13th World Conference on Earthquake Engineering
Vancouver, B.C., Canada
August 1-6, 2004
Paper No. 1337

ANALYSIS OF LAND USE MANAGEMENT FOR EARTHQUAKE DISASTER REDUCTION IN THE ASIA PACIFIC REGION

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SUMMARY

Land use control and management is one of the significant countermeasures initiated and implemented by local governments to reduce earthquake disaster. Land use is heavily tied to the economic development plan, and the consideration of land use control and management for disaster management is critical for sustainability of the city. However, it is not a common approach in Asia Pacific countries due to barriers including socio-economic or institutional issues. In this paper, factors of land use control and management for earthquake disaster reduction are analyzed in the case study of Marikina City (Metropolitan Manila, Philippines) to quantify barriers and facilitate the implementation of a management planning process in Asia Pacific countries. Land use management reveals the framework and activities that manage and control the use of land within the institutional framework, while land use planning determines the use of land with a specific purpose. And, land use management planning processes are focused in this study. These processes are divided into three phases: 1) planning background analysis, 2) planning strategy development, and 3) implementation strategies development. Factors of each phase are identified and applicable land use control and potential management methods for Marikina City are considered through the analysis of these factors.

INTRODUCTION

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Land use management is a newly emerging disaster reduction method. A number of local governments of the United States, Australia or New Zealand have applied for land use management programs for disaster reduction. However, in Asia Pacific countries, land use management is not a commonly used method to promote earthquake disaster reduction. Nonetheless, land use management should seriously be taken into consideration, especially in Asian cities with land use problems like high population density, high-rise buildings, or vulnerable residential houses in earthquake hazard-prone areas.

Land use management is more than regulating development activities in the area with laws, ordinances, and regulations. It should be linked to comprehensive land use plan and zoning ordinance to establish the bases for sustainable social and economic development of the city.

This research project focused on the development of a land use management Policies and program to be implemented for earthquake reduction. The process of policy development through experimental workshops is a distinctive component in this project. The critical factors in the process are discussed in this paper. The applicability, effectiveness, and implementability of land use management as a tool for disaster reduction is examined in this case study of Marikina City of the Philippines. In the analysis of land use management tools and evaluation of land use management polices and programs developed for Marikina City, land use management tools from the practices of the local governments of the United States. Especially, the State of California is a prime example of how land use management is implemented in a systematic way.

LAND USE MANAGEMENT PLANNING FACTORS FOR DISASTER REDUCTION

There are several critical factors that must be clarified before analyzing land use control and management methods. In order to identify these factors, the land use management planning process in Marikina City was reviewed. There are three phases in land use management planning for disaster reduction. They are planning background, planning strategy, and implementation as shown in Figure 1. This process is developed by incorporating factors of risk management process, such as Australia/NZ risk management standard (Standards Australia, 1999).

Planning Background

The first stage is a community risk analysis to collect planning background information. Elements at risk are identified based on hazard information analyzed by seismologists and engineers to quantify the risks of the area. Then, properties to protect are identified accordingly. The land use management and administrative context (including the legal system, organizational issues, and the plans and programs of the government) are analyzed along with identification of elements at risk. Legislation is a key factor in context analysis, as it provides the legal framework and mandate of the implementing organization. The organizational system and its roles are important aspects in the development and implementation of land use management policies, programs and plans. Finally, elements at risk such as population, buildings, land use activities, and infrastructure are identified and analyzed.

Planning Strategy

The second phase is the development of a policy for earthquake disaster reduction. A goal, objectives and policies, programs for disaster reduction are developed through discussion between government officials, experts, researchers, and other related groups.

