildings	182,700 buildings shall be reinforced based on 2001 building code (urban) and 10% of the construction cost of new houses (barrio)	182,700 buildings are to be reinforced by 2020 and seismic resistance will be improved. Heavily damaged building s 10,000 to 1,300; human casualties from 4,900 to 440 Direct damage reduction of buildings: 375.4 MUS$; direct + indirect damage reduction: 582.9 MUS$ Maximum Annual cost during the MP period (around 190 MUS$)	2,581 USD
2	Reinforcement of bridges	17 bridges and 400 piers shall be reinforced against 1812 earthquake	17 bridges and 400 piers shall be reinforced and road transportation will be secured and maintain road transportation, thereby secure socio-economic activities even in the 1812 earthquake scenario. Expected reduction in damaged bridges: 17.4 MUS& (17 bridges) More than 40,000 vehicles/ day at Arana are secured and socio-economic activities are maintained.	11 M USD
3	Debris flow control structures	86 Sabo Dams and 20 km of channel improvement for 1/100 year debris flow	2715 buildings in urban and barrio areas will be protected from debris flows. Expected Reduction of damage to assets = 93.5 M US$ Approximately 19,000 people will be protected from debris flows	141 M US
4	Slope protection structures	identification of risky slopes and to implement slope protection works	Protection of houses on and around the steep slope in the sediment disaster study area. Approximately 12,347(steep slope failure), 540 (landslide), total 12,887 buildings are located in the slope affected area Approximately 90,000 people could be protected from potential disaster	-
5	Drainage improvement in barrios	improvement of drainage in barrio area in order to reduce the risk of steep slope failure and landslide	Protection of barrio houses from land slide All barrio population (1.4 million) will benefit	-
6	Resettlement of people in risky area	1,000 buildings (1500 households, 7,000 persons) along the mountain streams to be relocated	1,500 families (7,000 people) living in the mountain streams will be protected	49.2 MUS$ (without land)
7	Early waning system for debris flow disaster prevention	early warning and evacuation system for debris flow disaster prevention	9,000 people in the sediment study area would evacuate from debris flows at a return period of 100 years. Improvement of prevention capacity against debris flow disaster by strengthening related agencies and community	1.18 MUS$
8	Land use and development control in the risky area	control on future land use in order not to increase the population and properties in risky area	Protection of people who are likely to live in risky area in the future, particularly future barrio population (0.4 million) will be protected.	-
9	Development of open space	development of open spaces as disaster prevention resources	Affected people (some 76,400) under the 1967 earthquake scenario will be likely to evacuate. 19,400 in urban & rural area and 57,000 in barrio area. In particular, barrio area and down town area are estimated short of evacuation spaces in the 1967 earthquake scenario.	--

Table 9.1.2 Summary of Master Plan Projects (2/2)

No.	Project	Outline	Expected effect	Cost
10	Publication of hazard maps/risk maps	publication of hazard maps and risk maps	All the Caracas people will be prepared against natural disasters, thereby reduce the damage.	
11	Education of people	promotion of education for disaster prevention in high, middle and primary level institution as well as through media	Level of prevention and preparation of people against natural disaster will be raised and thereby reduce the damage.	17 MUS$
12	Strengthening of daily community activity for disaster prevention	promotion of community activity for disaster prevention especially in the field of “early warning and evacuation” and “reinforcement of buildings”.	Community capacity against natural disaster will be improved through daily activity for good response against debris flow by early warning system and by reinforcing g their houses. Those living in 20 mountain stream and those who need reinforcement are benefited.	6.03 MUS$
13	Emergency command center	anti-seismic structure equipped with disaster information system and communication system	Emergency response operation will be secured and indirect damage will be reduced by efficient and effective operation by the center.	2.92 MUS$
14	Development of emergency information system	information system composed of database, computers with software	Improvement of plans and operations for disaster prevention, preparation, response, recovery & reconstruction will be assisted.	5 MUS$
15	Stockpiling of food, water and goods	stockpiling of food, water based on the 1967 earthquake scenario	Food and other necessities are to be secure for at least three days for the 1967 earthquake scenario.	40,000 US$
16	Emergency transportation network	road network plan to connect important buildings for emergency command and activities	Rescue operation and relief activities are to be secured b y securing transportation.	--
17	Evacuation plan and evacuation drills	evacuation plan after 1967 scale earthquake, evacuation drill plan	All the citizens are expected to raise their capacity against disaster. Especially, expected victims of the 1967 scenario (76,400 persons)	--
18	Rescue operation plan	rescue operation plan including institutional framework, equipments and community activities	Improvement of rescue operation capability to save human lives	40,000 US$
19	Plan of medical treatment	medical treatment plan based on the number of injured people in 1967 earthquake scenario	4500 people will be safely treated and 430 people will be hospitalized in case of the 1967 scenario earthquake.	411,000 US$
20	Mental Care and Support Skills in Disaster Situation	implementation of mental care training	Improvement of treatment for around 4,300 injuries. Those who are expected to suffer from PTDS, around 11% of the victim, are to be treated better.	-
	Total			2.8 billion US$

Table 9.1.2 Evaluation Summary of Each Project (1/2)

No.	Project	Economic	Finance	Social	Technical	Environment
1	Reinforcement of buildings	Large effect in reduction of damage of buildings	- Large cost is needed - Financial burden shall be determined. - Institutional financial support will be needed, especially for barrio families	Large effect in human damage reduction	- Not significant: Field test proves that no technical difficulties - Amount for reinforcement is large	- Noise, air pollution accompanied by the construction, some effect on traffic are anticipated but can be minimized
2	Reinforcement of bridges	Relatively large in reduction of damage to asset	Not significant impact	Large effect in socio-economic activities	Able to handle with the existing technology	Not significant impact
3	Debris flow control structures	Large damage reduction in property	Relatively large cost	Large impact on human damage reduction	Able to handle with the existing technology	- Natural environmental impact to the Avila, in water quality, hydrology, and eco system, which should be studied further in EIA - Environment impact has already been discussed with MARN. - Possible involuntary resettlement of people in the river channel work is anticipated.
4	Slope protection structures	Large damage reduction in property	Relatively costly compared with properties to be protect	Large effect on reduction of human damage	Able to handle with the existing technology	Relocation of people who live on the slope is anticipated
5	Drainage improvement in barrios	Relative effect on property	Large cost to cover all the barrio area	Large effect on barrio people (1.4 million)	Able to handle with the existing technology	Not significant impact
6	Resettlement of people in risky area	- Not significant impact	Relatively large cost will needed	- Relatively large number of people will be protected	Able to handle with the existing technology	Resettlement shall be designed in a voluntary way and plan shall be made in a participatory way
7	Early waning system for debris flow disaster prevention	Not significant impact	Not significant	Large effect on Large number of people	- Data accumulation is needed for better analysis for issuance of warning, while the system is operated	Not significant impact
8	Land use and development control in the risky area	Relative effect on the potential damaged buildings	Not significant	- Large effect on reduction of potential human damage in barrio area	Able to handle with the existing technology	Not significant impact
9	Development plan of open space	Not significant impact	- In barrio area, public support will be needed.	- Protect people indirectly - Urban amenity will be improved	Able to handle with the existing technology	Not significant impact

Table 9.1.2 Evaluation Summary of Each Project (2/2)

No.	Project	Economic	Finance	Social	Technical	Environment
10	Publication of hazard maps/risk maps	- Possible negative effect on property value	Not significant	- Large number of population will be benefited - Not direct impact to reduce human damage	Able to handle with the existing technology	Not significant impact
11	Education of people	Not significant impact	Not significant	- Large population will be benefited	Able to handle with the existing technology	Not significant impact
12	Strengthening of daily community activity for disaster prevention	Not significant impact	Not significant	- Large population will be benefited	Able to handle with the existing technology	Not significant impact
13	Emergency command center	Not significant impact	Not significant	- Maintain disaster management functions in emergency - Not direct reduction of human damage	Not difficult	Not significant impact
14	Development of emergency information system	Not significant impact	Not significant	- Maintain emergency oepration -Relatively small impact on reduction of human damage	Not difficult	Not significant impact
15	Stockpiling of food, water and goods	Not significant impact	Not significant	- Evacuee will be secured with the basic necessities and survive	Not difficult	Not significant impact
16	Emergency transportation network	Not significant impact	Not significant	Maintain emergency operation	Not difficult	Not significant impact
17	Evacuation plan and evacuation drills	Not significant impact	Not significant	Evacuees will be protected	Not difficult	Not significant impact
18	Rescue operation plan	Not significant impact	Not significant	Relative impact on reduction of human damage	Not difficult	Not significant impact
19	Plan of medical treatment	Not significant impact	Not significant	Relative impact on reduction of human damage	Not difficult	Not significant impact
20	Mental Care and Support Skills in Disaster Situation	Not significant impact	Not significant	Relative impact on reduction of human mental damage	Not difficult	Not significant impact

Table 9.2.1 Environmental Analysis of the Master Plan

Type	Disaster type	Project	Environmental Issues
Structural	Earthquake	Reinforcement of buildings	Potential impacts of the works may include noise and air pollution during the construction phase. However, they are judged insignificant as the project sites may locate in heavy traffic areas where pollution is already taking place and they have localized and temporary nature. Temporary interruption of traffic is, on the other hand, may need to be minimized through preparation of appropriate protocol, which needs to be developed when detailed construction plan become available most probably at the detailed design phase of the project.
		Reinforcement of bridges	
	Sediment	Debris flow control structures	Involuntary resettlement is an anticipated impact in the densely populated residential area. The extent of the impact, at the time of report writing, resulted from involuntary resettlement is uncertain, as the information on project location is not available. In addition, construction of sediment control structures in the national park may have a certain degree of impact involving changes of water quality and hydrology and resultant adverse effects on aquatic ecosystem.
		Slope protection structures	Major potential adverse impacts are not anticipated.
	Common	Emergency Command Center	The environmental impact of the project is judged insignificant because major project activity includes interagency coordination, information management and other non-structural measures to address problems in information management in emergency situation.
Non-structural	Common	Resettlement of people in risky area	The principal spirit of the project is to resettle the people living in risky areas on a voluntary basis to safer areas. The degree of project impact is uncertain due to limited project design information including project sites, methodology of resettlement, needs of site rehabilitation of out-going areas and consensus in incoming sites. Coherent adherence to the spirit needs to be ensured through close monitoring of project design.

Table 9.2.2 Impact Matrix of Sediment Control Project

Project: JICA Sediment Control Project

Project Impact Matrix

Project Actic	Phase		Overall Assessment	Social Environment: Involunrary Settlement	Economic activities	Traffic and Public	Split of Communities	Cultural Asset Issues	Water and common Rights	Public Health Conditions	Waste Disposal	Hazards(Risk)	Other Social Issues	Natural Environment: Topography and Geology	Soil Erosion	Groundwater hydrology	Surface water hydrology	Coastal Hydrology	Fauna and Frola	Meteology	Landscape Impact	Other Natural Issues	Pollution Control: Air pollution	Water Pollution	Soil Contamination	Noise and Vibration	Land Subsidence	Offensive Odor	Other Impact	Beneficial Impacts
Sediment Control Structures /Access Road	Planning	Land Acqusition/Relocation																												
	Construction	Land Alter/Spatial Occup.	○												○				○					○						
		Equipment servicing / fuelling	○																					○						
		Quarries and borrow sites	○							○													○							
	Operation	Spatial Occupation	○																○											
		Facility Operation																												◎
Minor modificati on of highway strucutres	Planning	Land Acqusition/Relocation																												
	Construction	Land Alter/Spatial Occup.	○			○					○																				
		Equipment servicing / fuelling	○																							○				
		Quarries and borrow sites	○							○													○							
	Operation	Spatial Occupation																												
		Facility Operation																												◎
Channel Work Consolida tion and Revetmen t Works	Planning	Land Acqusition/Relocation	◎	◎																										
	Construction	Land Alter/Spatial Occup.	○								○																			
		Equipment servicing / fuelling	○			○																	○			○				
		Quarries and borrow sites	○							○													○							
	Operation	Spatial Occupation	○				○																							◎
		Facility Operation	○														○													

CHAPTER 10

FEASIBILITY STUDY OF PRIORITY PROJECTS

CHAPTER 10. FEASIBILITY STUDY OF PRIORITY PROJECTS

10. 1 General

Feasibility study on two priority projects for the study was conducted. The priority projects for the study are " seismic reinforcement of buildings" and "early warning and evacuation for debris flow disaster prevention".

