Increasing resilience to landslides in Quito Metropolitan District

The role of governance, institutional and community capacities in landslide risk management

A Master Thesis by Daniela Cruz A.

Utrecht University
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Daniela Cruz
3361543
MSc Thesis (45 ECTS)
danicruza@gmail.com

Supervisors:
Dr. Frank van Laerhoven
Dr. Ulrike Weiland

Utrecht University
MSc Sustainable Development
Joint Master Program

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Quito, Ecuador
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ABSTRACT

Cities foster the occurrence of natural hazards which result of socially constructed risks. While natural phenomena cannot be prevented, the impacts can be limited through disaster risk management (DRM) to modify the likelihood of exposure, alter the attributes of exposed unites, and influence coping mechanisms and adaptations to finally influence positively the outcomes of a natural hazard. Determining how to increase the resilience of a community remains a challenge for sustainable development. The hypothesis this research tries to probe is that if certain institutional and community capacities are in place to enhance DRM, then the resilience of communities to landslides is increased. The objective is to determine what governance structure, institutional and community capacities are needed to increase the resilience of a community to landslide disasters in Quito Metropolitan District (QMD), the capital city of Ecuador in South America, where hazards and vulnerability combine to create risk.

Through techniques of empirical social research, the governance structure of the landslide risk management system operating in QMD was described. Landslide risk continues to affect the city and limits its risk management system. Economic limitations where found for specific landslide risk identification, as well a low level of information exchange and community awareness rising. Efforts to regulate land use have been extemporaneous and there is a lack of capacity to implement and monitor measures, as well as to offer mechanisms of compliance and regulation enforcement. There is still a gap in multi-stake holder participation and partnerships, and the post-disaster phase does not consider risk factors on the long term. From a case-study analysis at the community level, significant relation was found between landslide risk management and the following community capacities was identified: access to risk management information; public awareness; responsibility and commitment; community participation and involvement in landslide risk management; and coordination among different local actors.

Although the landslide risk management performance in Quito Metropolitan District was insufficient to the existing level of risk, it is emerging and can be enhanced. Several recommendations have been proposed and include acknowledging the importance of technical and scientific capacity to develop landslide risk assessments as well as allocation of funds and financial support. The development of a system to exchange information, the integration of the risk thematic into formal education, and the development of community awareness raising and training programs are required in order to increase community awareness. This has to go in hand with the implementation of effective control and monitoring mechanisms for land use regulation and the promotion of alternatives to the poor segments of the society to have access to a place to live. More efforts need to be putted on multi-stakeholder participation, involvement and partnerships among different actors, as well as on recovery mechanisms and social safety nets. The effectiveness of an integrated risk management system depends on the extent to which it engages all level of community, managers and stakeholders; it builds up strong institutional and community capacities; and it mobilizes public and private sector and civil society organizations at different levels to participate actively in the design and implementation of locally relevant disaster risk management strategies.

Key words: Landslide risk management, institutional capacities, community capacities.

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LIST OF ACRONYMS

CAF	Andean Development Corporation
CAPRADE	Andean Committee for Disaster Prevention and Relief
CCQ	Chamber of Commerce of Quito
CEMAC	Metropolitan Citizen Attention Central
CIREM	Interinstitutional Commission of Medical Emergencies Network
CEPAL	Economic Commission for Latin America and the Caribbean
COOPI	Cooperazione Internazionale
DFID	Department for International Development of United Kingdom
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EEQ	Electric Enterprise of Quito
ECHO	European Commission for Humanitarian Aid
EMAAP-Q	Metropolitan Enterprise of Sewer and Water
EMASEO	Metropolitan Enterprise of Cleanliness
EMI	Earthquake Megacity Initiative
EMOP	Metropolitan Enterprise of Public Works
FAO	Food and Agriculture Organization of the United Nations
GESI	Global Earthquake Safety Initiative
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographical Information System
GTZ	German Technical Cooperation
HFA	Hyogo Framework for Action
IDB	Inter-American Development Bank
IDNDR	International Decade for Natural Disaster Reduction
IG-EPN	Geophysical Institute of the National Polytechnic School
INAMHI	National Institute of Meteorology and Hydrology
IPGH	Pan-American Institute of geography and History
IRD	Research Institute for Development
LA RED	Social Studies Network in Disaster Prevention in Latin America
MDMQ	Municipality of the Metropolitan District of Quito
NGO	Non Governmental Organization
ORSTOM	French Scientific Research Institute for the Development in Cooperation
PGDT	General Plan for Territorial Development
PNUD	United Nations Development Program
PSA	Environmental Sanitation Program
PUOS	Land Use and Occupational Plan
QMD	Quito Metropolitan District
SEHAB	Municipal Secretariat of Housing and Urban Development

SIAPAD	Andean Information System for Disaster Prevention and Relief
SIEM	Integrated System of Medical Emergencies
SISHILAD	Hydrological Forecast System at the Pichincha Slopes and the Metropolitan Area of Quito
SPSS	Statistical Package for the Social Sciences Program
UN	United Nations
UNEP	United Nations Environment Programme
FPA	United Nations Population Fund
UN-Habitat	The United Nations Human Settlements Programme
UN/ISDR	United Nations International Strategy for Disaster Reduction

CHAPTER 1: INTRODUCTION

1.1. Urban growth and urban natural disasters

Global urban population has increased very rapidly in the last decades, with half of the world's humanity now living in urban areas (UNFPA, 2007). The speed and scale of urbanization brings a range of new challenges for cities, especially in poorer countries. Although cities hold the promise of growth and development, many cities nowadays confront devastating realities such as unemployment, violence, insecurity, poverty, substandard living conditions, and a corresponding vulnerability to the impacts of natural hazards, such as storms, earthquakes, tsunamis, floods and landslides (Lewis & Mioch, 2005).

In fact, not only global urban population has increased over the last decades, but also the frequency and severity of natural disasters worldwide, which triggered by natural hazards that exceed the ability of those affected to cope, cause human, material, economic or environmental losses (UN-Habitat, 2007). Urban agglomeration has a strong relation with the occurrence of natural disasters due to the massive concentration of people, goods, and infrastructure (Metz and Weiland, 2009).

But the increased concentration of people in cities is not the only reason why urban settlements are particularly vulnerable to the effects of natural disasters. A complex set of interrelated processes make cities foster the occurrence and intensity of natural hazards. These processes include rapid urbanization, modification of the urban built and natural environment by human actions, and the expansion of human development and settlements within cities into hazard-prone areas, such as earthquake zones, or areas without adequate rode, water and electricity infrastructure (Metz and Weiland, 2009; UN/ISDR, 2004; UN-Habitat, 2007).

If estimates are correct, by 2030, 60 per cent of the human population will be living in cities. From a sustainable development point of view, the welfare of future generations depends on how well present generations tackle the environmental burdens associated with urban growth (UN-Habitat, 2008). If cities are not properly planned and managed, they can threat the quality of the urban environment and therefore human well-being (UN-Habitat, 2008).

The objectives of sustainable development are of global interest: to achieve and maintain societies' well-being and equity, as a result of the interaction of processes in the economic, environmental, social and political scopes. However the increasing occurrence of natural disasters and their consequences pose severe constrains upon sustainable development in affected areas.

Disasters perpetuate poverty and force developing countries to postpone national development programs, thereby affecting the trajectory of development and holding it back. In this context, the reduction of the vulnerabilities of people and communities at risk and the protection of citizens and assets from the impact of disasters are also a global concern in order to achieve sustainable development within the context of a rapidly urbanizing world (CAF, 2006; UN-Habitat, 2003a).

1.2. Dealing with disasters

The current approach to deal with disasters is proactive and focused on building resilient communities through a systematic process known as disaster risk management (DRM). DRM tries to implement strategies, policies and improved coping capacities to lessen the adverse impacts of hazards and the possibility of disasters (UN/ISDR, 2009). The complex task of DRM involves the work of many actors at different levels.

Governance, which involves the interactions of a multiplicity of governing and each other influencing actors, mainly the state, civil society and the private sector (Stoker, 1998), is a key aspect in this process to articulate the interests of different actors, mediate their differences, and exercise their legal rights and obligations to mainstream disaster risk reduction into development planning (UN/ISDR, 2007).

Therefore success of DRM efforts is critically dependent on a governance structure and institutional frameworks that provide an enabling environment to manage disaster risk adequately (Ahrens and Rudolph, 2006). This enabling environment as supported by political commitment manifested through the adoption and promotion of sound policies, legislation, coordination mechanisms and regulatory frameworks, all of which provide the means to carry out DRM strategies. In this context, the interplay of formal and informal institutions plays a key role in reducing risks and shaping community resilience as they determine the rules, norms, and decision-making procedures which define social practices, assign the roles, rights and responsibilities of the different actors involved, and guide interactions among them (Young, 2002).

In general terms, institutional capacities will allow the creation of that enabling environment to manage and reduce disaster risk as well as to facilitate and support resilience development. As important as the institutional capacities, are the community capacities which allow the development of a culture of prevention and security in a community to guide the efforts towards reducing risks in the short and long term and to improve their capacity to manage risks.

Determining how to increase the resilience of a community to natural disasters and which institutional and community capacities enhance this resilience remains a challenge for sustainable development, particularly in regards to the poor and marginalized people who are the least able to cope with the damaging effects of disasters and bear the greatest costs in terms of lives and livelihoods. While natural phenomena cannot be prevented, the impacts can be limited through disaster risk management to modify the likelihood of exposure, alter the attributes of exposed unites, and influence coping mechanisms and adaptations to finally influence positively the outcomes of a natural hazard (FAO, 2008).

1.3. Research outline

This research is in line with others that try to motivate decision-makers about the necessity to have policies and strategies to manage different types of risks that are generated in a city and which involve as much as the authorities as the human settlements that live there. This is a

multidisciplinary topic and the objective is to motivate actions to reduce risks and to promote the sustainable use of land.

The focus of the research is to describe the governance structure of a disaster risk management system, and to determine institutional and community capacities necessary to increase resilience to natural disasters in the urban context. As this is a broad subject, the research delimitated a specific urban area and one type of natural hazard with the potential to become a disaster.

Quito, the capital city of Ecuador in South America, was chosen for this study. The rapid urbanization of the city, the topographic irregularities of the mountain system, the location in an area of intense volcanic and seismic activity, and the high susceptibility to flooding and landslides during severe rainy seasons, make Quito a city where hazards and vulnerability combine to create risk (EMI, 2005). Landslides are of particular attention because as the city continues to grow, new settlements occupy the slope of the mountain zones introducing tremendous vulnerability for the new dwellers.

1.3.1. Central question and objectives

The central question of this research is:

What governance structure and what institutional and community capacities will increase the likelihood of improving the resilience of a community to landslide disasters in Quito Metropolitan District?

In order to answer the central question, five sub-questions also need to be answered:

1. What characterizes an effective landslide risk management?
2. Which elements characterize the governance structure and institutional capacities of landslide risk management system in Quito Metropolitan District?
3. Are there gaps between what is defined as "effective landslide risk management" and landslide risk management in Quito Metropolitan District?
4. To what extend does community capacities make the difference between the occurrence of a landslide or a landslide disaster at a community level?
5. How can landslide risk management in Quito Metropolitan District be strengthened to maximize its performance and increase resilience of communities to landslides?

The research will provide a general understanding of the elements which characterize a good and effective landslide risk management for heavy rain events that can become landslide disasters. This will be followed by an empirical research to characterize the elements of the landslide risk management system within the governance structure operating in Quito Metropolitan District together with an institutional assessment in order to: 1) identify gaps between what ought to be a good and effective landslide risk management and what actually happens in the city; and 2) undertake in depth case study analysis of the community capacities

and practices in landslide risk management at a community level and its influence on the degree of resilience. The overall objective is to provide recommendations to improve landslide risk reduction in Quito in accordance with the governance structure, institutional and community capacities that have to be in place to build resilient communities.

1.3.2. Hypothesis

The hypothesis that will be tested is the following: If institutional and community capacities, that include organization and coordination, public involvement and commitment, information and communication, education and training, integration of disaster risk management into development planning, resources mobilization, cooperation and support, and implementation, monitoring and evacuation, are in place to enhance, deliver and implement (1) appropriate prevention mechanisms, (2) mitigation measures of the severity or consequences of disasters, (3) reliable preparedness actions, (4) rapid and effective response to disaster, and (5) effective recovery and reconstruction that takes lessons learned into account with a long-term perspective, then the resilience of communities to landslides is increased.

1.3.3. Operationalization of variables

In order to answer the proposed questions and test the hypothesis, two variables need to be operationalized. The dependent variable is resilience to landslide whereas the independent variables correspond to the institutional and community capacities in place. On one hand, a list of DRM indicators will be used to determine the extent of resilience of a community to landslides (as will be seen in chapter 5).

Effective DRM will occur if:

1. appropriate prevention mechanisms are available;
2. mitigation measures of the severity or consequences of disasters are implemented;
3. reliable preparedness actions exist;
4. rapid and effective response to disaster is in place; and
5. effective recovery and reconstruction takes lessons learned into account with a long-term perspective.

On the other hand, a list of institutional and community capacity indicators will be used to determine the capacities that exist at an institutional level in the Quito Metropolitan District as well as in the communities that face landslide risk (as will be seen in chapter 5). An effective landslide risk management will occur if there is institutional capacity for organization, coordination, resource allocation and mobilization, public involvement, information and communication, education and training, integration of a DRM approach, and implementation, monitoring and evaluation. It will also occur if there is community capacity for organization, community training and access to information, public awareness and participation, and co responsibility.

1.4. Organization of the thesis

The following chapter will provide background information to contextualize the research question and supply the history and terminology related with urban growth, urban disaster risk, vulnerability, disaster risk management, and the role of governance, institutional and local capacities, to be better able to follow the subsequent chapters. To bring the focus into DRM in Quito Metropolitan District, a background section will follow in chapter 3 to introduce some general characteristics of the metropolitan area, the demographic patters, hazard exposure and vulnerability to risks in Quito Metropolitan District. Chapter 4 will then be used for a review of the literature on the current state of the research. This section will concentrate on those issues and aspects that relate specifically to an effective DRM and the institutional and community capacities that increase resilience. Drawing form the literature, chapter 5 will present the methodology; chapter 6 the results and discussion of the work, to finally in chapter 7 draw conclusions from the research and recommendation to improve disaster risk reduction in Quito in accordance with the institutional, community and governance capacities to build resilient communities.

CHAPTER 2: BACKGROUND INFORMATION

This section is intended to contextualize the research question stated in the introduction and supply the history and terminology related to the topic. The first paragraphs will focus on the elements of disaster risk in general and in the urban context, to later on present some information on disaster risk management and disaster risk reduction.

2.1. Disaster risk

2.1.1. The relationship between hazards, vulnerability and disaster risk

As it was mentioned in the introduction, the frequency of recorded natural disasters worldwide has increased very rapidly, with a fourfold increase since 1975. Damages caused by disaster impacts include lives lost and injuries, physical damage to infrastructure and buildings, environmental damage resulting in the loss of ecosystem stability, and economic damage (UN-Habitat, 2007).

Between 1974 and 2003, a number of 6367 natural disasters occurred globally, causing the death of 2 million people, leaving 182 million homeless, and producing economic damage of approximately US$ 1.38 trillion (UN-Habitat, 2007). In line with this, the UN/ISDR (2006) reported more than 360 disasters in 2005 alone, with approximately 92,000 people killed, 160 million suffering from the impacts, and US$ 160 billion of direct material losses. For the year 2008, the human and economic losses caused by natural disasters were also devastating with more than 235,000 people killed, 214 million people affected, and economic costs over US$190 billion (Rodriguez et al., 2009).

Disasters of all kinds happen when natural hazards occurring in the biosphere, such as storms, earthquakes, tsunamis, floods, landslides, among others, have the potential to constitute a damaging event when they impact people and assets that are susceptible to their destructive effects (UN-Habitat, 2007; Lewis and Mioch, 2005). When this happens then a natural hazard becomes a disaster, and the likelihood that humans will be seriously affected by this hazard represents disaster risk.

Definitions of risk are commonly probabilistic in nature as they relate either to the probability of occurrence of a hazard that triggers a disaster, or the probability of a disaster and the likely consequences (Brooks, et. al., 2005). For this study, risk is conceptualized as relating to natural disasters triggered by natural hazards but mediated by the vulnerability of the exposed system.

In this context, vulnerability is defined as the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impacts of hazards (UN/ISDR, 2009). Therefore, risk can be understood as a function of hazard and vulnerability.

Risk = Hazard x Vulnerability

A risk exists only if there is vulnerability to the hazards posed by a natural event. Furthermore, the scale of a disaster, that is, the amount of damage and the loss of human life depends not only on the magnitude of the hazard event, but also on the coupled human-environmental system of concern in which vulnerability resides (UN-Habitat, 2007; Turner et al., 2003).

2.1.2. Adding detail to the vulnerability structure

As vulnerability is a determinant component of disaster risk it is important to contextualize it in a more detailed way. Societies are not external, but integral elements of the environment. In this sense, coupled human-environmental systems are integrated systems in which people interact with natural components, as is the case when a hazard impacts human populations (Liu et. al., 2007).

These coupled human-environmental systems are the vulnerable entities. Their vulnerability depends on three aspects: exposure, sensitivity and coping mechanisms (Turner et al., 2003). Exposure to a hazardous event is determined by specific components of the systems and by specific characteristics of the hazard. Examples of the components of the system include the individuals, households, classes and states exposed to the hazard, as well as the flora and fauna ecosystems. In terms of the characteristics of the hazard that the system is exposed to, they include the type of hazard, frequency, magnitude and duration (Turner et. al., 2003).

The second aspect of vulnerability is the sensitivity to any set of exposures as different systems maintain different sensitivities to perturbations (Turner et. al., 2003). Sensitivity is determined by human and environmental conditions such as social and natural capital. Within social capital and endowments, together with institutions, economic structures, knowledge and training, and entitlements that represent the legal and customary rights to exercise command over necessities for life, certain social units are differentially at risk (Turner et. al., 2003; UN/ISDR, 2004). In the same way, natural capital and biophysical endowments, such as soil, water, minerals, ecosystem structure and function, differentiate the sensitivity to an exposure in a way that a fragile environment will be more sensitive to a hazard.

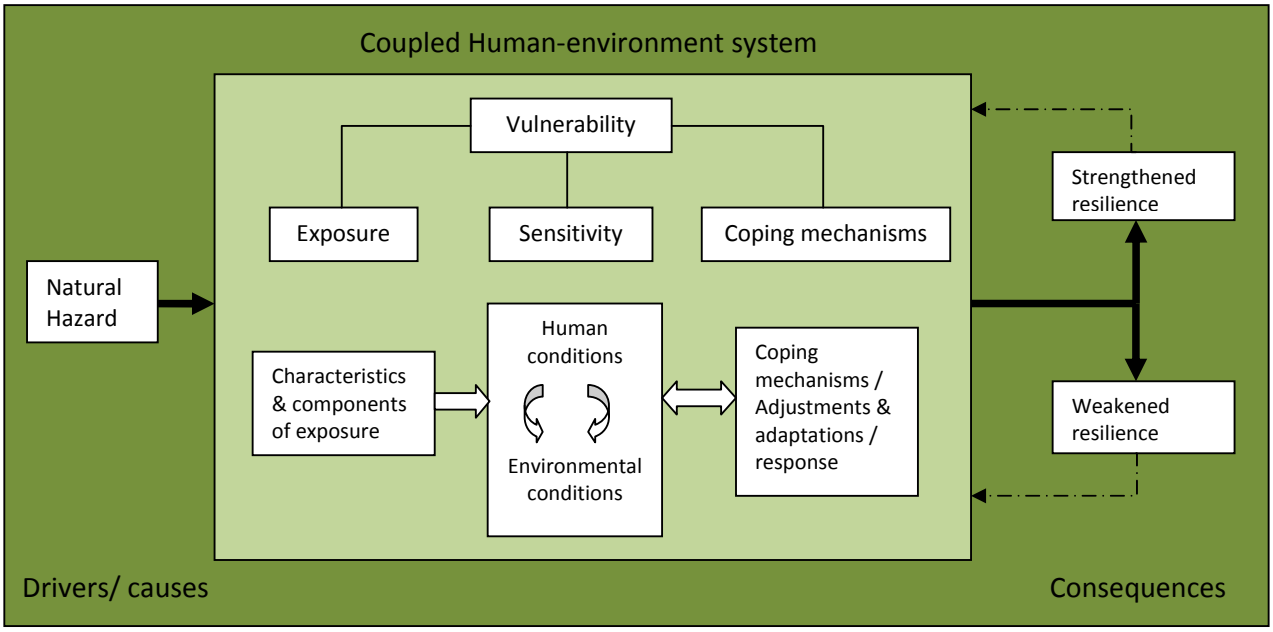
All of the social, economic, political and environmental variables that influence sensitivity of a system are shaped by dynamic pressures, such as rapid urbanization, population growth, deforestation, lost of soil productivity, among others, deeply rooted and linked to the national and international political economy (UN/ISDR, 2004).

The mentioned human and environmental conditions that determine a system's sensitivity influence the existing coping mechanisms take effect as the impacts of the exposure are experienced, as well as the adjustments and adaptations developed because of the experience (Turnet et. al., 2003). Social units have different coping capacities. These coping mechanisms may be individual actions or policy-directed changes, and in either way they influence and feed back to affect each other, so that a response in the human subsystem could make the biophysical subsystem more or less able to cope, and vice versa (Turner et. al., 2003).

As it can be seen, the recognition of vulnerability as a key element in the risk scenario comes together with an understanding of the ability or inability of a society to cope with a hazard using

its own resources. This represents the capacities of households or communities to reduce the potential negative impacts of hazards (FAO, 2008). In this sense, the response of the system, whether autonomous or planned, public or private, individual or institutional, to mitigate and respond rapidly to hazards, together with its outcomes, collectively determines the resilience of the coupled system (Turner et al., 2003; GTZ, 2005). Therefore, resilience can be defined as the capacity of a system to resist and absorb the effects of a hazard, to maintain certain structure and functions despite disturbance, and to recover or bounce back after an event in a timely and efficient manner (UN/ISDR, 2009; Twigg, 2007). This explanation can be better understood with the following diagram:

Figure 1 The vulnerability context in disaster risk



Source: Own elaboration derived from Turner et. al., 2003 and FAO, 2008.

Under this contextualization of vulnerability, coping capacities are an integral component to decrease vulnerability. The risk of a disaster increases as the frequency of the severity of a hazard increases, system's vulnerability increases, and their coping capacities decrease, and vice versa.

$$\text{Risk} = \frac{\text{Hazard x Vulnerability}}{\text{Coping capacity}}$$

2.2. Some facts of urban growth and urban natural disasters in Latin America

During the 20th century, the world's urban population has grown very rapidly from 220 million to 2.8 billion. However from 1990 to 2000, cities grew at 1.83 per cent and thus it is expected that the next decades will experience an unprecedented scale of urban growth, reaching almost 5 billion in 2030 and 6.4 billion by 2050 (UN-Habitat, 2008).

The UN State of the World's Cities 2008/2009 Report indicates that every day, 193,107 new dwellers are added to the world's urban population, which means approximately more than two people every second. However, not all regions show these growing trends in the same way or scale. The rapid increase in the urban share of total population, known as urbanization, is occurring faster in the developing world, which absorbs an average of 5 million new residents every month compared to 500,000 in developed nations (UN-Habitat, 2008).

As cities continue to grow so do threats. In many cases urbanization has not been sustainable, and as the UNFPA Report (2007) points out, inadequate urban management can turn opportunity into disaster when pressures on urban residents to earn incomes and to secure shelter, basic infrastructure, and social services increase. In addition, cities are becoming more unequal, particularly among less-developed regions. Rich and well-serviced neighborhoods are often situated near dense inner-city or peri-urban slum communities that lack basic services.

Therefore, although cities hold the promise of growth and development, many cities nowadays confront devastating realities such as unemployment, violence, insecurity, poverty, substandard living conditions, and a corresponding vulnerability to the impacts of natural hazards, such as storms, earthquakes, tsunamis, floods and landslides (Lewis & Mioch, 2005).

In Latin America, three-quarters of the population lives in urban areas, but the region has some of the most unequal cities (UN-Habitat, 2008). São Paulo and Rio de Janeiro in Brazil, Mexico City in Mexico, and Buenos Aires in Argentina are topping the list, followed by cities in Chile, Ecuador, Colombia and Guatemala (UN-Habitat, 2008).

Figure 2 Major Andean Cities in Latin America

Source: UNEP/GRID-Arendal, Environment & Poverty Times 04, pp 5

In regards to natural disasters, Latin America, and particularly Andean countries, are related with multiple natural processes associated with the geological and hidroclimatic history of the region. But natural disasters are also related with the patterns of land occupation, population vulnerability and economic activities during the development process, all of which have negatively affected development sustainability (CAF, 2006). In terms of population vulnerability, a significant proportion of the region's population remains very poor. According to the Economic Commission for Latin America and the Caribbean (CEPAL, 2007) in 2006, 36.5 per cent of the region's population was living in poverty with 13.4 per cent in extreme poverty. From these data, the number of people living in poverty in urban areas was nearly twice than in rural areas.

In the case of patterns of land occupation, urban centers have developed in a variety of geographic and topographic locations, as well as within a great range of environments: from sea level to more than 3,000 meters above sea level (Hardoy and Pandiella, 2009). Much of the urban expansion in Latin America has taken place over flood-plains or up mountain slopes, or in other zones not suited to settlements, such as areas prone to flooding, landslides, or other risks related with weather (Hardoy and Pandiella, 2009; IPCC, 2001). When natural areas are transformed into settlements, the infiltration capacities are reduced, and deforestation and erosion increased. This, together with the expected increase in scale, intensity, and frequency of rainfall, has sever impacts on the drainage systems, not sufficient to timely evacuate the increased water masses, leading to periodic flooding and landslides on geologically unstable slopes (UN-ISDR, 2002; Bigio, 2003).

The majority of dangerous sites are occupied by low-income groups. In general, these areas were felt vacant for low-income households to build on them only because of the environmental conditions that make them vulnerable and because they lack infrastructure and services (Hardoy and Pandiella, 2009). Low income groups inhabit overcrowded houses in neighborhoods with high population densities, or they have even developed informal settlements, commonly referred as urban slums (Hardoy and Pandiella, 2009).

Urban slums often lack one or more of the following conditions: access to improved water, access to improved sanitation facilities, sufficient living area, structural quality and durability of dwellings, and security of tenure (UN-Habitat, 2008). In addition, these urban slums are frequently located in sites prone to natural hazards, nearby rivers or on steep slopes, the only sites where low-income groups find housing they can afford or where they can build their homes, with layouts that include provision for road networks that would allow service installation and neighborhood regularization in the future (Hardoy and Pandiella, 2009; UN-Habitat, 2008). As a consequence, an increasing number of informal human settlements are turning into potential hotspots for disaster risk (UN-Habitat, 2007).

2.3. What makes cities vulnerable to disaster risk?

As it was mentioned before, a disaster is a function of risk processes, and results from a combination of the probability of occurrence of hazardous events, human vulnerability to the effects of a hazard, and insufficient capacity to reduce the potential negative consequences of risk (UN-Habitat, 2007). In the case of cities, a contradictory process of urban growth increases

the risk produced by natural disasters as urban centers continue to expand to more vulnerable areas (Lavell, 2000).

The logic of the above mentioned is the following: the location of an important number of urban centers worldwide is explained by their proximity to diverse natural resources, such as oceans, lakes, rivers, mineral deposits as well as tectonic intermountain valleys, or valleys on the slopes of volcanoes. However, the same resources that offer opportunities for human life can later become threats (Lavell, 2000). For instance, the location of urban centers in coastal areas exposed to hydro-meteorological hazards represents an additional risk factor (UN-Habitat, 2007). In the same way, rivers can eventually cause floods that put in danger surrounding communities, and the slopes of volcanoes can also be dangerous due to volcanic activity and landslides.

In the urban context vulnerability is socially constructed and it is affected by a complex set of interrelated processes. The concentration of assets, wealth and people in the cities is one of these processes. When people are concentrated in a limited area and a natural hazard takes place, then the impact will be much higher than what would have been if people were dispersed (UN-Habitat, 2007).

A second process is the rapid and unplanned urbanization together with the expansion of informal or formal settlements within cities into hazard-prone areas. When cities cannot cope to manage rapid population growth and the high demand for land, poor people settle illegally in unsuitable terrains, such as floodplains, reclaimed land, industrial waste sites, riverbanks and steep unstable slopes which are prone to natural hazards and the most vulnerable to the impacts of disasters (UN-Habitat, 2007). In addition these areas usually have inappropriate construction and lack basic services (Lavell, 2000). In fact over half of the urban population is below the poverty line in many developing countries and they are consigned to these socially segregated areas referred as to informal settlements (UNFPA, 2007).

These settlements, which are obtained by the occupation of land that does not belong to the person settling on it, are growing alarmingly all around the world (Leeds and Leeds, 1978). The inappropriate invasion of land characterizes these settlements as an illegal form of land use, characterized by inadequate and insecure living conditions that generate hazards. This implies that people living in slums have the most intolerable urban housing conditions, which includes insecurity of tenure; lack of basic services, specially water, sanitation, electricity and solid waste disposal; unsafe building structures; overcrowding; and location on hazardous land (UN-Habitat, 2007).

In addition, slums represent the home of the urban poor who struggle to survive within urban areas and therefore they have high concentrations of poverty as well as social and economic deprivation (UN-Habitat, 2007). While poverty increases people's vulnerability to natural hazards, disasters make their already precarious living conditions worse, creating a vicious circle of poverty and risk (Wamsler, 2007b). Even a hazard of low intensity is able to attain disastrous proportions when it hits communities living in such risky conditions with a limited capacity to withstand disasters.

However, informal settlements are not just the result of massive rural to urban migration and thus the illegal occupation of land for shelter. They are also the product of national and regional inequalities due to the changing economic nature of nations and the lack of policies to mitigate the effects of change (Macedo, 2000). In fact, the increasing number of people living in informal settlements and in inadequate conditions indicates the absence of effective solutions to solve housing needs.

A third process which is also relevant is the modification of the urban built and natural environment through human actions. The construction of a city implies a change in the natural environment into a social and constructed environment. As rapid urban development changes ecosystems, by the consumption of natural assets and the overexploitation of natural services, new hazards and natural disasters can result (IDNDR, 2002). Examples of this are deforestation leading to hillside erosion making people vulnerable to landslides triggered by heavy rains; shortage of appropriate drainage systems that make cities vulnerable to flash floods; or loss of mangrove ecosystems on urban fringes leading to coastal erosion and exposure to storm wind and waves (UN-Habitat, 2007).

A final process that exacerbates the vulnerability of cities to disaster risk is a failure of urban authorities to regulate land-use planning strategies, urban development and building standards. In fact despite the risk factors mentioned here, the UN-Habitat Report (2007) argues that vulnerability to disaster remains largely underestimated in urban development, without the necessary means to analyze urban disaster events and losses. In the absence of such controls and regulations, unsaved construction and land-use planning practices will increase and generate even greater vulnerability.

As it can be seen, disasters in urban areas are not natural events, but socio-environmental events that result of socially constructed risks (Cardona, 2004). Hence, disaster risk is the product of inappropriate and failed development, institutional failure, deficient urban management practices, ecological imbalance, and inadequate land-use planning, among others (Lewis and Mioch, 2005; Ahrens and Rudolph, 2006).

2.4. Dealing with disasters

2.4.1. A move from a reactive to a proactive approach

The traditional approach to deal with disasters has been based on emergency management with a relief-oriented and preparedness for response focus. Prior to the 1990s, attention was placed mainly in humanitarian response to emergencies after a disaster took place (Basabe, 2007). However modern societies cannot afford to value human lives and material assets only after they have been lost in a disaster. Although the role of relief assistance is vital, more attention had to be given to protective strategies that could help to save lives and to protect property and resources before they are lost (UN/ISDR, 2004).