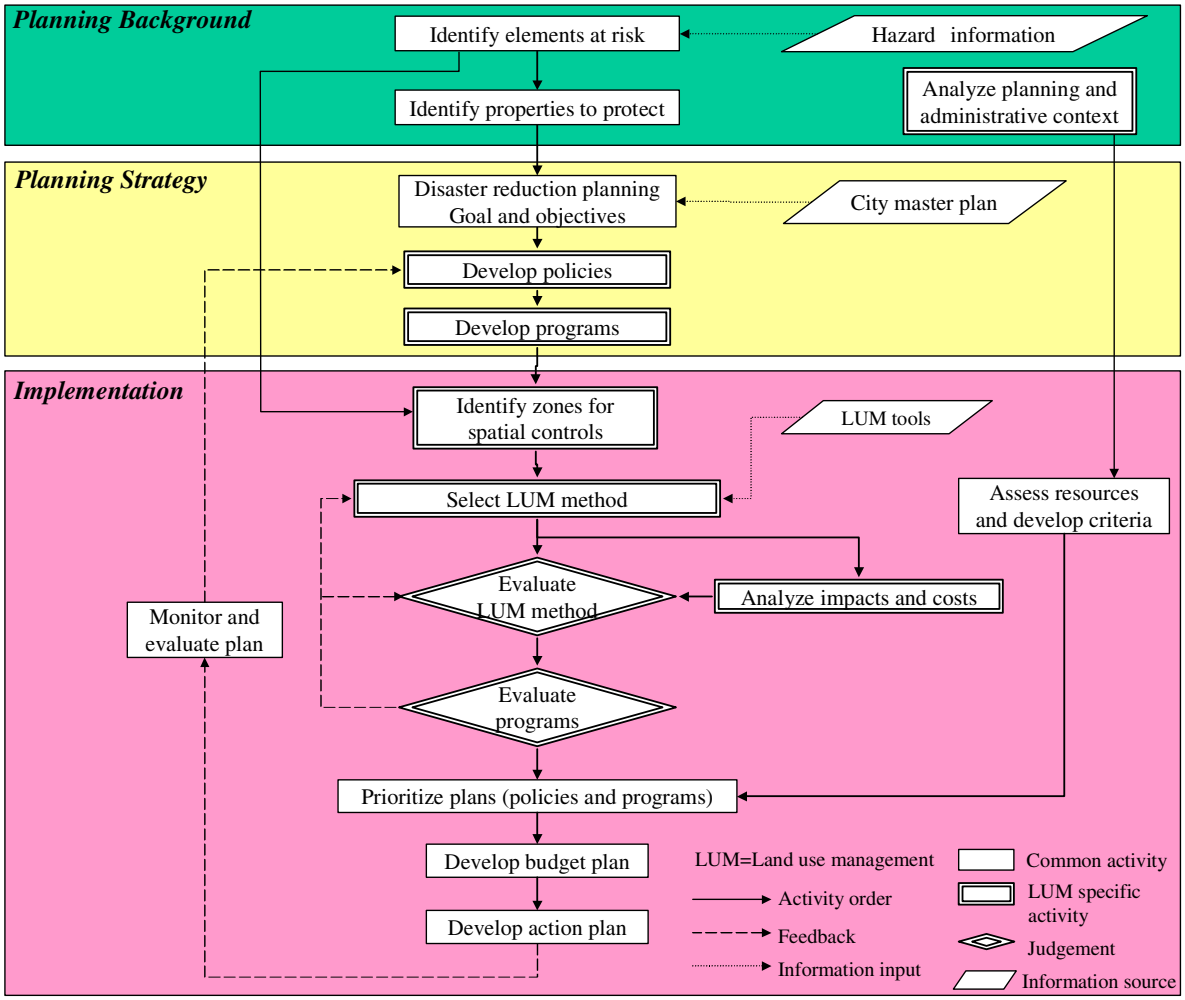

Figure 1. Land Use Management Planning Process

Implementation

In the final phase, implementation strategies are developed. The areas necessary for spatial control for disaster reduction are identified, and available resources, such as humane and monetary, or internal and external, are assessed. Policies and programs are prioritized by importance for the city and availability of human and monetary resources. Land use management tools are then selected to analyze and evaluate the applicability and impacts of policies and programs.

Components of Plan Quality

In addition to the factors of land use management planning process, there are components of plan quality for land use management plan developed by the governments. These are three dimensions, which are fact basis dimension, goals dimension and policies dimension. These components are important to establish the base for land use management plan by complementing the planning process for the comprehensive land use management plan. Each dimension is divided into several factors, and some of those are overlaps with factors of land use management planning process as shown as follows (Burby et al., 1997):

1. Fact Basis Dimension
   - Map information
   - Emergency response data
   - Exposure data

2. Goals Dimension
    - Hazard-related goals
    - Environmental goals
3. Policies Dimension
    - Awareness policies
    - Regulatory policies
    - Incentive policies
    - Infrastructure policies
    - Recovery policies
    - Preparedness policies

ANALYSIS OF PLANNING AND ADMINISTRATIVE CONTEXT

In the analysis of planning background, regional factors, the legal system, the organizational system, plans and programs, are discussed. In addition, risk elements need to be clarified based on the hazard analysis by Hasegawa (2004). National laws, regulations, and local government ordinances must also be considered. The government organizational system is also an important factor since it determines the appropriate policy for the city. Issues of concern are identified for the framework of policy development and implementation. Risk elements are identified to find physical areas of concern regarding land use management.

Information about legislation, organization and related plans were collected through interview with government officials and document surveys. Legislative and administrative system related to land use management for earthquake disaster reduction is analyzed through the comparison with one of the United States.