Based on the concept of the master plan, more detail technical, institutional and community study was conducted on both subjects.

Technical study for seismic reinforcement was done mainly for assessment of the strength of a barrio house and engineering reinforcement methodology by using a field test on seismic reinforcement of barrio houses. Technical study for early warning and evacuation placed emphasis on study of critical rainfall value to trigger debris flow from El Avila to the Caracas urban area.

Institutional study for seismic reinforcement focused on existing institutional framework for the project. The institutional study on early warning and evacuation was carried out by preparing a draft agreement to be signed by the related agencies involved such as the Ministry of Environment and Natural Resources, the Metropolitan District of Caracas, three municipalities in the study area and Central University of Venezuela.

The community aspect for both projects were studied through a social survey. Two communities for each project were selected, one from urban area and the other from barrio area, in order to study the feasibility of the project from the view point of community.

The feasibility of the project was studied from the view point of "economic aspect" and "financial aspect" as well.

The overall evaluation result of the two priority project is that both of them are feasible and are necessary to be implemented as soon as possible.

10. 2 Seismic Reinforcement of Buildings

10. 2. 1. Field Test of Seismic Reinforcement of Buildings

A field test on seismic reinforcement of barrio houses were conducted as one of the item of additional survey for feasibility study. The detail of the test is described in the Supporting Report S7.

The purposes of the test are ;

- to assess the strength of a real barrio house

- to assess the effect of seismic reinforcement of barrio houses

The model barrio houses were constructed on a slope by using the same design concept, the same materials, the same construction techniques and the same workers who construct real barrio houses.

Four same type of models were constructed first, and the three of them were reinforced with three different techniques in order to assess the effect of different reinforcement techniques. The four models were destroyed by a static horizontal force using two hydraulic jacks.

The result is summarized as;

- the strength of existing barrio houses was assessed ,

- the analysis of barrio house strength of each story by using the result of the field test revealed the fact that one story and two story barrio houses can stand the earthquake intensity of 1967 scale earthquake, which well explain the damage record of 1967 earthquake,

- the analysis of barrio houses strength of each story showed that three and more storied barrio houses have high probability of collapse by the earthquake intensity of 1967 earthquake,

- previously assumed damage function of barrio houses in the Mastet Plan are correct judging from the result of the field test,

- the reinforcement by adding grade beams at the foundation makes the structure stronger by 40% against earthquake,

- the reinforcement by adding clay brick walls or concrete brick walls does not improve the strength of the structure so much, and

- it is possible to estimate the relationship between the reinforcement cost and the reinforcement effect of barrio houses.

10. 2. 2. Technical Study of Seismic Reinforcement of Buildings

(1) Seismic Code of Buildings to be Applied

The judging base of the seismic evaluation and reinforcement plan for each criteria are applied as following seismic code of Venezuela;

- For the judging base of the seismic reinforcement plan of normal existing buildings is applied the seismic code of Venezuela 2001 “NORMA VENEZOLANA COVENIN 1756-98”.

- For the public building’s and buildings in use for a great number of people such as shopping mall and stadium etc. are applied the seismic code of Venezuela 2001 with use coefficient of 1.15.

- For the most strict judging base of the seismic evaluation of existing key facilities is applied the current seismic code of Venezuela 2001 with use coefficient of 1.30.

- For the judging base of the seismic reinforcement plan of non engineering existing buildings in Barrio and Rural area is the result of the field test of this Study.

(2) Proposed Procedure for Seismic Reinforcement

The seismic reinforcement plan is proceeded on following procedure;

Firstly, necessity of seismic reinforcement of the subject building is judged according to the result of seismic evaluation with seismic capacity as strength and ductility. Then, the feasibility of reinforcement methods is judged on structural condition and building function, and requirement with building owner and/or building operator. If the building has very low seismic capacity, and/or non-economical feasibility. In such special cases, it is judged to use restrictively or to be demolished.

In normal case, the subject building will be reinforced by following procedure;

- Prior investigation; hearing on the building function and special requirements etc. from building owner and/or operator and original design architect, and survey for condition of structural components.

- Definition of reinforcing target; reinforcing for lack of strength or ductility, and/or mixed them.

- Selection of reinforcement methods; adequate reinforcement methods for each structure.

- Planning of reinforcement; due to effect of reinforcement, and building function and use.

- Confirmation of reinforcing effect; estimation of seismic capacity and cost of new reinforced structure

(3) Selection of Seismic Reinforcement Methods for Each Building Type

Seismic reinforcing methods were studied for each type of structures such as RC Structural Buildings, Steel Structural Buildings, Brick and Adobe Masonry Structural Buildings and Non-Engineering Buildings in Barrio and Rural Area .

After applying the above policy, new damage functions were created and new damage estimation was made with seismic reinforcement project.

As a conclusion, the project of seismic reinforcement of buildings is technically feasible including barrio houses.

10. 2. 3. Institutional Study of Seismic Reinforcement of Buildings

Institutional study started from the assessment of existing institutional and legal structure for seismic reinforcement of buildings.

The latest building code is the one issued in 2001. However, when a new building code is imposed, the code is applied for a new building construction after the imposing date of the code and the buildings, which has been existing before the imposing of the code, is immune from the application of the new code.

There is no law or policy of seismic reinforcement of buildings in the central government or local governments now. Therefore, an institutional framework is newly proposed in the study for the purpose of this project.

(1) National government

As the problem of weak buildings against earthquake is huge and it is necessary for the central government to take initiative for the solution although basically the project should be carried out by the owners of the buildings. A new ministry named “Ministry of Housing” was created recently merging various housing development authorities before, making CONAVI as the core of the organization. The Ministry of Housing is in charge of policy making of all building in the country and the project of seismic building reinforcement should be in the hand of the ministry in terms of basic policy making.

Regarding the barrio houses, according to the social survey, it is rather difficult for barrio people to pay all the cost of the building reinforcement although the reinforcement cost is averagely 10 % of the new construction cost. Therefore, it is necessary for the Ministry of Housing to take initiative in barrio house reinforcement by introduction of subsidy for the cost.

Following responsibilities are proposed for the Ministry of Housing;

- legislation of policy and procedure for seismic reinforcement of buildings
- establishment of building code
- reinforcement methods recommended
- to implement government building reinforcement
- to initiate barrio house reinforcement project

(2) Metropolitan Government of Caracas

ADMC is in charge of disaster prevention of the Metropolitan District of Caracas and it should prepare a basic policy of seismic reinforcement of buildings in the area. The unique feature of the Metropolitan District of Caracas is that half of the population live in barrio houses and those barrio houses are most vulnerable structurally against earthquake.

Therefore, ADMC should prepare a policy on how to cope with the seismic reinforcement of barrio buildings.

Following responsibilities are proposed for ADMC

- preparation of risk maps of ADMC
- preparation of ordinances for the purpose
- preparation of barrio houses reinforcement policy
- to implement government building reinforcement

(3) Municipality Government

The municipality governments have authority to give permission for building development. Therefore, the municipal government is the one, which will implement the project directly.

It is proposed that the engineers office of each municipality will perform the rapid visual screening based on the methodology authorized by FUNVISIS. The municipality office shall have the authority to designate safe buildings after the RVS and issue an official sign of seismic safety.

The municipal government also shall promote the policy of seismic reinforcement of buildings by employing various incentives such as subsidy of reinforcement cost or tax exemption for reinforced buildings.

10. 2. 4. Community Study of Seismic Reinforcement of Buildings

Two communities were selected for survey of building reinforcement policy. The two communities are La Margarita in La Vega and San Bernardino.

The social survey was conducted in order to assess the acceptability and willingness to invest for the building reinforcement policy.

As a part of the survey, Mr. Yamazaki, who is in charge of Seismic Disaster Prevention and Ms. Chaverri, who is in charge of People's Organization went into the two communities with local consultant and had meetings with the people, starting from the presentation of the field test survey and the proposal of the JICA Study Team on seismic reinforcement of buildings and listened to their opinion about the proposal.

The result of the survey is summarized as;

- People in barrio have wrong perception about the strength of their houses because of few damage in 1967 earthquake, when most of the barrio houses were one or two storied.

- It is possible to let the people in barrio to realize the present risk of their houses by utilizing the photos, videos and charts showing the field test result of this Study.

- Once the people in barrio area realize their risk, they are concerned about the strength of their houses but affordability of seismic reinforcement is low and they are expecting subsidy by the government.

- People in urban area have knowledge in vulnerability of their houses and they can afford the cost but there is a strong distrust toward the policy of the government. It is necessary to forge credibility toward the government before mobilizing them for reinforcement projects.

10. 2. 5. Project Summary of Seismic Reinforcement of Buildings

The project has the following three components;

- Rapid Visual Screening (RVS) and Detail Seismic Evaluation

- Seismic Reinforcement Design

- Seismic Reinforcement Work

A total number of 180,000 out of 310,000 existing buildings, or 58% of all buildings in the Study Area are to planned to be reinforced. The detailed distribution of buildings for each step is summarized in Table 10.2.1.

The project implementation schedule is shown in Figure 10.2.1.

The RVS will take thee years starting from 2005 and the actual reinforcement work can start in 2007 up to 2020. At the initial stage of the time schedule, institutional arrangement will be necessary to implement the project smoothly.

10. 2. 6. Effect of the Project

With the project of seismic reinforcement of buildings, damage is estimated to reduce as shown in Table 10.2.2.

The effect of the project is impressive as both the number of heavily damaged buildings and the number of casualties will be reduced by one decimal order in both cases of 1967 earthquake scenario and 1812 earthquake scenario.

10. 3 Early Warning and Evacuation for Debris Flow Disaster Prevention

10. 3. 1. Technical Study of Early Warning and Evacuation

In order to assess the technical feasibility of the project of “early warning and evacuation for debris flow disaster prevention”, a study was made on two aspects. The one aspect is the global meteorological phenomenon which will cause a heavy rainfall triggering debris flow disaster in Caracas. Another aspect is the relationship between the rainfall amount and the occurrence of debris flow.

Regarding the global meteorological phenomenon causing heavy rainfall in Caracas, the historical two prominent events in 1951 and 1999 both occurred in the dry season in Caracas, in February and in December, respectively. In both cases, the cause of the long and heavy rainfall was brought about by the cold weather front developed from a low pressure in the Caribbean Sea. As the samples are only 1951 and 1999 events, it is difficult to conclude that debris flow occurs in Caracas, only when the cold weather front comes from the Caribbean Sea. However, it may be said that it is necessary to watch the phenomenon as an important symptom of debris flow. This kind of global meteorological phenomenon has been observed and publicized by MARN for a long time and it is possible to obtain the information through the WebPages of MARN nowadays. Much more, the activation of INAMEH,

global meteorological observation will become more intensive utilizing rainfall observation radar system.