During the 1990s, in the International Decade for Natural Disaster Reduction (IDNDR), the international focus was on reducing the consequences of natural disasters and on building a culture of prevention. This was a move from a reactive to a proactive approach. Science and

technology played key roles providing the knowledge for disaster reduction and widening it into the decision making processes. However, the decade ended with more deaths, economic losses and human suffering originated from the increased number of disasters (UN/ISDR, 2004). Fundamental problems in understanding and managing risk factors highlighted the importance of engaging people in hazard awareness and risk reduction activities (UN/ISDR, 2004).

The disaster-oriented approach that looked for actions to reduce the impacts of disasters and drove all the activities and resources towards a disastrous event had to change. Increasing attention was then given to the underlying causes of the disasters and to the need to reduce disaster risk and vulnerability of urban areas (Vermaak & van Niekerk, 2004). This move from a "disaster" talk to a "risk reduction" talk meant not only focusing on the disaster event but on understanding the risk processes on which to act (Bull-Kamanga et al. 2003).

After 2000, the successor of the IDNDR was the United Nations International Strategy for Disaster Reduction (UN/ISDR). The aim was twofold: one the one hand to enable societies to be resilient to natural hazards, while on the other, to ensure that development efforts do not increase vulnerability to those hazards. This means to build resilient communities by promoting increased awareness of the importance of disaster risk reduction as an integral component of sustainable development.

Disaster risk reduction (DRR) became a developmental concern. It is an approach that involves all the actions and systematic efforts to analyze and manage the causal factors of disaster. Managing disaster roots includes reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events throughout a society (UN/ISDR, 2009). With this new view, in January 2005, 168 countries and organizations adopted the Hyogo Framework for Action (HFA) 2005-2015 which recommends five priorities for action to build a safer and more disaster-resilient world, and emphasizes the need for multi-stakeholder involvement and national coordination for mainstreaming disaster risk reduction into policies, planning and programs (UN/ISDR, 2008).

2.4.2. Managing disaster risk

Disaster risk reduction is found within the broader concept of disaster risk management (DRM) defined as "the systematic process, organization, operation skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related disasters" (UN/ISDR, 2009, pp. 10). This is an integral multisectorial and multidisciplinary process of planning and implementing pre- and post-disaster activities and thus is focused on actions that help prevent, mitigate or prepare for risks (*ex ante*) while at the same time take into account the importance of immediate responses as well as post-disaster recovery and rehabilitation (*ex post*) (Metz and Weiland, 2009; Vermaak & van Niekerk, 2004).

The purpose of DRM is to reduce the underlying factors of risk and to prepare for and initiate an immediate response in the case of a disaster (FAO, 2008). Metz and Weiland (2009) talk about the disaster risk management cycle which incorporates all the phases of disaster risk management in a continuous process, covering the time before a hazardous event occurs, and

the short and long term period after an event. These phases correspond to pre-disaster, response and post-disaster, and conceptually they can be subdivided in five stages: prevention, mitigation and preparedness before an event occurs, and response and recovery after an even takes place.

During the pre-disaster phase, actions are aimed at strengthening the capacities and resilience of households and communities to protect their lives and livelihoods (FAO, 2008). This is done through measures to avoid (prevention) or limit (mitigation) adverse effects of hazards and to provide timely and reliable hazard forecasts for preparedness. During the prevention stage, risk analysis is necessary to identify the kinds of risks and their magnitude. Nevertheless risks cannot be completely avoided and thus they stay as remaining risks. Mitigation measures then are required to address the structural sources of vulnerability in order to reduce and mitigate the existing risk and prevent the loss of life, reduce damages and minimize the recovery costs (Metz and Weiland, 2009).

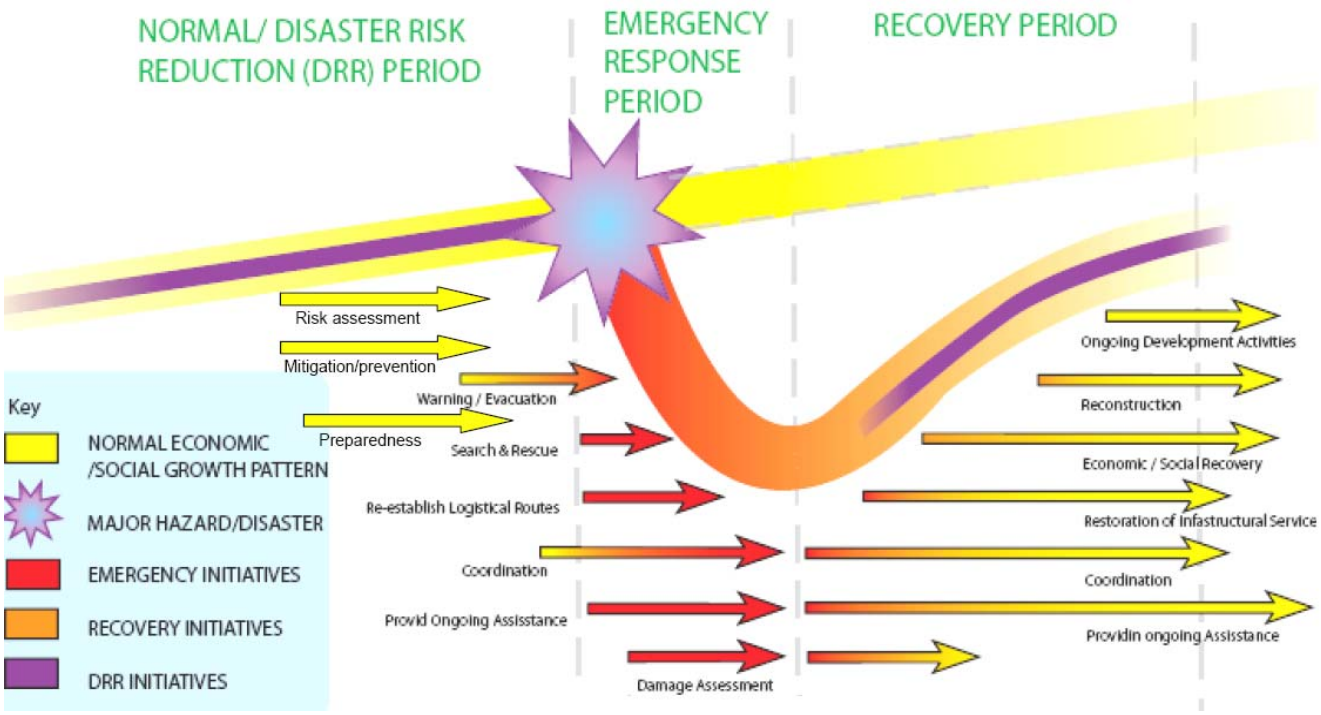
Mitigation measures are divided into structural and nonstructural measures. Structural measures refer to physical construction of hazard resistant and protective structures and infrastructure to reduce or avoid possible impacts of a hazard, while nonstructural measures aim at reducing risks and related impacts by a different set of mechanisms such as policies for land-use management and planning, construction standards, awareness, knowledge development, public commitment, participatory mechanism and provision of information (Metz and Weiland, 2009). Preventive and mitigating measures to reduce disaster risk are a key component of the disaster risk reduction.

Just before the occurrence of an event, the preparedness stage considers emergency preparedness to ensure effective response and enhance societies' readiness to cope quickly and effectively in the case a hazardous event takes place (Metz and Weiland, 2009). Actions and measures taken in this stage include emergency management planning, the establishment of good communication channels, and the set up of an early warning system to provide timely and effective information to avoid or reduce risk.

However, even if societies are prepared for a hazardous event, if it takes place, damages will occur. The response phase aims to reduce to the maximum the damages to people's live and satisfy basic needs. During this phase, communities and relief agencies focus on saving lives and property, and it includes all the measures within the scope of emergency aid during or immediately after the event, such as evacuation procedures, immediate assistance and assessing damage and loss (FAO, 2008; Metz and Weiland, 2009).

In the post-disaster phase, the focus is on recovery and rehabilitation. The aim is to support effective recovery and restoration of infrastructure and services, and safeguard against future disasters. It involves decisions and measures from sustainable development actors for the short term reconstruction of the living conditions prior to the event, as well as measures that contribute to the long term reduction of risks in a certain area integrating hazard mitigation into development (FAO, 2008; Metz and Weiland, 2009). The following figure illustrates the phases and stages of the DRM cycle.

Figure 3 Disaster Risk Management Cycle



Source: FAO, Disaster Risk Management System Analysis. A Guide Book, pp 6.

2.4.3. Increasing resilience through governance, institutional and community capacities

No single group or organization can address all the aspects of disaster risk management and reduction. It is a complex task demanding a collective response from different disciplinary and institutional groups (Twigg, 2007). In this sense, disaster risk management involves the work of many actors at different levels. For instance, prevention and mitigation are actions and measures that require the involvement of disaster risk reduction actors. Preparedness and response need the involvement of humanitarian actors, while recovery and reconstruction requires the work of sustainable development actors (Metz and Weiland, 2009). All of these actors can be from the public sector, international organizations, technical and professional bodies, NGOs, and other civil society organizations.

The importance of the relationship among different actors has been recognized by the Hyogo Framework for Action (HFA) where governance is a key aspect. Governance is associated with new forms of socio political interaction, or put in another way, the interaction of a multiplicity of governing and each other influencing actors, mainly the state, civil society and the private sector (Stoker, 1998). These relatively autonomous domains are able to make connections or work in an interactive process with various forms of mechanisms, institutional arrangements and partnership in such a way that policies for reducing disaster risk can be implemented and serve as a vehicle to reduce poverty and safeguard development with beneficial effects on sustainability (UN/ISDR, 2009).

Therefore, DRM requires a governance structure where different stakeholders and policy makers interact to manage DRR adequately. This governance structure represents an institutional matrix in which individual actors, social groups, civile organizations and policy makers interact with each other and has a key role in operationalizing the different phases of the DRM cycle influencing communities positively or negatively (Ahrens and Rudolph, 2006; FAO, 2008; King, 2008).

This governance structure is related with the institutions and processes for collective decision making by which society manages its development and resolves conflict, formally and informally, and therefore, it can affect any initiative in disaster risk management and reduction (Twigg, 2007). Thus, an analysis of governance focuses on the formal and informal institutions involved in decision-making and implementing the decisions made.

The use of the term institutions in this study refers to the rules, norms, and decision-making procedures, as well as to the organizations that define social practices, assign the roles, rights and responsibilities of the different actors involved, guide interactions and facilitates the coordination among them (FAO, 2008; Young, 2002).

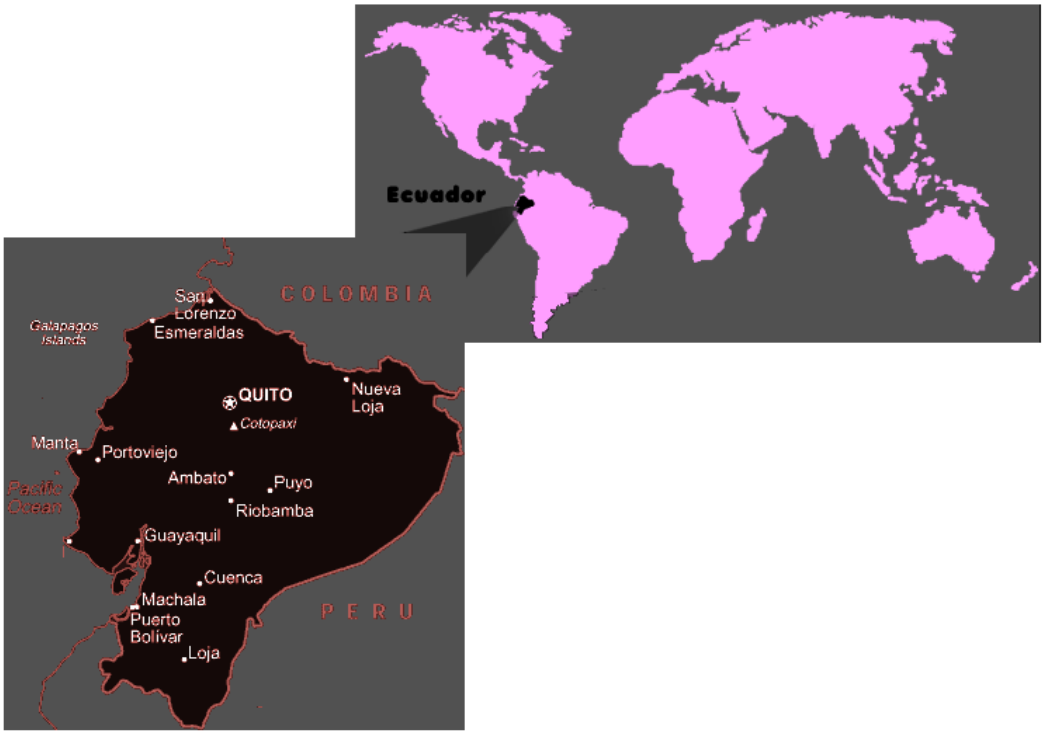
Institutions are composed by "the rules of the game" and the "actors". The rules of the game are the norms, values, traditions and legislation that determine how people should behave, while the actors represent the organizations and their capacities to operate according to those rules (FAO, 2008). Households, communities, firms and states (actors) may host many kinds of institutions that guide the behavior of their members. Such institutions include formal institutions, such as government institutions and organizations, as well as informal institutions, such as kinship, marriage, or inheritance, among others.

The interplay of formal and informal institutions plays a key role in reducing risks of disasters and shaping community resilience. This happens because institutions, social relation, structures, processes, resource access and governance 1) modify the likelihood of exposure, 2) alter attributes of exposure units such as households and communities, and 3) influence coping strategies and capacities and therefore vulnerability to disasters and their outcome (Manuta, 2006). Enabling institutions can create an enabling environment that provides the means to enhance the adoption and promotion of sound policies, legislation, coordination mechanisms, regulatory frameworks, organizational capacities and public commitment to decrease vulnerability and increase the ability to withstand disaster impacts (Ahrens and Rudolph, 2006; FAO, 2008).

As Ahrens and Rudolph (2006, pp. 209) state, "only if this governance structure facilitates the implementation and enforcement of public policies conductive to a country's economic and social development, sustainable livelihoods can be achieved and susceptibility to disasters be reduced". In this context, an understanding of the roles and capacities of formal and informal institutions related with DRM, which lie both within the actors and in the relationship among the actors (Manuta et al., 2006), are imperative to increase resilience to disaster risk.

CHAPTER 3: BACKGROUND TO STUDY LOCATION

Figure 4 Quito, Ecuador location



3.1. Geographical settling and territorial structure of Quito Metropolitan District

Quito, the capital city of Ecuador in South America, is located between 2.800 and 3.200 meters above sea level in a North-South longitudinal valley on very steep slopes at the foot of the active Pichincha volcano in the western range of the Ecuadorian Andes. The city is part of the Quito Metropolitan District (QMD), which has a total area of 424,717 hectares and develops North-South, 40 to 50 kilometers in length and 4 to 10 kilometers wide (EMI, 2005; Carrion, 2005).

In this territorial space different physical-spatial realities coexist with specific land use areas: forestry (27,6%), livestock (22%), agriculture (17,4%), urban (7%), high-Andean vegetation (9,22%), grassland (5,5%), slopes vegetation (2%), eroded areas (5,5%), and denuded areas (2,2%) (MDMQ, 2006).

The urban structure has been conditioned by the irregular topography of the city and the surrounding mountain system, with scarcity of flat land (EMI, 2005). The activities and functions within this territory are strongly determined by three main geographical structures of the metropolitan territory: compact in the central city, scattered in the suburban valleys, and isolated in the rural areas (MDMQ, 2006). The urban center concentrates and steers the dynamic configuration of the city of Quito from which the urban continuum established a scheme of

concentric radial articulation towards the platforms where other populated centers of the periphery in the north, south and oriental valleys are situated (MDMQ, 2006).

These geographical structures are correspondent with the physical characteristics of the territory, the land use classification, the demographic mobility processes, the pressure of land market, and the deterioration of the living conditions in the central city (MDMQ, 2006).

3.2. Demographic characteristics of the QMD

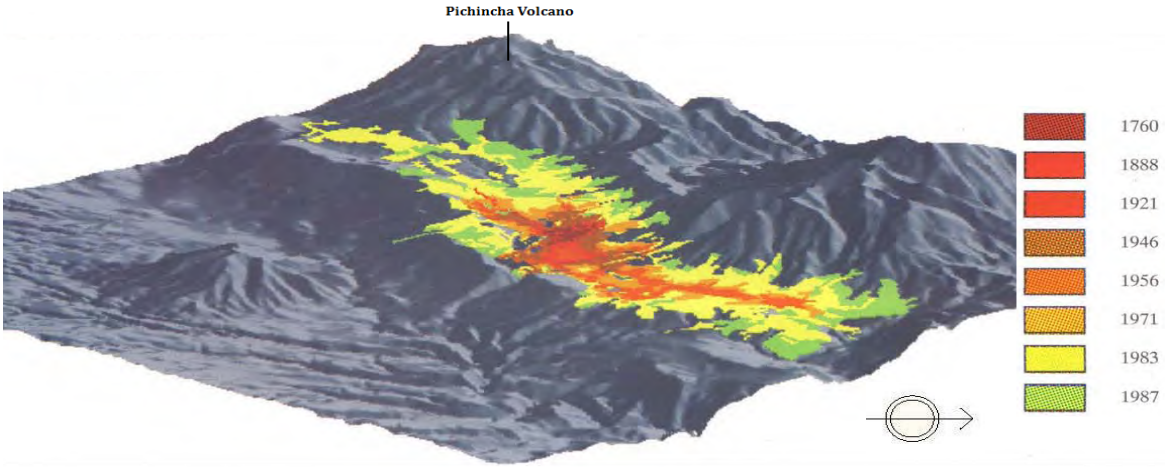
Although Ecuador remains a rural country, urbanization rates have increased rapidly since the beginning of the 20th century. In the mid eighteen century urban population was between 16 to 18 per cent. In 1950 such proportion was still around 28,5 per cent, in 1962 this rate increased to 36 per cent, in 1974 to 41,4 per cent, in 1982 to 49,7 per cent, and in 1990 to 55,4 per cent (IMG, IPGH, ORSTOM, 1992).

As is the case with many Latin American cities, Quito also reflects the trend of rapid urbanization due to continued migration to the city, lack of effective planning, and government decentralization which adds pressures on municipalities in dealing with urban management and provision of services (Fernandez et. al, 2006).

Until 1888, the population and area occupied in the capital city grew slowly, at 0,36 and 0,13 per cent between 1760 and 1880 respectively, not only because of the agricultural tradition of the country but also because of different crises that affected Quito, such as the reorganization of the colonial economy and wars for the independence (IMG, IPGH, ORSTOM, 1992).

From 1888 to 1946 profound demographic and spatial changes occurred in the city especially because of the construction of the railway line. The annual growth rate between these years increased from 2,98 per cent to 3,25 per cent (IMG, IPGH, ORSTOM, 1992). However the most important urban phenomenon of that period was the change from a nuclear growth within the center of the city to a longitudinal and peripheral extension. From 1946 onwards the city entered a phase of accelerated growth (IMG, IPGH, ORSTOM, 1992). The population increased six-fold from 1950 to 1990 while its area also increased twenty times.

Figure 5 Urban growth in Quito



Source: IGM, IPGH, ORSTOM, Atlas Infográfico de Quito, pp 30.

Of the 424,717 hectares of the city, the urban area occupies approximately 42,273 hectares, while the other land uses are for natural reserves, parks and ecological protected areas (191,723 hectares) and agricultural lands (189,921 hectares) (EMI, 2005). Figure 5 shows a map of the division of the urban, suburban and rural areas in QMD.

Over the last 15 years, the central city, settled over a plateau of 18.700 hectares, has experienced a process of densification and consolidation as a consequence of the dynamism of the construction sector, a process of land legalization, and the municipal intervention for the recovery of public space and habitability of infrastructure and services (MDMQ, 2006). All of these brought a high level of land occupation where only 7,57 per cent of the area is available, mainly those areas situated towards the north, the south, or on the slopes of the mountains. In addition, between 1990 and 2005, urban density increased from 61 to 91 habitants per hectare (MDMQ, 2006).

Meanwhile, the pattern of abandoning the historic and compact city since the 80s from the inside towards the valley triggered a process of expansive and diffuse peri-urbanization, which defines a disperse growth characterized by an uncontrollable and speculative expansion of residential areas (MDMQ, 2006). In this sense, many populated and agricultural areas in the valleys were incorporated progressively in a scattered way. Within this suburban area, 8.197 hectares were defined as urban land until 2005 and 15.594 hectares of land with the possibility of been urbanized until the year 2020 from which 28,53 per cent is still available. This correlates with the low densification, around 15 habitants per hectare (MDMQ, 2006).

Finally, land that cannot be urbanized corresponds to 393.421 hectares. In this land rural activities are developed, mainly agricultural and farming activities. 35 per cent of this territory corresponds to 21 areas declared as protection forests, and more than 38,6 per cent to land that

can be declared as protective zones because of their attributes. However there are some activities that cause severe ecological damage such as overexploitation of quarries and land for agriculture, and erosion (MDMQ, 2006).

Figure 6 Division of the Quito Metropolitan District

Source: SUIM-DMPT, www4.quito.gov.ec

3.3. Organization and management style of the city

The QMD accumulates important political, administrative and financial responsibilities that require the presence of many institutions and public services, as well as the administrative necessities due to the management of its own territory (EMI, 2005).

The Municipality of the Quito Metropolitan District (MQMD) accomplishes actions divided into three categories: political, administrative and provision of services. The political level is the highest in the MQMD. It is formed by a Mayor who is the executive power and a Municipal Council which is the legislative power. In this level the political and developmental decisions are taken and the metropolitan norms and regulation established (D'Ercole & Metzger, 2004).

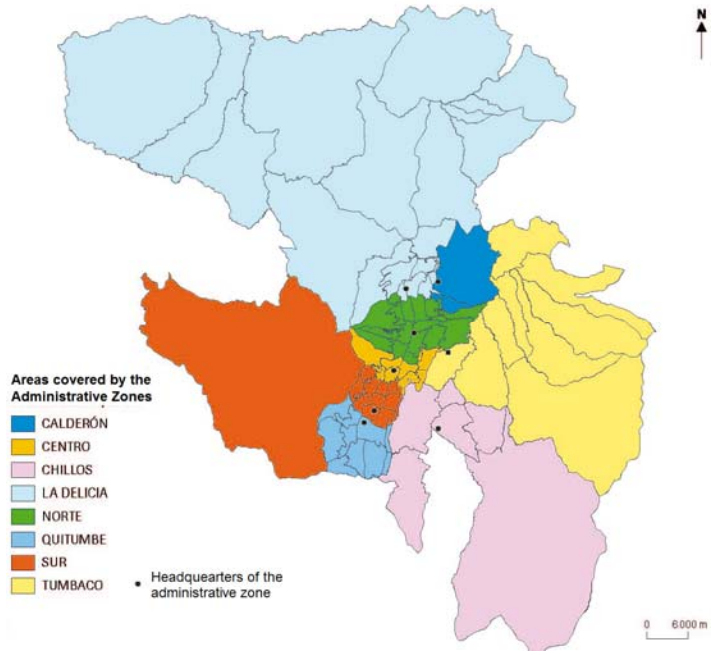
To address the administrative and management purposes, this level is subdivided in two: One is in charge of the administrative and financial management of the Municipality, such as the Administrative, Financial, or Human Resources Directions; the other one is organized in

different Secretariats, such as the Territory Secretariat, Security and Governance Secretariat, Environmental Secretariat, among others, which can propose policies, strategies and planning actions in their particular field (D'Ercole & Metzger, 2004; EMI, 2005).

The level of operation and provision of services is also divided in two categories: the metropolitan enterprises and the Administrative Zones. The first ones are public companies with legal status and financial autonomy in charge of executing projects and policies formulated to manage and provide services. Examples of such enterprises are the Metropolitan Enterprise of Sewer and Water (EMAAP-Q) and the Metropolitan Enterprise of Cleanliness (EMASEO) (D'Ercole & Metzger, 2004).

The Administrative Zones are the result of a process of decentralization initiated by the Municipality in 1991 which developed the Law for Decentralization. In this context, the QMD is divided into 8 Administrative Zones to execute institutional processes for a better provision of services and a closer relationship between the community and the local government (EMI, 2005). The Administrative Zones give operational and administrative services from the Metropolitan Secretariats. Their main responsibilities are the jurisdiction, territorial coordination and relation of the social organizations within their respective sectors according to the laws and regulations in place.

Figure 7 Administrative Zones in the MQMD



Source: D'Ercole & Metzger, Lugares Escenciales del DMQ, pp 170.

3.4. Exposure to hazards in the QMD

Due to the geodynamic, geomorphologic, hidroclimatic and anthropic context of the city, the QMD is exposed to many different types of hazards. Quito is located in an area of intense

volcanic and seismic activity. Major seismic sources capable of producing earthquakes that can hit the city are found within 60 to 80 kilometers associated with a continental complex faulting system and as far a 180 to 200 kilometers west of Quito on the Pacific Subduction Zone (EMI, 2005).

According to D'Ercole (2004a), the city has a global hazard index of 9, being 12 the highest, due to the high values of individual hazards such as earthquakes, volcanic eruptions, high susceptibility to flooding and landslides during severe rainy seasons, wildfires and technological hazards. Some of the hazards have a high probability of occurrence such as floods, landslides, or accidents associated with storage and transport of dangerous products. Others come with a lower frequency, as is the case of earthquakes and volcanic eruptions. In the same way, some hazards have limited or punctual effects or broader implications (D'Ercole & Metzger, 2004a).

In the case of volcanic eruptions, the capital city has been affected by two eruptions in the last decade, one from the Guaga Pichincha Volcano in 1999, situated 15 km west of the central city, and another one from the Reventador Volcano in 2002, situated some hundreds of kilometers from Quito (D'Ercole & Metzger, 2004a). Many active volcanoes are located in or near the QMD:

Table 1 Volcanoes surrounding the QMD

Volcano	Location	Years of Eruption
Guagua Pichincha	15 Km from center of Quito	1560, 1575, 1582, 1660, 1843 and 1868
Cotopaxi	60 Km south of Quito	1742, 1744, 1768, 1877
Cayambe	50 Km northeast of Quito	1785, 1986
Antisana	50 Km southeast of Quito	1728, 1773, 1801

In terms of seismic threat, the geodynamic context that originates volcanic eruptions also causes earthquakes. Quito has experienced 23 earthquakes of intensity higher than VI, from which 8 have intensity higher than VII. The strongest earthquakes that have affected Quito occurred in 1755, 1797, 1859, 1868 and 1987, this last one with intensity of IX in the epicenter, with dramatic consequences: between 1.000 to 5.000 people killed, and the breakdown of the oil pipe which affected the economy of the country (D'Ercole & Metzger, 2004a).

Geomorphologic hazards, which are downward displacements of land masses destabilized by natural phenomena (rains) or anthropic actions (deforestation, overexploitation of quarries), can also affect a big part of the QMD, but their frequency is much higher. 50 per cent of the metropolitan area has the conditions to trigger this type of events, for instance, the morphology (sharp peaks and steep slopes), the nature of the land (volcanic deposits), the drainage systems and soil erosion (D'Ercole & Metzger, 2004a). The most frequent geomorphologic hazards that affect the city are landslides.

Landslides correspond to the displacement of land masses on a slope of some meters of high that come down, take with them some houses, and cover the ones located in the lower part.

They are localized phenomena that can affect infrastructure and human lives. Landslides are frequent in the rainy season and are related with the weak cohesion of the volcanic deposits, humidity, and bad drainage.

Finally, the geomorphologic and hidroclimatic hazards can combine to produce a morfoclimatic hazard manifested through avalanches and mudflows. 85 creeks come down from the Pichincha slopes to the city. The difference in elevation from the peak, at 4.627 meters, to the lower part of the city, at 2.700 meters, is presented in short distances of 1 to 10 kilometers, which results in very steep slopes of 30 and 60 per cent. This, together with the high erodibility of the slopes, produces torrential flows when heavy rains occur (La Red, 1996).

3.5. Vulnerability issues of the QMD

The exposure to different types of hazards is a key component in the vulnerability of the District. However, prevalent conditions of vulnerability are associated with other factors. Rapid urbanization under conditions such as scarcity of flat land, limited housing supply, lack of policies related to land use, and social and economic crisis, together with the topographic irregularities of the mountain system, have made Quito a city where hazards and vulnerability combine to create risk (EMI, 2005).

In fact, one of the main causes of vulnerability of the population in Quito is poverty, apprehended not only in terms of economic income, but also under factors such as the quality of life, access to housing and basic services, and levels of education (D'Ercole & Metzger, 2004a).

The high vulnerability of the population due to high socio-economic fragility is linked to a poor resilience capacity. In the same line, there is high exposure of the building stock, which generally uses inappropriate construction materials. 60 per cent of total buildings are built without municipal permits and there is no certainty about anti-seismic structures in registered buildings. This physical vulnerability of the buildings in Quito is characterized by buildings

located in the old town made of adobe or un-reinforced masonry, high numbers of informal construction around the city, and weak seismic code enforcement capacity (EMI, 2005).

In spite of the inherent risk, during the past decades the slopes on the mountain zones of the city have been attractive to be urbanized, either legally or illegally. In the case of legal settlements, the urban landscape and the proximity to centric zones are the main reasons, while in the case of informal settlements the main reasons are availability and low price of land (La Red, 1996).