Legislative System

Laws, orders, and ordinances that provide the legal framework for land use management and earthquake disaster reduction are as follows:

- Local Government Code (Republic Act 7160)
- Presidential Decree 1556 (ten fundamental national disaster management policies, and the basic law government disaster coordination in Metro Manila)
- Executive Order No.72 (providing for the preparation and implementation of the CLUP (Comprehensive Land Use Plan) by local governments)
- City Ordinance No. 159 (regulation of land use along the fault line)
- Marikina Zoning Ordinance
- National Structural Code of the Philippines

Local government law (Republic Act 7160) approved the transfer of the legislative authority to local governments from the national government. Based on this law, the right to enact land use plans was transferred from The Housing and Land Use Regulatory Board (HLURB), and every local government must prepare a comprehensive land use plan enacted through a zoning ordinance (Marikina, 2002). Presidential Decree No. 1566 requires the establishment of disaster coordinating councils at national, Metro Manila, city municipality and barangay level, and development of disaster management programs. National government and Metro Manila governments support local governments to develop self-reliant program. Metro Manila's disaster management policy is more focused on preparedness and response rather than mitigation and recovery. Under the law, the National Disaster Coordinating Council (NDCC) was established to monitor and assist local governments to prepare emergency plans. The Metro Manila Disaster Coordinating Council (MMDCC) is responsible for directing Metro Manila cities to develop

disaster management plans. Under MMDCC, a City Disaster Coordinating Council was established to prepare each city plan. Republic Act 8185 was approved by Congress and further strengthens the jurisdiction of local governments over disaster management (JICA 2003). Finally, Republic Act 7160 strengthens local governments' authority to organize preparation for disasters.
After the announcement of the existence of the fault line in Marikina City by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), Marikina enacted City Ordinance No. 159 to regulate the use of land near the fault line for the purpose of earthquake disaster reduction. All buildings and structures to be built near the fault line are required to have a five meter easement on both sides of the Marikina fault trace and such other fault traces identified by PHIVOLCS (Marikina, 2000). Marikina City may require clearance from PHIVOLCS for the construction of buildings suspected to be within the fault line. City Ordinance No.159 was incorporated with a City Zoning Ordinance approved in 2003 to promote consistency with the land use plan.

The National Structural Code of the Philippines provides guidelines for building designs for all the buildings in the Philippines by regulating and guiding the design of buildings (height and structure) according to the type and size of the buildings (2001). In 2001, the Code was amended to incorporate seismic aspects reflecting the hazard information (fault line). As seismic design is uniformly applied to all buildings in earthquake hazard-prone areas according to the type of seismic sources and soil structure, city governments can maintain the quality of seismic safety construction as long as the Code is followed. City governments are provided discretion in their operation of the Code and the provisions of buildings. Marikina City requires landowners to submit a soil test for buildings over three stories.

Institutional Context

The government organizations involved in land use and disaster management are divided into three levels; national, Metro Manila, and city level.
The Housing and Land Use Regulatory Board (HLURB) is the national organization responsible for the following tasks related to land use planning:

- Set the standards and guidelines governing the preparation of land use plans;
- Monitor the implementation of such plans; and
- Adjudicate and settle disputes among local governments regarding land use and zoning.

With the transfer of authority to develop land use plan under RA 7160, HLURB focuses on monitoring and guiding local governments.

The Metro Manila Development Authority (MMDA) oversees the development of disaster management programs for all Metro Manila cities. Metro Manila's disaster management policy is more focused on preparedness and emergency response rather than mitigation and recovery. However, the concern over disaster mitigation is rising with the support of Japan's International Cooperation Agency (JICA) and many research activities conducted by international members. Santiago (2001) pointed out some of the projects MMDA is now taking on:

- Mapping and paleoseismology of active faults;
- Seismic microzonation of Metro Manila;
- Relocation of informal settlers from risk areas;
- Reformulation of land use and zoning; and
- Amendment of building code and other laws or regulations.

Under the guidance of NDCC and MMDCC, Marikina City established the Marikina City Disaster Coordinating Council (MCDCC) to develop an emergency management plan. As it concentrates on a preparedness program, a disaster management planning scheme to deal with mitigation and recovery is necessary in itself. Marikina City has strong leadership and autonomous power in developing its own

planning scheme. It has been achieving a great success in flood management through projects of infrastructure development and relocation of informal settlers.

Marikina city was approved a land use and zoning plan with the city zoning ordinance by HLURB in 2003. Marikina City also developed its CLUP, which was ratified by HLURB in 2001. These plan developments were enacted under the legislation of Republic Act 7160 (Local Government Code) and Executive Order No.72 that directs the future of the city in relation to activities of the community.