The Study Team collected information on rainfall amount and the occurrence of debris flow in Caracas, Vargas and Maracay. Because of the small number of records of debris flow phenomena and also few records of precise rainfall phenomena, it is not an easy task to draw a conclusion of critical value for early warning and evacuation for Caracas.

The Study Team proposed a pilot value for early warning utilizing available information and proposed to enhance the diagram by accumulating more information on rainfall and occurrence of debris flow.

As a conclusion, early warning and evacuation project for debris flow disaster prevention is technically feasible utilizing the existing technical skills and existing institutional framework.

10. 3. 2. Institutional Study of Early Warning and Evacuation

The Study Team proposed an institutional framework for early warning and evacuation based on the existing government institutional framework. Basically, existing government institution can coordinate to establish a system.

However, a new organization, which is in charge of observation and analysis of local meteorological and hydrological phenomena of Caracas and Vargas, in the Ministry of Environment and Natural Resources , was proposed.

It is also proposed for the Ministry of Environment and Natural resources to establish a protocol for early warning and evacuation system for debris flow disaster prevention or flood disaster prevention nationwide.

The Study Team proposed a draft agreement which will be signed among the related agencies for the early warning and evacuation system for debris flow disaster prevention. The proposed agreement is shown in Chapter 4 of this Main Report.

10. 3. 3. Community Study of Early Warning and Evacuation

Two communities were selected for survey on this particular subject. They are Los Chorros in an urban area and 12 de Octubre in barrio area.

The survey result shows that ;

- People in both urban area and barrio area have correct perception about the sediment disasters as they have experiencing frequent inundation and slope failure problems.

- In both communities, there exist strong community unity and hierarchy system of communication. There are also physical space for the community to have daily meeting among the members.

- In urban community, knowledge level on sediment disaster is high and people can access information from MARN directly through Web-site, while in barrio community, internet access is impossible.

- In both communities, people are willing to collaborate with governmental institution for sediment disaster prevention once such kind of collaboration is proposed by the institution such as the Civil Protection of the Municipal Government.

10. 3. 4. Project Summary of Early Warning and Evacuation

(1) Project outline

The project of early warning and evacuation for debris flow disaster prevention covers 47 mountain streams area with the total 2,700 buildings and 19,000 people.

The project involves the Ministry of Environment and Natural Resources, the Civil Protection of ADMC, the Civil Protection of each municipality, the Central University of Venezuela and the community.

The project is composed of publication of hazard map/risk maps, establishment of agreement among the related organizations, installation of required equipments for observation and communication and capacity building of personnel.

(2) Implementation schedule

The implementation schedule of the project is shown in Figure 10.4.1.

The first step of the project is establishment among the institutions and installation of equipments. As a long term scheme, capacity building of the regional office of MAR and operation and maintenance of the Operation Control Center and the Emergency Command Center are included.

10. 3. 5. Effect of the Project

By implementing the project, it is possible to safeguard the lives of the people living in the risky area of debris flow.

According to the hazard map and the risk map prepared by the Study Team, the total number of buildings in risky areas of debris flow is 2,700 including urban area and barrio area. The total number of residents estimated in the area is 19,000.

Therefore, 19,000 citizens in the area will be able to evacuate by the system and save their lives from the debris flow disasters.

10. 4 Operation and Maintenance

10. 4. 1. Operation and Maintenance of Seismic Reinforcement of Buildings

Reinforcement of buildings is not a single event project but it requires constant observation and maintenance. Because of weathering or fatigue of materials of buildings, the strength of buildings deteriorate with time.

Therefore, it is necessary to carry out periodical observation by using rapid visual screening method for every building. The owner of the building is responsible for the maintenance of the structure.

It is proposed to carry out periodical rapid visual screening for every building every 30 years after construction.

10. 4. 2. Operation and Maintenance of Early Warning and Evacuation

Maintenance of equipments

It is necessary to maintain and operate the equipments, such as rainfall gauging system , water level staff gauges and weir sensor system. The maintenance of rainfall gauging system and weir sensor system shall be done by the owner of the system, the Ministry of Environment and Natural Resources. The water level staff gauges shall be maintained by the community.

The maintenance of rainfall gauging system include payment of telephone bill for data transmission, payment of electricity to operate the receiving computer and change of batteries for rainfall date sending device.

Periodical inspection and maintenance is required for every electrical and mechanical part of the system. Periodical replacement of parts is also required to keep the good condition of the machines.

Operation of Institutional System

In order to activate the early warning and evacuation system as a whole in an emergency when the system is really needed, it is necessary to practice the activity of the system. The Metropolitan Civil Protection is responsible for such kind of practice, namely periodical drill.

It is proposed to do such kind of drill in two levels. One is a desk top exercise and the other one is real field drill.

The desk top exercise will be carried out by the representatives of each organization involved, such as the Ministry of Environment, the Metropolitan Civil Protection, the Operation Control Center, the Municipality Civil Protection, the Central University of Venezuela and Community Organization. This drill on the desk is proposed to be carried out twice a year.

The field drill will be carried out mobilizing all personnel related to this system including residents who are supposed to evacuate. This drill is proposed to be carried out once a year at the end of rainy season, say November 1st.

10. 5 Cost Estimate

10. 5. 1. Cost Estimate of Seismic Reinforcement of Buildings

(1) Unit Cost of New Building Construction Work (Building Replacement Cost)

JICA Study Team investigated each cost of new building construction work otherwise building replacement cost as shown table 10.5.1.

The typical rough unit cost of building replacement work in Caracas as shown in Table 10.5.2.

(2) Total Cost of Replacement and Seismic Reinforcement of Existing Buildings

According to the building inventory data, JICA Study Team assumed and investigated the building numbers and total floor area for each uses, the cost of building replacement and seismic reinforcing work of existing buildings in study area. Through our seismic evaluation and reinforcement planning, we assumed and investigated required ratio for seismic evaluation and reinforcement work, and cost of seismic reinforcement per building replacement cost.

The total floor area, total cost of replacement and seismic reinforcement work of existing buildings in study area are shown in Table 10.5.3.

Number of Buildings in each area and uses are shown in Table 10.5.4.

Ratio of required seismic evaluation and reinforcement, and cost of seismic strengthening per replacement cost for each category of existing buildings are shown in Table10.5.5.

(3) Cost Estimate of Early Warning and Evacuation

The cost is composed of four items as;

- Establishment of agreement among related organizations
- Installation and equipments
- Maintenance cost of equipments
- Capacity building of regional office

Cost of each item was calculated and the total cost for the project was estimated. (Table 10.5.6)

In the cost calculation, the following items are excluded as they are involved in other projects.

- Publication of hazard maps and risk maps
- Development and maintenance of disaster information system
- Construction and maintenance of an emergency command center

10. 6 Evaluation of Seismic Reinforcement of Buildings

10. 6. 1. Framework of Evaluation

The project was evaluated in the following criteria, taking into account the nature of the project:

Economic aspect is evaluated with cost-benefit analysis;

Financial aspect is studied to investment plan of this huge project comparing with the various budgets of governments;

Technical aspect is studied to confirm the local technological level for reinforcement especially for non-engineering buildings, is evaluated;

Institutional framework is evaluated in terms of legal framework, and other arrangement to promote reinforcement of buildings from rapid visual screening to reinforcement work; and

Community aspect is studied on how community will contribute to promotion of reinforcement of buildings

10. 6. 2. Economic Feasibility

Frame of economic evaluation

Benefit of the reinforcement of buildings is conceived as reduction of cost caused by earthquake disaster. Cost of natural disasters can be categorized into three; economic cost, human cost including loss of life and personal injuries, and ecological cost among other damage to ecosystem. Economic cost can be expressed in monetary terms, yet the other effects are difficult to quantify.

Economic loss caused by natural disaster can be categorized into three items: direct loss, indirect loss and secondary effect of the disaster. Figure 10.6.1 shows the links of those damage items. Direct cost relates to physical damage to capital assets, including buildings, infrastructure, industrial plants, and inventories of finished, intermediate and raw materials destroyed or damaged by the disaster.[1] Indirect cost includes output that come from damaged or destroyed assets and infrastructure and loss of earnings due to damage to infrastructure such as roads and airports. Secondary and macroeconomic effects take into account the short and long-term impacts of a disaster on aggregate economic variables.

Besides such economic activities, indirect cost related to rescue and medical activities, recovery activities are also reduced by the project.

Accordingly, in this analysis, quantitative limitation and data limitation, not all losses can be evaluated in monetary terms.

Benefits

In this disaster prevention study, *benefit* is conceived as reduction of damage by the project. Accordingly, based on the damage link, reduction of direct damage, indirect damage and secondary damage are calculated or estimated as much as possible, under the limited available data.

The damages caused by the 1967 earthquake scenario is used as the damage for economic analysis. Thus, reduction of the damage is difference between the damage caused by the 1967 earthquake scenario in case without project implementation and in case with project implementation.

The damage or cost of the following items are calculated in this study.

[1] Paul K. Freedman et al., "Catastrophes and Development Integrating Natural Catastrophes into Development Planning," *Disaster Risk Management Working Paper Series No. 4* (The World Bank, 2002).

- Direct damage: Damage to buildings assets
- Indirect and secondary damage: Economic damage to Caracas and outside Caracas
- Rescue operation and medical cost: Cost for rescue operation and medical treatment
- Recovery cost: Cost for debris clearance and temporary houses construction

Total reduction of costs that are quantified in this study are shown in Table 10.6.1, summarized as follows (see Supporting Report 27 for detail):

- Direct damage: Reduced 323.5million US $ from 389.1 milllion US$ to 65.6 million US$
- Indirect and secondary damage: Reduced 165.3 million US $ from 281.6 milllion US$ to 116.3 million US$
- Rescue and Recovery Cost: Reduced 42.2 million US $ from 49.0 milllion US$ to 6.8 million US$
- Total: Reduced 530.9 million US $ from 719.7 milllion US$ to 188.7 million US$

Costs

For the cost for the economic analysis, the cost that directly accrue the benefit, namely only the cost exclusive of tax for the reinforcement of the 10,020 heavily damaged buildings is employed for the economic analysis. The project of reinforcement of buildings starts with diagnosis of the necessity of reinforcement of buildings. As shown in Table 10.6.2, the total project cost is as follows:

- RVS fee: 15.6 million US$ (including IVA)
- Seismic Evaluation fee: 390.7 million US$ (including IVA)
- Seismic Design fee: 357.3 million US$ (including IVA)
- Construction Cost: 1,817 million US$ (including IVA)
- Total: 2,598 million US$ (including IVA)

Economic Evaluation

For economic evaluation, annual benefit accrued by the project is to be estimated. In this study, the annual benefit is estimated as follows:

Annual benefit = Total reduction of damage x annual probability of earthquake occurrence (1/return period).

It is said that the return period of earthquakes size of the 1967 is around 50 year to 100 years. However, the only concrete figure available about the return period of such earthquake is that by Fiedler G. He stated in "Resultados de Estudios Sismicos en Venezuela, precauciones prerenctivas, I. Simposimo, Nacional sobre Calamidadas Publicos, Instituto Sismologio, Caracas, 1962., that the return period of the earthquake in Caracas was 60 plus/minus 9.5 years. This means that an earthquake size of the1967 earthquake happens at return period of 50.9 year to 69.5 years. And although earthquakes smaller than this size may happen at shorter return period, they are not expected to cause damage to Caracas.

Accordingly in this study, the JICA Study Team employs the longest return period of 69.5 years for the 1967 earthquake scenario for the economic analysis.

The result of economic analysis is shown in Table 10.6.3. It shows that B/C = 0.99, and NPV = - 0.3 MUS$. Simply based on results calculated with the benefits that are estimated quantitatively, the project is slightly unfeasible from economic point of view. However, it should be taken into account that this is a disaster prevention project and reduces human casualty drastically, which is the major goal.