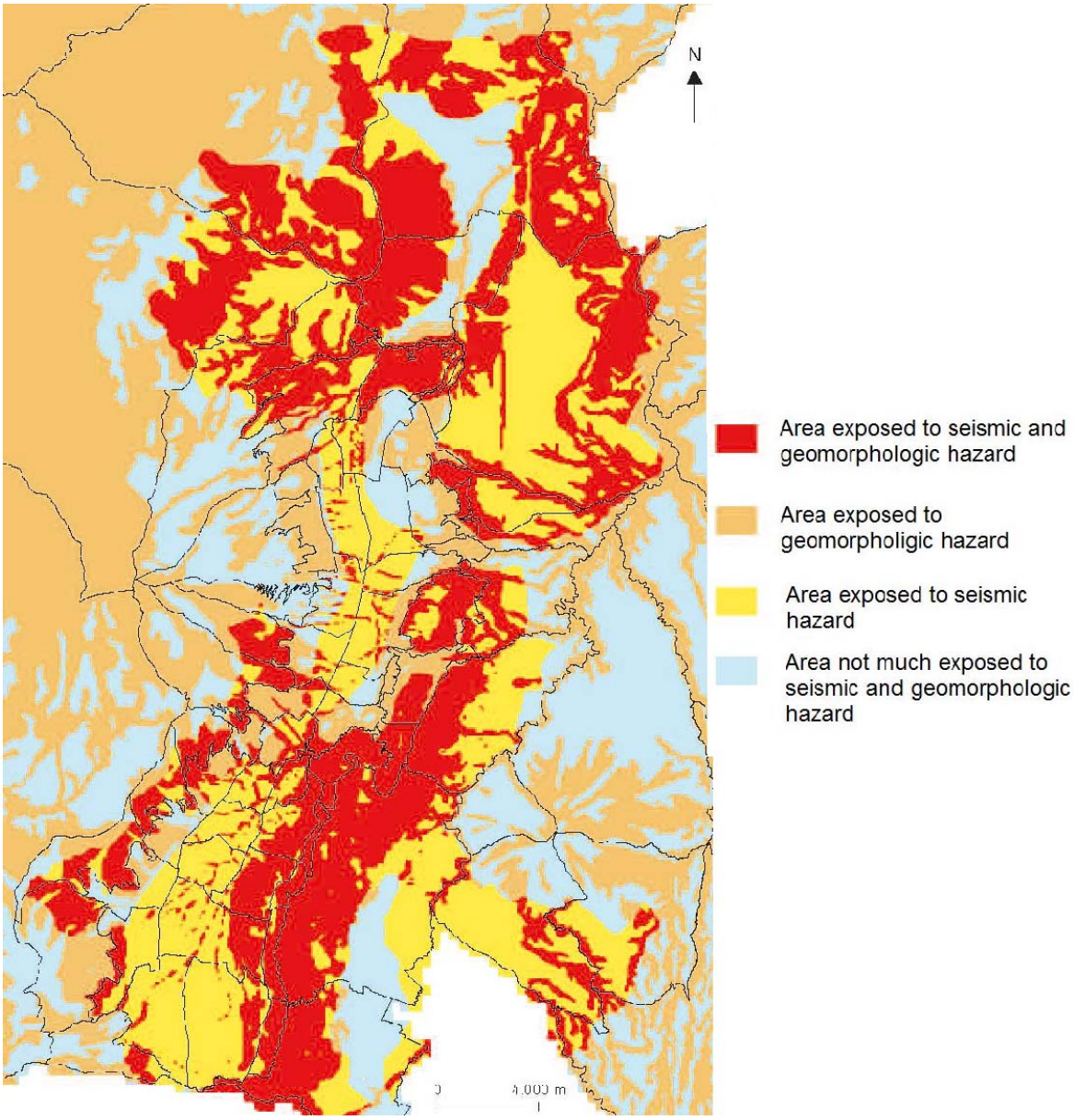
Out of a total of 508.728 housing units in Quito, approximately 153.317 housing units are built illicitly by low-income groups as a survival strategy in poor barrios. These informal settlements are located in slopes or in risk sites because of initial low purchasing land prices, and are built through self-help, producing environmental degradation through deforestation, fill the natural drainage with solid wastes, and therefore introduce a tremendous vulnerability (EMI, 2005).

This need of land for building has caused deforestation, with estimates of 100 hectares of forest being destroyed every year, and together with bad environmental practices, there has been an increase of solid waste that is inadequately treated and deposited in empty lots and ravines affecting the natural drainage system of the city (Carrion, 2005).

Under this scenario, there is high population exposure to hazards. According to D'Ercole (2004a) out of a total population of 1.842.105, there is an 18,7 per cent under high to very high vulnerability, mainly the population living in informal settlements without basic services; 42,8 per cent under relatively high vulnerability; and 38,5 per cent under low to relatively low vulnerability.

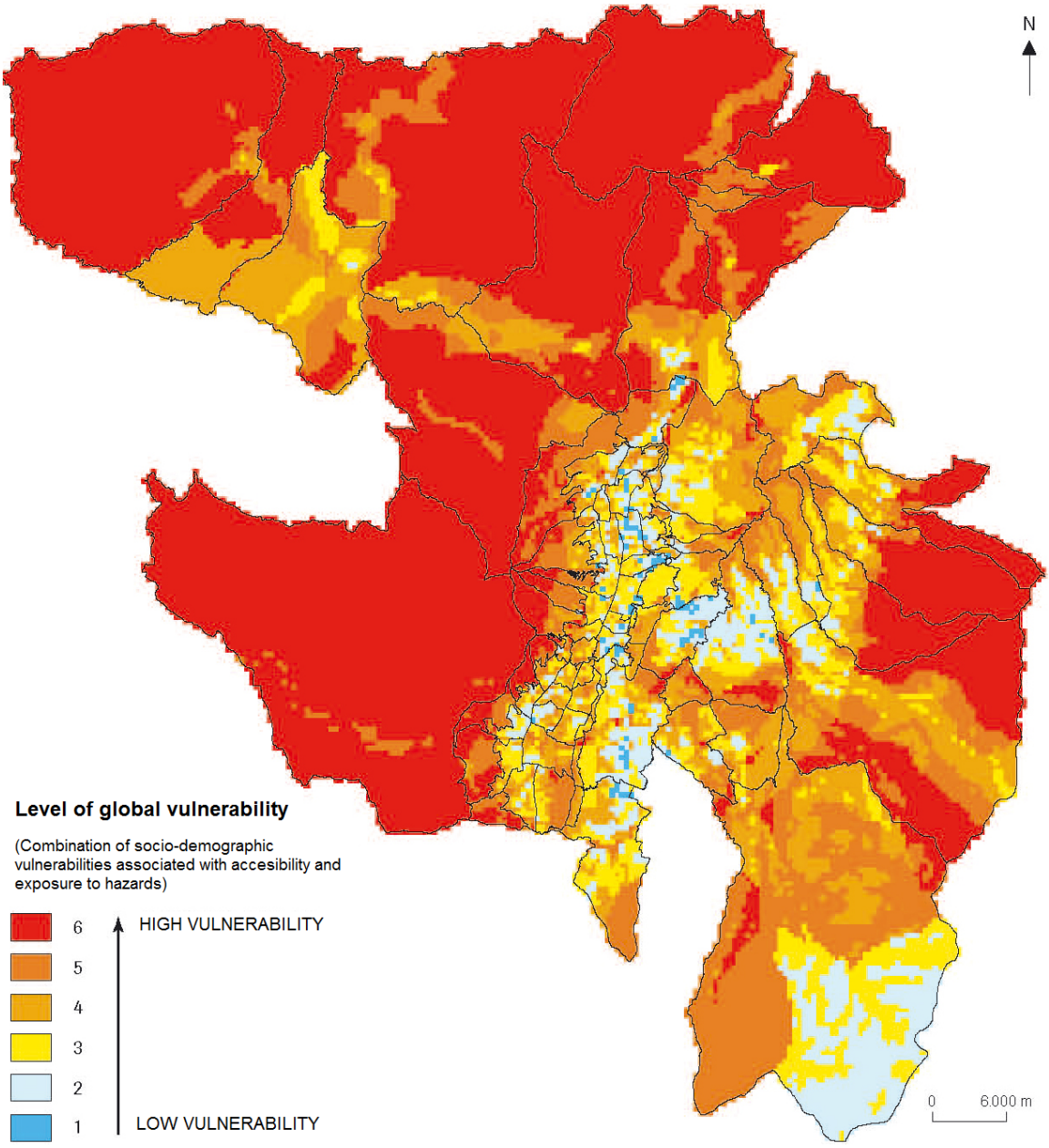
Figure 8 shows a map with the association of seismic and geomorphologic hazards in the QMD with a high and moderate level of danger, while figure 9 shows a map with the global vulnerability of QMD's population.

Figure 8 Seismic and geomorphologic hazards in QMD



Source: D'Ercole & Metzger, La vulnerabilidad del DMQ, pp 104.

Figure 9 Global vulnerability of QMD's population



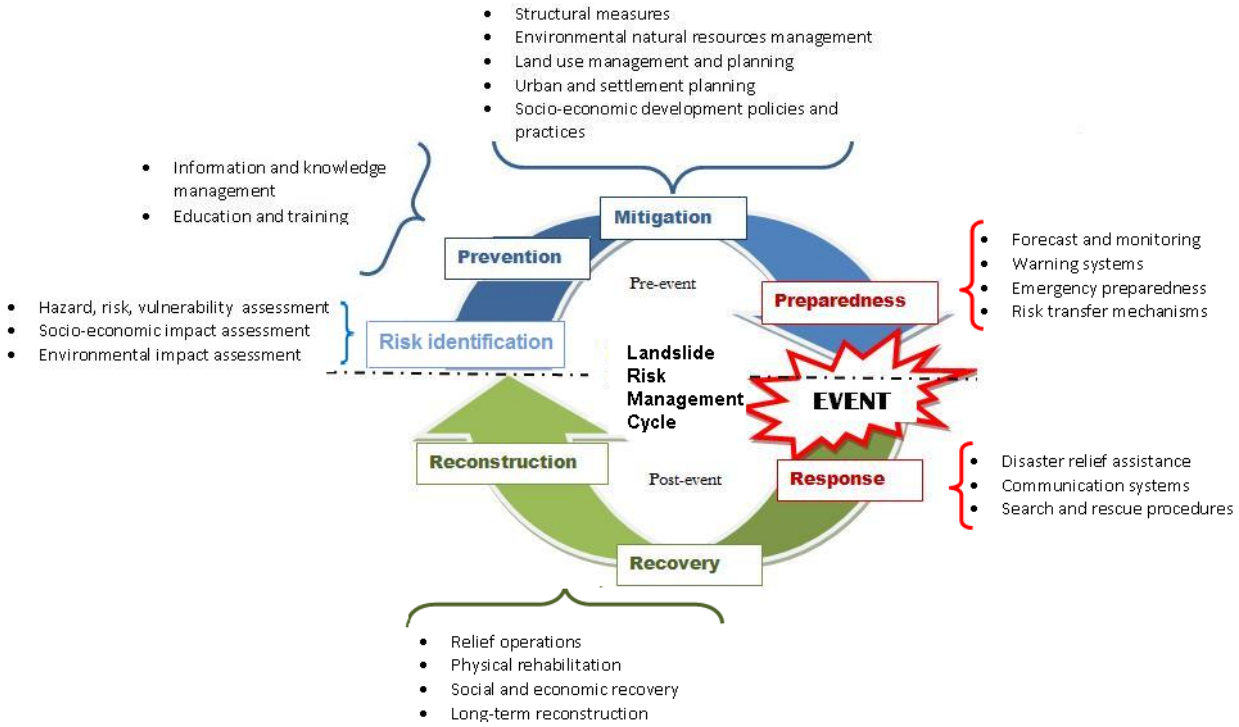
Source: D'Ercole & Metzger, La vulnerabilidad del DMQ, pp 261.

CHAPTER 4: REVIEW OF THE LITERATURE

4.1. What constitutes an effective landslide risk management?

This section presents information obtained from a literature review of several studies and programs of identified characterizing elements of effective landslide risk management in urban areas. Good DRM practices and characterizing elements are presented within the three phases of the DRM cycle: pre-disaster, response and post-disaster. The main components of these effective landslide risk management are summarized in the following figure.

Figure 10 Elements of an effective DRM



Source: Own elaboration derived from Metz and Weiland, 2009 and Basabe, 2007.

4.1.1. Pre-disaster phase

4.1.1.1. Risk identification

In order to mitigate landslide hazard effectively it is necessary to develop a better understanding of landslide hazards and to make rational decisions on landslide risk management (Dai et. al., 2001). Therefore, an effective landslide risk management begins with knowledge production on landslide hazard and on the physical, social, economic and environmental vulnerabilities faced by societies (UN-Habitat, 2007).

Knowledge production requires the development of technical and scientific capacity to develop landslide risk assessments that provide the scientific basis for understanding the mechanisms that trigger landslides and the scales at which they operate in order to mitigate them (Anderson & Holcombe, 2008; Van Niekerk, 2005).

Landslide risk assessment comprises the estimation of the level of risk and requires the following issues to be addressed: probability of landslide (hazard assessment), runout behavior of landslide debris (impact assessment), vulnerability of property and people to landslide (social, economic and environmental vulnerability assessment), and landslide risk to property and people (risk assessment). All of these areas are discussed next.

a. Probability of landslide

To assess the probability of landslides within a specific period of time and a given area, the conditions that cause the slope to become unstable and the processes that trigger the movement have to be considered. Two types of factors determine the probability of landslide for a particular slope; they are the preparatory variables and the triggering variables (Anderson & Holcombe, 2008). Preparatory variables, on the one hand, make the slope susceptible to failure without actually initiating it. These variables include geology, slope geometry and gradient, elevation, soil geotechnical properties, slope hydrology and vegetation cover, and long term drainage patterns. The triggering variables, on the other hand, shift the slope from a marginally stable to an unstable state and thereby initiate failure in an area of given susceptibility. These variables include heavy rainfall and seismic events (Anderson & Holcombe, 2008; Dai et. al., 2001).

There are several methods that have been developed to assess the probability of landslide. The more initial approach to landslide assessment is the compilation of landslide inventories which serve as the basis of most susceptibility mapping techniques (Dai et. al., 2001). Landslide inventory maps can be prepared by collecting historic information on landslide events or from aerial photographic interpretation coupled with field checking. Those maps can be used as an elementary form of hazard map and can determine estimates of landslide probability throughout a region where landslides have caused significant damage (Dai et. al., 2001).

Several countries have strengthened their disaster mitigations programs through Hazards Mapping Programs, as is the case in the Philippines after a flood and landslide disaster in 2003 (Catane et. al., 2008). That program included landslide susceptibility maps for the entire country mainly for rainfall and earthquake induced-landslides. After that program, several others were launched to manage the problem at a local level.

The traditional maps based on geo-morphological analysis from aerial-photo interpretation and field surveys are not useful for low rates of surface displacement. Advances in space borne, airborne and terrestrial remote sensing technologies have improved the ability to identify and map ground deformations, such as landslides, at different geographical scales. This is done through the exploitation of state-of-the-art Earth Observation data and technologies with high and very high resolution satellite optical sensors (Guzzetti et al, 2008).

In 2001, the Italian Space Agency supported technological and scientific applications of remote sensing technology to help identify, monitor, forecast and mitigate natural and manmade hazards, including slope failures (Guzzetti et al., 2008). In line with this, Hong and collaborators (2008) developed an experimental landslide prediction model to identify the timing for landslides induced by heavy rainfall. The system included zoning the global landslide hotspots from a high-resolution geospatial database; a real-time multi-satellite precipitation estimation system; and a simplified automated decision-making procedure which integrates both types of information to locate the likelihood of landslide occurrence.

Other approaches estimate landslide probability on the basis of data on preparatory variables with the assumption that the relationships between landslide susceptibility and the preparatory variables are known and thereby they are specified in models (Dai et. al., 2001). More deterministic approaches are based on slope stability analyses with the use of models for rainfall and earthquake induced-failures which consider the variability of soil properties to evaluated stability conditions (Dai et. al., 2001).

Statistical models involve the statistical determination of the combination of variables that have led to landslide occurrence in the past for areas currently free of landslides but with similar conditions (Dai et. al., 2001). This is done through the use of conventional multivariate statistical methods to assess landslide susceptibility and is more appropriate for landslide mapping at medium scales, making it possible to map out in detail the occurrence of past landslides and to collect significant information on the variables considered to be relevant (Dai et. al., 2001).

Anderson and collaborators (2006) developed a model that facilitates assessment of slope stability incorporating other factors that trigger landslides in steep slopes where unplanned housing has taken place without building code enforcement and lacking any form of adequate slope drainage. Besides considering soil hydrology and slope stability in the model, they also considered the housing density as it plays a key role in the context of hydrological impact. With that model they provided a measure of the relative stability of the slope within a realistic scenario. This allowed prioritizing modifications that may improve stability in order to improve slope management and undertake appropriate mitigation (Anderson & Holcombe, 2008; Anderson et. al., 2006).

As it can be seen, there are few reliable techniques available for assessing landslide hazard and they all require detailed geotechnical information on the existing conditions and a record of events descriptions. The accuracy of such assessments is determined by the length, quality and nature of the information record but the main drawback is the uncertainty associated with applying the findings to areas beyond where the precedence was established (Dai et. al., 2001).

b. Runout behavior of landslide debris

Another aspect of landslide risk assessment is to determine the extent of endangered areas and that requires accurate prediction of the runout behavior of a landslide. Runout behavior represents quantitative and qualitative spatially distributed parameters that define the impact and destructive potential of a landslide (Dai et. al., 2001). Those parameters include information on

the distance from the landslide source area to the distal deposition area; the width of the area subjected to landslide damage where impact on infrastructure occurs, referred as the damage corridor; the velocity of travel within the damage corridor which determined the potential damage to facilities; the depth of the moving mass that influences the impact force of the landslide; and the depth of deposits which can cause the collapse of a structure.

According to Dai and collaborators (2001) there are several factors that contribute to the impact of landslide debris. One of those factors is the slope characteristics such as slope geometry, the forming material of the slope, and the upslope influence zone. Another factor involves the mechanisms of failure, such as collapse of loose soil, and modes of debris movement once landslide is mobilized that influence velocity and travel distance.

The characteristics of downhill path traversed by the debris are another factor that affects the mode of debris travel. Some parameters of this factor include the gradient of the downslope path, possibility of channelization of debris, and characteristics of ground surface. For example, an increase in downslope gradient will favor the acceleration of an initial failure; the amount of water available for mixing with landslide debris and the gradient of the downslope channel way contribute to the transition of an initial landslide into a mobile debris flow. Finally, the presence or absence of pre-existing shears and the degree of fragility are an important factor that controls the post-failure movement of landslide.

Some methods are used for predicting rounout distance of landslide debris. One of those methods includes empirical models that provide tools for predicting the rounout distance and distribution of landslide debris. Another method includes simplified analytical models which describe the physical behavior of debris movement. A third method involves numerical simulations of conservation equations of mass, momentum and energy that describe the dynamic motion of debris, and a rheological model to describe the material behavior of debris (Dai, et. a.l., 2001).

c. Vulnerability assessment

Vulnerability assessments provide an understanding of the interaction between a given landslide and the affected elements. In general terms, the vulnerability to landslide depends on the characteristics of the landslide (runout distance and volume and velocity of sliding); buildings and infrastructure at risk, their nature and their proximity to the slide; and the people at risk, their proximity to the slide, the nature of the buildings and roads that they are in, and their location in the building or on the road (Dai et. al., 2001).

The assessment of vulnerability is to some extent subjective and largely based on historic records. Given a particular facility type and the probable depth of debris at the location, the vulnerability factor for that specific facility can be assessed systematically by expert judgment (Dai et. al., 2001). Other method to assess the vulnerability of people and property to landslide is based on the statistics of detailed historic records. However only in a few places those records are available as is the case of Hong Kong, almost unique in terms of the detailed records kept on landslides and their consequences. Other methods even correlate the vulnerability of elements at risk (infrastructure and people) and the characteristics of the landslide (Dai et. al., 2001).

d. Landslide risk assessment

The process of landslide risk assessment depends on the completeness and quality of the basic information detailed above related to historic landslide data and other physical and social data (Dai et. al., 2001). It is important to consider the indirect costs, such as interruptions in economic activity, as well as the direct damage caused by landslides, when assessing landslide risk. The relevance of undertaking such assessments is fundamental to compare the costs between developing preventive and mitigation programs or recovering from a disaster (Van Niekerk, 2005).

There are different types of risks that can be assessed in regards to landslide. One of them is the distributed landslide risk assessment to provide a risk map that depicts the level of risk in terms of fatality or economic loss at different locations of a given region (Dai et. al., 2001). Another is the site-specific landslide risk assessment which provides a systematic analysis of the hazards and level of risk in terms of fatality or economic loss at a given site to determine if the risk levels are acceptable or not, and to evaluate different mitigation measures on the basis of cost-benefit analysis (Dai et. al., 2001). Finally, the global landslide risk assessment serves to define the relative contribution to the total risk. This is useful to provide a reference for landslide risk management and consideration of resources allocation and policy-making (Dai et. al., 2001).

4.1.1.2. Prevention

An appropriate way to approach landslide risk reduction is through preventive measures and programs developed with local communities and institutional initiatives designed to build capacity within vulnerable communities (Anderson et. al., 2006). In order to develop such preventive measures and programs, several elements need to be considered, for instance, information and knowledge management, as well as education and training. The following lines look at these elements in a more detailed way.

a. Information and knowledge management

The information and knowledge generated regarding disaster risk have to be managed and transferred to the public in order to build understanding and awareness and construct a culture of safety and resilience at all levels by empowering the society to adapt with the dynamic geological conditions (Karnawati & Pramumijoyo, 2008).

Improving awareness means managing and exchanging information and the outcomes of research on this field. It involves the establishment of mechanisms that ensure dissemination of landslide maps and disaster reduction information among the general public; establishment of informal education programs; strengthening networks and regional linkages; promoting dialogue and cooperation between different actors; considering traditional knowledge, promoting the inclusion of disaster risk reduction in education and training; and promoting public awareness through media engagement (UN/ISDR, 2005).

An effective link between source (research institutes, government agencies and universities) and receiver of information (schools, communities, families) has to be established to transfer and disseminate the information in order to achieve public awareness and preparedness (Karnawati & Pramumijoyo, 2008). Key persons from community, religious and ethnic groups are also important to raise awareness and sensitivity of the community.

Another important link that has to be established is the one between the source of information and the planners and policy-makers to support the development of appropriate regional master plans and regulations in geohazard prone areas which guide the efforts to build up a culture of prevention of communities, families and individuals (Karnawati & Pramumijoyo, 2008).

Dissemination has to reach the public through various mass media, such as leaflets, booklets, books, television, radio, internet, as well as through several activities and programs (Karnawati & Pramumijoyo, 2008). In addition, the creation of DRR information platforms, technical information centers and communication networks facilitates access to information. Some good practices have developed DRM Information Systems and Communication Plans that include the areas of communication, education, social participation and community empowerment, political and institutional development, and inter-institutional and inter-sectarian articulation (UN/ISDR, 2005).

b. Education and training

Appropriate education programs, formal and informal, for geohazard awareness and preparedness is needed to empower the communities living in vulnerable areas and to reduce the number of victims affected by landslides (Karnawati & Pramumijoyo, 2008). A benefit from educating the population and decision-makers of disaster risk reduction issues is that "risk aware" communities and governments can also take steps to improve their resilience to landslides (Anderson & Holcombe, 2008).

Universities have important roles as the providers of information and knowledge and also as the media for transferring that information to communities (Karnawati & Pramumijoyo, 2008). Formal education programs at the university level related to geological education have to be enhanced to produce knowledge to anticipate geological disasters and to provide qualified human resources capable of improving the resilience of a society in response to potential disasters (Karnawati & Pramumijoyo, 2008).

In fact, the students are the ones that will become the potential future researchers to develop technologies for disaster prevention and control, and the potential future analysts and policy makers to anticipate and manage geological disasters in their respective regions (Karnawati & Pramumijoyo, 2008). For this to be accomplished the establishment of specialization courses of DRR offered at universities, the development of capacity building programs for professionals in the different fields, and the creation of disaster risk management training centers should be enhanced.

The establishment of networks for geohazard educations at national and regional levels is crucial in order to facilitate the effective learning and research programs on geohazard

education. For instance, since the year 2003, the ASEAN University Network and the South East ASEAN Education Network established the Field of Geological Engineering Networks which consists of several universities from Member Institution Countries to carry out education and research of geohazard. In addition, since the year 2008, this Network established Integrated Fields of Disaster Mitigation to improve research based education for DRR (Karnawati & Pramumijoyo, 2008).

Formal education at school level to include basic and simple knowledge on geology to understand geohazards have also been introduced in the curricula of some Asian countries although this has not proven to be successful yet in improving student's attitude for geohazard awareness and preparedness (Karnawati & Pramumijoyo, 2008). Those programs still need to be further evaluated and enhanced through innovative methods of teaching and learning that go beyond the definition and causes of geohazards and include mechanisms of occurrence, symptoms, and practical knowledge on mitigation, preparedness and emergency response.

Informal education is another effective mechanism to improve public awareness through the implementation of sustained programs of community awareness and community capacity building. Anderson and Holcombe (2008) stress the development of three successful approaches to encourage individual home owners to be aware of the issues and to take steps to implement the proposed methodology: First, the selection of a "show home" from the community to show the necessary features of "good drainage practices"; second, the design of a poster to illustrate all the features of the "show home" as an example to improve slope stability through better drainage; and third, media coverage of the project and the interventions (Anderson & Holcombe, 2008).

The successful methodology for landslide risk reduction implemented by Anderson and Holcombe (2008) pointed out two overarching elements: a management team composed of government and community expertise to reflect a multidisciplinary approach, and a technical "toolbox" which included not only the research and design of the methodology but also a training programme delivered to the team.

4.1.1.3. Risk reduction and mitigation

Once the risk from a landslide or susceptible areas are identified, and information and knowledge about the underlying causes of disaster is available, strategies, activities and measures to reduce and mitigate disaster risk are designed and applied. Anthropogenic activities, such as altering slope geometry with earthworks, and loading slopes with buildings and infrastructure, increase landslide risk. Additional factors are also variations in the surface water and groundwater regimes as well as changes in vegetation.

Reducing landslide risk involves either reduction of landslide hazard or reduction of communities' vulnerability to landslides, or both (Anderson & Holcombe, 2008). Under this scenario, physical interventions as well as behavioral changes are needed. These have been divided in structural measures and non structural measures (environmental management, land use planning and management, urban and settlement planning, and socio-economic

development). Measures that have been already delivered on the ground and shown to be effective are presented in the following lines.

a. Structural mitigation measures

Structural mitigation measures may be seen as an engineering solution strategy for reducing either the probability of landslide or the probability of spatial impact of a landslide (Dai et. al., 2001). The use of physical measures, such as drainage, slope-geometry modification, and structures, is the most direct and costly strategy for preventing and controlling landslide.

Two general approaches exist for mitigating landslide risk: one is the correction of the underlying unstable slope to control initiation of landslides by means of controlling surface water, and the other one is controlling of landslide movement (Dai et. al., 2001).

The most common remedial measures to correct the underlying unstable slope in specific sites are modifications of the slope geometry by drainage of surface and ground water, excavation, and the use of retaining structures and internal slope reinforcement ((Dai et. al., 2001). These hard engineering solutions represent an excellent solution for landslide if correctly designed and constructed but in many cases they can prove expensive (Anderson & Holcombe, 2008).

Controlling surface water on slopes is a critical element in landslide risk reduction. Excess pore pressures trigger slope instability and therefore drainage systems preventing such pressures are a general requirement (Anderson & Holcombe, 2008). Ditches and drainage are used to reduce surface water infiltration into potential slide mass. Underground drainage systems and pumping wells are also use to remove ground water and decrease pore pressure, increasing in this way the shear strength of soil (Dai et. al., 2001).

Excavation is used to flatten the slope gradient by removing unstable material from the crest of the slope and adding material to the toe for more stability. However this may not be easy to implement in long translational slides with no obvious toe or crest, or in very complex unstable areas in which a change in topography may adversely affect the stability of other area (Dai et. al., 2001).

The placement of retaining structures is also used to increase slope stability and resistance to movement. Such structures include gravity retaining walls, crib-block walls, gabion walls, passive piles, piers and caissons, cast-in situ reinforced concrete walls, or reinforced earth-retaining structures with strip, sheet polymer metallic reinforcement elements (Dai et al., 2001). Other less expensive solutions that individual residents can afford consist of specialized plastics held in place by a wire mesh (Anderson & Holcombe, 2008).

An alternative landslide mitigating strategy of structural measures is to control the movement of landslide debris in order to reduce the spatial impact of landslides. The more traditional measures use the installation of mechanical barriers where necessary to protect structures (Dai et. al., 2001). They include diversionary structures or levees to direct landslide debris into predetermined depositional areas, retaining walls to withstand and repel impacts, and debris defenses to absorb kinetic energy. These structures are effective for small failures, but

ineffective on very steep slopes of for containing large failures. In fact, for the application of these structures their effectiveness and economics should be considered (Dai et al., 2001).

b. Environmental natural resource management

In order to develop an appropriate approach to landslide risk a number of factors need to be integrated. There are several characteristic of landslide risk prone areas, particularly in unplanned housing areas, that make environmental management a key aspect in dealing with the risk.

Such communities usually have mains water supply, but no planned drainage from properties. In fact, surface water infiltration on slope areas has been determined to be the main cause of landslides, and the clear relationship between the rainfall falling on a slope and the resultant instability is critical in suggesting remedial measures (Anderson et. al., 2006). In addition, vegetation on slopes is sometimes replaced to grow food due to necessity without considering the impact on slope stability (Anderson et. al., 2006) and deforestation continues to increase. Furthermore, even if residents recognize the risks, they lack appropriate design of building skills to implements drainage ditches or retaining walls.

There are several measures, practices and changing behaviors related to environmental management that are needed and have a beneficial impact reducing the risk of landslides. Those measures and practices include:

- Surface water management in areas already subjected to slope instability in order to achieve full drainage on the slope through the provision of surface drains. For example, Anderson and collaborators (2008) developed a surface drainage plan that encompassed an entire hillside and which was developed and implemented jointly with local residents. The plan consisted on key intercept drains a cross the slope in upslope locations, carefully configured to connect with existing drainage provision;
- Waste management in order to reduce, reuse and recycle waste to close the loop of resource circulation; to control waste in the waterways and roads to prevent blockage or reduce the drainage capacity of a drainage system to natural rivers; and to maintain drainage channels;
- Mitigation of environmental damage;
- Development of legislation to stop deforestation in slopes and minimize surface run-off and soil erosion in milder-slope areas;
- Development of green areas in between the community areas in order to absorb water and to slow down the flow;
- Revitalization of the urban environment infrastructure by measures that include conserving, regenerating or creating natural green environments.
- Establishment of environmentally sensitive lands known to be at risk as parks or ecological areas to avoid urbanization and settlement development.
- Development of environmental impact assessment to control and analyze the environmental impact due to particular development.

c. Land use management and planning

The relationship between urban population growth, the physical demands of human settlements, short and longer term economic trade-offs, and appropriate use of available land are evident. Since location is the key factor that determines the level of risk associated with a hazard, land-use planning carefully designed and rigorously implemented is a fundamental approach for mainstreaming DRR into urban development processes (UN/ISDR, 2004). In effect, Burby (1998) argues that by planning for and managing land-use to enhance sustainability, vulnerability to disasters can be reduced.

Planning controls can be seen as a way of reducing expected elements at risk by removing or converting existing development, or by discouraging or regulating new development in unstable areas, this being the most economical and effective means for local governments if feasible (Dai et. al., 2001).

Land-use planning should be considered as a natural extension of conducting hazard assessments and risk mapping in a way that it enables local authorities to gather and analyze information about the suitability of land for development. Understanding the limitations of hazard-prone areas by policy makers, potential investors and community residents helps to reduce disaster risk by regulating the expansion of human settlements and infrastructure (UN-Habitat, 2007). New development can be prohibited, restricted or regulated in landslide-prone areas and they can be used as open space, parks, woodland and recreation (Dai et. al., 2001).

How can land-use planning be used as a tool for disaster risk reduction? One example that can be mentioned here is the three color coded zoning system in Switzerland which guides the development of buildings. Charts of degrees of danger are developed based on hazard maps to guarantee a uniform way of assessing the different kinds of natural hazards that affect Switzerland, such as floods, landslides, snows or avalanches. The parameters use to classify the danger are the intensity and probability. These parameters define three degrees of danger represented by the colors red, blue and yellow, which means high, potential or no hazard, respectively. The danger zones are delineated on the local plan together with areas suitable for construction as well as zones where additional protection is required. In this case, according to the Federal Law for Land-use-Planning, the cantons must identify in their Master Plan all areas threatened by natural hazards (Latertin & Raetzo, 2001).

In this context, land-use planning and management work together. While plans provide general guidance for managing development, land use regulations, such as zoning, set specific rules to determine where development is allowed and how it should take place so that vulnerability from natural hazards is minimize (Burby, 1998). Land-use management also includes complementary policies and strategies to achieve the objectives of enhancing sustainability.

Several measures and strategies related with land use management and planning have been developed as part of a DRR strategy with the potential to reduce landslide risk in Andean capitals of Latin America (PNUD et al., 2007). Those measures include the development and implementation of Municipal Territorial and Land Use Management Plans as well as Territorial Ordering Maps to map risk areas and regulate processes within those risk zones, as in the example above. Such regulations take place through the classification and zoning of disaster-

prone areas as unsuitable for development and construction; the declaration of high risk zones as protection lands together with the restriction of illegal land occupation on those protected lands; and the restriction of land-use activities on steep sloping areas.