As reviewed, the shift of legitimate authority in land use management and disaster management has shifted from the national government or higher government agencies to local governments. In the next subsection, the roles of key government agencies are discussed relating to land use management and disaster management.

Comparative Analysis with the City of the state of California

Differences of the system between the Philippines and the United States are found in which government organizations establish and operate the regulations. Marikina City enacted City Ordinance to regulate the use of land along the fault, and it is incorporated to Zoning Ordinance, and set the requirements of geotechnical investigation to new developments in building permit procedure. On the other hand, the City of San Jose in the State of California for example, utilizes state laws (Earthquake Fault Zoning Act, Seismic Hazard Mapping Act) to regulate the use of land, require geotechnical investigation to developers and prepare hazard map to be used for development of general plan or provision of building permission to incorporate seismic safety elements. Thus, both enactment and operation of the regulation or ordinance are conducted in local government level in Marikina City's case, while standard regulation is provided by the State and operated by the city in San Jose's case. It is summarized that in San Jose City's case, the State provides the framework for earthquake disaster management on that the city can develop their own plans or programs, while in Marikina's case, cites need to develop city's own disaster management framework to develop plans or programs by being provided the authority and obligation legally.

It is considered that the comprehensive development plan must serve as the basis for the development of a land use plan (Integrated Environmental Management for Sustainable Development 1997). In the current regime of public administration (Integrated Environmental Management for Sustainable Development 1997):

- Institutional roles are fairly well defined;
- Horizontal linkage among sectors (natural resources, transportation, tourism, agriculture) are relatively strong; and
- Vertical linkage among various levels of administration and government (national, regional, provincial, city, and municipal) are relatively weak.

It enables Marikina City to have the organic linkages among the comprehensive development, the zoning and the land use plans, capital investment programs. However, from the perspective of earthquake disaster management, the city's disaster reduction aspects are incorporated in the zoning ordinance but not in the comprehensive plan. In the case of Marikina City, only the fault line setback is regulated over zoning ordinance after the CLUP is developed. While, the state of California requires local governments by the state law to utilize hazard information in general plans.

Regarding the relationship between building code and zoning ordinance, there is no clear relationship is found in the National Structural Code of the Philippines and California Building Code. There is a difference between Marikina City and San Jose City. In Marikina City, Department of City Engineer is in charge of providing building permission by monitoring zoning ordinance and structural design in one window. On the other hand, in San Jose City, a developer needs to go through several departments to

obtain permissions, such as land use and building. Yet, both procedures generate same output as long as zoning ordinance and structural design guidelines are followed. There are problems in operation rather than in the program for building permit provision. Developers are required by law to obtain a building consent when they construct buildings, but they occasionally change the building structure or type of building to one that is not in line with the zoning ordinance after the documents for building consent are submitted.

In terms of the usage of hazard information, currently, only fault rupture information is incorporated in the zoning ordinance to compliment City Ordinance No. 159, which regulates the use of land along a fault line. No other hazard information, such as liquefaction, ground shake, or landslide are identified and incorporated into ordinances. Hazard information is provided by PHIVOLCS with the direct communication between the city and PHIVOLCS. However, the exact location of fault line is clarified, therefore, City Ordinance No.159 is not in strict operation at this moment.

ANALYSIS OF ELEMENTS AT RISK

Marikina City, pierced by the West Valley fault, developed as a bedroom community with a population of 427,037, and the size of 2,150 hectares. The City is located at the north end of a basin of soft soils that would be subject to heavy ground shaking in a Magnitude 7.0 earthquake, considered highly likely by the Philippine Institute of Volcanology and Seismology. Average population density is more than 20,000/km^2, which is relatively large compared to other cities in Asia. Most of the land is built-up, and approximately 40 percent falls in the area with a degree of Peak Ground Acceleration (PGA) of more than 710 cm/s^2 (Hasegawa, 2004)). Approximately 33 percent of the current land use is residential and 36 percent of the commercial area is occupied by small businesses or stores with residence. Thus, housing, stores, and small office buildings are included in the seismic risk.

In terms of public facilities and infrastructure, a development plan for high-rise buildings in highly developed zones is planned in high hazard risk areas. Marikina City recently developed the concept of "Little Singapore" as a future city vision including development of high-rise buildings to formulate the commercial center in this earthquake-prone area.

Problems and weakness of Marikina City in terms of land use are summarized as follows:

- Scarcity of spaces for further development;
- Threat of the Valley Fault System;
- Preponderance of mixed uses in the city;
- Large proportion in residential areas;
- No hierarchy of roads; and
- Development vision of commercial center in highly hazard-prone areas.