Conclusions

The project shows that the cost and benefit are almost even in economic terms.

The project contributes much to reduction of human casualty, that is the primary goal of the Master Plan.

In barrio areas, if the project will be implemented as self-help type work or with community people used as workers with governmental financial support, the reinforcement of buildings might contribute to local economy.

Financial Feasibility

Public sector

The total cost of reinforcement project, inclusive of IVA, is 2,581 MUS$. The annual cost of the project is shown in Table 10.6.4. Table 10.6.5 compares the project cost with GDP (2003), national budget (2003), Ministry of Infra (2003), AMDC budget (2003), and budget of newly established Ministry of Housing (2004). Total cost of the reinforcement of buildings (2,581 MUS$) accounts for 3 % of GDP in 2003, and 10% of the national budget of 2003. When the annual cost is compared with them, the cost is about 0.2 % of GDP and 0.7% of the national budget at most

Individuals

Based on the community pilot study in La Vega in barrio area and San Bernandino in urban area both in Libertador, when they understand the vulnerability against earthquake, they still have limited willingness to spend on reinforcement even though they would like to reinforce the buildings.

Urban community can spend some on reinforcement. On the contrary, barrio people have different tendency to invest on reinforcement. Barrio people with relatively much assets have intention to invest on reinforcement to protect their property while the people of the lowest strata cannot afford because their central concern is how to secure daily necessities rather than protecting their scarce property from earthquake. In either case, they need public support for reinforcement.

Conclusion

Comparing the project cost with national budget or other sources, the project has a large impact on public budget.

This shows the case where all the cost covered by the public sector. However, in reality, individual owners have to pay. The amount the government shoulders have to be discussed further.

The project's target and schedule should be further discussed, taking into account the both government and building owners financial limitation.

For barrio houses, the governmental financial support shall be need more than urban areas.

Technical aspect

The project is technically feasible with local technical level. Even non-engineering buildings located in barrio areas can be reinforced with local technology, based on the field test of barrio house breaking, the study team conducted.

However, the project has to treat with a great number of buildings for RVS, seismic evaluation, design, and construction, which might cause a shortage of engineers and workers.

Table 10.6.6 summarizes the numbers of buildings to be screened, evaluated, and designed and reinforce until 2020. The project requires 100 engineers for RVS, 800 engineers for seismic evaluation, 640 engineers for reinforcement design. Number of buildings to reinforce is around 13 thousand annually for 14 years. Such a large number of engineers and construction workers are to be employed not only from Caracas but from the entire country or abroad.

Institutional Aspect

Institutional aspect of the project is summarized as follows:

Fist of all reinforcement of buildings is not a main agenda in disaster management in Caracas. Reinforcement of existing buildings is just stated in the seismic related COVENIN[2] but how to promote it has not been discussed and there has not been clear policy on that.

Many steps should be taken for promotion of reinforcement of buildings. However, starting with the seismic COVENIN, the institutional arrangement can be established, including roles of the central and local governments and institutions for promotional activities, financial support, technical support, and implementation.

The recent establishment of Ministry of Housing is reflecting that the central government's emphasis on housing policies. Taking advantage of this, AMDC encourages national government to conceive the reinforcement of buildings as national project.

Community Aspect

To promote the project of reinforcement of buildings, enhancement of the awareness of people about the importance of the reinforcement of buildings is one of the most important factors because the most of the buildings are owned by individuals. Besides such individual awareness raising, people's willingness to reinforce their buildings is a key to the success of the project.

The social survey at an urban community of San Bernadino and a barrio communities of La Vega in Libertador[3] reveals that in barrio area, they are consolidated as unit and ready to take a collective action about reinforcement, as long as they can have a financial resource. The social survey also reveals that the higher stratum of the barrio society is likely to invest in reinforcement of their buildings while the lower strata of barrio has less affordability to spend on reinforcement. If governmental financial support will be realized they are willing to reinforce their houses.

On the other hand, in urban community, they understand the importance of the reinforcement of buildings. However, the community has strong distrust about the deed of the government. This distrust would hamper the promotion of the reinforcement of buildings as long as the project is promoted as governmental initiatives. Therefore, rapport-building between community and government would be one of the first steps that are mandate to promote reinforcement of buildings in

[2] Norma Edificaciones Sismorresistentes COVENIN 1756-98 (Rev. 2001)

[3] The Study Team conducted social survey at an urban community in San Bernandino and a barrio community in La Vega, both in Libertador municipality. to grasp the perception of people about reinforcement of buildings, the social survey were conducted in, both of which are estimated to suffer from higher rate of heavily damage buildings under the 1967 earthquake scenario (for detail, see Supporting Report S24)

urban area. With respect to financial aspect, the people in urban community have willingness to invest their own in reinforcement as long as the amount is affordable.[4]

Conclusions

- The project is judged is most effective to protect life of people from earthquake under the 1967 scenario case. The project of reinforcement of buildings aims primarily at protecting life of people. In this sense, this project is effective although the project cannot prevent 100% of human casualty.

- This project shows that the cost and benefit are almost even, with a slight economic unfeasibility.

- This project needs a huge investment in financial terms. Financial aspect is a key to implementation of the project even though this project has a huge contribution to damage reduction. Based on the social survey, people have willingness to invest in reinforcement at a certain level. To promote this project, the following should be further discussed within the related agencies.

1) Incentives for building owners such as subsidy, tax cut, low interest loan, or insurance system, taking into account the financial limitation of both public and private sectors.

2) Promotion of people's understanding about the importance of reinforcement.

- Institutional arrangement shall be started with putting the reinforcement of building as agenda. And the other institutional arrangement in financial and technical matters shall follow.

- Communities, once they understand their vulnerability to earthquake, are willing to reinforce buildings, but this again requires financial support from the government. However, the urban community has relatively distrust to the government, therefore governments have to build rapport or win trust from community that also is critical.

[4] In the community workshop, as example, the following calculation was done: The price of one apartment building of four apartments per floor about 70 to 80 square meters each, with twelve floors, ranges between 90 to 140 million of bolívares. Divided by floors and apartments, the single apartment cost of reinforcement (using 10% of cost of building as reinforcement cost, according to broad estimates from JICA Study Team Experts) is about 9.8 million Bs. People's willingness to pay for this is negative at first however a simple calculation of monthly installment break-down, say some 20 thousand Bs per month per each family member, is acceptable by the community people.

10. 7 Evaluation of Early Warning and Evacuation for Debris Flow Disaster Prevention

10. 7. 1. Framework of Evaluation

Early Warning System is a non-structural measure designed to protect people and other movables from debris flow, not aimed to protect unmovable assets such as buildings. The project covers the 47 quebrada areas north of Guaire river with 19,000 people. With the early warning system, people are expected to evacuate more effectively from debris flow.

Early warning system is a series of actions from collection and analysis of the relevant information,the resulting issue of early warning, and evacuation activities of affected people based on the eaarly warning. Variou technology are used, and wide ranges of actors are involved in the system and each actor has their own sub-system which are linked to make the entire early warning system. Accurate and timely data collection analaysis are required for functional system. Each actor should act as designed, through communitcation system among the actors.

The project aims to reduce human casualty and economic and financial analyses are judged unfit to evaluate this project. The following aspects are selected as evaluation criteria:

- Institutional aspect: Evaluate framework of laws and regulations, agency's capacity and coordination and communication among the relevant agencies and also community

- Technical aspect: Evaluate technical aspects to provide necessary warning based on accurate and timely data collection and analysis on hazard and risk

- Community aspect: Evaluate capacity to act according to early warning from the institute and evacuate effectively and timely.

Institutional Aspect

The early warning system is judged feasible from institutional aspect. The institutional linkage and coordination is prerequisite for successful system operation. Because the early warning has not been operated among the related agencies, the initial institutional arrangement is important. The study team proposed the draft agreement among the related agencies, and they have been discussing it for effective system operation. Starting with the existing institutional framework including creation of INAMEH which will start on the finish of VENEMET, it is judged that the related agencies with progressive improvement will be able to handle the early warning system.

The system would work, among others, realizing the following points at each level to overcome the limitation at present time..

(1) National level

- Promote VENEHMET project
- Establish and strengthen a regional branch of MARN to unite present rainfall monitoring system, update hazard map, and study hydrological features of Caracas.
- Formalize agreement for the early warning system, the JICA Study team proposed

(2) AMDC level

- Construct Emergency Operation Center to house Operation Control Center for disaster management of Caracas
- Develop (train) human resources in early warning

(3) Municipal level

- Issue the evacuation instruction to vulnerable community based on the information from AMDC and MARN
- Collaborate community in the planning and operation of the system

Technical Aspect

Among various information, a Critical Line (CL) is a key to issue a timely and proper early warning, though it is one of the technical difficulties of the system. In described in detail in Supporting Report 18, the Study Team preliminarily formulated a Critical Line with a limited available data to provide a threshold rainfall amount to assess a disaster situation and thereby decide on an issuance of evacuation. The CL shall be modified upon the accumulation of available information for model formation.

Even though a CL is granted as one of the information based on which the warning will be issued, with this preliminary CL as reference, the system would be started and will be improved gradually being operated.

Community Aspect

In the early warning system, because of the complexity, the operation within communities was thought to be rather difficult. However, the early warning system is judged as feasible from community aspect based on the results of the pilot study at communities in Caracas at 12 de Octobre, and Los Chorros in Sucre municipality.

In the early warning system, existing community organizations can be used as a core entity to play an important role in both urban and barrio communities. The communities are willing and responsive to the new system through the experience of the pilot study with the communities in urban and barrio areas.

The proposed early warning system shall provide openly to the community more accurate and timely information and instruction which the communities need.

A key is the relation between community and municipal agency like CP who has to have a close relationship with community and build up a rapport. In addition, when the system will be planned and designed, the communities shall participate actively so that they feel they are really a part of the system.

On such occasions and for enlightenment and improvement of the community in early warning system, the third party or intermediary groups will be utilized to act as a facilitator or mediator.

Conclusions

The Early Warning System will be feasible from institutional, technical, and community aspects. The following are important points in early warning system.

- In Venezuela, meteorological warning has been used as global, national, and regional warning, not for a local warning at this moment.

- However there is a program that can be a base for the system, such as VENEHMET. The system is expected to be operated based on the official agreement among the related governmental agencies, and communities in the near future.

- In respect to technical aspect, although more accumulation of necessary information and record of disaster are needed to establish more accurate analytical models, the system can be started with the provisional analytical models such as CL the JICA Study Team studied, even which requires further modification.

- Communities are willing and able to be part of the early warning system. They shall not be treated with passively in the system from the planning stage, but they shall be participating positively from beginning of the system establishment, thereby they shall feel they are part of the system. In order to enlightenment and improvement of community in the early warning system, intermediary groups, or external experts play an important role.