Still, land use management and planning by its own cannot achieve results if other development sectors don't tackle the same issues of urban population growth and demand of space for settlements integrating a disaster risk reduction approach. A set of other measures in urban settlement planning as well as development policies in the socio-economic sector need to be in place.

d. Urban and settlement planning

Unplanned housing developments in vulnerable communities on steep slopes pose problems for the residents in terms of lives, social and financial costs; for the governments in terms of potential relocation or post-disaster costs; for engineers in assessing the nature of hazards and risks; and even for donor agencies in terms of establishing the form of disaster mitigation policies that should be promoted (Anderson & Holcombe, 2008). Several strategies have proven to be effective to deal with the problem of unplanned housing and they are mentioned next.

Access to land for housing

By improving access to land for housing the poor, the expansion of settlements onto physical hazardous sites can be limited (El-Masri & Tipple, 2002; Budds, et al. 2005). The focus is on directing development of human settlements into vacant public land by providing different types of incentives such as:

- Initiating sites and services and core housing schemes;
- Expanding infrastructure and residential zoning;
- Applying legislation to facilitate land tenure legalization;
- Encouraging the formation of housing associations;
- Controlling property market and stimulating low-income housing production;
- Improving public transport and developing new employment opportunities;
- Improving access to financial sources such as loans and credits;
- Adopting suitable tax systems;
- Increasing the supply of urban land for housing the poor by the private sector. To encourage the private sector to develop in vacant land, other incentives can be used, for instance tax exemption, infrastructure development, improvement of land transactions, or imposition of higher land taxes on underdeveloped property; and
- Improving access to existing public housing schemes through the reduction of unfair allocation practices associated with the reexamination of the physical conditions of settlements to improve density by increasing build-up areas or encouraging subdivision.

A successful example occurred in Ilo, a port city in Southern Peru with approximately 70.000 inhabitants where there was municipal support for land-for-housing (Diaz & Miranda, 2005). Over the last 25 years, housing and living conditions have been much improved, and informal settlement and land invasion has not taken place, despite being an industrial town with rapid

population growth. A planned development of the city took place through a municipal government programme of providing land for low-income households supported by private housing associations and a national government housing programme. The new settlements were developed following programs designed by the municipal authorities and housing associations, and incorporating the pertinent infrastructure, provision of water, sanitation and solid waste collection, as well as land tenure. This showed that working to deal with the underlying risk factors was effective to reduce the impact from natural hazards.

Alternate use of land

Another way to prevent mushrooming of new settlements in environmentally sensitive lands, is to put the land already known to be at risk to suitable alternate use, such as parks or productive urban farms, which will suffer minimal damage in the event of a natural disaster (El-Masri & Tipple, 2002; Gumpta & Sharma, 1999). Another alternative is to provide incentives for commercial groups to develop those sites at acceptable levels of risk, meaning that mitigation measures could be taken into account at an early stage in the development of those sites, perhaps by risk-resistant construction, adequate eviction and emergency plans.

Legalization and upgrading programs

A further way of reducing risks is by reducing the vulnerability of already existing informal settlements, requiring the legitimization and improvement of existing informal settlements through upgrading programs. In general terms, upgrading consists of physical, social, economic, organizational and environmental improvements undertaken at a local level in cooperation among citizens, community groups, businesses and local authorities (UN-Habitat, 2003a).

The actions for informal settlement upgrading include:

- Installing or improving basic infrastructure, like water supply, sanitation, waste collection, storm drainage and flood prevention;
- Removing or mitigating environmental hazards;
- Providing incentives for community management and maintenance;
- Constructing or rehabilitating community facilities;
- Adequate access to land and resources;
- Regularizing security of tenure;
- Improving access to health and education;
- Empowering the poor to promote community organizations and cooperative actions to implement infrastructure and housing projects, strengthen social capital, and improve living, environmental and economic conditions.
- Providing technical support.

In some cases, communities with the highest risk level need to be relocated. This is considered after a careful investigation into different variables: landslide hazards level, awareness, housing and structural condition, and livelihood (Sugathapala, 2008). However there are concerns about this type of resettlement programs because of the impact on the livelihood of the people relocated. It is extremely important to identify the socio-economic background of these

vulnerable people, including livelihood and occupation in these situations so that the programs can be successful (Sugathapala, 2008).

For example, the city of Santo André in the metropolitan region of São Paulo, Brazil has about 15% of its population living in slums located in flood- and landslide-prone areas. In 1997, the municipality chose the Sacadura Cabral settlement for relocation as part of a slum upgrading program because the areas was prone to flooding every year and it was densely populated (Oliveira and Denaldi, 1999). In order to achieve upgrading and reduce flood risk, the area had to be leveled with earth and a total of 200 families had to be relocated to nearby sites to allow redevelopment and upgrading of the site. The planning authority was initially in charge of selecting the families that would be moved but later on this was replaced by a more communicative strategy built around a series of public meetings with communities and their leaders.

The result of the meetings was a relocation plan in with the local community had the responsibility to select the families. The agreement reached was that families would be housed within 1 kilometer form Sacadura Cabral and they would be given access to subsidized credit to acquire the houses. Demolition of the relocated families' homes and leveling of the land was followed by a process of internal relocation within the settlement and leveling of the rest of the flood-prone area. The local people had then the role of leading the reconstruction and upgrading process with technical assistance from the local authorities (Oliveira and Denaldi, 1999).

e. Socio-economic development policies and practices

One of the most important aspects to deal with landslide risk reduction, particularly in informal settlements, is to recognize that they are an integral part of the urban landscape. Not recognizing them and not providing basic services for informal settlements, because it would be seen as a signal of approval, will exacerbate the vicious circle and increase their vulnerability to risks (Gumpta & Sharma, 1999).

Recognizing informal settlements in land-use and urban planning requires an approach that includes several scales that influence the quality of life of people. This means not only the spatial parameters of physical vulnerability, but also the social and economic requirements of a society's development. This entails linking land-use planning to socio-economic realities, types of hazards, costs and benefits, land market, land-use and zoning, planning and regulation, as well as land tenure and registration that characterize each situation (Gumpta & Sharma, 1999; El-Masri & Tipple, 2002).

This can be achieved by several strategies:

- Establishment of public policy interventions for reducing socio-economic vulnerabilities (increased access to resources, increased employment opportunities, increasing macroeconomic stability and other policies made to improve quality of life);
- Establishment of innovative financial instruments (credit markets, micro finance) that provide poor households access to financial resources to reduce, share and transfer risks;
- Establishment of social safety nets to provide assistance in managing the impact of risks and immediate financial support to victims;

- Creation of mitigation/vulnerability reduction funds;
- Development of landslide insurance policies and mechanisms (grants, small short term loans, or disaster loans);
- Reinforcement and retrofitting of public and private assets;
- Development of recovery schemes;
- Development of incentives to implement measures to reduce housing vulnerability (such as tax reduction);
- Establishment of social housing programs to provide housing on vacant land with services and infrastructure.

Some successful programs have designated a new political framework with a strong emphasis in improving the quantity and quality of housing for low-income groups. This, supported by new legislation, financial instruments and partnerships with the private sector, has been fundamental to obtain the desired objectives, as is the case in São Paulo's municipal government (Budds, et al. 2005). They designed a policy framework focused on pro-poor housing and urban development policies and programs to face the situation of one-third of its 10 million inhabitants living in poor-quality housing in sub-standard settlements.

This policy framework included the following key aspects:

- Institutional restructuring with the creation of 31 district councils within the municipality to decentralize the municipal administration.
- Creation of new policies that reduce the price of urban land and define the right to adequate housing.
- Development of financial instruments: The Municipal Housing Fund consists of the Municipal Secretariat of Housing and Urban Development (SEHAB)'s share of general tax transfers and locally generated revenue from municipal taxes. In addition, increased links between the municipal, state and federal governments are promoted to get support for the squatter upgrading programme, create a subsidy programme for the lowest-income families, and create a national housing system from local to national level. In order to expand sources of financing, the municipal government has also negotiated further financial packages from the Inter-American Development Bank and established a number of agreements with public and private agencies.
- Partnerships establishment with the private sector such as the Federal Savings Bank and the State Housing and the Urban Development Company to create new forms of finance for housing. The Residential Leasing Programme sells property belonging to the municipal government at a subsidized price, locates land for building, or converts buildings into apartments. The Social Housing Subsidy Programme provides direct subsidies to low-income families to acquire housing. Another agreement was established under which the state government provides finance, the municipal government donates public land, designs the projects, and the housing units are build and sold by the State Housing and Urban Development Company. Finally there are also agreements to facilitate legal and technical assistance for low-income groups.
- Creation of new legal mechanisms to implement the measures and prevent speculation in the property market, stimulate the production of flow-income housing, prioritize interventions in low-income settlements, and legalize land tenure for low-income residents.

- Public participation in policy design and decision-making by the creation of the new Municipal Housing Council formed as a tripartite council consisting of 16 representatives from popular housing movements, 16 from civil society organizations (including NGOs, unions, universities and professional associations), and 16 members of the municipal, state and federal government.

4.1.1.4. Preparedness

Another part of the components of DRM before a hazard event is disaster preparedness. Actions involved in preparedness include monitoring and warning systems that serve as a strategy to reduce the impact of expected elements at risk by evacuation in advance of failure, emergency preparedness, and risk transfer mechanisms.

a. Forecast and monitoring

For landslides or potential slopes where structural measures to stabilize slopes were impracticable or not cost-effective, monitoring and landslide warning are an alternate option to reduce landslide risk (Dai et. al., 2001).

Potentially unstable slopes have to be monitored to provide information on the magnitude, rate, location and direction of deformation; pore pressures; and seismic acceleration if the landslides are triggered by earthquakes (Dai et. al., 2001). Based on the monitoring data, the existing conditions of a particular slope or landslide are assessed to determine whether or not the landslide is active or potentially unstable. If it is, then three strategies can be applied: do nothing and accept the consequences of failure; stabilize the slope and install a monitoring program to verify the effectiveness of stabilization works; or use a monitoring program in order that the potentially affected residents can be warned of instability and, if necessary, evacuated prior to the occurrence of failure (Dai et. al., 2001).

Permanent Scatterer SAR Interferometry is nowadays one of the most advanced technologies for surface deformation monitoring. For instance, the Italian National Defense Department launched a Monitoring Landslide Risk Program to identify, map and monitor landslides of different types through state-of-the-art earth observation technologies, and to forecast rainfall-induced landslides through models and thresholds of existing landslide information, quantitative rainfall forecasts, precipitation measures, and estimates of rainfall obtained from meteorological satellites (Guzzetti et al., 2008).

b. Warning systems

Landslide warning systems have been developed to issue landslide warnings in large prone to landslides. They can save lives and reduce damages if they are properly implemented. However predicting landslide occurrence is a difficult task and an expensive one in terms of money and time (Hong et al., 2008).

Some warning systems are based on empirical and theoretical relations between rainfall characteristics and landslide initiation; on geological determination of landslide prone areas; on real-time monitoring of a regional network; and on precipitation forecasts (Dai et. al., 2001). Regional warning systems can alert the general public to the potential landslide activity, but the amount and intensity of rainfall necessary to initiate landslides varies within specific geological, hydrological, and soil properties. Those systems can only provide information on when the landslide would occur, and are more useful if they are used together with regional landslide hazard mapping to determine potentially hazardous zones and the timing of landslide initiation (Dai et. al., 2001).

Nowadays the possibility of using satellite remote sensing and other global data sets to develop a global landslide database, global landslide susceptibility maps, and high time resolution, multi-satellite precipitation analyses with sufficient accuracy and availability to detect heavy rainfall events that provoke landslides (Hong et al., 2008).

Warning systems involve the establishment of communication and information systems with operative support groups and community participation promoted by the media, handbooks, and community training. For instance, a weather-based regional landslide hazards warning was developed in China, in 2003, as part of a prevention program of monitoring and prevention by masses. In this program China Meteorological Administration provided rainfall data, and the Ministry of Land Resources made forecast for geohazard risk and released warning notices through China Central Television at prime time after broadcasting daily weather forecast. In 2004, over 700 landslides were successfully predicted and warned, resulting in 46,000 persons evacuated from risk areas (Yin, 2008).

Dai and collaborators (2001) proposed a framework for landslide risk assessment and management through the development of a comprehensive landslide information system. This involves the use of Geographical Information Systems (GIS) linked with remote sensing technology, telecommunications and warning systems to establish a landslide database. This database includes a multi-scale and temporal database comprised of a physical database, a socio-economic database, an unstable slope and landslide inventory, and a monitoring database. Once this spatial and temporal database is developed, the data can be combined with a landslide risk assessment database, which includes information on probability of landslide, runout behavior and vulnerability assessment of elements at risk to determine landslide risk. By the use of modeling processes both of these databases can be combined in various ways to evaluate what will happen in certain situations in order to determine landslide risk management strategies based on a cost-benefit analysis and acceptable risk.

c. Emergency preparedness

Another way to be prepared in case of a landslide is by developing emergency management service systems; emergency preparedness plans so that the communities can know what to do in cases of a landslide; and health networking. It is useful to establish a City Fund for emergency preparedness and response and to have availability of equipment and tools to act in case of an emergency. Emergency response training programs are a good way to enhance and strengthen disaster response capacities.

d. Risk transfer mechanisms

While there are many ways to reduce and mitigate disaster risks some aspects of the risk may be too costly or too difficult to mitigate in an effective manner. Therefore, an emerging area of interest for the risk that cannot be mitigated or estimated is the potential for financial instruments of risk management to finance risk and offer affordable insurance services that would spread the burden of disaster risk (DFID, 2004; ProVentium, 2009).

In most developed countries, the government and private insurers, either alone or in partnerships, provide safety nets for victims by giving post-disaster assistance and monetary compensation (Linnerooth-Bayer & Mechler, 2007). However, while the developed world has access to those mechanisms to help manage the risks, effective risk transfer mechanisms are often neither available nor affordable to the poor in low-income countries, even if it is offered by the government (Linnerooth-Bayer & Mechler, 2007; ProVentium, 2009).

In this scenario, innovative risk-sharing mechanisms that extend traditional public-private partnerships to include NGOs, international financial institutions and other donors have emerged to pool and transfer catastrophe risk to the global financial markets and extend the benefits of insurance to groups that would otherwise be underserved by insurance markets. Such partnerships can provide secure financial arrangement to low-income communities before a disaster strikes (Linnerooth-Bayer & Mechler, 2007).

For large volumes of risk that affects many people at once and could over-expose national service providers, mechanisms that spread the risk across international reinsurance markets are needed. For instance, catastrophe bonds could provide opportunities to bind the necessary instruments to link world financiers with poor people, and this, together with corporate social responsibility and national social protection programs, maybe in partnership with private sector financial service providers, could be an effective way to assist the most exposed people to hazards in poor countries (DFID, 2004).

After the 1999 earthquake in Turkey, a Turkey Catastrophe Insurance Pool was established by the government to provide affordable insurance to homeowners in urban areas in order to share portions of the risk within the country and transfer other portions of the risk to international reinsurance. This showed that it is possible that governments and development organizations work proactively with the private sector to address market gaps in insurance coverage (ProVentium, 2009).

A national insurance pool like the one in Turkey is still not viable in low-income countries with little insurance infrastructure and where households cannot afford anything but minimal costs. In those cases, microinsurance instruments are also emerging to indemnify losses from catastrophic natural disaster risks. For instance, in the coast of Andhra Pradesh in India, microinsurance services are provided since 2004 as part of a disaster preparedness program to vulnerable families by a profit-oriented, but publicly owned insurer. This type of partnership between insurers and NGOs, sustained by the regulatory authorities and local volunteers, proved to be successful in providing disaster cover (Linnerooth-Bayer & Mechler, 2007).

At the community level, microinsurance has also emerged as a potential solution for poor communities to have access to insurance coverage and post-disaster financial resources, allowing in this way the poor to protect their assets and retain their financial gains if a disaster occurs (ProVentioum, 2009).

Nonetheless, the potential benefits of extended partnerships to provide disaster safety nets still face some challenges in improving affordable disaster insurance. Those challenges include the problems of estimating risks, the requirement of stable institutional settings, and the need of supporting systems without crowding out the private market or reducing incentives for preventing disaster losses (Linnerooth-Bayer & Mechler, 2007).

4.1.2. Response phase

In case a landslide takes place, the response phase aims to reduce to the maximum the damages to people's live and satisfy basic needs. During emergency management activities, the organizations that provide first aid have to apply suitable and organizational procedures and logistics of the managers in charge of technical rescue in order to save the highest numbers of human lives involved in a landslide (Longoni & Papini, 2008).

An effective emergency management system includes:

- Committees for disaster relief assistance that can be established immediately in case of a landslide;
- Good communication facilities and access to roads to deliver immediate assistance;
- Search and rescue procedures established;
- Fast-training kits for actors at local level;
- Establishment of systems to regulate that compensation procedures are transparent;
- Establishment of mechanisms for recording and reporting disaster losses and damages caused by the landslide; and
- Availability of national and international assistance for emergency response.

Emergency measures to prevent secondary displacement of soil mass are also necessary to consider within the response phase. For the security of the inhabitants, a monitoring system and an information transfer system is needed for evacuation of inhabitants in case of a recurrent event (Marui, 2008).

More advanced approaches on emergency management also focus their efforts on defining operative and technological instruments which should provide real support to managers when conducting the first emergency operations in case of a landslide. This approach stresses the importance of developing procedures, technical solutions and decision support systems that allow decision makers to provide prompt responses and effective coordination of all the actors within the Civil Defense System in a way that it can contribute to ensure efficiency during operations (Longoni & Papini, 2008).

4.1.3. Post-disaster phase

Recent catastrophic events demonstrate the importance of post-disaster and sustainable relief interventions to mitigate and recover from crises as well as to prevent lapsing back into crisis by ensuring a longer term developmental strategy (UN-Habitat, 2003b).

a. Relief operations and rehabilitation

When natural disasters such as landslides occur, human settlements, people and property are among the most affected. For that reason, post-disaster responses consider, in addition to meeting urgent human needs, the physical infrastructure and human settlement problems that arise (UN-Habitat, 2003b).

In that context, post-disaster responses are characterized by rapid rehabilitation projects, such as water and sanitation, housing, irrigation, food-security measures and health, not really linked to the overall long-term development objectives. This situation, beside of aggravating the precarious social conditions by creating dependency on aid, also represent a waste of financial and human resources invested in short-sighted emergency relief (UN-Habitat, 2003b).

Beyond the physical aspects of rehabilitation, what is needed is a recovery process for sustainable development that offers the opportunity for the society to strengthen local organizational capacities and promote social safety nets to facilitate economic, social and physical development long after a disaster (UN-Habitat, 2003b).

b. Recovery and reconstruction process

A recovery processes for sustainable development refers to a process of long-term reconstruction, economic recovery, and restoring people's livelihoods. This process is one that continues for a longer time after the disaster, revisits past practices and rewrites policies affecting future development in disaster-prone areas in order to build the foundations for development (UN-Habitat, 2003b).

Post-disaster reconstruction is a complex process that tends to entail a cycle that includes assessment, planning, project development, implementation and monitoring, with the affected population at the center of the process (The World Bank & GFDRR, 2010).

Until the impact of a disaster is assessed, no systematic response can be mobilized. For that, assessment is one of the most powerful tools in the reconstruction process. Assessments allow the establishment of the extent of post-disaster damage, loss and needs. In general, early rapid assessments have to be undertaken and then followed by more detailed, sector-specific assessments. Detailed housing condition assessments are needed to estimate the total cost of reconstruction and to allocate resources. In addition, the assessments have to be focus on consultation with affected people, the particular needs of different groups, their working efforts and willingness to participate (The World Bank & GFDRR, 2010).

Once the impacts of a disaster are known and quantified, reconstruction planning can begin. Defining an integrated reconstruction policy and strategy to guide reconstruction programs is a key point. The reconstruction policy is pivotal because it establishes the expectations of the affected communities and provides the framework for intervention (The World Bank & GFDRR, 2010).

Long-term reconstruction involves the following aspects:

- Establishing an institutional strategy in which relevant stakeholders from key sectors are identified and coordinate their actions.
- Establishing a financial strategy which estimates reconstruction costs, mobilizes financial resources, defines and implements housing schemes, and establishes financial management systems. In the case of housing assistance schemes, decisions regarding eligibility criteria and housing assistance have to be clear and established and then objectively applied. When post-disaster housing assistance is being allocated, policy makers have to address issues such as who gets a house, what type of house solution can they receive, and how much housing assistance will they receive.
- Promoting community participation in order to carry out consultation with affected communities and establish collaboration.
- Establishing a reconstruction approach to define reconstruction approaches, relocation requirements, and land use, and planning measures. For instance, a building-back-better approach encourages to build development into post-disaster work and to consider the extent to which development pathways led to the accumulation of risk and eventual disaster event, and the opportunities to build reduction into reconstruction.
- Establishing risk management to set up measures of environmental risk management and disaster risk reduction in reconstruction.

In general terms, the post-disaster phase is not about just responding to disasters, but it's about working with communities and governments to ensure that lives and livelihoods are better protected in case of another disaster (The World Bank & GFDRR, 2010).

4.2. The role of governance

As it can be seen from the previous section, landslide risk management is a complex task and it is unlikely that a single organization will be working in all of the relevant areas. Rather, it is more likely that one organization will want to build on its existing strengths and consider the support of other organizations to complement its own work. For instance, an organization with expertise in risk identification might want to make sure that the results of its work are shared and applied; therefore, it may want to become involved in public information work and early warning systems (Twigg, 2007).

This type of interaction between different actors and the processes for decision-making are part of the governance structure and represents a crosscutting theme that includes planning, regulation, integration, institutional systems, partnerships and accountability, issues that can affect any initiative in landslide risk management and reduction (Twigg, 2007).

Several studies have focused on what is needed to deal with the problem of managing urban land prone to disasters and integrating disasters and settlement development. There is the need to root the understanding of the factors underlying landslide disaster risk in local contexts and the need to create a locally owned process of risk identification and reduction at the local level with the involvement of all relevant actors. This highlights the importance of governance for reducing disaster risk by which different stakeholders and policy makers interact, mainly the state, with a strong political commitment, the civil society, with a strong multi-stakeholder participation, and the private sector involvement.

In terms of the public sector, landslide risk reduction needs to be a national and local priority, and commitment as well as accountability from public authorities at all levels is required in order to achieve implementation of risk reduction policies and actions (UN/ISDR, 2004). A planning and regulatory framework that proactively facilitates access to safe land, housing, infrastructure and services for the urban poor that also provides secure land tenure can help build more resilient cities (UN/ISDR, 2009). In this way, countries or cities must develop or modify policies, laws, and organizational arrangements to integrate disaster risk reduction into development planning (UN/ISDR, 2005).

For this to be accomplished, landslide risk reduction approaches require the political will to intervene and to invest in land with a long-term sustainable objective. Enhancement of the public and administrative sector to deal with urban land by coordination between different departments involved, and re-evaluation of building codes, regulations and standards is imperative (El-Masri & Tipple, 2002). In the same way, the establishment of efficient linkages between major policy fields, such as housing, land management and spatial planning for informal settlement policy interventions, needs to be part of an integrated national strategy, to solve multi-sectoral and multi-level issues that influence the quality of life of people (Gumpta & Sharma; 1999; El-Masri & Tipple, 2002). In this sense, the involvement of a wide range of urban government divisions and departments, as well as many governmental agencies that work within sub-city or municipal levels and at a higher level, such as provincial and national is needed (Dodman, 2009).

But risk management and reduction is beyond the capacity of governments alone. Involvement of the private sector has shown to play a role in the reduction of disaster risk, particularly in the context of informal urban expansion processes. Some successful programs place a strong emphasis in improving the quantity and quality of housing for low-income groups with the support of financial instruments and partnerships with the private sector that can favor the urban poor (Budds, et al. 2005).

Practices based on microfinance, micro insurance and catastrophe financing can increase resilience in urban areas and can help avoid the translation of disaster impacts into poverty outcomes. In this way, by generating higher incomes from a different range of sources, individuals have a better chance of reducing risks by gaining access to safer housing in safer location, accumulating assets, and protecting assets at risk through insurance (UN/ISDR, 2009). In this sense, the planning and regulatory framework and infrastructure investments provided by municipal governments can profoundly influence the scope and location of all other private investors who are looking for land where to build. These investors vary from large enterprises to small informal entrepreneurs and from large property developers to low-income households.

Up to here it is clear that local governments play a key role and this is supported by the private sector; nonetheless communities are the ones that finally balance the proposed measures against criteria such as necessity, effectiveness and affordability. Consequently, the implementation of risk reduction measures requires a grassroots approach whereby the societies at risk are fully informed and participate in risk management initiatives. Participation of local communities is crucial both for understanding local needs and empowering people to address those needs as well as to send a message to local communities that their voice is valued. A participatory planning approach involving consultation with the people concerned, gives legitimacy and support to the decisions made, and increases the chances of mobilizing the community, its cooperation and its responsibility (El-Masri & Tipple, 2002).

The notion of rights and responsibilities is important; while people have the right to feel protected in their communities, they also need to be aware of their shared responsibility to protect themselves (Lewis & Mioch, 2005). Competent and accountable governance structures in partnership with an active civil society can help develop innovative solutions (UN/ISDR, 2009).

This governance scenario shows that the political and economic institutions have important consequences for disaster management programming, as well as factors related to the capacity of relevant individual actors and organizations that come into play when policies are to be implemented (Ahrens and Rudolph, 2006).

4.3. The role of institutional and community capacities

Disasters are linked not only to hazardous events but also to the vulnerabilities of the exposed elements and capacities within the society to cope with them. Communities do not exist in isolation. Communities' resilience is influenced not only by their own capacities, but also by capacities outside the community such as emergency management service, social and administrative services, public infrastructure and a web of socio-economic and political linkages with the wider world (Twigg, 2007). These outside capacities are the institutional capacities and represent the enabling environment. Therefore, institutional and community capacities are required to systematically build resilience (UN/ISDR, 2007).

Lebel and collaborators (2006) developed a framework for assessing four classes of institutional capacities and practices for effective DRM: the capacity for deliberation and negotiation to ensure that interests of socially vulnerable groups are represented; the capacity to mobilize and coordinate resources for prevention and response actions; the capacity to transform potential action into implementation; and the capacity to evaluate for continual improvement, adaptive course correction and learning from key actors.

In the same line, Tompkins and collaborators (2008) identified four critical factors that have led to risk reduction in two climate vulnerable areas: flexible, learning-base, responsive governance; committed, reform-minded and politically active actors; disaster risk reduction integrated into other social and economic policy processes; and a long-term commitment to managing risks. If disaster management does not address the fundamental causes of

vulnerability, then people living in hazard-prone areas are able to cope in the short-term, but are left in poverty and at risk in the longer-term. In this context, the adoption of good governance mechanisms, which include stakeholder participation, access to knowledge, accountability and transparency, in disaster risk reduction policy, can create the policy environment conductive to build long-term adaptive capacity to climate-driven impacts.

Another study by Bollin and collaborators (2003) on risk management by communities and local governments in Latin America and the Caribbean identified the capacities required to manage risks at the national, sub-national and local level. Those capacities include: organizational capacity to design institutional strategies and structures with clear definition of functions and responsibilities of each actor and to control how resources will be used; cooperation and coordination capacity to combine local efforts with regional and national policies, and policies of other localities through mechanisms of communication and the exchange of experiences and information; integration capacity to integrate risk management into development processes of sectorial policies; communication capacity to raise awareness of decision-makers, promote a culture of prevention in the society, exchange systematized knowledge and experiences; capacity to involve the public to participate; compliance, monitoring and evaluation capacity; and capacity to support and promote continual capacity building.

There is not yet clear what institutional and community capacities are the ones that make the difference between the occurrence of a landslide event and a landslide disaster. Based on the literature reviewed some of the most important capacities are classified here in 6 major areas:

a. Coordination and organization capacity

As one of the main problems to confront risks is the overlapping of functions between different governmental and non-governmental agencies and stakeholder groups at national, regional, municipal and community level that do not coordinate adequately and can lead to avoidance for any of their responsibilities, there are challenges for coordination and assigning responsibilities in DRM.

One of the indicators of high institutional capacity is to have an organizational capacity to clearly defined roles, functions, and responsibilities among all actors involved in DRM. A clear understanding of the institutionalized operations and their practice is needed to avoid overlapping and make sure that societies' response is appropriate to the risk. Therefore, designing and executing programs and policies addressed to reduce the underlying causes of vulnerability requires the capacity to coordinate across different governmental and non governmental agencies, as well as between authorities and the public. Coordination must be both horizontal and vertical because the local level is a subset of the global and therefore it establishes close relationships with other regional levels. At the same time, activities have to be coordinated across all the phases of the DRM cycle to link or transfer responsibilities and budgets for programs over time (Bollin et.al., 2003; Lebel et. al., 2006)

Coordination is also essential in regards to resource allocation as a major issue of DRM to have sources of funding available to implement measures. Often the problem is not in the deficit of

domestic finance but in how to mobilize and channel existing resources and avoid misuse of funds allocated (APN, 2005). In this context, capacities to mobilize and coordinate effectively resources when are where they are needed is crucial in all phases of the DRM cycle (Lebel et al., 2006).

A final aspect within the coordination capacity is coordination and cooperation between the public and private sector which allows more secure and diverse funds for disaster risk management. DRM systems need to have the capacity to explore the opportunities of other sources of financing, such as micro-finance and insurance, and therefore connectivity, networks and the development of partnerships is relevant.

b. Public involvement and commitment capacity

Studies have revealed that there is a self-serving belief that disaster management is a technical problem that only needs expert judgment and therefore systematically excludes the interests of the most socially vulnerable groups (Lebel et al., 2006). Effective DRM requires that the interests of vulnerable groups are represented. However, it is not enough that the interest of various stakeholders are represented, but DRM systems need to have the capacity to open channels for public participation and deliberation by which vulnerable and marginalized groups can benefit and have advantages from the programs and policies aimed at reducing risks of landslides disasters.

Public participation is a very important aspect because it has implications for the level of downward accountability, credibility and legitimacy. Accountability is the means to more open, transparent and responsive institutions. It increases trust in public institutions that would otherwise hinder the ability to implement DRM measures. When there is lack of trust in public institutions, warnings to prepare and evacuate can go unheeded by local authorities and the population (Lebel et al., 2006).

In general, actions within DRM are much more likely to be followed-up and implemented if there is a significant group of stakeholders involved, who have a sense of ownership and responsibility for them (Lebel et al., 2006). Hence, consolidation of community capacities that allow wide participation of stakeholders in decision-making process, planning and implementation phases is a challenge for DRM systems.

Community members have therefore a catalytic part to play in DRM programs as they can help raise awareness of landslide management issues in their own and other communities. People are often the subject of development rather than active participants in the process. For improvements to be achieved and sustained, community members must become empowered through the development process (Anderson & Holcombe, 2008).

The level of commitment of the stakeholders is crucial for successfully managing disaster risk. Committed and politically active actors in the public and private sectors give credibility and political feasibility to DRM and are therefore supported by the population.

c. Information and communication capacity

Communication is essential to raise awareness of decision-makers and promote a culture of prevention in the society. Access to information, incorporation of local knowledge and scientific information, systematization of that information and of experiences need to be exchanged between other sectors for efficient and effective decision-making as well as to promote attitudes of prevention and self-responsibility among all actors. Establishing adequate mechanisms of communication and exchange of information and experiences allows better coordination between local efforts, regional and national policies, and policies of other localities. This implies knowledge transfer of the factors that generate risks and the elements and instruments to reduce them, as well as of the stakeholders that are working towards common objectives, to all relevant actors of the DRM systems.

d. Integration capacity

It has been shown by several authors that there is a failure to integrate DRR into development planning. Bollin and collaborators (2003) determined that the capacity to integrate the focus of risk management into development processes as a cross-cutting theme into sectorial policies is still low in many countries in Latin America and the Caribbean. In this sense, good performance of risk reduction can be negatively affected by factors beyond the scope of the competence and control of DRM systems and that is why DRM has to be integrated into other social and economic policy processes and sectors related to land-use patterns, land-cover change, urbanization, and settlement development planning.