Accordingly, risk elements of Marikina City are as follows:

- Population density;
- Residential houses and small business buildings; and
- High-rise buildings in planned commercial areas.

Areas of heavy population density are shown in Figure 3. Approximately a half of the area with a degree of PGA of 710 cm/s^2 is occupied by the highly population density are of more than 20,000/km^2. It means that a large number of people are exposed to the earthquake hazard.
Figure 4 shows the example of a damage risk assessment result that the vulnerability of houses is assumed to fall in type F curve (poor quality) in the GESI method. The total number of complete collapse buildings is estimated over 11,000 houses is estimated to collapse under the assumption (Hasegawa, 2004).

The Comprehensive Land Use Plan shows strategically located zones for commercial and industrial development in Marikina City. The zoning map guides new commercial growth into locations near the Marikina River, the central business district, and along major roads. Areas for mixed use projects and industrial growth are to the northeast of the central business district near the industrial area. However, Marikina City is traversed by the West Valley Fault System reaching northward and southward through the region. Lands zoned for business (Figure 5) happen to be located in areas subject to heavy ground shaking in a Magnitude 7.0 earthquake (Figure 2). Unless precautions are taken, many existing buildings in Marikina City would be seriously damaged or destroyed in such a quake (Topping, 2004).

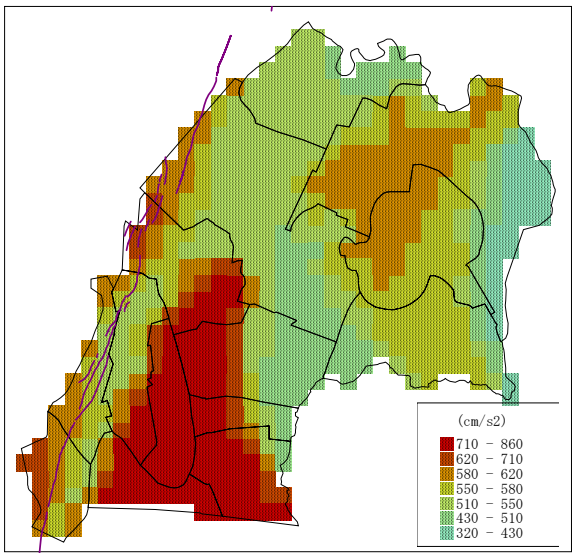

Figure 2. Hazard Map (PGA)
Source: Hasegawa, 2004

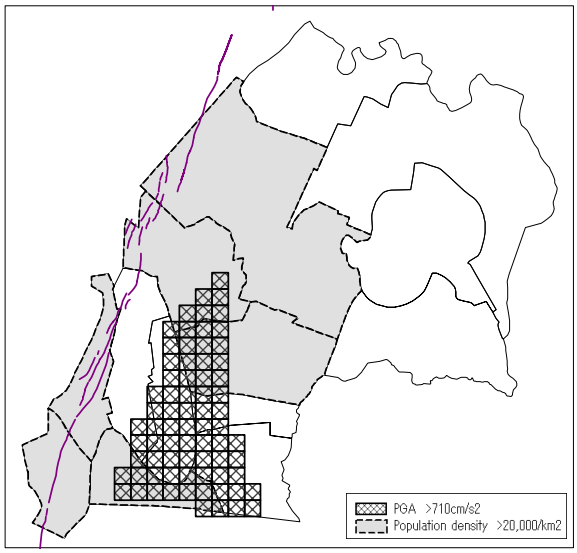

Figure 3. Population Density Area

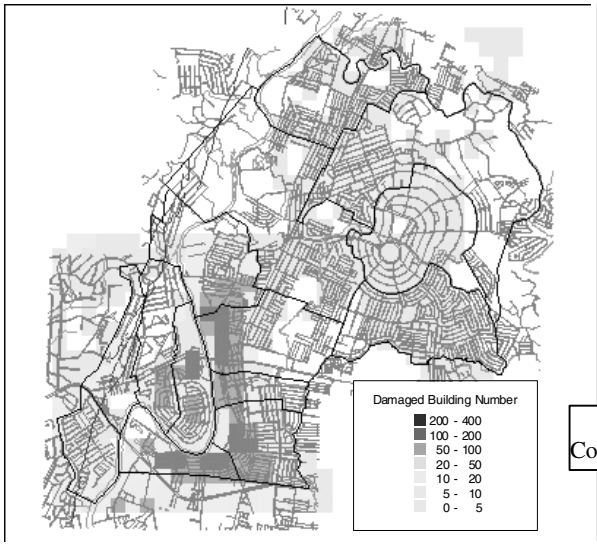

Figure 4. Building Damage Assessment Map (Complete Collapse)
Source: Hasegawa, 2004