Table 10.2.1 Number of Buildings for Reinforcement by Area

	Urban	Barrio and Rural	Total
Total	83,499	231,158	314,657
RVS	62,620	184,900	247,500
Detail Seismic Evaluation	50,080	166,400	235,010
Seismic Reinforcement Design / Seismic Reinforcement Work	40,060	142,700	182,740

Table 10.2.2 Effect of Seismic Reinforcement of Buildings

Earthquake Case	Estimated Damage	Without Project	With Project
1967	Heavily Damaged Buildings	10,000	1,300
	Human Casualties	4,900	400
1812	Heavily Damaged Buildings	32,000	5,300
	Human Casualties	20,000	2,300

Table 10.5.1 Reference Price in Caracas as of February 2004

(1920Bs = 1US$)

A. Basic Materials: (+IVA)	
1. Ready mixed Concrete: Fc250	240,000 Bs/ m^3 + Labor cost
2. Concrete in site mixing	200,000 Bs/ m^3 + Labor cost
3. Reinforcing Bar: fy4,200 (12m length)	1,400 Bs/ Kg : 1 package: 2 tons
4. Steel fabric mesh	1,500 Bs/ m^2
5. Brick 15 cm in thickness	380 Bs/ No. 17 Nos./m^2
6. Concrete Block 15 cm in thickness	500 Bs/ No. 17 Nos./m^2
7. Cement	10,000 Bs/ package 42.5 Kg/ 1 package
8. Gravel/ Sand/ Plastering material	18,500/ 22,500/ 20,000 Bs/ m^3
9. Wooden form: Plate; 0.3m x 2.4m x 25mm Sheet; 1.2m x 0.6m x 25mm Square Bar; 50mm x 100mm	30,000 Bs/ m2: for Beam & Column 10,000 Bs/ Bs: for Slab & Wall 3,000 Bs/ ml: for Support
10. Ceramic Tile: 33cm x 33cm	10,000 Bs/ m^2 : 9 units/ 1m^2
B. Material and Labor: (+IVA)	
1. New Construction (Total Price)	500,000 ~ 600,000 Bs/ m^2
2. Structure and Masonry Wall (no finish)	280,000 Bs/ m^2
3. Labor cost of structure only	60,000 Bs/ m^2
4. Labor cost of wall only	4,000 Bs/ m^2
Wall + plastering both sides	12,000 Bs/ m^2
5. Paint finishing	8,000 Bs/ m^2
6. Asphalt Waterproofing 6mm thk.	12,000 Bs/ m^2
7. Installation of Ceramic Tiles w/ mortar	10,000 Bs/ m^2
8. Structural Steel Fabrication work	6,500 Bs/ kg
9. Square Steel Pipe	8,000 Bs/ kg
10. Base Plate	10,500 Bs/ kg
11. Anchor Bolt (A-32S)	16,500 Bs/ kg
C. Others: (+IVA)	C. Others: (+IVA)
1. Demolition by hand and disposal of Debris	6,000 Bs/ m^3
2. Excavation by Machine	5,000 Bs/ m^3
3. Excavation by Hand	7,000 Bs/ m^3
4. Electrical work (Cable 12mm)	45,000 Bs/ point : 6 points/ 50 m^2
5. Sanitary Plumbing (PVC)	30,000 Bs/ point : 2 points/ 50 m^2

Source: JICA Study Team

Table 10.5.2 Typical Rough Unit Cost of Building Replacement Work in Caracas

(As of February 2004, 1920Bs = 1US$)

1A. Dwelling Houses in Urban area	
1) Low class of dwelling (80-100 m^2) ($100 m^2$)	400,000 - 600,000 Bs/ m^2 50,000,000 Bs/ 1 House
2) Middle class of dwelling (100-200 m^2)	600,000 - 800,000 Bs/ m^2
($150 m^2$)	105,000,000 Bs/ 1 House
1B. Dwelling Houses in Barrio area (70-100 m^2)	150,000 - 200,000 Bs/ m^2
($100 m^2$)	17,500,000 Bs/ 1 House
Selling cost	300,000 Bs/ m^2
2A. Apartment Houses in Urban area	600,000 Bs/ m^2
($150 m^2$)	90,000,000 Bs/ 1 Family
2B. Apartment Houses in Barrio area	300,000 - 400,000 Bs/ m^2
($100 m^2$)	35,000,000 Bs/ 1 Family
3. Office Buildings	
1). Reinforced Concrete Buildings Architectural work Structural work Building Equipment work Electric work Plumbing work Air Conditioning work Elevator Total	 210,000 Bs/ m^2 (42%) 190,000 Bs/ m^2 (38%) 100,000 Bs/ m^2 (20%) 30,000 Bs/ m^2 20,000 Bs/ m^2 20,000 Bs/ m^2 30,000 Bs/ m^2 500,000 Bs/ m^2
2). Structural Steel Buildings Architectural work Structural work Building Equipment work Total	 250,000 Bs/ m^2 (41.7%) 250,000 Bs/ m^2 (41.7%) 100,000 Bs/ m^2 (16.6%) 600,000 Bs/ m^2
3). Masonry Buildings (Existing Building) Architectural work Structural work Building Equipment work Total	 330,000 Bs/ m^2 (60%) 150,000 Bs/ m^2 (25%) 120,000 Bs/ m^2 (20%) 600,000 Bs/ m^2
4). Commercial Building (Excluding inside finishing)	500,000 Bs/ m^2
5). Hospital Buildings (Excluding Medical Equipments) Small Hospital (without Bed) Large Hospital (with Beds)	 600,000 Bs/ m^2 900,000 - 1,000,000 Bs/ m^2
6. School Buildings	400,000 Bs/ m^2
7. Factory Buildings (Steel structure with light roof)	200,000 Bs/ m^2

Source: JICA Study Team

Table 10.5.3 The Total Floor Area, Cost of Replacement and Seismic Reinforcement of Existing Buildings in Caracas

(As of Feb. 2004)

Area	Category: Type of Building	Category: Item	Total Floor Area (m2)	Building Replacement Cost (M. Bs)	Seismic Reinforcement Cost (M. Bs)
Urban Area	Dwelling House	High Class	526,000	526,000	36,200
		Middle Class	3,244,000	2,271,000	156,500
		Low Class	3,507,000	1,754,000	120,900
		Sub Total	7,277,000	4,551,000	313,600
	Apartment	Low Rise: 1 ~ 3	2,404,000	1,442,000	99,400
		Middle Rise: 4 ~ 8	11,683,000	7,594,000	629,500
		High Rise: 9 ~	9,345,000	6,074,000	434,900
		Sub Total	23,432,000	15,110,000	1,163,800
	Office Building	Low Rise: 1 ~ 3	1,878,000	939,000	64,700
		Middle Rise: 4 ~ 8	7,511,000	4,131,000	342,500
		High Rise: 9 ~	7,510,000	4,506,000	322,600
		Sub Total	16,899,000	9,576,000	729,800
	Hospital and Governmental Office	with Beds	504,000	479,000	39,700
		without Bed	734,000	440,000	30,300
		Governmental Office	4,672,000	2,570,000	213,000
		Sub Total	5,910,000	3,489,000	283,000
	Other Important Building	Low Rise: 1 ~ 3	1,002,000	501,000	34,500
		Middle Rise: 4 ~ 8	2,004,000	1,102,000	91,400
		High Rise: 9 ~	1,500,000	900,000	64,400
		Sub Total	4,506,000	2,503,000	190,300
	Urban Area Total		58,024,000	35,229,000	2,680,500
Rural Area	Dwelling House	Slope ＞ 20degree	1,527,000	611,000	58,700
		Slope ≦ 20degree	9,639,000	816,000	173,000
Barrio Area	Dwelling House	Slope ＞ 20degree	13,424,000	2,349,000	300,700
		Slope ≦ 20degree	17,474,000	3,058,000	275,200
	Rural & Barrio Total		42,064,000	11,234,000	807,600
Ground Total			100,088,000	46,463,000	3,488,100
US$ (1920 Bs= 1US$)				24,200 M.US$	1,817 M.US$

Source: JICA Study Team

Table 10.5.4 Number of Buildings in Each Area and Uses

Area	Nos. of Bldg.	%	Category	Nos. of Bldg.	%	Class, Story	Nos. of Bldg.	%
Urban Area	83,449	100	Dwelling House	58,449	70	High C.	1,753	3
						Mid. C.	21,626	37
						Low C.	35,070	60
			Apartment House	6,680	8	1 ~ 3	2,004	30
						4 ~ 8	3,340	50
						9 -	1,336	20
			Office Building	12,526	15	1 ~ 3	3,758	30
						4 ~ 8	5,010	40
						9 -	3,758	30
			Hospital and Governmental O.	3,340	4	w/ Beds	84	2.5
						No Bed	918	27.5
						Govn. O.	2,338	70
			Other Important Building	2,504	3	1 ~ 3	1,002	40
						4 ~ 8	1,002	40
						9 -	500	20
			Urban Area Total	83,449	100		83,449	
Rural Area	25,175	10.9	Slope ＞20degree	10,182	40.4	---	---	
			Slope ≦ 20degree	14,993	59.6	---	---	
			Sub Total	25,175	100			
Barrio Area	205,983	89.1	Slope ＞ 20degree	89,491	43.4	---	---	
			Slope ≦ 20degree	116,492	56.6	---	---	
			Sub Total	205,983	100			
	231,158	100	Rural & Barrio Total	231,158	100			
	314,657		Grand Total	314,657	100			

Source: JICA Study Team

Table 10.5.5 Ratio of Required Seismic Evaluation and Reinforcement, and Cost of Seismic Reinforcement per Building Replacement Cost

Area	Category			Ratio of Building Number	Ratio of Required Seismic Evaluation (Ratio of Seismic Reinforcement)	Cost of Seismic Reinforcement / Building Replacement Cost
	Type	Item	Year Built			
Area	Type of Structure	R. C. Structure		82.1%		
		Steel Structure		3.7%		
		Masonry		14.2%		
	Year Built	Before 1967 *1		51.7%		15%
		1968 ~ 1982 *2		37.4%		10%
		After 1983		10.9%		5%
	Number of Story		*1	44.1%	80%, (80%)	15%
		Low Rise: 1 ~ 3	*2	30.4%	75%, (70%)	10%
			*3		70%, (60%)	5%
			*1	6.4%	90%, (90%)	15%
		Middle Rise: 4~8	*2	4.6%	80%, (80%)	10%
			*3		70%, (70%)	5%
			*1	1.1%	95%, (70%)	15%
		High Rise: 9 ~	*2	2.5%	90%, (60%)	10%
			*3		85%, (50%)	5%
Rural Area	Dwelling House	Slope＞20degree	---	40.4%	80%, (80%)	15%
		Slope≦20degree	---	54.6%	80%, (75%)	10%
Barrio Area	Dwelling House	Slope＞20degree	---	43.4%	80%, (80%)	20%
		Slope≦20degree	---	56.6ºº%	80%, (75%)	15%

Source: JICA Study Team

Table 10.5.6 Cost of Early Warning and Evacuation

Item	Cost (USD)
Establishment of Agreement	4,000
Installation of Equipments	100,000
Annual Maintenance Cost of Equipments	56,000
Capacity Building of Regional Office	300,000
Total	460,000

Table 10.6.1 Comparison of Damage Without and With Project

(unit: MUS$)

Item	Damage Without Project (A)	Damage With Project (B)	Benefit (A-B)
Direct cost	439.6	64.2	375.4
Heavily damaged building value	313.2	53.5	259.7
Human damage	126.4	10.7	115.7
Indirect & Secondary Economic loss	281.6	116.3	165.3
Loss to Caracas (study area) economy	230.8	95.4	135.5
Loss to National economy	50.8	21.0	29.8
Rescue & Recovery cost	49.0	6.8	42.2
Emergency + medical cost	6.9	1.2	5.6
Debris clearance	33.6	4.3	29.3
Temporary house cost	8.5	1.2	7.2
Total	770.2	187.4	582.9

Source: JICA Study Team

Table 10.6.2 Estimation of Engineering Fee for Seismic Evaluation and Seismic Reinforcement Design

	No. buildings	Cost for all the buildings in the study area		Cost for 10,020 buildings For economic analysis
		Cost (MUS$)	Cost less IVA (MUS$)	Cost less IVA (MUS$)
RVS	247,500	15.6	13.4	0.38
Seismic Evaluation	216,480	390.7	336.8	11.4
Seismic Design	182,760	357.3	308.0	12.7
Total Engineering fee	-	763.6	658.3	24.4
Construction cost	182,760	1,817	1,566	53.5
Grand Total		2,581	2,224	77.9