In this way, the response for disaster risks and disasters is much better fit to the changing nature of social disasters beyond the physical hazard causing them. As Tompkins and collaborators (2008) argue, in order to shift the vulnerable and poor out of the conditions that define their long-term vulnerability, disaster risk interventions need to be effectively coupled with other policy interventions to promote synergies between existing disaster response strategies and policies that address the structural inequalities at the root of socio-environmental vulnerabilities are addressed.

e. Implementation, monitoring and evaluation capacity

Effective planning and coordination among different actors has no sense if the potential actions cannot be transformed into actual practice, and therefore be implemented. Institutionalized capacities to effectively use resources and execute actions require several different kinds of measures to implement them during all the phases of the DRM cycle, not only after a disaster has taken place (Lebel et al., 2006).

Vigilance in the application of local and national regulations is necessary to prevent the generation of new risks. At the same time, the performance of DRM systems, programs, policies and measures implemented needs to be monitored and evaluated so that there are opportunities to learn, improve and adjust.

f. Adaptive capacity

Because there are many uncertainties about knowing when, where and how disasters will occur, it is important that DRM systems have the capacity to be flexible, adaptive, able to learn (learning-based institutions) form past success or failure, to responsively reshape their structures as necessary to deliver positive disaster management processes and outcomes (Tompkins et al. 2008). If there are institutionalized evaluation and monitoring procedures for DRM systems, then there needs to be room for improvements in performance and adjustments, and that is why flexibility and the capacity for current arrangements to foster learning is important. The ability of DRM systems to bend and learn through experience shows its ability to manage crises more effectively and efficiently. Furthermore, the importance of institutionalized support for continual capacity building is necessary to adjust and improve.

From this literature review of the elements that constitute an effective landslide risk management and the institutional and community capacities that are believed to make the difference between the occurrence of a landslide event and a landslide disaster, a methodology was developed to test the hypothesis that if certain institutional and community capacities are in place to deliver an effective landslide risk management, then the resilience of communities to landslides is increased. This methodology is explained in the next chapter.

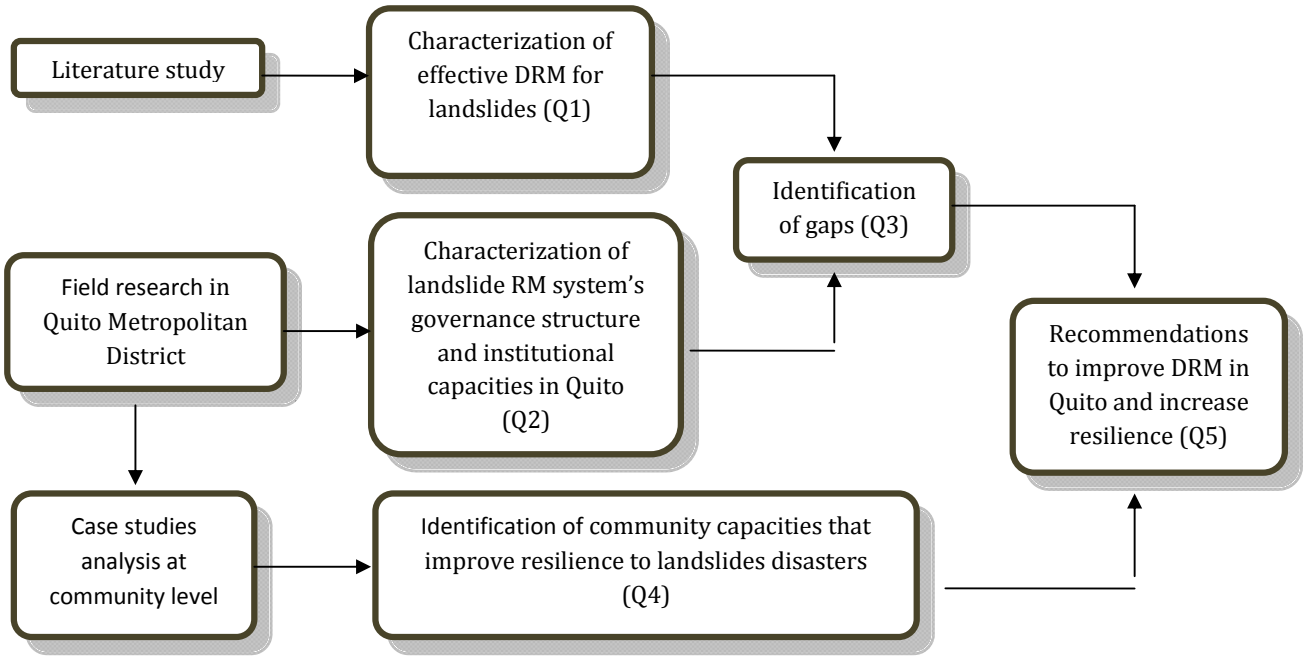
CHAPTER 5: RESEARCH METHODOLOGY

The methodology applied for the research and described in the following lines is based on techniques of empirical social research that include data collection techniques, such as interviews and surveys.

Figure 11 describes the process of the research to answer the questions presented in the introduction:

1. What characterizes an effective landslide risk management?
2. Which elements characterize the governance structure and institutional capacities of landslide risk management system in Quito Metropolitan District?
3. Are there gaps between what is defined as "effective landslide risk management" and landslide risk management in Quito Metropolitan District?
4. To what extend does community capacities make the difference between the occurrence of a landslide or a landslide disaster at a community level?
5. How can landslide risk management in Quito Metropolitan District be strengthened to maximize its performance and increase resilience of communities to landslides?

Figure 11 Research process



5.1. Collection of bibliographic information to develop indicators

The first phase of the research included collection of bibliographic information to develop a set of indicators to:

1. Determine relevant mechanisms and processes that influence key issues for DRM in order to characterize the landslide risk management system in Quito;
2. Perform an institutional assessment of the identified landslide risk management system in order to describe the governance structure and to determine which institutional capacities define an effective landslide risk management system; and
3. Perform a landslide risk management assessment at the community level to determine which community capacities make the difference between a landslide event and a landslide disaster.

5.1.1. Key issues for DRM

The first indicators developed were meant to identify the institutions, organizations and actors involved in key issues for DRM with main responsibilities and supporting roles. These indicators were divided according to the 7 phases of the DRM cycle presented in Chapter 4. Those phases include: risk identification, prevention, mitigation, preparedness, response, recovery and reconstruction. These indicators are presented in Annex 1.

5.1.2. Institutional assessment of the landslide risk management system

The second set of indicators was developed to analyze and measure the level of performance of the landslide risk management system and the institutional capacities in place. Each of the indicators has a different number of sub-indicators valued according to four performance levels that range from 1 to 4:

1. Low: Performance is low or nonexistent.
2. Emerging: Performance is insufficient for the existing level of risk, but is emerging.
3. Significant: Performance is adequate, but with some restrictions
4. Optimal: Performance is outstanding, innovating and creative.

For the dependent variable of landslide risk management the indicators quantify three composite categories: risk identification, risk reduction, and emergency preparedness/disaster management. The indicators and sub-indicators are present here and the criteria to determine the level of performance is presented in Annex 2.

Indicator 1: Landslide risk identification (LRI)

- Sub-indicator 1: Systematic disaster and loss inventory (LRI1)
- Sub-indicator 2: Landslide monitoring and forecasting (LRI2)
- Sub-indicator 3: Landslide evaluation and mapping (LRI3)
- Sub-indicator 4: Landslide risk and vulnerability assessment (LRI4)

Indicator 2: Landslide risk reduction (LRRI)

- Sub-indicator 1: Landslide risk consideration in land use and urban planning (LRRI1)
- Sub-indicator 2: Hydrographic basin intervention and environmental protection (LRRI2)
- Sub-indicator 3: Implementation of landslide-event control and protection techniques (LRRI3)
- Sub-indicator 4: Housing improvement and human settlement relocation from landslide prone-areas (LRRI4)
- Sub-indicator 5: Application of safety standards and construction codes (LRRI5)
- Sub-indicator 6: Reinforcement of public and private assets (LRRI6)
- Sub-indicator 7: Insurance and reinsurance coverage and loss transfer strategies of public assets, housing and the private sector (LRRI7)

Indicator 3: Emergency preparedness and disaster management (EPDMI)

- Sub-indicator 1: Organization and coordination of emergency operations (EPDMI1)
- Sub-indicator 2: Emergency response planning and implementation of warning systems (EPDMI2)
- Sub-indicator 3: Endowment of equipments, tools and infrastructure (EPDMI3)
- Sub-indicator 4: Simulations, updating and test of inter institutional response (EPDMI4)
- Sub-indicator 5: Rehabilitation and reconstruction planning (EPDMI5)
- Sub-indicator 6: Implementation of social safety nets and funds response (EPDMI6)

For the independent variable of institutional capacities, the indicators considered were those that allow the creation of an enabling environment conductive to manage and reduce landslide risk as well as to facilitate and support resilience development. The indicators for this variable are presented here, and the criteria to determine their level of performance are presented in Annex 3.

Institutional capacity (ICI)

- Indicator 1: Landslide risk management system organization (ICI1)
- Indicator 2: Coordination between the different actors of the landslide risk management system (ICI2)
- Indicator 3: Integration of landslide risk management approach in other sectors (ICI3)
- Indicator 4: Budget allocation and mobilization (ICI4)
- Indicator 5: Cooperation and support to manage landslide risk (ICI5)
- Indicator 6: Public participation and accountability (ICI6)
- Indicator 7: Education and strengthening in landslide risk management (ICI7)
- Indicator 8: Community training and awareness (ICI8)
- Indicator 9: Information and communication management (ICI9)
- Indicator 10: Implementation, monitoring and evaluation (ICI10)

5.1.3. Community capacities in landslide risk management resilience

For the last part of the research, two types of indicators were also developed to test the hypothesis that if certain community capacities are in place to enhance an effective landslide

risk management, then the resilience of communities to landslides is increased. These indicators are similar to the previous ones with the difference that they are focused on a community level. In this sense, there is the dependent variable for landslide risk management and the independent variable for community capacities. Each indicator is also valued according to the same four performance levels.

On the one hand, the landslide risk management variable includes four indicators presented here, and the criteria to determine their level of performance are presented in Annex 4.

Community landslide risk management

- Indicator 1: Risk consideration in land use and construction (LRM1)
- Indicator 2: Mitigation and risk reduction measures implementation (LRM2)
- Indicator 3: Emergency preparedness and disaster management (LRM3)
- Indicator 4: Recovery (LRM4)

On the other hand, the community capacity indicators are those that allow the development of a culture of prevention and security in a community in such a way that the efforts are driven to reduce landslide risk in the long term and the capacity to manage risks is improved. These indicators are presented here, and criteria to determine the level of performance are presented in Annex 5.

Community capacity (CCI)

- Indicator 1: Community organization (CCI1)
- Indicator 2: Community training in landslide risk reduction and management (CCI2)
- Indicator 3: Access to risk and risk management information (CCI3)
- Indicator 4: Public awareness (CCI4)
- Indicator 5: Responsibility and commitment in regards to landslide risk reduction (CCI5)
- Indicator 6: Community participation and involvement in landslide risk management (CCI6)
- Indicator 7: Coordination among different local actors (CCI7)

5.2. Gathering information to describe the governance structure and characterize the landslide risk management in QMD

Part of the field research in Quito Metropolitan District included a diagnostic study at the municipal level to explore the overall landslide risk management system. This phase included the following steps:

First, an initial preparation included the collection of information about the city landslide context and the existing risk management systems. This was done by means of meetings with the representatives of the District focal point in charge of DRM as well as with representatives of sectorial departments, such as land use and urban planning, professional staff in relevant district-level programs and projects, representatives of organizations and the private sector. Collection and review of documents, mandates, policies, DRM programs and project reports was also undertaken.

Second, key organizations, actors and stakeholders involved in the DRM systems at various levels (state organizations, non-governmental organizations, community based organizations, civil society organizations, cooperative society groups, private sector) were identified according to the first indicators developed. This information was organized in a monitoring sheet of the key processes and relevant actors presented in Annex 6.

Third, a landslide risk management institutional assessment process proceeded once the key actors involved were identified. The purpose of this assessment was to determine the primary roles and functions of various organizations at different levels by disaster risk management elements, that is, by all the different phases of the disaster risk management cycle. The assessment was determined specifically for landslide events.

The methodology used at this level, included open and semi-structured interviews with selected key informants that, in one way or another, were previously identified as having a role in this regard. Annex 7 presents all the interview formats developed specifically for each stakeholder. To keep track of the information generated in the institutional assessment, a summary chart of the different organizations involved in landslide risk management at the city level was produced, indicating their roles and responsibilities. This will be presented in the results.

The final phase of this section included the data analysis to integrate and structure the information collected during the institutional assessment in order to present a scenario of the key organizations, their responsibilities and regulatory frameworks that characterize landslide risk management practices in Quito Metropolitan District. In addition the level of landslide risk management performance was measured using the landslide risk management indicators presented previously as well as the institutional capacities of the landslide risk management system. This part of the analysis included an analytical process to identify and analyze the strengths and weaknesses of the assessed DRM system.

5.3. Gathering information to identify community capacities for landslide risk management

In order to identify and test the community capacities theorized to be among the most influential determinants of resilience, case-study analysis at a community level was the second part of the field research. For this analysis, the resilience to landslides at the community level was considered as the dependent variable assessed using the community landslide risk management indicators explained previously. The level of resilience was then analyzed in relation to the community capacities, which represent the independent variables, and which were assessed using the community indicators. This part of the study was supported by surveys[1] developed to qualify each of the indicators for both, the dependent and independent variables applied to a representative part (sample) of QMD population (universe).

1 The Urban Risk Reduction Program of the QMD Municipality supported institutionally, technically and economically the development and implementation of surveys in 150 neighborhoods of the capital city. This provided more accountability and willingness of the population to participate in the surveys.

5.3.1. The sample

The sampling framework consisted of a number of 150 communities or neighborhood selected form a total universe of 1156 neighborhoods belonging to the 8 Administrative Zones of QMD. The criteria for this selection was based on including neighborhoods that have both 1) been identified as having geomorphological risk and 2) registered landslide events in the past 5 years. The unit of analysis corresponded to the president or leader of each of the neighborhoods within the study area. In case the president was not able to participate, the vice-president or another member of the neighborhood commission was delegated to answer the survey. Annex 8 presents the list of neighborhoods according to each administrative zone.

Figure 12 shows a map of QMD in which the first criteria (geomorphological risk) is represented by colored areas and the second criteria (past occurrence of a landslide events) is represented by red dots. Neighborhoods that coincided with both of these criteria were chosen to be part of the study.

5.3.2. The surveys

The surveys were developed for the community leaders. The 51 questions of the survey allowed assessing the landslide risk management performance in each neighborhood as well as the community capacities in place, according to the indicators presented above. This survey is presented in Annex 9.

Once the survey was prepared, it was validated in the field. To validate the survey, 5 were applied randomly and with the results obtained from this field testing, some questions that were not clearly understood or too complicated for the community leaders were modified.

5.3.3. Surveys distribution

The field work to apply all the surveys lasted one month. A team of 7 interviewers was set up to apply the surveys. This team received training in order to clearly understand all of the questions of the survey, the sampling framework, the objectives, and in general obtain all the information that the community leaders may want to know. Once this team was established and ready, each of the 150 community leaders were contacted to arrange a date to visit the neighborhood and apply the survey. The surveys were applied under supervision, and after they were finalized, they were handed in and the information was reviewed together with the interviewers.

5.3.4. Data processing

Once the surveys were reviewed, each of the questions were codified and digitalized to create a data base in the Statistical Package for the Social Sciences Program (SPSS). This software package allowed processing statistically the data. Closed questions were considered as nominal variables. For instance in the question: “What is the status of legalization of your neighborhood?” the possible answers for this variable were four, obtaining the following information in the SPSS:

Table 2 Nominal variable data processing

Variable X	Frequency	Percentage
Legal	88	58,7
In process	44	29,3
Not legal	16	10,7
Other	2	1,3
Total	**150**	**100**

For open questions, the similar answers were unified to classify them as scale variables. For instance in the question: "What is your neighborhood doing to take care and protect the environment, the basins and the slopes?" the different answers were unified and classified in the 7 possible options, obtaining the following information in the SPSS:

Table 3 Scale variable data processing

Variable X	Frequency	Percentage
Raising awareness	14	9,3
Community work	7	4,7
Nothing	44	29,3
Structural works	1	0,7
Waste management and slope cleaning	34	22,7
Recycling	4	2,7
Reforestation, ecological protection	46	30,7
Total	**150**	**100**

From this information, a quantified description of how landslide risk is being managed by the community to determine the level of resilience of the community, and what some of the community's perceptions and capacities in place are in regards to landslide risk management.

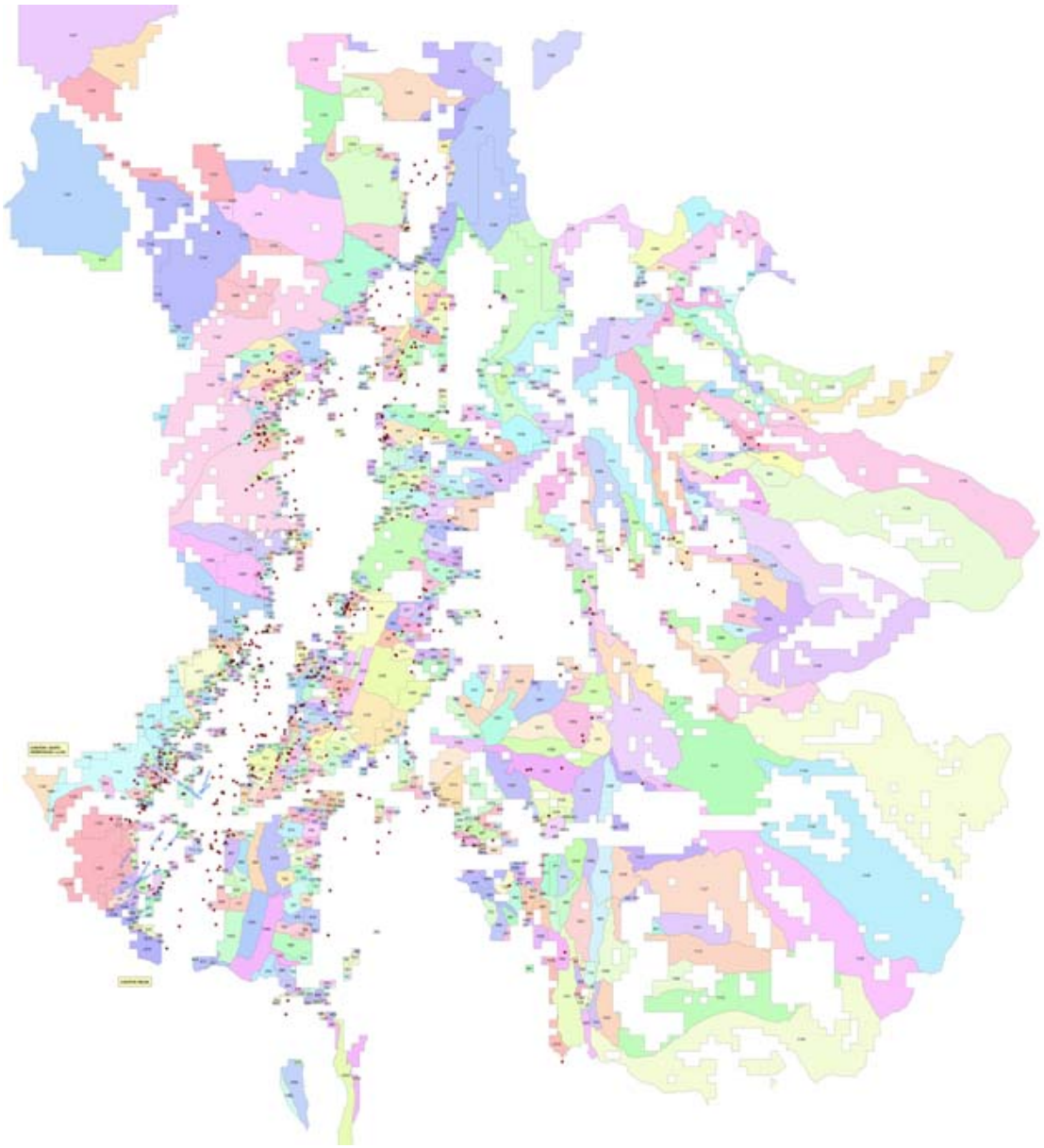
In addition, from all of the questions within the survey, specific questions were selected to calculate scores that influence landslide risk management and community capacities in accordance with the indicators developed. From those scores, different ranges were assigned which corresponded with the four levels of performance from 1 to 4. Also, variables that assign total scores for vulnerability, landslide risk management and community capacities were calculated.

From those scores and calculations, three procedures were carried out:

1) Construction of frequency tables of each of the variables corresponding with landslide risk management and community capacities.
2) A mean comparison analysis through the Variance Analysis (ANOVA). For this, the Administrative Zones were considered as the factors, and vulnerability, landslide risk management and community capacities as the dependent variables.
3) A regression analysis to define relation between the landslide risk management, defined as the dependent variable, and the community capacities, defined as the independent variable.

The outcomes allowed to provide recommendations in regards to the institutional and community capacities and practices that will increase the likelihood of improving the resilience of a community to landslide disasters in Quito Metropolitan District.

Figure 12 Neighborhoods selected for the research



Source: Own elaboration

CHAPTER 6: RESULTS AND DISCUSSION

This research collected information to characterize the current landslide risk management system implemented in Quito Metropolitan District and its governance structure in order to analyze and measure its level of performance as well as the institutional capacities in place. At the same time, a landslide risk management assessment at the community level was done in order to identify the community capacities that increase the likelihood of improving the resilience to landslide disasters. Throughout this chapter, besides presenting and discussing the results, some of the main opportunities and limitations found will also be reviewed.

The information has been organized in three parts: First, the governance structure of the landslide risk management system in Quito Metropolitan District is presented. Second, the level of performance of that system and of the institutional capacities is assessed in order to discuss the main limitations and opportunities. Third, the communities' characteristics and the way they manage landslide risk is presented in order to determine and discussed the level of performance of the community landslide risk management and their capacities to find out what makes the difference between a landslide event and a landslide disaster.

6.1. Landslide Risk Management System in QMD

6.1.1. Legal framework

The State Modernization Law of 1993 promotes decentralization and co participation for public management. In QMD the process of decentralization begun with the Quito Metropolitan District Regime Law through which the competences over land use policies were transferred to the Municipality. As such, the Municipality has privative and exclusive authority in the field of territorial and urban planning, and that is the responsibility of the Territorial Ordering and Public Participation Secretariat.

The current development and public policies model that the Municipality of Quito Metropolitan District is working on includes development planning as a strategic practice to manage the city. The adoption of this practice has allowed the formulation of a city project that incorporates risk and preventive planning and the definition of sectorial policies and plans that support territorial intervention in QMD.

The General Plan for Territorial Development

Since 2000, the General Plan for Territorial Development (Plan General de Desarrollo Territorial - PGDT) is the legal instrument for the Municipality to manage the territory and regulate a harmonic growth of the city (MDMQ. 2006). This PGDT (reviewed in 2006) incorporates the notion of risk reduction, sustainable use of land and safe territorial development with three complementary instruments that provide the legal framework for any land intervention in Quito: the Land Use and Occupation Plan (PUOS), the Land Regime Ordinance, and the Architecture and Urbanism Standards.

Within the reviewed PGDT, land is classified in three types:

- Urban land: This is land located inside the urban limit of the city, which is fully equipped with all basic services.
- Developable land: This is land that has partial infrastructure and is susceptible to be incorporated within the urban process from 2011. This zone of probable urban expansion respects the conservation and protection of green areas.
- Non developable land: This land is not for urban processes and it is intended to promote and guarantee a sustainable use of natural, agricultural and forest resources. This land constitutes ecological reserves of the city, agricultural land, forest belts o high-risk zones.

The Land Use and Occupation Plan (PUOS) allows land use for construction by setting specific standards and parameters for land use, occupation and division in order to favor a denser occupation. Within the PUOS, the categorization of ecological protection zones allowed for the first time to consider natural hazards into territorial ordering. Areas located on slopes higher than 30%, at risk sites, in ravine areas, or areas of landscape, historic, archeological and ecological value are considered as ecological protection zones and therefore they are not developable land.

The Land Regime Ordinance guides land occupation according to current regulations. This ordinance establishes the responsibilities of the municipal entities in relation to land use and occupation, and the rights and responsibilities of land owners and of the management mechanisms.

The Architecture and Urbanism Standards comprise the seismic provisions that specify the design forces and resistant requirements for the structures build in the city. They include the norms that all edification must comply in accordance with the Ecuadorian Code of Construction, a technical and normative document that establishes the guidelines and quality for construction.

Those standards incorporate an ordinance correspondent with slope management, which protects, regulates and conserves ravines and slopes from occupation and edification. For instance, it establishes that when one lot limits with a slope, the protection fringe has to be of 10 meters in horizontal length, less if the slope is less than 30º and its stability is demonstrated technically. It also established the parameter to manage slopes. For example, when the slope is not higher than 5 meters and it does not require a retaining wall, it should be covered by low vegetation and its higher part should be free of humidity.

6.1.2. Policy framework

From the formulation of the PDGT, and in the context of an institutional restructuring and incorporation of different actors form the civil society, several sectorial policies and plans have been formulated and are being implemented. Several of these policies promote the improvement of the population's quality of life and social-territorial unbalances in order to create and defend the public space, protect the environment and prevent disasters.

Land and housing to improve living conditions

The policies and interventions related with land and housing promote the expansion and improvement of housing living conditions in a dignified, safe and healthy way of Quito's population, particularly that of the most vulnerable social sectors. This implies the promotion and facilitation of urbanized land offer, and the provision, improvement and rehabilitation of housing located in a suitable and equipped living environment in a way that contributes to the integrated and balanced development of both, the population and the territory (MDMQ, 2006).

As such, there are policies of land and edification regularization which imply integrated regularization of neighborhood and edification tenure in the District. This promotes the incorporation of irregular settlements within the urban structure, beginning in that way a gradual process of regularization of those settlements and provision of infrastructure and services.

According to this, land regularization is limited to those settlements not located in ecological protection zones or high-risk zones such as steep slopes. This has to be correspondent with a progressive urbanization of social housing. There are also policies that promote new housing construction in order to open the offer of the market inside zones defined for social housing for people that cannot access housing in the formal market and that require public support.

The Neighborhood Regularization Program was established to solve the issue of land tenure in favor of the legal owners and to integrate the neighborhoods within the urban limit into the urban processes. Nothing located outside the limit of what is consider as urban land in the PGDT can be regularized or can have permission for construction. In order to regularize neighborhoods settled on developable land, a certain amount of years, according to the PDGT, are necessary for them to be incorporated.

The Neighborhood and Housing Upgrading Program was established in 2006 to improve the quality of life of families living in the poorest neighborhoods by supporting the municipal efforts to improve infrastructure, accessibility, basic services, and public space. This program includes three components:

- Housing upgrading: It consists of several activities to improve, repair or assure the structural stability and security; impermeability; installation of electricity, water, sewer and telephone network; and expansion of the houses.
- Housing relocation: In the case of houses located in unsafe areas or that have problems of land tenure, they are consider for relocation of the families involved. This is done by several mechanisms such as relocation to lots acquired by them and with the support of the municipality for self-construction, relocation to municipal lots, or relocation to housing units that have been negotiated and executed by social or private promoters.
- Neighborhood environment improvement: It implies communitarian actions to improve the environmental conditions of the surrounding areas in order to improve and preserve public spaces, adequate and conserve equipments, and implement security actions.

Infrastructure, basic services and environmental quality

A policy of provision of infrastructure and basic services constitutes the physical support for territorial development. The guidelines for this policy are focused on expanding the provision and improvement of the quality of infrastructure services; adapting the territory to the social demands, and meeting the needs of rural areas, among others. The main interventions include the provision of drinking water, the management of solid waste and residual water, and decontamination and recuperation of rivers and slopes.

There is an environmental policy which promotes QMD as a territory with optimal environmental quality and sustainable use of natural resources. For this, the protection of natural areas is promoted by the conservation, protection and impact mitigation in forests, micro basins, protected areas and ecological reserves through protection actions in the hydrographic micro basins, forestation and reforestation in rural and natural areas, and habilitation of metropolitan parks and natural reserves.

Risk prevention and emergency management

The revision of the PDGT (2006) also included risk prevention and emergency management policies in order to prepare QMD as a territory and population that prevents natural and anthropic risks. The main guidelines of this policy are:

- Reduce risk and prevent the population of the occurrence of natural and anthropic disasters.
- Create a Risk Prevention and Emergency Management System conceived as a municipal system of multisectorial, interinstitutional and multidisciplinary work.
- Increase leadership and institutional capacity to establish policies.
- Define clear competences between different state institutions working in the topic.
- Establish mechanisms of permanent education and training.
- Create a metropolitan fund for risk mitigation and emergency attention.
- Generate a culture of prevention.
- Strengthen research about risk and vulnerability as a strategy for risk reduction, improvement of preventive planning, and the establishment of a strategy for urban land use in risk zone management.

In 2010 the Security Agenda of QMD established the guidelines for 9 public security and risk management policies. Policies related with DRM are presented in the following table:

Table 4 Public security and risk management policies

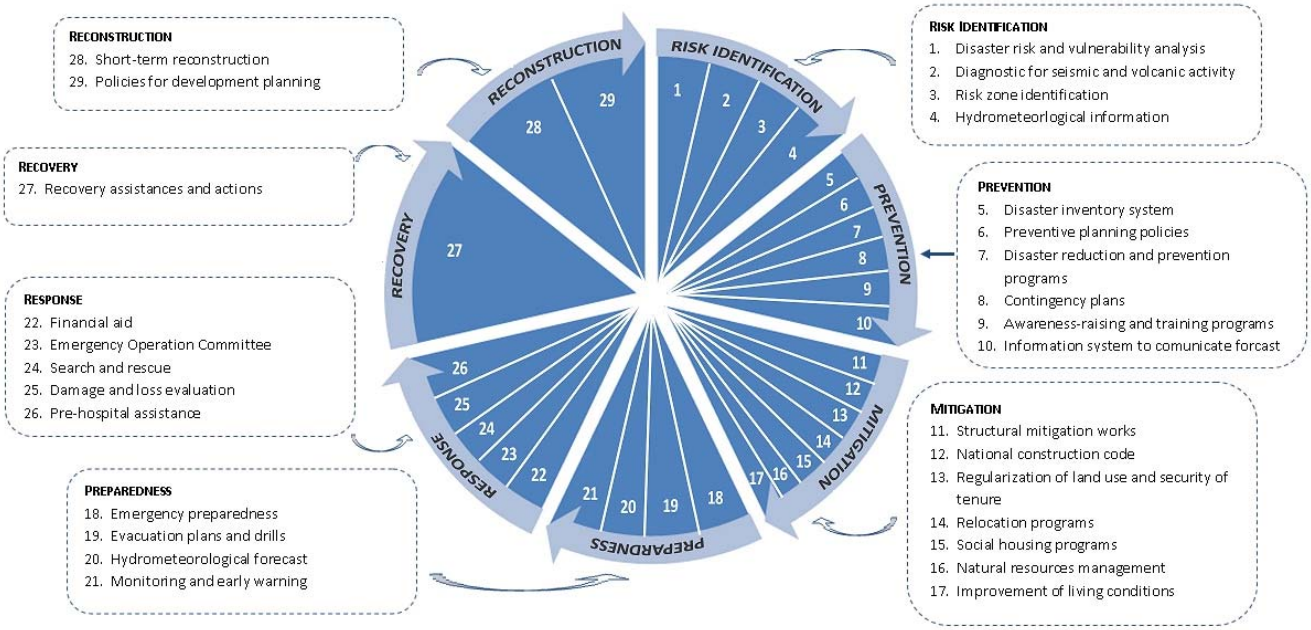
1. Specialized District Police	**1.1. Promote the conformation of a decentralized District Police for Quito.**
	1.2. Promote a quick, efficient and timely police for citizens' calls.
	1.3. Promote an efficient work of the Judicial Police for public security in MQD.
2. Emergency Management System	2.1. Strengthen the institutionalism of the Interinstitutional Committee of Medical Emergency Network (CIREM).
	2.2. Improve the operative capacity and resources for a timely and efficient pre-hospital care.