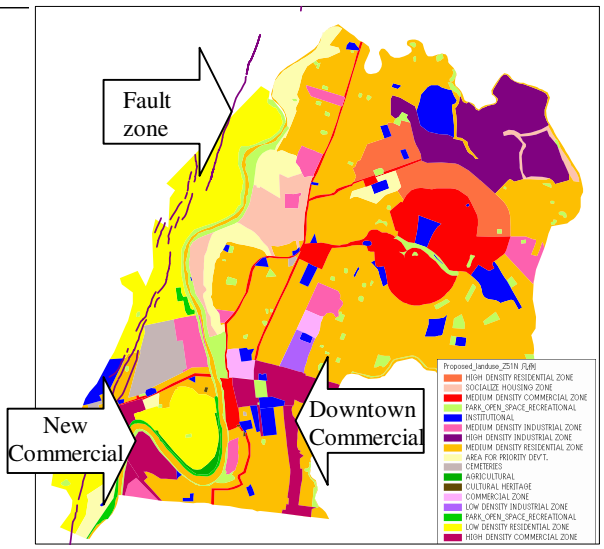

Figure 5. Land Use Map

LAND USE MANAGEMENT TOOLS FOR DISASTER REDUCTION

Land Use Management Tools

The purpose of land use management is to control and regulate the use of land in essential areas with various kinds of tools. Land use management tools are divided into six categories (Burby et al. 1998). Building code for seismic hazards should be operated in relation to hazard information or zoning ordinance. Development regulations and information dissemination are the most commonly used land use management tools. Critical and public facilities policies involving mainly infrastructure development are relatively expensive method although the effectiveness is high. These tools developed in the United States need to be assessed the applicability to Asia Pacific countries based on the available resources, such as required technology and knowledge level, administration system or power, and financial resources (Table 1).

Table 1. Land Use Management Tools

Land Use Management Tools	Required Ability and Resources		
	Technology /knowledge	Admini-stration	Financial
Building Code			
• Special building standards/codes for seismic hazards	High	Moderate	Moderate
Development Regulations			
• Zoning ordinances	Moderate	High	Low
• Subdivision ordinances	Moderate	High	Low
• Special hazard area, fault setback, or flood hazard area regulations	Moderate	High	Low
Critical and Public Facilities Policies			
• Capital improvements program (CIP)	High	High	High
• Location of public facilities outside of hazard areas (to discourage development)	Low	High	Low
• Location of public facilities to reduce risk of damage to infrastructure	Low	High	Low
Land and Property Acquisition			
• Acquisition of open space /recreation /undeveloped lands for mitigation	Low	High	High
• Acquisition of damaged buildings in hazard areas	Low	High	High
• Relocation of public facilities to reduce damage to infrastructure	Low	High	High
• Acquisition of development rights or easement	Low	High	Low
• Transfer of development rights (TDR) away from hazard areas to safer locations	Low	High	Low
Taxation and Fiscal Policies			
• Preferential (reduced) taxation for open space or reduced land use intensity of lands in hazard areas	Low	High	Low
• Impact taxes or special assessments to fund the added public costs of hazard area development	Low	High	Low
Information Dissemination			
• Public information program	Low	Moderate	Low
• Construction practice seminars or builder/developer mitigation	Low	Moderate	Low
• Hazard disclosure requirements in real estate transactions	Low	Moderate	Low

Source: Burby, 1997

5.2 Example of Practices

Some of the land use management practices of the local governments of the state of California are introduced to observe the applicability of the countermeasures with the reference to Table 1. and components of plan quality; that is, fact basis dimension, goals dimension and policies dimension discussed earlier.

Fault Setback

The local governments in the State of California are required by state law to control and regulate new or renewed construction development projects within the zones (Alquist-Priolo Earthquake Special Studies Zone Act). Single-family wood frame and steel frame dwellings up to two stories, not part of a development of four units or more, are exempt. This law is applied to housing area development projects even though houses fall into the exempt category. Before a project can be permitted, cities and counties require a geologic investigation to demonstrate that proposed buildings will not be constructed across active fault lines. A licensed geologist must prepare an evaluation and written report of a specific site. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 15 m). Figures 6 and 7 show the examples of fault line setback in the state of California.

Figure 6. Setback from the Fault Line
(Photograph by Maki, N.)

Figure 7. Fault Line Map
Source: State of California, 1982

Map information and Information Dissemination

The purpose of the State Seismic Hazard Map Act of California law is to require the state geologist to prepare seismic hazard maps to identify areas susceptible to ground shaking, landsliding, and liquefaction. Cities and counties must then use the map in preparing their general plan safety elements, and also requires local governments to ensure developers of new or renewed construction projects within the identified area acquire the seismic hazard maps and obtain the geotechnical reports for the development (EERI, 2004). Single family wood frame and steel frame dwellings up to two stories not part of a development of four units or more are exempt.