Source: JICA Study Team

Table 10.6.3 Flow of Cost and Benefit

(unit: MUS$)

	year	Cost					Expected benefit	Net Benefit
		RVS	Detailed Seismic Evaluation	Seismic Reinforcement Design	Reinforcement Work	Total Cost		
1	2005	0.05				0.1		-0.1
2	2006	0.11	0.8	0.4		1.3	0.0	-1.3
3	2007	0.11	0.8	0.8	3	5.0	0.0	-5.0
4	2008	0.05	0.8	0.8	3	4.9	0.6	-4.3
5	2009		0.8	0.8	3	4.9	1.2	-3.7
6	2010		0.8	0.8	3	4.9	1.8	-3.1
7	2011		0.8	0.8	3	4.9	2.4	-2.5
8	2012		0.8	0.8	3	4.9	3.0	-1.9
9	2013		0.8	0.8	3	4.9	3.6	-1.3
10	2014		0.8	0.8	3	4.9	4.2	-0.7
11	2015		0.8	0.8	3	4.9	4.8	-0.1
12	2016		0.8	0.8	3	4.9	5.4	0.5
13	2017		0.8	0.8	3	4.9	6.0	1.1
14	2018		0.8	0.8	3	4.9	6.6	1.7
15	2019			0.8	3	4.1	7.2	3.1
16	2020				3	3.3	7.8	4.5
17-50	2021 - 2054						8.4	8.4
	NPV					29.6	29.3	-0.3
	B/C							0.99

Source: JICA Study Team
Note: Earthquake return period is assumed as 69.5 years. Referring JICA project evaluation guideline, 50 years is employed as project life. 12 % is employed as discount rate as the World Bank uses in a project in Venezuela.

Table 10.6.4 Annual Cost for Reinforcement of Buildings

(unit: MUS$)

Year	RVS	Detailed Seismic Evaluation	Seismic Reinforcement Design	Reinforcement Work	Total
2005	2.6				2.6
2006	5.2	30.1	13.2		48.5
2007	5.2	30.1	26.5	129.8	191.5
2008	2.6	30.1	26.5	129.8	188.9
2009-2018		30.1	26.5	129.8	186.3
2019			26.5	129.8	156.3
2020				129.8	129.8
Total	16	391	357	1,817	2,581

Source: JICA Study Team
Note: inclusive of value added tax (IVA, 16%)

Table 10.6.5 Percentage of Project Cost to GDP and Various Budgets

Item	Project Cost	GDP (2003 est.)	National Budget (2003)	MINFRA Budget (2003)	MINFRA project budget (2003)	Min. of Housing (2004)	AMDC Budget (2003)
Year	(MUS$)	85,748 (MUS$)	25,968 (MUS$)	1,936 (MUS$)	884 (MUS$)	625 (MUS$)	600 (MUS$)
2005	2.6	0.0%	0.0%	0.1%	0.3%	0.4%	0.4%
2006	48.5	0.1%	0.2%	2.5%	5.5%	7.8%	8.1%
2007	191.5	0.2%	0.7%	9.9%	21.7%	30.6%	31.9%
2008	188.9	0.2%	0.7%	9.8%	21.4%	30.2%	31.5%
2009-2018	186.3	0.2%	0.7%	9.6%	21.1%	29.8%	31.1%
2019	156.3	0.2%	0.6%	8.1%	17.7%	25.0%	26.0%
2020	129.8	0.2%	0.5%	6.7%	14.7%	20.8%	21.6%
Total	2,580.6	3.0%	9.9%	133.3%	291.9%	412.9%	430.1%

Source: GDP data from Central Bank (http://www.bcv.org.ve/EnglishVersion/Index.asp), National and MINFRA budget from "Resumen de la, LEY DE PRESUPUESTO 2003," Office of National Budget, (Oficina Nacional de Presupuesto) Ministry of Finance, AMDC budget from AMDC. For newly established Ministry of Housing news paper website "

Table 10.6.6 Annual Number of Buildings for Reinforcement Project

Year	RVS			Detailed Seismic Evaluation			Seismic Reinforcement Design			Reinforcement Work		
	Total	Urban	B+R	Total	Urban	B+R	Total	Urban	B+R	Total	Urban	B+R
Total Number	247,500	62,600	184,900	216,480	50,080	166,400	182,760	40,060	142,700	182,760	40,060	142,700
2005	41,250	10,433	30,817									
2006-2007	82,500	20,867	61,633	16,652	3,852	12,800						
2008	41,250	10,433	30,817	16,652	3,852	12,800	6,769	1,484	5,285	13,054	2,861	10,193
2009-2018				16,652	3,852	12,800	13,538	2,967	10,570	13,054	2,861	10,193
2019							13,538	2,967	10,570	13,054	2,861	10,193
2020										13,054	2,861	10,193

Source: JICA Study Team

Note: B+R denotes "barrio and rural."

Year	05	06	07	08	09	10	15	16	17	18	19	20
Rapid Visual Screening (RVS)	3 yeares 100 Engineers Urban: 62,600 Buildings											
	Rural &Barrio: 184,900 Buildings											
Detailed Seismic Evaluation	13 years 800 Engineers Urban: 50,080 Buildings											
					Rural &Barrio: 166,400 Buildings							
Seismic Reinforcement Design		13.5 years 640 Engineers Urban: 40,060 Buildings										
				Rural &Barrio: 142,700 Buildings								
Construction Work			14 years Urban: 40,060 Buildings									
				Rural &Barrio: 142,700 Buildings								

Source: JICA Study Team

Figure 10.2.1 Project Implementation Schedule for Building Reinforcement

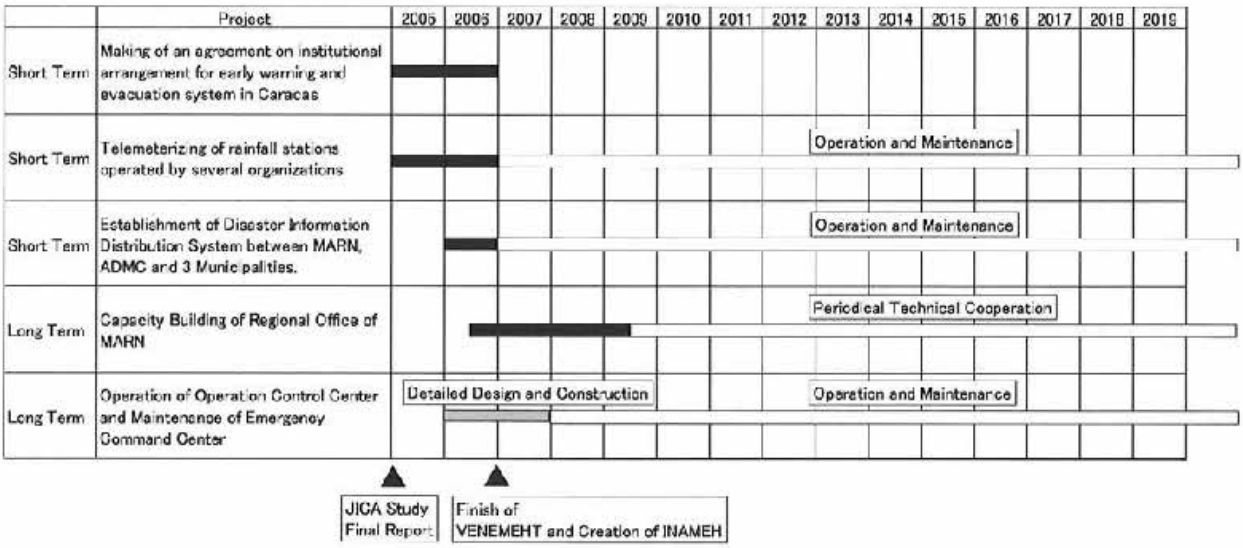
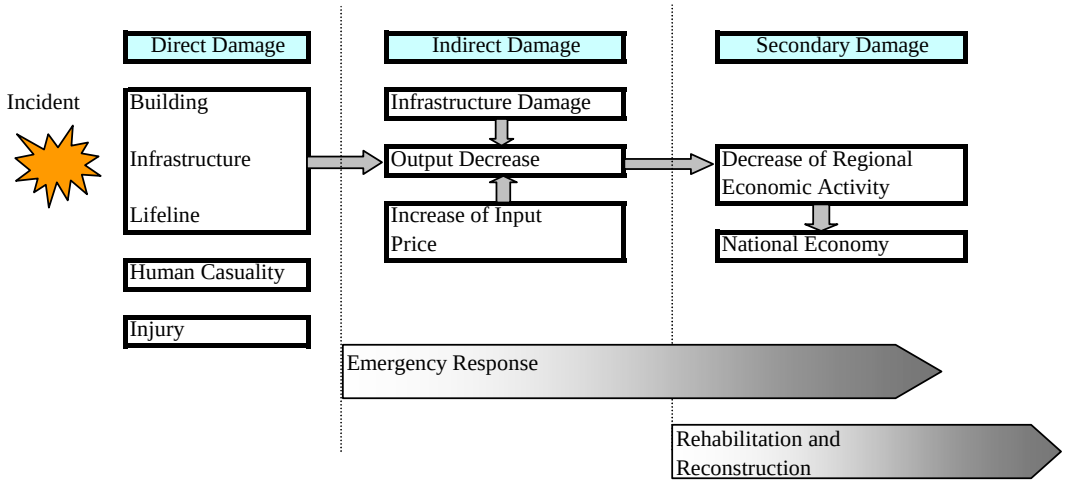


Figure 10.4.2 Project Implementation Schedule for Early Warning and Evacuation



Source: JICA Study Team based on Paul K. Freedman, et al., "Catastrophes and Development Integrating natural Catastrophes into Development Planning," Disaster Risk Management Working Paper Series No.4, World Bank, 202

Figure 10.6.1 Damage Link

CHAPTER 11

GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND DATABASE SYSTEM

CHAPTER 11. GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND DATABASE SYSTEM

11. 1 Introduction

The study team has recompiled and prepared a large number of GIS maps and database. A base map in GIS format has been prepared in the scale of 1:25,000 and working map has been prepared in the scale of 1:5,000 for the urbanized area. Some parts of study area also have the working map in the scale of 1:1000. Digital image processing of satellite images (Aster and Landsat) has been carried out for getting the regional view of the study area. Aerial photographs in some parts of study area were orthorectified for the digital interpretation and overlaying with the existing maps.

Many GIS analysis have been done to create new layers. Digitization of paper map has been also carried out.

Database development has been done for population data and building inventory data based on census of 2001. Also database analysis has been carried out to develop physical and social vulnerabilities. Finally, the analysis of damage scenarios and damage estimation has been integrated to the GIS system.

11. 2 GIS System Design

The study team has prepared a basic GIS standard, data format, system platform to be used in the project. Based on the discussion with the counterpart team, these standards were finalized on the following aspects.

- System platform,
- Units of measure,
- Datums,
- Map projections,
- Terminology,
- Cross-platform data translation processes
- Available data sets
- Symbol sets,
- Data storage and naming convention

11. 3 Database System Design

The database design and structuring was based on the following principles.

- Understanding the requirements before beginning to build the solution.
- To follow the existing and accepted standards for the design.
- Writing code that is readable.
- Separate user interface and data management.
- Design for the most efficient use of the program by the user.
- Program codes that can be re-used.

11. 4 GIS System Developments

The collected data were converted to GIS system using the standard GIS design developed for the project. Following processes were applied to the data received from different institutions.