	2.3. Optimize users' access to the Metropolitan Central of Citizen Assistance.
3. Public Participation for Security	3.1. Promote active public participation for public security.
	3.2. Guarantee that citizenship is a proactive element in security management in QMD through programs and training on self-protection.
4. Natural and Anthropic Risk Prevention	4.1. Drive and assume risk management as a cross cutting discipline in QMD territorial planning and development.
	4.2. Develop a culture of prevention and population preparedness in case of natural and anthropic risks.
	4.3. Protect the population and the territory from adverse events that may occur due to natural, anthropic or technical origin.
	4.4. Form a Municipal Risk Management System with human, technical and financial capacities.

6.1.3. Institutional framework of landslide risk management

In order to characterize the landslide risk management system operating in QMD, the main institutions and actors involved during the pre- and post-disaster activities were identified. In this way, for each of the seven phases of the DRM cycle (risk identification, prevention, mitigation, preparedness, response, recovery and reconstruction), these institutions and actors, together with their roles and responsibilities were assessed. They are briefly presented in the figure 13 and 14, and a summary chart of this information is available in Annex 10.

Figure 13 DRM activities



Source: Own elaboration

Figure 14 Main institutions involved in DRM

Source: Own elaboration

In QMD risk management is dispersed in different levels and entities of the institutional structure of the Municipality, as it will be seen in the following lines. However it is important to mention that there is a Risk Management Unit attached to the Security and Governance Secretariat, which has resources from a public security tax, and is in charge of:

- Supporting the formulation of policies oriented to natural risk prevention.
- Elaborating contingency plans for the different geographical settings in order to reduce the level of risk by reducing its effects and increasing the response capacity.
- Defining risk zones, potential effects, evacuation plans.
- Elaborating operational procedures for different scenarios as well as community organization programs in case of a hazardous event.
- Evaluating and monitoring risk and establishing physical mitigation measures.
- Undertaking research and socio-economic studies of the possible risk areas.

In the same way, there is the Territorial Coordination and Public Participation Secretarial in charge of territorial management which, as it was explained previously, generates a number of instruments with a preventive approach for land use and occupation. Within this Secretariat is the Irregular Neighborhoods Unit in charge of regularizing land use and providing security of tenure. There is also the Land, Habitat and Housing Secretariat where the Land and Housing Unit takes a role in relation to housing policies.

Furthermore, within the institutional structure of the MQMD there are several actions that contribute to risk prevention and mitigation developed by some metropolitan Enterprises, such as The Metropolitan Enterprise of Sewer and Drinking Water (Empresa Metropolitana de Alcantarillado y Agua Potable - EMAAP-Q), the Cleaning Metropolitan Enterprise (Empresa Metropolitana de Aseo (EMASEO), the Metropolitan Enterprise of Public Works (Empresa Metropolitana de Obras Públicas – EMOP), the Electric Enterprise of Quito (EEQ), the Metropolitan Housing Enterprise, and the Urban Development Enterprise of Quito.

To complete an integrated vision of the institutional framework, other state institutions, international organisms, private organizations, civil society organizations as well as citizen networks, have been identified to contribute in one way or another to the risk management system in QMD, as it will be seen throughout this analysis.

a. Risk identification: the first step to develop risk management strategies

From the point of view of a DRM approach, the first thing is to know what the risks are in order to take action based on that knowledge. The main institutions that produce knowledge related with risk identification are few. The most important state institutions are the Geophysical Institute of the National Polytechnic School (IG-EPN) and the National Institute of Meteorology and Hydrology (INAMHI).

The IG-EPN is the national reference for the diagnostic and monitoring of seismic and volcanic activities. It is in charge of reducing the impact of these two events in the country through permanent monitoring, scientific research and applied technology. Some of the information that has been produced is related with volcanic risk mapping, earthquake damage and impact scenarios, seismic zoning, and implementation of monitoring and early warning systems at the national level for volcanic eruptions and seismic activities.

On the other hand, the INAMHI is in charge of providing information about the weather, climate and hydrological resources at the national level through the use of science and technology. This information is important to understand processes related with flooding, landslide and mudflows and to produce early warnings.

Of additional importance are some international research institutions that have provided a significant knowledge in relation to disaster risk and vulnerability. Among those institutions is the Research Institution for Development (IRD), and the Expert Mission of the Italian Geothermic, both of which have conducted and developed research and projects in collaboration with local counterparts such as the MQMD, the EMAAP-Q, the INAMHI and the IG-EPN.

At the end of the 80s faced with the problem of rapid urban expansion, difficult to control, a research program began in Quito with the participation of several institutions and the Municipality. The objective was to develop and use geographic information systems (GIS) to regulate urban growth. Thanks to this, in 1992 an infographic atlas of Quito was published which until now serves as a reference of the city in regards to natural characteristics, risks, public services, population and urban growth dynamics, and housing , neighborhoods and mobilization characterization.

During the 90s, as part of the support for the International Decade of Natural Disaster Prevention, some projects about earthquakes were conducted. For instance, the "Global Earthquake Safety Initiative" (GESI) was developed in 21 cities with the objective of developing a method to quantify disaster damage and losses in order to generate awareness for risk reduction. In the same line, the "Earthquake Megacity Initiative" (EMI) had the objective of facilitating access to scientific information related to natural hazards in some cities around the world in order to improve response.

In relation to generating hydrometeorological information, an important project began in 1996. This was in collaboration with the EMAAP-Q, the IRD and the INAMHI all of which, due to the necessity of solving the flooding and landslide problems, decided to conduct a Hydrological Forecast System at the Pichincha Slopes and the Metropolitan Area of Quito (SISHILAD). This project had an observation and monitoring network composed of several meteorological stations for the Metropolitan District.

During the last 15 years, the MQMD, through its risk reduction policy, has promoted significant technical and scientific knowledge production related to hazards, vulnerabilities and risks. A research program between the Planning and Territory Metropolitan Direction of the MQMD and the IRD took place between the years 1999 and 2004. This research focused on developing an Information System of the Essential Elements at Risk and Mobility in QMD with the objective of improving the understanding of vulnerability and risk in the city, developing methodologies for vulnerability analysis, and producing tools for decision making either for preventive planning or disaster management.

From this research three books were published in 2004: Essential elements of QMD, The vulnerability of QMD, and Mobility, essential elements and risk in QMD. This information is the most recent and frequently used among disaster risk management and territory management actors and institutions. It had a focus on defining an integrated risk management system as a policy to supports a safe development of the city and therefore, the Municipality has incorporated in a permanent way this knowledge in the different ordering plan and action plans.

One of the private institutions that continuously supports knowledge production is the EMAAP-Q. Throughout the projects and programs this institution implements actions to manage drinking water, sewer and risk in the Pichincha Slopes, they produce information related to the identification of risk areas and physical and social vulnerabilities of the edifications and the people living in those areas.

The most recent work it promoted was on 2009 with the development of a methodology to qualify risk in order to promote mitigation measures. Such a methodology covers the necessity

to have available a qualification method well structured that allows registering, processing, analyzing and systematizing the information. In that way, it provides a technical basis for decision making. This methodology was applied by the EMAAP-Q as case studies in 7 slopes located in the Center and South part of the city to generate the following information: hazard maps, physical vulnerability of exposed elements, social vulnerability assessment of families living at risk sites, and evaluation of the conditions and factors that contribute to increase risk.

b. Managing information and knowledge during prevention

The information and knowledge generated in the first phase of DRM has to be managed and transferred to the public and decision makers. At a regional level, the Social Studies Network in Disaster Prevention in Latin America (LA RED) is the meeting point of many people and institutions involved in disaster risk management in the different Latin American and Caribbean countries. LA RED supports different initiatives, one of them, which begun in 1994, focused on addressing the lack of systematic information about the occurrence of low and high impact disasters. As a result, they conceptualized a system of acquisition, consultation and display of information about disaster of varying impact at a country level based on a data base of historic disasters. The methodology and software tool produced is called Disaster Inventory System (DesInventar) and serves to facilitate dialogue between actors and institutions and work as a planning and action tool to prevent and mitigate disasters.

More systematic information and knowledge management also comes from regional projects supported by international organizations. For instance, the European Commission together with the Andean Committee for Disaster Prevention and Relief (CAPRADE) supported the PREDECAN project (2005-2009) which conceptualized and designed an Andean Information System for Disaster Prevention and Relief (SIAPAD). This information system tries to make sure that the information generated meets technical and quality conditions in order to have access to and facilitate the use and distribution of data, information and services related with risk management. This system has made a progress in the creation and consolidation of spatial data infrastructures available at the national and subregional level.

One example is the Geographical Risk (GEOriesgo) web portal, which provides the people and institutions users informatic tools for publication, search, access, visualization and exchange of cartographic and documented information related with processes of risk management in the Andean countries. Each country has its own web portal. The sources of information are the same institutions generating the information, in a way that access to information is centralized, but the information is not.

This type of Information System is mainly feed and used by public and private institutions at the national level. At a more local level, the INAMHI works with an information system to communicate the weather forecast, predictions and meteorological phenomena to the mass media, the public and emergency management institutions, such as the Civil Defense.

Mass media has a key role informing the population, but some of that information does not have a solid base. The information is directly produced by the media and it plays a role in warning, giving immediate information about occurring disasters and some prevention measures. During

the time of the research, two major disasters occurred in Latin America: the Haiti and Chile earthquakes, and for that reason the topic of natural disasters received much attention during some period of time.

In addition, due to the notable climate change events that have been more pronounced in this last year, much attention was given to the possible landslide and flooding events that can affect the city. Several press notes were devoted to this topic, particularly because of the very rapid increase of informal settlements in areas not appropriate for construction which have already suffered these natural events. Most of the information provided makes clear the fact that prevention works are lacking in the city and that there are a large number of neighborhoods located in risk zones. This serves as a way to raise awareness in the population of the danger to continue building on not developable land.

A current Information and Communication System at the city level, that assures an effective transfer of knowledge and information between the institutions generating knowledge of Quito and the public or decision makers was not identified. Only the Information System of the Essential Elements at Risk and Mobility in QMD, produced in 2004 is available to inform the public.

c. Preventive planning to reduce risk

The Municipality, in collaboration with the security and emergency management institutions, intervenes in prevention, mitigation and recovery during an event to protect the life and wellbeing of the population. Within their preventive objectives is the reduction of vulnerability by preparing the population, monitoring natural events, and mitigating in risk zones.

Each year the Security Departments in each of the 8 Administrative Zones are in charge of preparing a contingency plan for the rainy season in order to reduce vulnerability in risk zones. These Security Departments work under the guidelines of the Security and Governance Secretariat which provides technical support to guide each Administrative Zone in the development of those plans according to the local needs. The actors involved in this plan include: local authorities (Security and Governance Secretariat, administrative zones, Security Departments, Environmental Protection Units, Metropolitan Health and Education Direction), technical and scientific institutions (INAMHI), metropolitan enterprises (EMAAP-Q, EMOP-Q, EMASEO and EEQ), emergency management institutions (National and Metropolitan Police, Firefighters of QMD, Red Cross, Civil Defense and the Shyris Army Division) and the community.

The contingency plans explain in detail the procedures and the responsibilities of the different actors. The activities included in this contingency plan are focused monitoring and registering events, preventing risk in vulnerable areas, transferring information to the population to develop a culture of prevention, and preparing for emergency.

The Security Departments in the Administrative Zones provide technical information of morphoclimatic events that occur in their respective jurisdictions from inspections in situ and monitoring activities during and after an event. In order to have the same information from all

the Administrative Zones there is a data registering form prepared by the Risk Management Unit to be applied by the Security Department staff when an event has taken place. The information obtained here is general information on the exact location, date, time, type of event, cause and response answer; material effects, either affected or destroyed, in regards to roads, vital lines, social infrastructure, productive infrastructure and the environment; and social effects related to the number of people affected, sheltered, relocated, hurt and death.

This systematic registration has allowed the creation of an integrated base for morphoclimatic events in the QMD since 2006 which is part of the evaluations done to prepare the contingency plans. In the contingency plans, in order to prevent risk in vulnerable areas and undertake mitigation works, a risk scenario for landslides and floods is developed for each zone. This risk scenario is based on an exchange of several variables that include:

1) An identification of the most vulnerable sectors in the administrative zone. This identification includes the socio-demographic characteristics of the population.
2) A risk assessment of each of the sectors based on the relation between the number of recurrent landslide and flood events and the number of affected people.
3) A physical vulnerability assessment of each sector based on the topography and land geomorphology, the presence of protection works and basic service coverage.
4) A socio-demographic vulnerability assessment based on the age structure of the population and socio-economic vulnerability.
5) The response capacity based on the coverage of emergency institutions, the existence of education programs to prepare the community, emergency plans and monitoring systems, level community organization, and communication channels with the administrative zone.
6) A damage and loss evaluation.

The next stage in the contingency plans is risk prevention in those areas that according to the risk scenario are the most vulnerable. Risk prevention consists of two things: one is the implementation of mitigation works by the EMAAP-Q, EMOP-Q and EMASEO, and the other one is the development community awareness-raising and training programs and the creation of community risk management committees, in order to develop a culture of prevention and prepare the population in case of an emergency.

The final aspects of the contingency plans include the guidelines for an effective emergency response and to reestablish the activities of the affected communities through short-tem recovery.

d. Education and training during prevention as a way to increase awareness

Risk-aware communities help to improve the resilience to landslides. The institutions that have a main role in community awareness-raising and training programs for the communities include some of the emergency management institutions, such as the Red Cross, the National and Metropolitan Police, and the Firefighters, as well as the local administration at the municipal level.

Because in the past years, this multiplicity of organizations were sometimes working in the same areas without coordination among them, now the Security and Governance Secretariat of the Municipality has a vertical coordination role for this matter. This vertical coordination consists of setting the main awareness-raising and training activities' topics and dates that each of the 8 Administrative Zones have to execute through the Security Department. Each Security Department in each administrative zone has freedom to decide how to implement and execute those activities according to their contingency plans, and they are the ones that need to coordinate with the emergency management institutions in each zone.

The two main natural hazards faced by the city, other that volcanic eruption and earthquakes, are the very heavy rains during the rainy season that can cause flooding and landslides, and the forest fire during the dry season. As such, two topics related with natural disasters are incorporated in the training programs developed by the municipality: one is called the Rain Plan for the rainy season, and the other one is called the Fire Plan for the dry season.

In the execution of plans, the Firefighters and the Metropolitan Police, together with the promoters of the Security Department are in charge of giving training in different neighborhoods. In the case of the Fire Plan, talks are given in fire prone-areas identified by the Firefighters from the fire data base they manage. Different educational and informative material, such as booklets, informative games, brochures, pamphlets, are produced by each Security Department and they are handed out during the training programs.

The Red Cross, independently also undertakes training activities to prepare the population in case of a natural hazard so that they know what to do in case the emergency entities do not arrive in place. They work with the communities topics such as first aid, emergency preparedness, evacuation roads, meeting points, community risk mapping to identify dangerous and safe areas, and the communication systems. In many cases the Red Cross works in coordination with the Firefighters, and National and Metropolitan Police.

The Civil Defense also trains some of the Security Promoters in each Security Department of the Administrative Zones in order to transfer their knowledge. In the same way, the Civil Defense prepares institutional volunteers of the Civil Defense so that they have a trained team to respond in case of an emergency. These volunteer teams are trained in emergency assistance as well as on how to undertake an evaluation of damages and needs with the communities.

Another institution that performs training activities is the EMAAP-Q through the Environmental Sanitation Program (PSA) of the Pichincha slopes since 1998 funded by the Inter-American Development Bank (IDB) and executed by the EMAAP-Q. As part of the social component of this program, community training programs have been developed in the neighborhoods located in the slopes. In the areas where the PSA is working, the Administrative Zones do not intervene.

Not only risk-aware communities help to improve the resilience to landslides, but also risk-aware decision makers. In this regard, the United Nations Development Program (PNUD) gives financial and technical assistance to the local administrations. In 2009 the PNUD, with funds from the World Bank, started a Disaster Risk Reduction Program in QMD. As part of this program there have been several trainings for the technical team in charge of risk management

in each administrative zone. One of these trainings was focused on transferring a methodology for elaborating contingency plans.

But education also involves formal education that produces knowledge and develops qualified human resources capable of improving the resilience of a society. In terms of primary and secondary education, the topic of natural risks and disasters is not incorporated in the curricula. At the university level, only the careers of Civil Engineering offer the development of Civil Engineers with a clear conciseness of the responsibility of preserving the environment and preventing natural disasters. Other careers such as Architecture also incorporate the importance of risk evaluation and land stability for the design and plan elaboration.

In both of these careers, the development of research for thesis has produced important information about seismic risk and susceptibility, but then again, that information is not easily shared out of the university level. The same happens with the Association of Architects in Quito, an institution that also has a role developing qualified professionals that take into account the risk component. However, the several researches and consultancies that are continually generated are only useful as a means of work, but they are not applied research.

Recently the Municipality is looking for partnerships with several Universities have count with Architecture Schools in order to begin studies to know the current state of the infrastructure and equipment of the city.

e. Civil engineering works as structural mitigation measures

Structural mitigation measures address the structural sources of vulnerability in order to reduce the probability of occurrence of a hazardous event, reduce the potential effects, and mitigate the existing risk by protecting and retrofitting the exposed elements. During this phase the municipality intervenes through the Administrative Zones together with two municipal enterprises: the EMOP-Q and the EMAAP-Q.

In general, the risk promoters of the Security Department in each administrative zone are in charge of making inspections in the neighborhoods within their administration limits in order to identify areas that require the implementation of structural measures. Once those areas are identified, the EMOP-Q is in charge of executing the works of civil engineering to stabilize slopes, improve and maintain roads, and construct bridges for vehicle and people circulation, particularly in irregular settlements where the opening of roads id done without any technical consideration. In this sense, the EMOP-Q contributes to correcting and mitigating constructed risk in irregular settlements, especially those located in slope areas.

The EMAAP-Q also participates. It is in charge executing any type of work that has to do with sewers. These small works are important to reduce the effects of heavy rains and avoid landslides and include, for example, the opening of ditches, canals, fencing construction, retaining walls and plastic coverage.

NGOs working in development have also supported this type of works in specific neighborhoods. For instance, the Cooperazione Internazionale (COOPI), with funds from the

European Commission for Humanitarian Aid (ECHO), has intervened in some of the most vulnerable neighborhoods (Serrano, 2004).

The EMAAP-Q, in addition of their specific role of managing drinking water and sewer, has been intervening for more than 10 years in the Pichincha slopes with many programs financed by the IDB and counterpart resources from themselves. First they begun in the northern slopes of the Pichincha with the Pichincha Slope Project (Proyecto Laderas del Pichincha) and now they are continuing towards the Center and Southern slopes with the Environmental Sanitation Project (Programa de Saneamiento Ambiental – PSA).

The PSA had a first phase which concluded in 2007 and now the second phase begun in 2008 and will have 6 years of implementation. Their work is important not only for the management and security of the slopes, but also for the entire city's security as their work help to control the natural drainage, retain excessive flows and sediments, and reduce the overload of the sewer system to avoid landslides and floods. Their activities include big civil engineering works such as the construction of concrete and earth dams, concrete levees, reservoirs, diversion works, collectors, and collectors' repair, and small works, such as small dams, rock barriers, and steps with ditches to control erosion.

During the first phase of the project there was some questioning about the effectiveness of those works, such as that some of the dams and reservoirs were built on soil which means that in case of a strong alluvium those structures would not resist and instead, would increase the material that would be carried down. But those considerations were taken into account for the second phase of the program, which in addition of the structural works, developed complementary integrated interventions to manage risk in slopes, as it has been seen previously and will continue to be seen throughout these lines.

f. Territorial and urban planning as non-structural mitigation measures

Territorial and urban planning in Quito has been the sole responsibility of the Territorial Coordination and Public Participation Secretariat within the Municipality, which is in charge of regulating land use and occupation, putting attention on risk prevention. In order to fulfill those objectives, this Secretariat, in coordination with the Administrative Zones, are in charge of land use regulation in the city and in slope areas, the admission of construction and the protection and conservation of slope areas from occupation and edification.

In order to construct a new edification, the only requirement is to register the architectonic plans in the Municipality, but there is not a consolidated registration system. All the plans presented are register without anyone controlling that the national and municipal construction codes and standards are being respected. In fact, it is expected that the architects and engineers in charge of making plans are responsible enough to comply with the construction codes and standards. Afterwards, once the edifications are constructed, there are no mechanisms to control and verify that the registered plans were the ones really constructed.

In regards to land use, even though the administration of the territory is under the sole responsibility of the Municipality, there are other actors that contribute to the localization,

conformation and consolidation of irregular settlements in non developable land, many of them located on slopes and risk areas. These actors include cooperatives that do not work in accordance to the municipal normative and, adding to this the fact that within the PGDT there are no mechanisms or instruments for an effective control of that normative, there is an increasing number of irregular settlements.

As a way to solve this situation, Slope Stations were created in each administrative zone with the objective of controlling illegal occupation on slopes and, in that way, stop and control settlement in high social pressure zones. The Administrative Zones are responsible for these stations. Their activities involved the notification of irregular settlement to municipal dependencies, protection of the environment, application of sanctions, monitor the correct use of land, and monitor protection areas.

The stations have not been very effective. Only one of them gained much attention due to an agreement between the Municipality and the PSA of the EMAAP-Q. This was called the Pichincha Slope Station and it was specially created to undertake inspections, verify risk situations, control that construction is within the municipal norms and that there is no construction on the border of the Pichincha slopes, and apply sanctions if it were the case. This is the only station that has administrative and operative resources to develop their work. It works in collaboration with the metropolitan police for the inspections. However, the head of the Station acknowledges the fact that this Station is not enough to control settlement in the entire sector and this is evidenced by the high numbers of irregular settlements that continue to develop on the Pichincha slopes.

g. Socio-economic development policies to reduce risk and prevent disasters

The processes of regularization and upgrading contribute to mitigate constructed risk and reduce the vulnerability of some segments of the population living in poverty. Once they are regularized, the population has rights and therefore they can have access to basic services. In face of the increasing numbers of irregular neighborhoods, many of them located on risk land, the Territorial Coordination and Public Participation Secretariat as well as the Land, Habitat and Housing Secretariat are in charge of implementing the policy of incorporating irregular settlements within the urban structure.

In many of the irregular settlements, the inhabitants are the ones that not only settle and slowly urbanize an area and form a neighborhood, but they also develop new forms of social networks in order to improve their living conditions and obtain basic services and equipment. This implies the creation of organized groups (pro-improvement committees, housing committees, neighborhood committees) as a mechanism to stop the extortion they are subjected to, or in other cases due to the need of basic services or basic social equipment works, such as schools, healthcare centers, and recreational areas. These forms of associations contribute to the spatial organization of the territory and are continually trying to become regular.

In the regularization process, the representatives of the communities participate as well as other external actors, such as NGOs, which intervene with the communities to improve their living conditions. The activities involved in this process at the municipal level include the reception of

documentation for revision, technical and legal analysis; verification that the neighborhood is located within the urban area of the city; the elaboration of a report to be presented to the Planning Commission; and assistance to the community leaders to obtain certain requirements.

The Irregular Neighborhood Unit of the Territorial Coordination and Public Participation Secretariat was created in 2010 to regularize land use according to the current normative. There are a large number of neighborhoods that have not been planned and whose inhabitants do not have land tenure security. Therefore, the objective of this Unit is to regularize those neighborhoods that, according to the uses of land, are allowed to be there. With the creation of this Unit and the availability of economic and human resources to work on the problematic of regularization and risk, the objective is to work together with other municipal dependencies to provide solutions for those identified neighborhoods.

This new process of regularization includes neighborhood upgrading and mitigation of risk. In order for a neighborhood to be regularized it has to comply with certain normative. In this way, the neighborhoods undertake improvements such as obtaining access to basic equipment and infrastructure or developing green spaces. This is also a way of mitigation, because the neighborhood has to reduce the risk they might be exposed to. If the neighborhood complies with the normative and it is located on developable land, then they can enter the process of regularization. But if the neighborhoods are located on risk areas or zones declared as ecological protection zones, then they cannot be regularized. In those cases resettlement becomes an alternative.

The EMAAP-Q, with the PSA, implements complementary interventions to the structural mitigation measures in the Pichincha slopes to manage risk. From the information they produce about the vulnerabilities and risk, the PSA works with the people to help them adapt to their living conditions in order to improve their resilience and mitigate the risk. In this context, they initiated in 2004, the Resettlement and Environmental Education Plan to manage hydrodynamic and morphodynamic risk on slopes and ravines of the central and southern part of the Pichincha slopes. The resettlement plan is supported by an interdisciplinary management of the social, technical and environmental areas, before, during and after resettlement.

As it is impossible to resettle all the people, they developed a methodology to qualify risk in which their activities are sustained. In this way the families found in high probability and intensity of risk are selected to be resettled, they analyzing their socio-economic and cultural characteristics. After resettlement there is a one year monitoring and evaluation period to verify the living conditions and basic services, and social networks conformation. For the rest of the families, risk is mitigated and they are trained in a way so they can adapt to their living conditions and improve their coping response.

In 2010, resettlement was institutionalized within the Municipality to implement a Relocation Program. This program is a joint effort from the Risk Management Unit of the Security and Governance Secretariat, the Irregular Neighborhood Unit of the Territorial Coordination and Public Participation Secretariat, The Land, Habitat and Housing Secretariat, and the Metropolitan Housing Enterprise.

For this program, the Land, Habitat and Housing Secretariat is in charge of mapping municipal and public land to develop housing programs for relocation of families. Once this land is identified, the Metropolitan Housing Enterprise is in charge developing the new housing projects that will be used for relocating those people. The Secretariat has to look for financial fund at the national and international level.

At the same time, the Security Promoters of the Security Departments in each administrative zone are in charge of identifying the most vulnerable irregular neighborhoods living at risk areas. This information will then be transferred to the Irregular Neighborhoods Unit to determine the possibilities of relocation. This Unit will begin to map each of the selected neighborhoods to determine the characteristics of the families and select the ones that need to be relocated.

It is expected that by 2011 the first housing programs will be ready to begin with the relocation of 300 families that have been registered in the program and that fulfill the requirements for relocation. This in fact is a low number if we consider that approximately a total of 3000 people are living in risk areas.

In order to prevent that more families continue to settle in risk zones, the Territory, Habitat and Housing Secretariat is aware of the need to offer land or housing accessible for the popular sectors that go to risk areas not because they want to but because is the only area they can go to.

The implementation of the social housing policy was previously only implemented by different NGOSs. For instance, the NGO CIUDAD began in 2001 the project “Stept by step” (Paso a paso) with the objective to facilitate access to credit for housing to low income families as well as to improve their capacity to manage the construction process. The challenges of this project were that low income families could be benefited with the housing bonus from the State, that they could access to appropriate credits, and that they could enjoy cheap but good quality housing. This NGO prioritizes its work with associated inhabitants in order to give financial credit under their personal responsibility, but also to establish a guarantee of the association to which the inhabitants belong to. The NGO has strategic partners. It makes agreements with financial entities that can complete housing financing and that present comparative advantages in their credit offers, such as the Savings and Credit Cooperative of the Chamber of Commerce in Quito. It also has partnerships with private construction enterprises, to improve their market offers in regards to quality and prize.

The development of the social housing policy has gained much more since 2009 when it became a national policy. The Urban Development and Housing Ministry is supporting strategic planning and cities management through the execution of integrated programs incorporated in the projects of harmonic and dense cities. The objective of that Ministry is to develop housing programs for low-income families. One of the mechanisms to support this is by the implementation of a housing bonus for low-income people that want to buy a new house. This works in collaboration with other sectors and actors.

There are some institutions in charge of the construction of the social housing programs; some of them are the Metropolitan Housing Enterprise, Ciudad Bicentenario, Ecoarquitectos, and Casa Mia. There are also ONGs that that support social development strengthening such as

CIUDAD; and there are financial institutions that promote accessible credit for low-income groups, such as Fondo Vida, Cooperativa de Ahorro y Crédito "Construcción, Comercio y Producción", and the Ecuadorian Housing Bank (Banco Ecuatoriano de la Vivienda).

h. Environmental natural resource management to reduce risk

Environmental management is a key aspect in dealing with landslide risk. The institution that works in this thematic is again the EMAAP-Q through the System of Hydrologic Regulation and Flood Control in the Slopes (SISHILAD) that looks for the reduction of hydrodynamic and geodynamic risk in slope settlements and the adequate operation of the sewer system. They undertake management activities such as hydro regulation and flood control works; improvement, renovation and capacity extension of the old and new collectors; and dissipation works and velocity control of water courses.

The SISHILAD is part of the PSA which, other that the engineering and resettlement interventions, has been implementing solutions in the natural and urban area. For instance they are working in the restoration of slope areas that should not be occupied and should be conserved as natural drainage or obligatory retreat to avoid disasters. Those spaces are incorporated into the public space of the city and converted into recreational areas, parks, and urban connectivity sites.

The PSA is also supporting solid waste management in slopes. Waste management in Quito is an unresolved problem, particularly in the high slope zones because access for waste recollection is more difficult. In addition, it causes drainage problems in the city because people living in those areas use the slopes as garbage dumps not allowing the occurrence of the natural area where the water runs. The PSA provides technical assistance to the competent local authorities in charge of urban solid waste management, such as the Environmental Secretariat and the EMOP. This topic is also incorporated in the Environmental Education Programs that the PSA undertakes in different communities.

All the interventions of the PSA are developed with a previous study that defines all the sanitary problems of the study areas. They have developed a methodology defined as avoided damage to incorporate the costs and benefits of each project as well as the profitability.

In addition to these, the PSA is also working on a big Natural Area Conservation Plan for the higher parts of the Pichincha slopes that are nor urban nor developable, and where people continue to settle in. This management plan is a complete integrated study that includes the creation of a municipal management organism, part of the Municipality, dedicated exclusively to the conservation and management of those areas. Their work would involve the development of projects and partnerships between the Municipality, the private enterprise, the owners of those lands and the communities living there in order to control the expansion of the city and the good use of natural land. This plan was concluded and is now in a phase to determine the implementation and transfer of the responsibility to the Municipality.

i. Monitoring and warning systems enhance societies' readiness to cope

QMD has available monitoring and warning systems which are being operated by entities that include the IG-EPN, the INAMHI and the EMAP-Q. The first two institutions have an agreement with the Municipality to provide seismic and meteorological information. The IG-EPN monitors seismic and volcanic activities, and the INAMHI operates and maintains the national infrastructure of meteorological and hydrological stations to provide information about the weather, climate and hydrological resources. The EMAAP-Q, as part of the PSA, also undertakes hydrological monitoring through weather stations located at different site within the limits of the program.