Zoning Ordinances and City Planning

San Jose has zoning ordinances in consideration of seismic aspects in its General Plan. In the policy development phase, land use management policies for earthquake disaster reduction are developed. Based on the land use management policies, zoning ordinances are developed to control the use of land by

specifying or regulating development activities. A summary of the hazard and earthquake policies statements of the General Plan of San Jose City is shown in Table 2.

Table 2.Hazard and Earthquake Policies in the General Plan of the City of San Jose

Hazard Policies	
1. Mitigation of risk to an acceptable level in development permission 2. Observance of acceptable risk exposure levels and consideration in the development review process 3. Updating of the San Jose Building Code 4. Promotion of awareness and caution among San Jose residents regarding earthquakes	
Earthquake Polices	
1. The City should require that all new buildings be designed and constructed to resist stresses produced by earthquakes. 2. The City should foster the rehabilitation or elimination of structures susceptible to collapse or failure in an earthquake. 3. The City should only approve new development in areas of identified seismic hazard if such hazard can be appropriately mitigated. 4. The location of public utilities and facilities in areas where seismic activity could produce liquefaction should only be allowed if adequate mitigation measures could be incorporated into the project.	
5. The City should continue to require geotechnical studies for development proposals; such studies should determine the actual extent of seismic hazards, optimum location for structures, the advisability of special structural requirements, and the feasibility and desirability of a proposed facility in a specified location. 6. Vital public utilities as well as communication and transportation facilities should be located and constructed in a way that maximizes their potential to remain functional during and after an earthquake. 7. Land uses in close proximity to water retention levees or dams should be restricted unless such facilities have been determined to incorporate adequate seismic stability. 8. Responsible local, regional, State, and Federal agencies should be strongly encouraged to monitor and improve the seismic resistance of dams in the San José area	
Zoning ordinance related to seismic hazard	
Very Low Density Residential: 2 Dwelling Units Per Acre	In areas planned for this density the designation is based upon topographical and/or geologic considerations. This designation applies to certain areas that are subject to ground failure from liquefaction and where, therefore, higher densities are not appropriate.
Urban Hillside: 1 Dwelling Unit Per 5 Acres	Because of the geologic conditions found throughout these areas (landslides, soilcreep, earthquake faults) and the extraordinary public costs associated with hillside development, uses should be low intensity in character.
Non-Urban Hillside	Because of the pervasive geologic conditions in the hills (landsliding, soilcreep, earthquake faults) and the extraordinary public costs of hillside development, uses must be limited to those having very little physical impact on the land and requiring no urban facilities or services.

Source: City of San Jose, 2000

DEVELOPMENT OF POLICIES AND PROGRAMS

Development Process

Land use control and management policies were developed through a series of workshops with the participation of Marikina City government officials from different departments, representatives of Marikina City, experts, and researchers. Fields of experts and researchers range from architecture, to urban

planning, to social science, to civil engineering. Details of the workshops are explained in the studies of Kondo (2004) and Tamura (2004).

Workshop is an important communication tool to develop land use management policies for earthquake disaster reduction through collaborative work with stakeholders, government officials of Marikina City. Five workshops were planned to discuss land use management policy with stakeholders.

a) Problem Identification Workshop
b) Risk Assessment Workshop
c) Planning Workshop
d) Implementation Workshop
e) Stakeholder Resource Assessment Workshop

In the first two workshops, earthquake disaster risks of Marikina were identified and assessed to understand the vulnerability of Marikina City. GIS was used to visualize the hazard and risks to make stakeholders easy to understand.

After understanding the earthquake disaster risks of Marikina, land use management policies for earthquake disaster reduction were developed, and programs were discussed in Planning Workshop. Based on the discussed policy, programs were discussed in Implementation Workshop. In Implementation Workshop, policies were modified to adjust programs. There were ten objective categories, and land use management is one of them. "Economic development", "Institutional initiative", and "Financial resources" are related objective categories with land use management.

Policy Analysis

Throughout the series of workshops, one objective statement, five policies were developed under the objective category of land use. The objective statement is "Realize the vision of Marikina as a 'Little Singapore' facing minimal risk of earthquake disaster damage through a well-defined land use plan and disaster management program." Developed policies strategies are as follows:

1. Review/restudy the Comprehensive Land Use Plan and make revisions consistent with the Earthquake Disaster Reduction Plan, if necessary.
2. Incorporate earthquake safety measures into building planning and construction processes.
3. Control and regulate construction of buildings in identified risk areas, including areas with fault line, landslide threat, and liquefaction threat.
4. Control and regulate construction of high-rise development.
5. Establish a proactive Recovery and Reconstruction Plan.