- The paper format maps were screen digitized by scanning and georeferencing the scanned images.
- All the digital maps received in CAD formats were checked and edited for respective topology and converted to GIS format topological models. Additionally, they were converted to La Canoa coordinate system by using the coordinate conversion routine developed by JICA Study Team.
- The received GIS format maps were checked for the topology and attribute accuracy as well as relevance. The coordinate conversion was done when applicable.

11. 4. 1. Base Map Preparation

The JICA Study Team uses the topographic map of 1994, scale 1:25000 developed by IGVSB as its base map for the study. Additionally working topographic maps in scale 1:5000 and scale 1:1000 (year 2000) are being used for the detail analysis. The working topographic map in scale 1:5000 covers the urbanized area of ADMC.

(1) Base map of Scale 1:25000

A base map in the scale of 1:25000 in CAD format is purchased from IGVSB. The base map is being used for the preparation of all the relevant maps. This base map is obtained from IGVSB in La Canoa coordinate system. This base map is already converted to GIS format and GIS compatible layers with attribute data. These layers has been edited and updated in the course of

study period depending on the availability of the recent and more precise scale map and other information.

Table 11.4.1 shows the list of the GIS layers created from the base map.

(2) Working map of Scale 1:5000 and 1:1000

For the urbanized area, a working map of 1:5000 scale is obtained from Hidrocapital. Similarly working map of 1:1000 scale is obtained from Municipality of Sucre. These maps were originally in Loma Quintana system and were reprojected to La Canoa system using standard conversion routine developed by the study team.

(3) Digital Elevation Model (DEM)

DEM was prepared for the scale of 1:25000 and the scale of 1:5000 based on the corresponding contour maps. Further, a DEM of 2m pixel size (scale 1:2000) for the urbanized area was developed.

11. 4. 2. Orthorectification of Aerial Photos

Aerial photos taken in March 2002 were purchased (in paper format) from IGVSB and scanned with high resolution (1200 dpi). Some of the aerial photos in barrio and rural areas were georeferenced and subsequently orthorectified using the DTM of scale 1:5000. These orthorectified aerial photos are used for interpretation of buildings and houses as well as expansion of the barrio area.

11. 4. 3. Digital Image Processing

Different satellite images spanning the different year were obtained for the study, the most important among them being Aster image and LandSat images. Aster image covering ADMC was obtained for April 2003 and LandSat images were obtained for the years 1986, 1990, 1992, 1997 and 2001.

11. 4. 4. Administrative Boundaries Definition

Several sources of data were received and used to establish administrative units.

11. 4. 5. Microzone

Microzone, by definition, is the spatial units which divides the Metropolitan area in some sort of sectorization and where database (like Building, Population, Open Spaces, Road Networks and other Public Facilities) can be established. Further, these microzones could be used for presenting risk map as well as the results of damage scenarios. In future, these units can be used for planning purposes as well for evaluating the existing resources vs. degree of danger.

These units are the existing spatial divisions that exist in Caracas Metropolitan area with following sub units.

- Urbanized Area
- Barrio Area
- Rural Area
- Parks and Open Spaces

11. 5 GIS and Database Maintenance

The creation of a GIS database has been a huge, expensive and time consuming task. The Study team expects that these GIS and Database system will be put into maintenance mode in order to retain its value. This is often only slightly less labor-intensive than the initial creation of the database and regains the benefit of the database.

Some data layers do not change and require little maintenance except when software versions are updated. Other layers such as parcel or ownership change on a daily basis and require constant attention. Usually the best course of action within the Counterpart team is to assign an "owner" to oversee to the maintenance on a regular basis. This person (or organizations) is responsible for obtaining updates of the information and transferring it to the digital version of the layer in order to make it available for general use.

Maintaining accurate, up to date and reliable GIS data is critical in a successful operational GIS. Data maintenance includes updates of, additions to, deletions from and conversion of the database. In order to maintain the GIS data integrity, these changes have to be performed in a very careful manner.

The basic policy of study team was followings.

- Data will be shared with all the counterpart team unless it is restricted.
- Acknowledgement of received data in the final report.
- Result will be published only with the agreement of C/P team.

The counterpart team may need to design the detail procedure and protocol for the continuity of the GIS database maintenance in the following aspects.

- Data use
- Data Update/ Modifications
- Data Security
- Data Analysis
- Result Publication

11. 6 Disaster Management Information (DMI) System

As mentioned before, the GIS system developed in the JICA project has been able to recompile a large number of data layers and has produced a lot of thematic maps required for planning and decision making for disaster related activities in the metropolitan area of Caracas.

During the discussion with counterpart members, it has been agreed that this GIS system should be maintained and used as one of the component of proposed Disaster Management Information System. Development of GIS system from the beginning is very costly; however, maintenance requires fewer resources than development.

11. 6. 1. Purpose, Objective and Goals

(1) Purpose

- Effective diagnosis and management of disaster cycles
- Aid to effective decision making during disaster
- Aid to Effective coordination

(2) Objective

To help disaster prevention and attention (management) in all of the disaster stages, namely before: Mitigation/Preparation; during: Response; and after: Recovery and Reconstruction.

(3) Goals

- Uniform and consistent Metropolitan Spatial Database
- Spatial data that is reliable/precise for the given time period and Scale
- Spatial Data infrastructure that can be used by legitimate user any time, all the time and from anywhere

11. 6. 2. Expected Results and Functions

(1) Expected Results

- GIS based disaster information management system in place
- Development of related data collection schemes

- Establishment of data interchange and data managements protocols
- Data analysis and use protocols
- Publication of hazard and risk maps for public use
- Distribution of scenario analysis among different agencies

(2) Expected Functions

- Real Time Data Analysis - Disaster Response, Early Warning, Disaster Scenario (15-20 Minutes)
- Short Term Data analysis - Forecasting (1-2 Days)
- Mid Term Data Analysis - Research and Diagnosis (Hazard and Risk map updating), Planning (Mitigation /Preparation)(1-2 Years)
- Long Term Data Analysis - Disasters Scenarios (Continuous)

11. 6. 3. Proposed DMI System

The proposed DMI system will have three sub systems.

- Integrated communication system
- Information management system (based on GIS and database system)
- Decision making and disseminating system

Table 11.4.1 GIS Layers Created from the Base Map

FILENAME	MAP LAYER
\Base_Map\Contour_Line\elevation_26_06.shp	Contour Lines
\Base_Map\Facilities\airport.shp	Airport
\Base_Map\Facilities\club.shp	Club
\Base_Map\Facilities\Fence.shp	Fence
\Base_Map\Facilities\Golf_Field.shp	Golf Field
\Base_Map\Facilities\Horse Track.shp	Horse Track
\Base_Map\Facilities\Metro Line.shp	Metro Line
\Base_Map\Facilities\School and Sport Buildings.shp	School and Sport Buildings
\Base_Map\Facilities\vegetation.shp	Croplands and Forest
\Base_Map\Hydrologic_Network\Channel.shp	Channel
\Base_Map\Hydrologic_Network\Check_Dam.shp	Check Dam
\Base_Map\Hydrologic_Network\Coast Line.shp	Coast Line
\Base_Map\Hydrologic_Network\Lagoon Of Seasonal Regimen.shp	Lagoon
\Base_Map\Hydrologic_Network\Reservoir.shp	Reservoir
\Base_Map\Hydrologic_Network\River Of Seasonal Regime.shp	River of Seasonal Regimen
\Base_Map\Hydrologic_Network\River.shp	River
\Base_Map\Life_Line\Gasoline Tank.shp	Tank
\Base_Map\Life_Line\High Tension Electric Line.shp	High Tension Electric Line
\Base_Map\Life_Line\Pipe Line.shp	Pipeline
\Base_Map\Road_Network\Path_Road.shp	Foot Path
\Base_Map\Road_Network\Paved_Road.shp	Highway, Paved Road and Street
\Base_Map\Road_Network\Secondary_Road.shp	Secondary Road
\Base_Map\Road_Network\Tunnel.shp	Tunnel
\Base_Map\Urban_Area\Buildings.shp	Building-polygon
\Base_Map\Urban_Area\buildings_line.shp	Building-line
\Base_Map\Urban_Area\Urban_Areas.shp	Urban Area

CHAPTER 12

STUDY ON SEDIMENT DISASTER CAUSED BY HEAVY RAINFALL IN FEBRUARY 2005

CHAPTER 12. STUDY ON SEDIMENT DISASTER CAUSED BY HEAVY RAINFALL IN FEBRUARY 2005

12. 1 Introduction

Between February 6th (Sunday) and February 10th (Thursday) in 2005, a large amount of rainfall occurred influenced by a developed cold front in the west coast and Andean mountain regions in Venezuela. Because of this heavy rainfall in dry season, 62 people died, 60 people are missing, 222,893 people were affected and 44,633 houses were damaged. (The figures were compiled by the Ministry of Interior and Justice by February 18th). There are reports road interruptions, road damage, breach of rive banks and flood damage from various parts of the country. After the disaster, Mr. Miura of the Study Team together with Mr. Jose Fra of the counterpart team and the JICA expert Mr. Nagata visited the sites of disaster in Caracas and in Vargas on 26th February, 2005. Consequently, the importance of the proposed Master Plan projects in the JICA Study targeting Caracas was recognized again.

12.2 Field Survey Result

The survey report will be prepared and will be handed over to the Venezuelan side as " Disaster Survey Report in February 2005" by the JICA expert Mr. Masaichi Nagata including the area other than the place of field visit on 26th February.

12.3 Relation with the JICA Study

According the to the survey of the disasters, the importance of the Disaster Prevention Basic Plan for the Metropolitan District of Caracas was recognized. Items for special note area as follows; (No corresponds to the Project Number proposed in the Plan.)

No.3: Debris Flow Control Structures

During the field survey, the Sabo dam constructed by Corpo Vargas on San Jose de Galipan River in Vargas was surveyed. The existing Sabo dam has stored the debris from upstream and the storage was full. The Sabo dam played a significant role to reduce the amount of sediment run-off downstream and at the same time, contributed to prevent further erosion of river side by making the rive bed slope milder. Thus, the effectiveness and the importance of debris flow control structures were recognized in Vargas. Therefore, it is expected that the proposed debris flow control structures be constructed as planed.

No.4 Slope Protection Works, No.5 Drainage Improvement in Barrios

Including the 19 de April area visited on February 26th, many steep slope failures occurred this time were caused by mal-drainage as well as incomplete sewerage. As proposed in the Plan, drainage improvement in barrio area is the most realistic and effective solution. The policy should be implemented by relevant authorities as soon as possible. When the slide is in a large scale or roads are protection targets, it is necessary to consider slope protection works proposed in the Plan.

No.6 Early Warning and Evacuation for Debris Flow Disaster Prevention

Fortunately, in this recent disaster, no death was reported by sediment disasters in Caracas. However, similar kind of sediment disasters will repeat themselves in future. Therefore, it is necessary to establish early warning and evacuation system as soon as possible and it will be implemented by MARN, ADMC Civil Protection, Municipal Civil Protection and communities.

No.7 Resettlement of People in Risky Areas

During this recent disaster no debris flow occurred in mountain streams in Caracas. However, larger rainfall in future will definitely cause debris flows in the same manner as in 1999. Therefore, it is necessary to implement the resettlement of people in risky area by the relevant authorities.

No.8 Land Use and Development Control in the Risky Area

The 19 de April area, where a large scale land slide occurred, had been damaged by the same kind of disaster in 1988. These kinds of area where land slide repeating should be designated as the restricted area and be converted to, for example, a park. By taking this opportunity, the government should imposed strict regulations in the area so that the land should not be used for housing construction again. It is expected that the local or the national governments acquire the land.