This information serves as the basis for issuing early warning, either about heavy rains that can generate floods and landslides, or lack of rain. However, as Ecuador is located in the tropical zonal, predictions are not accurate and therefore they issue forecasts only for the next 24 hours. The Metropolitan Police collaborates with early warning by patrolling around the areas known to be at risk, either a risk of landslide, floods or fires.

Early warning is transmitted through a communication network of the District which goes to all the 8 Administrative Zones and the emergency management institutions (Red Cross, National Police, Metropolitan Police and Firefigthers). All of these institutions have radios to communicate between them and the Metropolitan Citizen Attention Central (Central Metropolitana de Atención Ciudadana – CEMAC) whose objective is to guarantee security in the city. For instance, if there is a threat of heavy rain, the CEMAC informs all the administrations and emergency management institutions to be prepared. In each administrative zone, the Security Promoters are in charge of informing the population.

On the basis of the information provided by these warning systems and the events that have occurred, the local authorities and emergency management institutions are in charge of developing institutional and community coordination and organization activities for prevention, protection, evacuation and recovery.

j. Emergency preparedness

Within the contingency plans for each administrative zone the actions and actors involved for an effective response are clearly defined. It includes a map of the resources available, such as shelters, communitarian police units, safe point and hospitals. As these contingency plans are supposed to be transferred and socialized with the communities, each Security Unit is forming and implementing the creation of risk management teams in several neighborhoods located in the most vulnerable areas. These teams are trained in different topics such as emergency response, evacuation to shelters, safe points and evaluation of damages and lose. The Firefighters, Red Cross and the Metropolitan Police collaborate with the Administrative Zones in the informative talks and education campaigns.

The Municipality gives certain emergency assistance equipment for these teams as well as radios to be in contact with the security promoters and emergency management institutions in each zone. These teams are the ones constantly attending to training activities organized by each

administrative zone. In some neighborhoods there have been emergency drills, mainly for earthquakes, volcanic eruption or fires.

In the slope areas were the EMAPP-Q, with the PSA is working, they have also conformed communitarian groups for slope management who are working in a participative way in the implementation and promotion of the activities for risk reduction.

k. Response

At the city level there is the Metropolitan Emergency Operative Committee (COE-M), integrated by different emergency management institutions, by those in charge of knowledge production and by the municipal structure. The COE-M is a coordination, planning, direction, control and supervision institution of all the activities during an emergency. In case of a main emergency in the city, the COE-M is activated immediately by the Mayor of the city, and calls all the members that integrate it in order to determine what actions will be taken. Once this is decided, the members contact each of their institutions to implement the decision taken.

The CEMAC is then an integrated and coordinated system that allows having immediate help from the emergency management institutions: Civil Defense, Red Cross, National and Metropolitan Police, and Firefighters. In this sense, the CEMAC commands and coordinates citizen attention management in different emergency situations through the use of technology and telecommunications, to minimize the time of response and achieve a timely and effective attention, to assist with the required help, to define operational protocols, and to standardize results.

During response, the Civil Defense, Firefighters and Red Cross are in charge of pre-hospital assistance, communication, search and rescue, transfer of victims to hospitals and damages and loss evaluation in order to coordinate the necessary resources. Voluntary teams of each of those institutions that have been trained previously are activated to support the tasks. The National and Metropolitan Police have a supporting role and they are in charge of evacuating the victims and maintain order.

Another space for coordination at this stage is through the Interinstitutional Commission of Medical Emergencies Network (Comité Interinstitucional de la Red de Emergencias Médicas - CIREM), created in 1995. The CIREM is a public institution with administrative and financial autonomy in charge of defining policies for the organization and functioning of the medical emergency services in the country. This institution has georeferenced all public and private hospital and healthcare centers in the city as well as all the ambulances, so that if an emergency occurs, they inform the emergency institutions where to take injured people.

Currently the CIREM is formed by those institutions in charge of pre-hospital assistance, but the Public Health Ministry is trying to change the CIREM into the Integrated System of Medical Emergencies (Sistema Integrado de Emergencias Médicas – SIEM) in order to incorporate not only the pre-hospital component during an emergency, but also a communication system, which in the case of QMD would be connected to the CEMAC, and a safe hospital component. The

role of this new System would be to establish the national norms and guidelines for the three components.

l. Recovery and rehabilitation after an event

During the recovery phase in settlements that have been affected by landslides on slopes, the affected areas are determined in order to develop and execute a Rehabilitation and Reconstruction Plan. Each administrative zone is in charge of the recovery of areas under their jurisdiction. For instance, if a landslide has occurred and many houses have been destroyed, then automatically those areas become protected zones, and it is the responsibility of the Municipality to prevent resettlement in there. To control this, those areas are converted into reforestation zones, agricultural lands, recreational areas, or they are closed and covered with geotextil mesh. The houses that have been affected are expropriated and the families are sent to municipal houses.

In the Rehabilitation and Reconstruction Plans, the metropolitan enterprises also participate, depending on the objective of the recuperation. All metropolitan enterprises must allocate 0,05% of their annual budget for recovery works caused by natural disasters. Therefore, if after a landslide the collectors or part of the drinking water system have been affected, then it is the responsibility of the EMAAP-Q to undertake the respective measures.

However, it is important to mention that these recovery strategies are much localized and for small events that may occur in the city and affect a determined number of houses or sectors. There are no technical or institutional capacities to cope with major events.

6.2. Landslide risk management and institutional capacities' performance

After the characterization of the landslide risk management system and the institutional assessment presented above, the indicators developed for landslide risk management in QMD and for the institutional capacities were used to measure their level of performance, which varies from 1 to 4. On the one hand, landslide risk management has a level 2 of performance, which is insufficient for the existing level of risk, but this performance is emerging, as can be seen in table 5.

For landslide risk identification, the main drawback was found for landslide monitoring and forecasting, followed in less intensity by systematic disaster and loss inventory, and landslide risk and vulnerability assessment. For landslide risk reduction, the main drawbacks were found for reinforcement of public and private assets, and insurance and reinsurance coverage and loss transfer strategies, followed in less intensity by hydrographic basin intervention and environmental protection, and application of safety standards and construction codes. Finally, for emergency preparedness and disaster management, the main drawback was found for implementation of social safety nets and funds response, followed in less intensity by emergency response planning and implementation of warning systems, and rehabilitation and reconstruction planning. All of these limitations will be immediately discussed in more detail.

Table 5 Landslide risk management performance

LANDSLIDE RISK MANAGEMENT PERFORMANCE						
Landslide risk identification		**Landslide risk reduction**		**Emergency preparedness and disaster management**		**Total performance level**
Sub-indicator	**Performance level**	**Sub-indicator**	**Performance level**	**Sub-indicator**	**Performance level**	
LRI1	2	LRRI1	3	EPDMI1	3	
LRI2	1	LRRI2	2	EPDMI2	2	
LRI3	3	LRRI3	3	EPDMI3	4	
LRI4	2	LRRI4	3	EPDMI4	3	
		LRRI5	2	EPDMI5	2	
		LRRI6	1	EPDMI6	1	
		LRRI7	1			
Subtotal	**2**		**2,14**		**2,5**	**2,21**

On the other hand, institutional capacities performance also has a level 2 of performance, insufficient but emerging, as can be seen in table 6. The main drawbacks were found for the following indicators: education and strengthening in landslide risk management, information and communication management, and implementation, monitoring and evaluation. These are followed in less intensity by landslide risk management system organization, coordination, integration of landslide risk management approach in other sectors, budget allocation and mobilization, and public participation and accountability.

Table 6 Institutional capacities performance

INSTITUTIONAL CAPACITIES PERFORMANCE	
Indicators	**Performance level**
ICI1	3
ICI2	2
ICI3	2
ICI4	2
ICI5	3
ICI6	2
ICI7	1
ICI8	3
ICI9	1
ICI10	1
Total	**2**

6.2.1. Opportunities and limitations of the landslide risk management system

The trend for disaster risk management in Quito until 2000 was focused on a reactive approach that for many years was institutionalized, putting all the efforts on emergency assistance and basic reestablishment of affected activities, and lacking clear policies and strategies able to steer vulnerability reduction in the population and the infrastructure over the territory.

Then after 2000 the approach became proactive, focusing on the incorporation of prevention and risk reduction into the planning processes. There has been a progress in the city in terms of developing and implementing policies and a development model focused on development planning with the risk thematic and preventive planning as a central aspect of this practice. The city is working now in such a way that the population and its institutions assume risk management as an integrated part of their institutional and organizational practices.

A move towards in this respect was the elaboration of a Public Security Agenda for QMD presented in March 2010 as an effort to implement risk management policies in the short and long term. This plan represents the potentiality of designing a joint effort between different actors and it is considered as the first step to develop integrated actions for risk reduction. There is now a road being constructed towards strengthening the institutional capacity to reduce vulnerability.

The problem is that landslide risk continues to affect the city and limits their risk management systems. Landslides are frequent natural events that occur on slope areas, but they are exacerbated due to several factors. One of the most important factors that generate risk conditions is the growing number of irregular settlements that each year occupy the transition zones between the natural areas and the urban areas, many of them on the border of steep slopes, without any municipal mechanism being able to control it. Another very important factor is a lack of environmental consciousness of the people in general, and of the people living on those areas, in particular, that has not allowed for the development of a clear recognition of the aspects that contribute to the conservation of natural areas and the adequate use of slopes.

A lack of awareness related with natural resources use, management and conservation of natural areas contributes to increase the level of risk and put in danger the life of many people living in precarious conditions. An inadequate management of natural resources and solid waste, together with an insufficient sewer network characteristic of those sectors, makes people remove sewage into natural streams and use slopes as garbage dumps, filling in this way the natural drainages and increasing the level of generated risk. What are then some of the limitations of this landslide risk management system and its institutional capacities?

Economic limitations for specific landslide risk identification

The city has had progress in regards to risk identification and knowledge production. There are now available risk maps; physical, social and economic vulnerability assessments for different sectors of the economy; and historical records and catalogues for earthquakes, eruptions, landslides, floods, and other natural and anthropic disasters. Nevertheless the information and

knowledge produced is not being continually updated, and there is a lack of detailed studies specific for landslide risk assessments for the entire city.

The most relevant information available related to vulnerability and risk of QMD was produced in 2004 as part of an important Information System of the city, but updated studies are limited. The most recent and complete information available on landslide risk assessments represent only one sector of the city, the Pichincha slopes, thanks to the Environmental Sanitation Program (PSA) carried out by the EMAAP-Q for many years, which had the financial means necessary to produce information in order to intervene in that area. But other than this program, there has been a lack of financial resources to carry out research, either by national research institutions or by the local government.

In this sense, the low level of resources allocation and mobilization, as one of the institutional capacities needed to create an enabling environment to manage and reduce risk, has a consequence on one of the landslide risk management indicators: risk identification and knowledge production.

Lee and Hencher (2008) argue that a lack of investigation and knowledge about the main factors causing slope failure put limitations on the measures that should be taken to reduce them. In fact, one of the main problems that lead to low community awareness and high numbers of victims is lack of information. In this sense, it is necessary that the national and local government acknowledge the importance of developing technical and scientific capacity to develop landslide risk assessments that provide the scientific basis for understanding the mechanisms that trigger landslides and the scales at which they operate in order make rational decisions on how to mitigate risk (Anderson & Holcombe, 2008; Van Niekerk, 2005).

This need to develop technical and scientific capacity is evident when landslide hazard maps are developed, but confusion on how to interpret those maps and their acceptability pose major concerns as far as practical recommendation is considered (Anderson & Holcombe, 2008). For instances, some maps may not identify areas that may be susceptible to landslides unless they have already occurred; other maps may be incomplete and lack the incorporation of frequency and magnitude of landslide occurrence; and others may identify large tracks of land as disaster prone areas without considering the scale of the triggering variables (Anderson & Holcombe, 2008; Catane et. al., 2008; Dai et. al., 2001).

In addition, the economic limitations not only impede the conduction of surveys to develop complete inventories of landslide past and current events; detailed inventory and systematization of social, economic and environmental effects and losses; detailed risk studies that consider the economic and social impact of landslide events as well as analysis of the physical vulnerability of essential buildings, and social vulnerability for the population; and slope stability assessments, all of which are lacking in QMD, but also limit access to advanced methodologies and satellite-based data making it difficult to produce effective landslide inventories and maps (Catane et. al., 2008).

This insufficient technical information has been acknowledged by the local government. The Public Security Agenda is promoting constant research and effective technology transfer to support risk reduction as well as financial support to develop risk reduction research with the

involvement of national research institutions, universities, applied research centers and international organisms. As immediate actions of the plan there are five projects that will be implemented and that have funding. These projects include:

- Updating of seismic microzonation and seismic vulnerability in Quito.
- Diagnosis and evaluation of the risk situation of irregular and vulnerable neighborhoods with the probability of landslide event in order to determine mitigation measures, such are relocation.
- Detailed seismic vulnerability assessment of irregular and vulnerable neighborhoods in order to provide technical assistance to house owners to reduce structural vulnerability.
- Physical vulnerability evaluation of essential edifications of QMD in order to determine future structural reinforcement.
- Physical vulnerability of basic services such as drinking water, sewer, electricity, telecommunications and roads.

As it can be seen, the main focus is on seismic studies. There is the need to incorporate specific studies for landslide risk assessments that address the probability of landslides, the runout behavior of landslide debris, the vulnerability of property and people to landslide, and the landslide risk to property and people, and to look for financial support to carry them out.

The need to establish a system to exchange information

Another limitation posed to risk identification other than the economic restrictions to develop research, is the low level of information exchange, found within the information and communication management institutional capacity. In spite of the enormous effort that some research institutions do to develop research and produce risk and vulnerability maps, the information is not being used and exploited by decision-makers or by the population and therefore it doesn't have the impact it should. If research outcomes and information do not reach the community living in the dangerous sites, then there is no community awareness (Karnawati & Pramumijoyo, 2008).

The information produced in different sectors of the Municipality stays within that sector and there are no mechanisms to exchange it. For instance, the record of landslides and floods, their impacts and effects, produced by the Security Promoters in each Administrative Zone since 2006 is not exchanged with the Territorial Ordering Secretariat in charge of the regularization program. This not only limits the impact that information could have, but also makes other departments use their financial resources to produce the same information.

Therefore, at the city level, an Information and Communication System that assures an effective transfer of knowledge and information between the institutions generating knowledge of risk in Quito and the public or decision makers does not exist yet. This has been recognized as an institutional drawback, particularly during the implementation of the current Relocation Program whose executers argue that the information that has already been produced by different actors is dispersed and difficult to access.

For example, the PSA has produced a lot of social, economic, geographic, and hydrological information of the Pichincha slopes. They have even developed a methodology to evaluate risk and determine relocation procedures. That information is available for the people working in the PSA, but it is a very useful information for the people working in the Relocation Program of the Municipality. During the time of the interviews, it was frequent to meet people working for the Relocation and Social Housing Programs of the Municipality in the EMAAP-Q asking for such information in order to use it and don't spend more money and time producing the same information.

Cross-cutting coordination among research institutions, universities or technical departments as the sources of information for landslide management and the receiver organization and institutions (NGOs, schools, community, families) which are responsible for community preparedness is necessary to develop cultural willingness and preparedness for landslide and other disasters mitigation and risk reduction (Andyani et. al. 2008).

As a way to manage more efficiently information, currently there is a project intended to put together all the information that is now dispersed in different sectors and units into a general information database accessible to everybody. With the creation of this information database there is opportunity to make a much better use of the information and the resources invested. But there is still the need to develop more effective mechanisms to transfer the information to the population so they know the risk that really exists where they are settling on.

Developing a culture of prevention through education

In the natural areas of the slopes of Quito several activities and processes developed negatively affect the interactions between nature and human beings. These activities include an inadequate high grassland management, farming and agricultural activities on very steep slopes, degradation of native vegetation cover, low or inexistent management of the planted forests, processes of irregular settlement, and garbage deposit on natural drainages. These processes have been developing for many years, but as it was stated before, they have been exacerbated by an increase of human settlements in natural areas that limit the urban area of the city which cause an accelerated degradation of natural resources and landslide events.

A lack of education and information for the population in regards to natural hazards, risk, vulnerability and the environment was identified during this study. It is necessary to improve the knowledge of the population so they can be aware of the different aspects and causes of the problems.

The majority of the population know about landslide risk that affects them or the rest of the city mainly because on their own experiences. There has been progress in the dissemination of risk information to the public and in the establishment of community awareness-raising and training programs. However those programs do not cover a big area of the territory. At the municipal level, the Administrative Zones undertake training programs in some of the most vulnerable neighborhoods, not in all, which include information related to risk, prevention and emergency preparedness. Since this last administrative period they have been working in the formation of communitarian teams to react during the rainy season. However, the involvement of the

communities is not high, only a minority of the inhabitants in each neighborhood participates. The security promotes need to look for people that wants to participate and then it is difficult to count with them again.

The incorporation of academic and education programs regarding risk management into formal education was also found to be absent and that is why within the institutional capacity of education and strengthening of risk management, this received the lower level of performance.

The Public Security Agenda also recognizes this gap and promotes the integration of the risk thematic into school and high school educational curricula as well as in the university curricula. For the immediate actions there is funding to develop a project of public and scholar information campaigns with the participation of the Security and Governance Secretariat, the Administrative Zones, the Education Ministry and the National Risk Secretariat. The objective is to design and implement two types of campaigns: one addressed to the community with basic information about earthquakes, and the other one addressed to schools, for students and teachers, with information about earthquakes and prevention. Some advance in this regard was identified as now some universities offer a third and fourth level careers specifically for disaster risk management.

Community awareness raising and training needs to be strengthened further more, and consider other types of hazards other than seismic events. It has to include a bigger number of neighborhoods and deepen the knowledge about the aspects that contribute to the conservation of natural areas and the adequate use of slopes of the population living in the transition zones between the natural areas and the urban areas. In this sense, it is important to develop, not only risk prevention campaigns, but also environmental education programs in order to change the communities' attitudes related with natural resources use, management and conservation.

The PSA is developing an environmental education campaign addressed to the population living in neighborhoods located in this transition zone to create consciousness in their inhabitants of the value of conserving and managing natural areas and avoiding irregular settlement. The main objective is that communities can become partners in the control and conservation of those areas. More of these initiatives necessarily need to be implemented.

Extemporaneous efforts to regulate land use

Having available information related to vulnerability and risk in QMD allows a better understanding of the physical and geographic context of the city in such a way that it provides the basis for preventive territorial ordering, land use planning, and effective mitigation measures. In this context, hazard and risk zoning provides an ideal framework for land-use planning, development control, the application of building codes and ordinances, as well as guidelines for engineering practice. In general terms, it can provide the information for decision-making (Dai et. al., 2001). However the city began to use this information for planning purposes and began to incorporate a preventive approach for disaster risk reduction into specific policies and plans long after the city had expanded into hazard prone areas, such as steep slopes or areas now declared as ecological protection zones.

The situation is that in the initial urban plans there was not enough information about landslides and floods and therefore the risk thematic was not incorporated as a determinant factor for land use and occupation. When the first studies allowed to consider risk and to have a more precise knowledge of the risk zones, the city was already built on those areas. In this sense, the efforts to try to control and regulate land use and occupation of slope areas have been extemporaneous as the expansion processes of the city have already occupied a big part of them.

Anyhow, the objective of the current PGDT is to foresee urban expansion and land use in zones that concentrate the least number of hazards or where they are present with less intensity. Nonetheless, although the Municipality shows progress in land use and occupation regulations to prevent future irregular settlement in risk areas, in many cases it does not have the capacity to offer measures to prevent inadequate land use, reduce the vulnerability of irregular settlements, and offer mechanisms to ensure compliance and regulation enforcement.

This is not something new or unique of QMD. Even though risk reduction is recognized as a pre-condition and an integrated aspect of sustainable development, Wamsler (2007a) argues that when it comes to practical implementation of mitigation strategies, not much is achieved, even when money is available.

The challenge of land-use planning and the social reality

Land-use planning measures and construction codes are a potential approach to reduce disaster risk and to classify disaster-prone areas as unsuitable for development and construction, but it is also a challenging one to implement because of conflicting values about land which reflect cultural, social and economic differences in many societies (UN/ISDR, 2004). It is precisely in those disaster-prone areas not suitable for development where irregular settlements continue to expand. In this sense, land-use planning techniques and construction codes to control disaster risk in irregular settlements of urban communities, and especially in developing countries, face limitations. The most straightforward limitations are the high investment costs for prevention, a failure to implement the measures, or if the measures are applied, a lack of monitoring and enforcement.

In the case of QMD, the institutional capacity of implementation, monitoring and evaluation received the lower level of performance due to a low implementation of risk reduction policies and measures and absence of mechanisms to control the fulfillment and implementation as well as to monitor progress. For instance, in spite of the existence of the National Construction Code, more than 60% of the constructions are built without municipal approval. And even if they were approved, currently it does not guarantee that the structures are resistant to natural events because the Municipality registers architectonic plans, but not structural plans. In addition, the lack of control and monitoring mechanisms pose a big problem. Currently a plan can be certified and registered in the Municipality and then something completely different be constructed.

But those are not the only limitations. Wamsler (2007a), in a research about managing urban disaster risk for the urban poor, acknowledges that neither urban development actors nor disaster risk management professionals have addressed the two-way relationship between

disasters and urban settlement development. According to Wamsler, four issues are drivers of this situation: there is a limited recognition and understanding of the nexus between disasters and urban settlement development; there is a separation between both working fields from the local to the global level as well as among these levels; there are increasing, but yet unsustainable, efforts to mainstream disaster risk management within settlement development programming; and there is a big gap between what households and communities need or do to deal with risk and disasters and the way in which urban development actors support them.

The complexity of the interaction between disasters and settlement development is evident in many cases where the objectives of conventional planning systems are often detached from the socio-economic realities that the informal sector presents (Gupta and Sharma, 1999). When the poor and unemployed migrate to the cities, they arrive in large numbers and occupy illegally any available piece of land. In this context, regulations that determine vacancy of land for future expansion or environmentally sensitive zones become soft targets.

Those who can afford it stay away from hazard-prone areas and live in the spaces of land-use and zoning regulations and building codes, but such measures are affective only if they are strictly enforced. When land is illegally occupied, enforcement and regulation do not occur, and therefore regulations do not have an effect on the informal sector. Furthermore, regulations may not be accessible for the urban poor or they may not be in a position to afford them (Gupta and Sharma, 1999).

This was evidenced in the case of irregular settlements in QMD where the problem of non compliance is exacerbated by the social reality of the population that do not considers landslide risk when they look for a place to live and decide to settle illegally on risk zones. In this context, the poor sectors of the population don't even register plans. It is not that they chose to settle in areas not included in the urban limit, but without any other alternative, they are forced to settle illegally. The poorest sectors of the city difficultly can access the market to obtain land and housing and therefore they build their own houses and find the way to provide themselves with services and equipment, consolidating in this way their neighborhood. In addition the predominant perception of the population living in risk areas is that a disaster has not happened and therefore it is not necessary to consider it.

The role of local governments dealing with irregular settlements

The above mentioned activities are part of the communities' survival strategies in which they form a type of social organization, in many cases run by people that manage them in their convenience and take the role of organizing the territory (Serrano, 2004). As irregular settlements slowly continue to be consolidated they force the Municipality to eventually regularize them and provide them with basic services and equipment.

But according to some authors, certain local governments fear that recognizing irregular settlements and expanding services for those areas would be a signal of approval, so they do not consider them (Gupta and Sharma, 1999). The reality behind this incongruence and in fact behind the factors that affect risk within vulnerable locations such as irregular settlements is that many local governments have limitations. Municipal governments usually have a range of

departments to address different aspects of urban management such as infrastructure and service provision, implementation of regulatory frameworks to ensure public health and safety, and urban planning, including land-use management and planning. As Dodman et al. (2009) point out, although there are many variations in the form of local government intervention and the extent to which some roles are the responsibility of higher levels of government, the extent to which they actually meet their responsibilities has great implications on the ability to reduce disaster risk.

A large number of city and municipal governments in low- and middle- income countries lack investment capacity, funding, a strong local revenue base, as well as technical capacity; some also have political structures with limited accountability to their citizens, especially the poorer sectors (Dodman et al. 2009). For example, cities where most of the population lives in illegal and informal sectors can reflect local governments lacking the resources to meet their responsibilities and limited capacities to invest; those governments are unrepresentative, unaccountable and anti-poor, regarding the population living in informal settlements as the problem.

On the other hand, there can also be local governments more accountable to the citizens in their jurisdictions, but these can lack the financial, human and technical capacity to fulfill responsibilities for urban development plans, zoning and land-use management. The profits that can be generated by changes in land-use designation and in public works contracts make corruption difficult to control (Dodman et al. 2009).

But it is important to understand the necessity to recognize that informal settlements are an integral part of the urban landscape. Not recognizing them and not providing basic services for informal settlements, because it would be seen as a signal of approval, will exacerbate the vicious circle and increase their vulnerability to risks (Gumpta and Sharma, 1999).

Recognizing informal settlements means not only the spatial parameters of physical vulnerability, but also the social and economic requirements of a society's development. This entails linking land-use planning to socio-economic realities, types of hazards, costs and benefits, land market, land-use and zoning, planning and regulation, as well as land tenure that characterize each situation.

How does QMD deal with land-use planning limitations and irregular settlements?

In order to deal with the challenges faced by land-use planning, several actions have been considered. First of all, the Chamber of Commerce of Quito (CCQ), in collaboration with the Housing Ministry of Ecuador, are reviewing and updating the National Construction Code. Their objective is to develop a new Ecuadorian Construction Code. The Construction Code that has been applied since 1975 until now was based on the United Stated Construction Code with several adjustments for the topic of seismic risk. Currently the CCQ coordinates and administrates the resources for the promotion and diffusion of the document they are working on. This new Construction Code is including topics such as: seismic risk and requirements of earthquake-resistant design; materials of construction that cause vulnerability; evaluation of existing structures for reinforcement; and human security, among others. The level of advance

of this document is 90%. Once it is finished the CCQ will promote and share the document among different institutions and professionals to validate it.

This initiative necessarily has to go hand in hand with the establishment of effective control and monitoring mechanisms to avoid the construction of infrastructure that has not been registered. The new approach is that the Municipality returns to perform the task of approving and then registering the architectonic and structural plans. This was an activity already done by the Municipality many years ago, but due to all the bureaucratic procedures and the high level of corruption, the Municipality decided to be in charge only of the registration. Now, face with the problem of lack of construction regulation and non-compliance of the municipal normative and ordinances, the Municipality is developing a new system in which the plans first have to be approved in order to be registered. Within this new system, the universities and architecture colleges would be involved in qualifying technically the compliance of the architecture and technical norms.

In addition, besides improving the situation of plans approval and registration, there is the urgent need to solve the problems of self-construction and low level of risk perception to be able to stop illegal slope occupation. Among the key aspects to solve these issues are, as it was mentioned previously, the importance of developing a culture of prevention in the population, the need to offer other alternatives to the poor segments of the society to have access to a place to live, and the availability of control mechanisms to avoid illegal occupation.

In respect to this last control aspect, slope commissariats were created to control illegal occupation, but it was found that they have not been effective in their function. As a way to change this situation, the Municipality is undertaking some institutional modifications to create a centralized municipal institution to take all the responsibility and competences of control and sanction. This is the Metropolitan Control Agency.

Giving more alternatives to the poor sectors

The current social housing policies institutionalized in the Municipality are a good opportunity for reducing urban expansion into hazard-prone areas. As an inclusive policy, the Municipality is working on regularization in order to solve land tenure in favor of the legitimate owners of land and integrate the neighborhoods in the urban processes, providing them with infrastructure and services to reduce vulnerability.

However it is not easy for neighborhoods to be regularized. The population stresses that there are several factors that complicate this process for them. Among those factors are a lack of community organization to reunite all the documents required and to go through all the legal procedures; a lack of continuity of the process either because the community leaders have changed or the administrators of the Municipality have also changed; a lack of knowledge and information about the process; a lack of financial resources; a lack of requirements asked by the Municipality such as existence of basic services, infrastructure, and green areas; and the location of the neighborhoods in ecological protection zones, in high risk-zones, or in transition zones.

In this sense, although the Regularization Program tries to integrate irregular neighborhoods into the urban processes, this is not an easy task, and still requires the establishment of a better methodology and procedure to be effective. In addition it is important to know that regularization can also generate negative reactions as the proliferation of more irregular settlements with the expectations that once they are established, the Municipality will have to legalize them. That is why this process has to go hand in hand with more control and other alternatives to avoid more irregular settlement.

Land use regulations are now being complemented with Relocation Programs of houses located in irregular settlements and risk areas. It is a difficult task to decide what to do with all the irregular settlements that exist in QMD. The experience of the Resettlement Program implemented by the PSA should be considered. It seemed that the Municipal Relocation Program is being treated as an urgent matter, and the actors in charge are defining really quickly who the beneficiaries would be, but it is not yet clear what the procedures and criteria are going to be to select the families and how is the relocation going to be implemented and monitored. It would be useful if the successful experiences of the PSA and the methodology developed by them could be considered and transfer to the municipal authorities in charge of this new program.

In addition more efforts should be put to develop programs that allow to take advantage of those free spaces left after relocation in order to give them another functionality and avoid that they are occupied again. For example they can be converted into recreation zones, camping zones, green areas, parks or sport areas. This shows that managing slopes is a complex task that requires the involvement of different sectors.

The need of multi-stakeholder participation and involvement

Landslide risk management demands a collective response from different disciplinary and institutional groups and therefore it demands the development of partnerships. According to Twingg (2007) it is unlikely that a single organization will be working in all of the relevant areas. Rather, that organization will want to build on its existing strength and consider the support of other organizations to complement its own work. For instance, an organization with expertise in risk identification might want to make sure that the results of its work are shared and applied; therefore, it may want to become involved in public information work and early warning systems.

This is an aspect that was found to be missing in QMD. There are not specific organizations focusing their efforts on determined aspects of the management cycle that work with partners to ensure that other important aspects of resilience are not forgotten and that work to strengthen community capacities. The only example that has been continuously mentioned here is the work carried out by the PSA and therefore it is necessary to make use the experience gained by that program.

There are several reasons why the PSA has been a successful way to manage risk in the Pichincha slopes. First of all, the program has financial resources to develop different activities related with the disaster risk management cycle. The financial resources have allowed the

program to develop hydrological research, risk assessments, impact assessments and socio-economic assessments in order to determine appropriate mitigation works and actions. With that information they have developed different methodologies and criteria to apply mitigation measures that include the environmental education program, the resettlement program and the natural resources management program, other that the structural mitigations works. In addition they have developed evaluation and monitoring mechanisms of those programs. But one of the most important aspects is that they have implemented a participatory strategy.

According to the people working in the PSA, this last aspect is one of the most important ones but also the most difficult to obtain. All the work done in the slopes has a participative strategy in which all the actors involved and the communities participate throughout all the phases of the program. Participation begins during the diagnosis and continues through the design of strategies, decision-making and then implementation. This participative approach tries to build sustainability of the program and involvement of the community. However the PSA acknowledges the difficulty of achieving the involvement of the different actors, either the municipal actors of the community.

In the case of the Municipality, although they acknowledge that the PSA is an excellent program, they have so many things to solve that risk management has not been given much attention until recently. A lack of horizontal coordination between the PSA and the Municipality is evidenced, for instance, by the fact that many of the studies done and the plans developed by the PSA have been delivered to the different Secretariats of the Municipality and the Administrative Zones' departments directly in charge of managing the territory, but there has not been any feedback or use of the results. It was frequent to hear from the municipal entities that they do not intervene at all in the Pichincha slopes under the intervention of the PSA because it is not their competence and the PSA is doing a good job. Only recently the PSA and the Security and Governance Secretariat are interacting to exchange information useful for the Relocation Program.