Programs were developed under those policies.

Policy 1 is to strengthen the linkage of earthquake disaster reduction policies with the comprehensive land use plan. Policy 2 is related to building permission provision to promote the procedure of earthquake safe building practices. Spatial control of the development in earthquake-prone area using the hazard information is incorporated in policy 3. Policy 4 is to control or regulate the construction of high-rise buildings in earthquake hazard-prone area in relation to economic development. Finally, policy 5 mentions about the pro-active action to develop preparedness plan for recovery and reconstruction. Policies and programs for "education" and "public information" were developed to complement land use management countermeasures (Earthquake Disaster Mitigation Research Center, 2004).

PRIORITIZATION OF POLICIES AND PROGRAM AND EVALUATION OF MANAGEMENT METHODS

Through the series of workshops, programs were developed for each policy with the reference of land use management tools described in the previous chapters. Those land use management practices of the United States were introduced during the workshops to government officials of Marikina City. Policies and programs were prioritized in the consideration of the applicability to Marikina City. Table 3 shows selected policies and programs after the evaluation of all policies, programs and applicable land use management methods. Earthquake disaster reduction policies for critical facilities, such as lifeline and public buildings, were discussed differently from land use management issue; however, these policies should be discussed together for the more effective and efficient policy development. Furthermore, the city's development plan involves capital improvement programs, so that, these related issues need to be discussed together with the development plan, which could improve the sustainability of the city.

Table 3. Policy/Program and Management Methods

Policy	Program	Management method
Review/restudy the Comprehensive Land Use Plan and make revisions consistent with the Earthquake Disaster Reduction Plan, if necessary	- Incorporate earthquake mitigation and preparedness into the City Vision and Comprehensive Land Use Plan - Review and modify zoning regulations for earthquake mitigation and preparedness	Development regulations Development regulations
Control and regulate construction of buildings in identified risk areas, including areas with fault line, landslide threat, and liquefaction threat	- Identify and incorporate seismic hazard and risk areas into the Comprehensive Land Use Plan. - Recommend property owners to upgrade structures	Development regulations Information Dissemination
Control and regulate construction of high-rise development	- Require conduct of soil investigation and geotechnical reports in high rise development areas of greater risk - Identify areas most suitable for high-rise building construction	Building code Map information
Establish a proactive Recovery and Reconstruction Plan.	- Designate potential evacuation routes and areas - Strengthen preparedness for earthquakes through developing evacuation sites - Prepare post-event procedures for a long-term reconstruction strategic plan.	Preparedness plan Preparedness plan Reconstruction plan

Source: Earthquake Disaster Mitigation Research Center, 2004

CONCLUSIONS

Process and factors of land use management planning are clarified and analyzed in the case study of Marikina City (Metropolitan Manila, Philippines) to assess the implementability and applicability of land use management for earthquake disaster reduction in the Asia Pacific region. Through the series of workshop, the process was proved to be effective, and high potential of the government ability was demonstrated. In policy analysis, land use management methods that require relatively low resources, such as development regulations, information dissemination, and map information were selected.

The factor analysis differs from government to government; it is often discussed that barriers to local actions are due to a lack of commitment, shortfalls in capacity, and failure to act regionally (Mileti, 1999).

Success of Marikina Case Study partly depends on the highly legitimate ability and skills of the government officials of Marikina. However, it is important to find crucial elements through this case study, so that they can be vital information for other area. There are some general factors that need to be identified for the implementation of land use management.

Moreover, in the case study of Marikina City, not all the process was completed yet. The important factor, such as development of budget plan, still remains to complete the comprehensive plan. In the next stage, financial resources issues should be studied to develop the realistic budget program for the realization of land use management policies and programs

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ACKNOWLEDGEMENTS

The principal author would like to acknowledge helpful insights provided by the following individuals: Mr. Kenji Okazaki, Coordinator, Disaster Management Planning Hyogo Office, UN Centre for Regional Development, Kobe, Japan; and Mr. Masayuki Watanabe, Specialist in Water Resources Development and Disaster Prevention, Institute for International Cooperation, Japan International Cooperation Agency.

This project is part of the Development of ***E***arth***q***uake and ***T***sunami Disaster Mitigation Technologies and Their Integration for the ***A***sia-***P***acific Region sponsored by the Earthquake Disaster Mitigation Research Center, National Research Institute for Earth Science and Disaster Prevention, Japan. I express my appreciation to Dr. Hiroyuki Kameda, Director of EDM for supporting this project.