No. 10 Publication of Hazard Maps and Risk Maps, No.11 Education of People

The sediment disasters in Caracas this time , mainly “steep slope failures”, occurred in the risky slopes identified in the Study and described in the hazard maps. The importance of publication of hazard maps and risk maps of the area in order to draw attention of the residents was recognized again. At the same time, it is necessary to implement the education of people so that they will live away from risky area or they will be ready to evacuate from where live if they live in risky areas, when a disaster is anticipated.

No.12 Strengthening of Community Disaster Prevention Activities

In order to implement the early warning and evacuation system, strengthening of community disaster prevention activities is essential. On the other hand, sediment disasters in Caracas during this recent disaster occurred in many places at the same time and it is difficult for official rescue organizations such as fire fighters to cope with the situation. It is required to promote community activities for disaster prevention.

No.13 Emergency Command Centre

The importance of the emergency command centre proposed as the bases of disaster management administration before and after the disaster was recognized. Presently, the Metropolitan Civil Protection Office playing the role of the emergency command centre but the communication system is inadequate and the definition of their function is not clear. It is expected that the emergency command centre proposed in the Plan (equipped with the communication system, disaster management information system and it plays the role of bases for dispatching early warning and evacuation recommendation.), should be constructed as soon as possible.

12.4 Regional Disaster Prevention Plans for Other Regions

Through this recent disaster, risk of sediment disaster exists not only in Caracas or in Vargas State, but also in other states in the country. Although this JICA Study is limited to the Metropolitan District of Caracas for its target, the Disaster Prevention Basic Plan proposed in the Study can be applied for the other part of the country as a model plan. It is necessary to prepare other regional disaster prevention plans as soon as possible.

Photos

Existing Sabo Dam in San Jose de Galipan

Land Slide in 19 de Abril

Damaged House in 19 de Abril

Damaged House in Antimano

CHAPTER 13

CONCLUSION AND RECOMMENDATION

CHAPTER 13. CONCLUSION AND RECOMMENDATION

13. 1 Conclusion of the Study

13. 1. 1. Hazard Feature of the Area

The Study Area has a history of earthquake disasters and sediment disasters.

Caracas City experienced some large earthquakes since 1500's when the history of the city began. The largest earthquake occurred is in 1812 when thousands of people died because of collapse of many buildings. The most recent earthquake in the Caracas history if 1967 earthquake when 275 people died. Considering these earthquake history, there is a possibility of occurrence of such scale of earthquakes as 1812 earthquake or 1967 earthquake.

The urban area of Caracas extending from the foot of El Avila to the Guaire River is a fluvial plane composed of debris flow from El Avila. The historical record of debris flow shows that in 1951, a large scale debris flow occurred in some mountain streams and caused damage. The most recent phenomenon is in 1999, when debris flow occurred along Catuche and Anauco mountain streams and some hundred people died. The mountains surrounding Caracas urban area have risky steep slopes or landslide mass. Strong intensity of rainfall in rainy season often causes landslides and steep slope failures in such areas.

13. 1. 2. Social Vulnerability and Social Capacity of the Place

Because of high concentration of population and assets, the risk of the city once a natural hazard occurs is high. Much more, the distribution of population in Caracas in terms of social vulnerability and social capacity against natural hazard is not uniform. About a half of the Caracas population live in so called barrio area and the social vulnerability is high according to the social survey.

Through this study, physical vulnerability distribution such as building damage ratio was developed on the GIS platform and at the same time social vulnerability/capacity distribution of the area was created from the result of social survey.

The physical vulnerability map and the social vulnerability/capacity map were superimposed. The result shows the risk distribution of the area taking into account the physical and social vulnerability. The map shows the uneven distribution of risk in the area.

13. 1. 3. Disaster Prevention Basic Plan

Disaster Prevention Basic Plan for the Metropolitan District of Caracas was formulated based on the analysis of the area in terms of natural hazard, human activity in the area, social vulnerability and social capacity. As the earthquake disaster scenarios, 1967 earthquake and 1812 earthquake were selected and damage were simulated. For sediment disaster scenario, rainfall amount with the probability of once in one hundred years was selected to simulate the damage.

The targets of the protection were defined as “human lives”, “property” and “function of the city”.

The master plan is composed of twenty projects and seven of them are major projects in order to attain the objectives of “making a safer Caracas” and “acting effectively in emergency”. The major six projects are “seismic reinforcement of buildings”, “seismic reinforcement of bridges”, “construction of debris flow control structures”, “resettlement of people from risky area”, “early warning and evacuation for debris flow disaster prevention”, “an emergency command center” and “strengthening community activities”.

The total project cost of the master plan was estimated as around US$ 2.8 billion by the target year 2020.

The master plan was evaluated from the viewpoint of economic aspect, financial aspect, social aspect , management aspect and environmental aspect. The master plan was evaluated as workable through good coordination of institutions in national, regional and municipality levels as well as community participation.

The effects of the master plan projects are as follows;

- When the 1967 earthquake is assumed, the number of buildings heavily damaged will be reduced from 10,000 to 1,300. The number of casualties will also be reduced from 4,900 to 400.

- When the 1812 earthquake is assumed, the number of buildings heavily damaged will be reduced from 32,000 to 5,300. The number of casualties will also be reduced from 20,000 to 2,300.

- When the 1812 earthquake is assumed, the road traffic around Arana and other points will be cut without the projects, while with the projects, there will be no such damage on the highways.

- When debris flows caused by 100 year rainfall are assumed, with the debris flow control structure, 2,700 buildings along the mountain streams and 19,000 people will be saved.

- By implementing early warning and evacuation project, the resident can evacuate safely when various scales of debris flows occur.

13. 1. 4. Feasibility Study on Priority Projects

Among the master plan projects, two priority projects were selected for feasibility study. The priority projects were selected based on the selection criteria of “significance”, “urgency”, “immediate consequences”, “technical feasibility”, “economic feasibility”, “the result of initial environmental examination”, “prospect of financial sources”, “social necessity” and “requests of the counterparts”.

As a result, “seismic reinforcement of buildings” was selected as a priority project for earthquake disaster prevention. For sediment disaster prevention, “early warning and evacuation for debris flow disaster prevention” was selected as a priority project.

According to the detail study including the field test on barrio houses reinforcement, the effect of the project became clearer.

In the case of 1967 earthquake scenario, the number of heavily dmaged building will be reduced from 10,000 to 1,300 and the number of human casualties will be reduced from 4,900 to 400 by the implementation of the seismic reinforcement of buildings. In the case of 1812 earthquake scenario, the number of heavily damaged building will be reduced from 32,000 to 5,300 and the number of human casualties will be reduced from 20,000 to 2,300 by the project.

By the implementation of the project of early warning and evacuation for debris flow disaster prevention, lives of 19,000 people, who live in the area where debris flow of various scales may attack , can be saved.

These two projects were evaluated from the viewpoint of economic aspect, financial aspect, social aspect, management aspect and environmental aspect. The feasibility of the two projects were verified through the study and strategy for promotion of the projects were formulated.

13. 2 Recommendation

Through this study, the disaster of the Metropolitan District of Caracas has been analyzed from the viewpoint of technological aspect, environmental aspect, social aspect, institutional aspect, legal aspect and community aspect by the Study Team with the close cooperation with the Venezuelan Counterpart.

The proposed disaster prevention basic plan is the product of repeated discussion among the Study Team members and the Counterpart team members.

Through this Study and preparation of the plan, the Study Team found some recommendations to the Venezuelan side.

(Recommendation to the Metropolitan District of Caracas)

- The ADMC should , referring the Supporting Report S1 of this Study, formulate and authorize the Basic Plan for Disaster Prevention of the Metropolitan District of Caracas including the five municipalities in the area, those are Libertador, Chacao, Sucre, Baruta and El Hatillo,

- The ADMC should start to implement the projects proposed in the this Study in order to reduce the vulnerability and increase the capacity to cope with natural disasters which will attack this area,

- The ADMC should hold discussion with the national civil protection to authorize the proposed Basic Plan for Disaster Prevention of the Metropolitan District of Caracas,

- The ADMC should promote coordination among the national government agencies, the Metropolitan government, the municipal governments and the communities in order to attain integrated disaster prevention for the Metropolitan District of Caracas, and

- The ADMC should lead the municipal governments to formulate their own regional disaster prevention plan referring the Basic Plan for Disaster Prevention of the Metropolitan District of Caracas.

(Recommendation to the Ministry of Interior and Justice)

- The national basic policy and the national plan of disaster prevention is the essential base of Venezuela. The national plan for disaster prevention should be formulated as soon as possible,

- The National Civil Protection should authorize the Basic Disaster Prevention Plan of the Metropolitan District of Caracas proposed by the ADMC after discussion with Metropolitan Civil Protection,

- The National Civil Protection should construct the National Emergency Command Center in order to act effectively in national emergency,

- The Metropolitan District of Caracas is the capital city of the country and the most important city in Venezuela. The national government should implement the project for disaster prevention in Caracas in order to save the lives of the people, the value of the assets and the function of the city, and

- The national government should promote coordination among the national government agencies, the Metropolitan government, the municipal governments and the communities in order to attain integrated disaster prevention for the Metropolitan District of Caracas.

(Recommendation to the Ministry of Housing)

- The Ministry of Housing should establish a policy on seismic reinforcement of buildings in the country,

- The Ministry of Housing should establish an institutional framework to promote seismic reinforcement of buildings in the country,

- The Ministry of Housing should take initiative in barrio houses seismic reinforcement project, and

- The Ministry of Housing should promote the project of drainage improvement of barrio area in order to reduce the risk of landslide and steep slope failure in the area.

(Recommendation to the Ministry of Infrastructure)

- The Ministry of Infrastructure should implement the project of seismic bridge reinforcement after detail seismic evaluation of the structures proposed in this plan.

(Recommendation to the Ministry of Environment and Natural Resources)

- The Ministry of Environment and Natural Resources should implement the project of debris flow control structures to protect Caracas,

- The Ministry of Environment and Natural Resources should establish a national policy on early warning and evacuation for sediment disaster prevention, and

- The Ministry of Environment and Natural Resources should establish a branch office in Caracas so that it will perform detail observation and study of the local meteorological and hydrological phenomena in the area of Caracas and Vargas.

(Recommendation to the FUNVISIS)

- FUNVISIS should establish a system to transmit the information on seismic events in the area to the ADMC when a significant level of earthquake hit the area,

- FUNVISIS should create a system to train engineers for the skill of Rapid Visual Screening as a part of the project of seismic reinforcement buildings, and

- FUNVISIS should promote and implement the study on seismic reinforcement of barrio houses.

(Recommendation to the Institute of Fluid Mechanics, UCV)

- IMF should continue research on debris flow phenomenon in Caracas Area,

- IMF should continue research on critical rainfall amount for the purpose of early warning and evacuation from debris flow disasters, and

- IMF should promote the early warning and evacuation system for debris flow disaster prevention collaborating with the related agencies with rainfall data in the area.

(Recommendation to the Municipal Governments)

- Each municipal government should prepare their own regional plan for disaster prevention referring to the Basic Plan for Disaster Prevention of the Metropolitan District of Caracas,

- Each municipality should coordinate and promote community organizations and community activities for the realization of disaster prevention policies in each municipalities, and

- Each municipal government should promote seismic reinforcement of buildings through their engineers' office.

(Recommendation for citizens)

- Every citizen of the Metropolitan District of Caracas should prepare for natural disasters in order to safeguard their lives and properties,

- Every citizen of the Metropolitan District of Caracas should formulate a community organization, where a disaster prevention is included as one of its purpose, and

- The community organization should coordinate with the municipality government in order to make their activity effective for disaster prevention.