In addition to the lack of interaction between the PSA and the Municipality, another limitation is found because of lack of continuity. For instances, as part of the PSA, technical staff of the 8 Administrative Zones was trained for almost a year in the thematic of risk management, with the involvement of international experts and the development of workshops to motivate them to learn and know about the topic and then be able to apply it in their work. The objective was to consolidate a network of people prepared and trained in risk management and slope management. But this was not fulfilled. With the change of administration many of the trained staff left, others were changed to other departments, leaving very few trained technicians. This problematic has to be reinforced so that the time and resources invested training staff is not lost.

In regards to the communities' involvement, the population is used to a political patronage, to demand and ask for things, not to be active participants in the development of the city, or in the case of poor people living in the high parts of the mountain they are used to live in bad conditions. In this context, working with the communities requires constructing and changing their mentality in such a way that they want to live in good conditions, and that they comprehend the need to share responsibilities as well as rights. This is a long and sustained process that has not been achieved yet, but has had progress. They have set up several

commissions to manage the slopes and communitarian groups that have been working and promoting actions to reduce risk.

Looking for institutional support for the PSA

The Environmental Sanitation Program is being implemented by one executor unit which is temporal; it exists as long as financial resources are available. In this case, although the work done by the PSA has been really important in terms of reducing hydrodynamic and geodynamic risk in the slope settlements and in the city as a whole, many of their initiatives and programs, once the program is finished, will remain without an institutional support and be at risk of losing those experiences if they are not institutionalized by the Municipality.

After 2013, when the PSA finishes, it is expected that each topic of the program will be assumed by the competent institutions. For instance, everything related to drainages, collectors and water management works are competence of the EMAAP-Q, so it assumes those functions. But all of the other activities in the Pichincha slopes have to be assumed by the Municipality. At the moment there is good receptivity form the current administration and the risk management topic has gained a lot of attention. Therefore, the people working in the PSA think it is a good moment to institutionalize this management.

Currently the PSA is interacting with the Security and Governance Secretariat to determine who will be in charge of the continuity of the project's activities. It is still not clear if the Secretariat will assume the functions or if there will be a unit created within the Secretariat specifically to manage slopes. However if they continue to create more units, there will be more activities divided and that necessarily requires more vertical and horizontal coordination among all the actors.

Establishing an Integrated Risk Management System

The Municipality has been undergoing several institutional arrangements in order to develop the capacity to improve risk prevention and reduce vulnerability. One of those institutional arrangements was the creation of the Risk Management Unit within the Security and Governance Secretariat. But the current risk management system is affected by some coordination drawbacks. At the moment, from this institutional assessment, a set of actions focused on prevention and mitigation were identified as being implemented by different institutions within the municipal structure and other private actors, as well as the civil society. But all of those actions are not adequately coordinated.

Vertical coordination from the Risk Management Unit with the security units in each Administrative Zone works well, although in some administrative zones the people interviewed pointed out that there is lack of coordination within each administrative zone, particularly when it comes to budget allocation. But horizontal coordination between all the actors identified to be involved in any phase of the risk management cycle needs to be developed.

The landslide risk management system scenario of QMD is not disappointing. In fact, its performance, although was determined to be insufficient, it is emerging and can be enhanced. Much attention now is being put to the establishment of an Integrated Risk Management System in charge of establishing as mandatory the fulfillment of the dispositions related to risk management and defining the competences of the different institutions working on the same thematic in order to avoid overlapping of functions. In this way, this Integrated Risk Management System could be in the position to demand the different levels and sectors within the municipal structure the incorporation of the risk management components in an integrated way.

In the same way, an Integrated Risk Management System could be an option to face the problem of lack of continuity. Each time there is a change of major, which is every four years, or there are changes in the administrator of each administrative zone, or the directors of different Secretariats, the activities and progress gained in specific areas is frequently lost.

From emergency response to prevention

There has been a change in the vision of risk management in QMD from the reactive to the preventive. The development of contingency plans for the rainy season are a good way to prevent, mitigate and control the impacts produced by the hydrometeorological and geodynamic events that are recurrent during the rainy season and that cause many of the landslides and floods that affect the city. However there still needs to be more work done in the awareness raising processes. One of the objectives is to develop a culture of prevention so that the communities do not continue to construct risk, this was already discussed. But the other objective is to increase the knowledge of emergency preparedness in order to have more resilient communities.

In this case, the Public Security Agenda is also promoting the development of awareness raising campaigns; the transmission of information to individuals, families and the community; the development of family and neighborhood emergency plans; the promotion of communitarian teams for response; the organization and expansion of community teams' training programs; the development of training with social communicators and mass media; and the execution of drills. Some of these activities have already begun, but they need to be strengthened.

An aspect that has not been developed in QMD's activities to prepare against landslide events is risk transfer and insurance. Within the landslide risk management performance, this indicator received the lower level of performance. In the city specifically, and in the country in general, an insurance culture does not exist. The population spends less than 1% in any type of insurance, and this is mainly for automobiles. In addition to this, the costs are really high and therefore there is not much opportunity for people to have insurance.

Usually insurance companies do not consider the location of as asset when it is insured. In this sense, insurance does not have a preventive role, they only compensate. Only recently some international re-insurance companies, with a wider vision abut risk, are demanding national insurance companies to ask the research institutions for information about possible effects of volcanic eruptions.

This low perception of the insurance companies about natural hazard risks has to do with the fact that in the city it has not been necessary yet to pay high costs due to natural events. But in case of a big disaster and enormous damages in the infrastructure and equipment, the city in general and the institutions in charge of emergency management, monitoring, the Municipality and other private enterprises, do not have an economic support that would help all of them to recover. Even less the poor sectors of the city.

During a conference of Disaster Risk Reduction in Quito, one of the speakers presented an experience of the Municipality of Manizales, Colombia, with an insurance policy that could be applied in Quito. Manizales is the only city in Latin America and the Caribbean that has a collective voluntary insurance policy to protect the poorest sectors of the city. It was developed after an earthquake completely destroyed the city. This policy represents a partnership in which the Municipality facilitates, through an information systematization process, the collection of a fee for damage insurance for each building property in the city. In this system, the higher sectors of the society subsidize the poorest sectors of the city. This type of insurance policy is a way of reducing risk and improving the quality of life of the population because in order to be incorporated, the neighborhoods have to be regularized and comply with the land use regulations, therefore avoid risk areas. Although this experience has not been applied in Quito, there are now the knowledge and the political will to consider it during the decision making process.

Improving the emergency response systems

In terms of emergency management, this phase of the disaster risk management cycle is more advanced. During the last 10 years several institutions and organisms have been created and modified to have more coordination and cooperation among the different emergency management actors. There is the Central Emergency Committee that makes decisions in a coordinated way about the priorities and actions to be taken in case of an emergency. The existence of a coordinating body is considered a progress in this respect. Thanks to this, the capacity of the emergency management institutions to work together has increased, the interinstitutional relations have strengthened, and procedures, roles and protocols among the different institutions have been defined.

However it is important to mention that this organism acts only during an emergency, afterwards, the connections disappear. In addition, some interviewed people pointed out that the communication channels between all the emergency management institutions are not really clear. There are still some improvements that can be made in the emergency response systems. For instances, the Public Security Agenda presented a project to support this improvement through the strengthening of the CEMAC; the design emergency and contingency protocols; the improvement of the pre-hospital and hospital emergency attention; and the strengthening of the COE.

Another project within that Agenda is the development of a District Communication System to face natural disasters. This implies the design of a system to manage communication in a technical, rational and well dimensioned manner in case of a disaster. It is necessary to have

communication protocols, which at the moment are not available, in order to incorporate the different communication media in the diffusion of official information before, during and after a potential event that affects the district.

The need to develop recovery mechanisms and social safety nets

Throughout this landslide risk management institutional assessment, post-disaster phase was the one less developed. This phase basically recognizes a shot term recovery, but reconstruction does not consider risk factors on the long term. Most of the population stated that after an even, they have not received support or help to recover, although some people mentioned that they received help from the Municipality in terms of construction machinery, social and economic help in a few cases as well as relocation in the case of destroyed houses. It was not possible to identify a generalized development of reconstruction plans that address the issue of physical damage with the notion of re-building better and social recovery based on risk scenarios before an event.

Most of the communities stated that after a landslide event it is the same neighborhood the one that supports affected families and recover by themselves. There were no permanent social investment funds to support vulnerable communities focusing on the poorest socio-economic groups. Neither it was possible to identify social networks for the self protection of livelihood means of communities at risk, nor regular micro-credit programs for the rehabilitation and reconstruction aimed at reducing human vulnerability.

In this sense, there is a lack of capacity of the institutions to act on rehabilitation and reconstruction and there is the need to establish rehabilitation and reconstruction plans and strategies that include socio-economic aspects.

Measuring progress

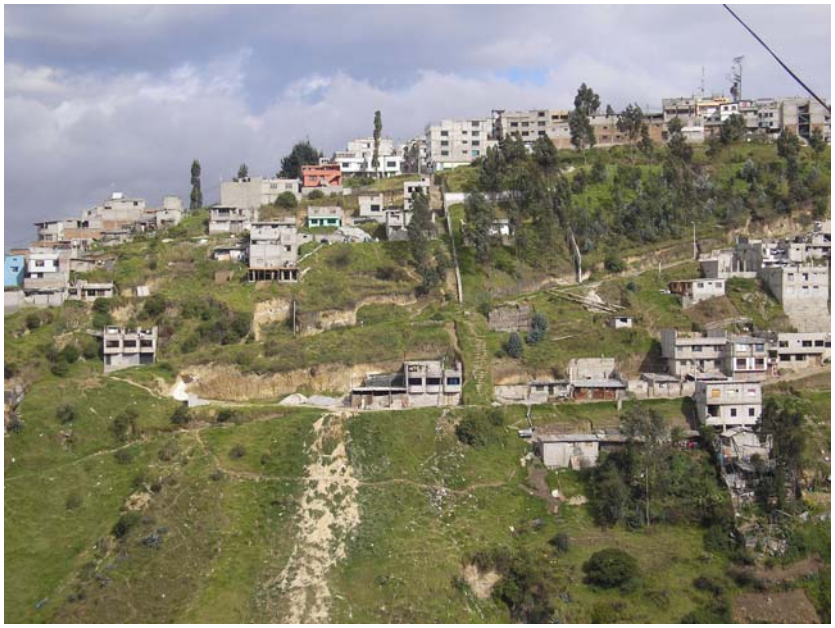
Up to here, some of the limitations and potentialities of the landslide risk management system have been identified. But it is necessary to consider a way of measuring the progress of the different proposal and plans that have been stated. In this context, a set of criteria and indicators should be developed by the coordinating institution in order to: assess their effectiveness and progress; help systematize and establish achievements, best practices, generic standards, and priorities; compare different approaches; identify existing gaps and constrain in order to address them with informed decisions; and guide action to reduce disaster risk (Cardona, 2007; Mitchell, 2003; UN/ISDR, 2004).

6.3. Landslide risk management at the community level

Many experts in the topic of risk management recognize that the only effective way to reduce society's vulnerability to natural disasters is by involving the community because risk is the result of unsustainable development. In this context, this section is focused on landslide risk management at the community level in order to analyze the capacities of the communities living

in landslide prone-areas as well as the way they actually manage this problem. The following paragraphs present the outcomes of the surveys applied in 150 neighborhoods of QMD to provide a general description of the vulnerability scenario of the neighborhoods and the community landslide risk management systems. This will allow to develop a landslide risk management and community capacities assessment to evaluate their level of performance and discuss what makes communities resilient to landslide disasters.

6.3.1. Neighborhoods vulnerability

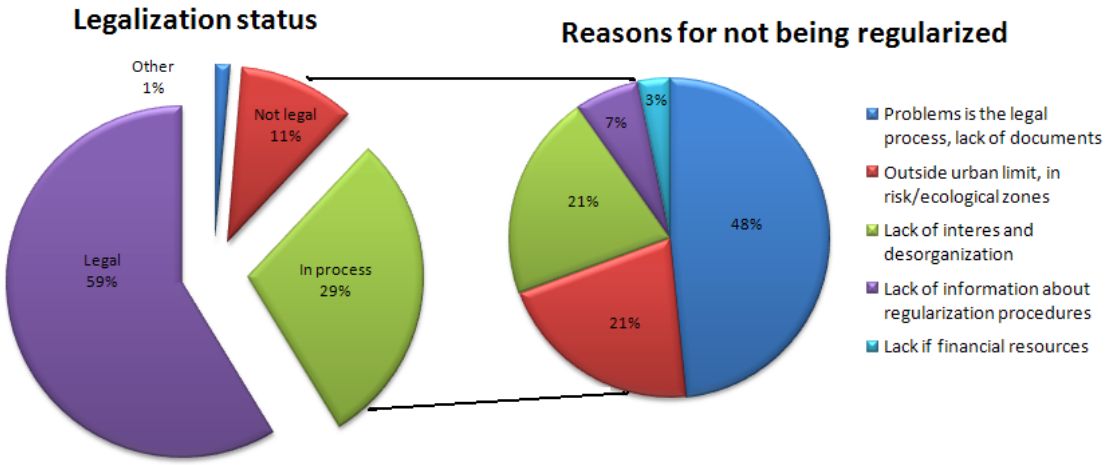


Political and social vulnerability of the neighborhoods

One of the main aspects that exacerbate the risk of landslide and the vulnerability of the population is the illegal settlement in slope areas. Of the 150 neighborhoods included in the analysis, 40% of them were not legal neighborhoods, of which 29% are in the process of regularization. The main reasons for not being legal neighborhoods include: problems in the legal process and lack of documents that prove who are the legal owners of the land; the fact that they are settled in areas outside the urban limit, such as ecological protection zones, risk zones or rural areas; lack of interest of the community to become regular neighborhoods and

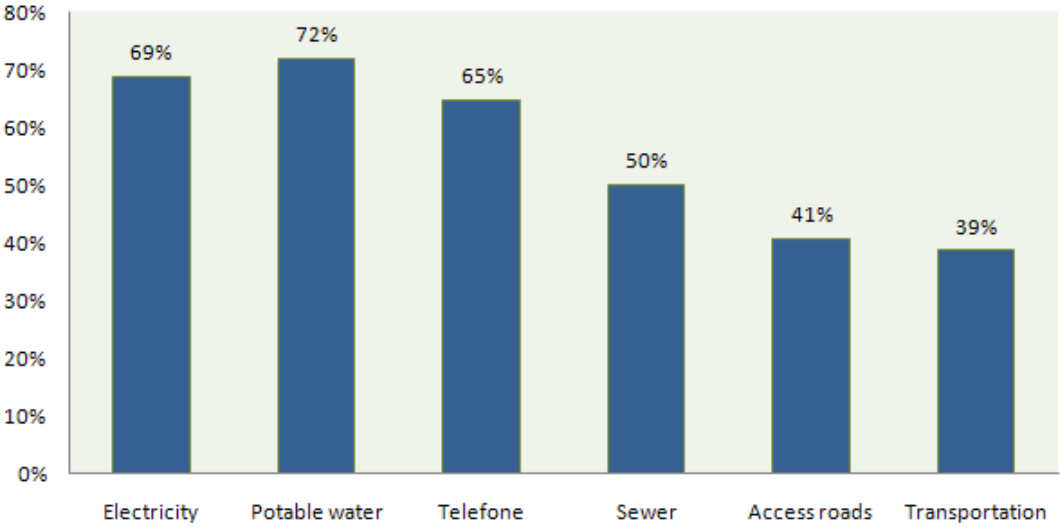
lack of organization among the members of the community; lack of information about the regularization procedures; and lack of financial resources to spend in the gathering of documents and all in all the process of regularization.

Figure 15 Legal and not legal neighborhoods



An additional aspect that increases vulnerability is lack of basic services. The results of the surveys showed that the neighborhoods do not have total coverage of services such as electricity, drinking water, telephone, sewer, access roads and transportation. There is a close relation between partial basic services coverage and the illegal status of the neighborhood. The services that have less than 50% coverage are sewer, roads and transportation. This is an important aspect to consider as the lack of sewer in many neighborhoods is one of the factors that increase landslide risk.

Figure 16 Percentage of basic service coverage



Community organization

In terms of the community organization, 97,3% of the members of the neighborhood get together to discuss several issues related to the neighborhood such as works needed for the improvement of the neighborhood, regularization or security. In several neighborhoods they are organized in different committees with specific roles, as can be seen in the table 7.

Table 7 Community organizations

Type of organization	% of neighborhoods with those organizations	Main activities
Community Committee	79%	• Works for the neighborhood • Neighborhood organization • Regularization
Improvement Committee	50%	• Works for the neighborhood • Security • Community development • Regularization
Security Committee	29%	• Security activities • Training and awareness-raising campaigns
Community Squad	16%	• Surveillance • Security
Housing Cooperative	6%	• Neighborhood upgrading • Regularization
Savings and Credit Cooperative	11%	• Credit for development • Saving money • Regularization

The Community Committees are formed of a president, vice-president, treasurer and secretary and are in charge of arranging and negotiating works needed for the neighborhood, the process of regularization, as well as organizing the community and informing them about their activities. There are also Improvement Committees in charge of negotiating works for the improvement of the neighborhood and community development, supporting the regularization process and security within the neighborhood.

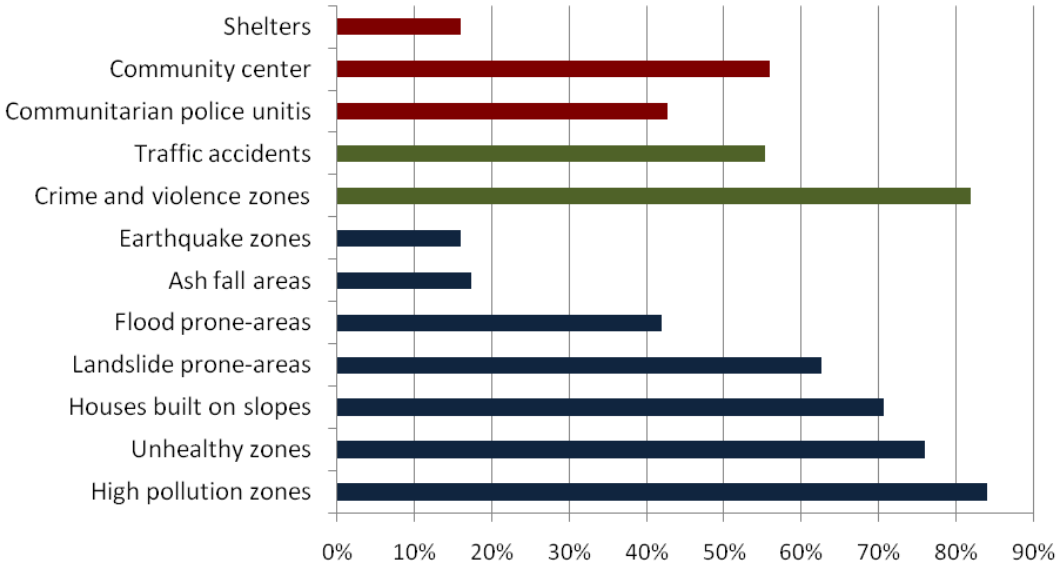
Two types of organizations in charge of security issues are present in less frequency. One of them is the Security Committees which have been conformed in only 29% of the neighborhoods included in the study as part of the Security Agenda of the Security Secretariat. These committees have a direct relation with the Security Promoters in their Administrative Zones and receive training based on the contingency plans for the rainy and dry season as well as equipment for emergency management. The others are the Community Squats found in only 16% of the neighborhoods with the function of surveillance and security mainly for crime and violence.

Even in less percentage housing cooperatives and saving and credit cooperatives are found in the neighborhoods to support their members to have access to credit and social housing projects. Therefore, not many people can have access to this type of support and thus they are forced to look for a place to live according to their possibilities.

Risk and vulnerability perception

The perception that the community has in regards to the risks they are exposed to and their vulnerability was also obtained from the surveys. More than 60% of the community leaders identified high pollution and crime and violence as the most relevant risk zones in their neighborhoods, followed by unhealthy zones, houses built on slopes and landslide prone-areas. A fewer percentage of community leaders identified safe areas such as community centers and communitarian police units.

Figure 17 Identification of risk and safe areas



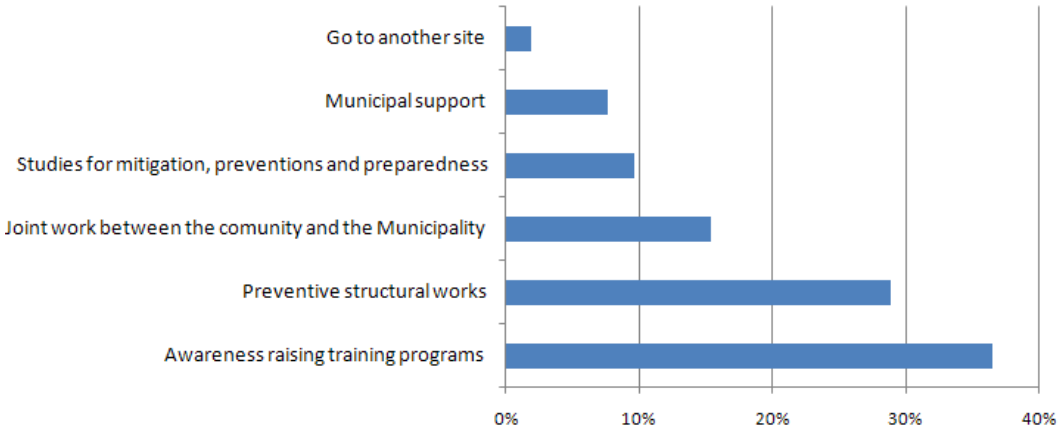
When asked which of the identified natural events has been the most frequent, the majority of the people (38%) answered “none of them”, followed by landslide events (29,3%) and floods (15,3%). This shows that there is low perception of landslide risk and low level of risk awareness, as the 150 neighborhoods selected for the study had registered at least one landslide event since 2006. Moreover, according to risk and vulnerability studies, the entire city is located in a risk zone, mainly for earthquake and seismic events, but not even those risks are identified by the communities.

On the one hand, 58% of the community leaders think that the communities feel safe in regards to landslide events. They base this assumption on the fact that landslide events have not occurred (26%); they consider their neighborhoods as safe zone without landslide risk (62%); only a few feel they are prepared to act in the case of a landslide (10%); and a minority feels safe because of the commitment of all the members of the community. On the other hand, 42% don’t feel safe because they recognize that they are located in a risk zone and that the constructions are not properly made.

For the community leaders that do not feel safe, the most import actions they think are needed in order to improve this situation are an increase of awareness raising training programs (37%)

and the development of preventive structural works (29%). In less frequency, some believe that what is needed is the joint work and corresponsability between the community members and the Municipality (15%) and more efforts to undertake studies to determine mitigation, prevention and preparedness measures (10%). Still a few rely solely on the work of the Municipality to improve their safety situation (8%) and even less consider necessary going to another place to live (2%).

Figure 18 How to improve community security?



Level of vulnerability

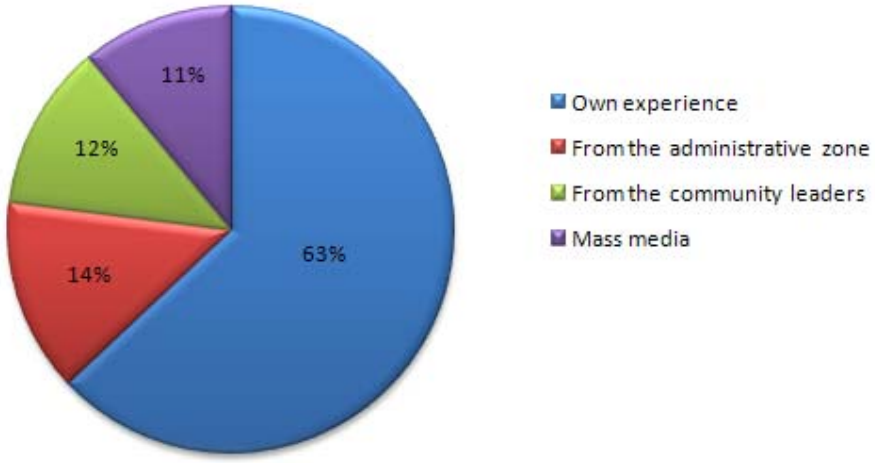
According to the political and social vulnerability of the neighborhoods, their organization and the risk and vulnerability perception of the population, a level of vulnerability was assigned to each of the neighborhoods which varied from low, medium and high. The majority of the neighborhoods (72%) showed medium vulnerability, followed by high vulnerability (25%). Only 3% of the neighborhoods had a low level of vulnerability.

6.3.2. Community landslide risk management performance

Access to information, education and training

Risk and vulnerability perception, as well as landslide preparedness is related with access to information, education and awareness-raising campaigns. In this context, 41,3% of the community leaders mentioned that the population living in their neighborhoods has not heard about the hazards and risks that affect them and this is reflected in the low level of risk awareness. The rest of the leaders (58,7%) believe that the population living in their neighborhoods knows about hazards and risk, particularly they know something about landslides (27,3%), floods (16%), other natural disasters (10,7%), and prevention (2,7%). According to the interviewed this knowledge has been obtained mainly from their own experience and in a less degree from education and awareness-raising campaigns from the Municipality, the community leaders or from the mass media.

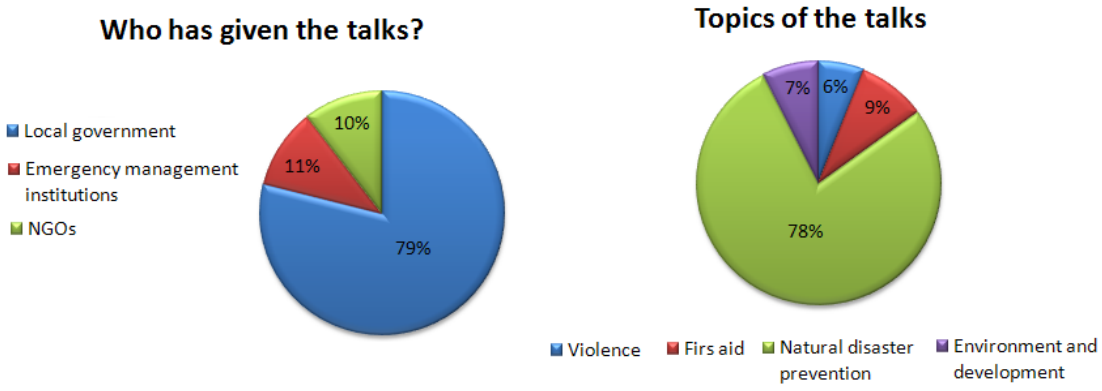
Figure 19 How do people know about hazards and risks that affect them?



In regards to awareness-raising training programs, 44,7% of the interviewed stated that the members of the community have received talks about hazards and risk in the last two years, of which the majority have been annually (31,3%), occasionally (19,4%) or semiannually (16,4%). Less than 9% of the talks are more frequently received, every three months, every month, or every week.

The Administrative Zones are the ones more frequently identified as giving those talks with the main topic being natural disaster prevention and security. In the neighborhoods where these talks have been done, 30% of the interviewed think that only a minority of the community participates, 29% think that only a small part of the community participate, 27% think that a big part of the community participate, and 14% think that the entire community participates.

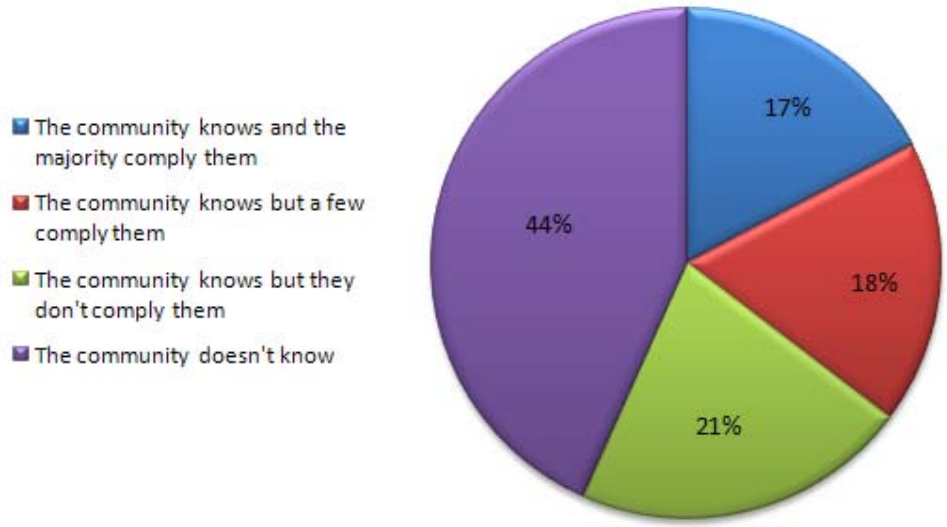
Figure 20 Awareness-raising and training programs



Preventive and mitigation measures

According to the community leaders, a big percentage of the population (43%) doesn't know about land use occupation regulations and construction codes. The rest of the population knows them, but only 17% of them complies those regulations.

Figure 21 Community knowledge and compliance of land use regulations

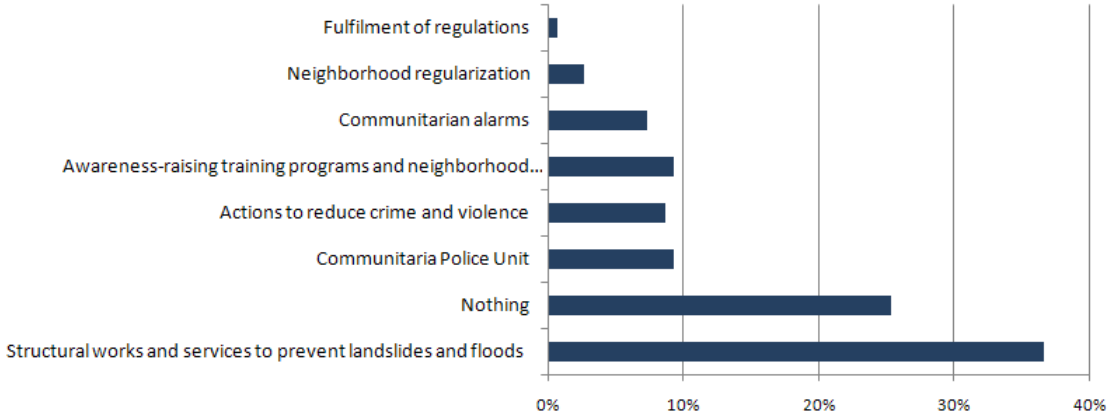


In the same line, only 30% of the population considers the risks they are exposed to at the moment of building their houses. The main reasons why the population doesn't comply the regulations or consider risk when they look for a place to live are: a lack of knowledge, information and interest (46%); the need they have for a place to live and the reduced economic resources (21%); the fact that they consider there are no risk that would affect them (17%); the lack of control mechanisms (7%); and the fact that they are irregular settlements (2%).

Responses to landslide events were seen to fit the "no action" behavior, reflecting risk rejection and the passive acceptance of risk. 26% of the interviewed reported that in their neighborhoods they have done mitigation works to protect against landslides. This mitigation works include water collectors, contingency walls, reforestation, sewer cleaning, as well as slope filling. Of those mitigation works, 72% have been done either by the Administrative Zones or by the Municipal enterprises. The rest has been done by the community as self-protection works.

In general terms, the community leaders recognize that one of the major achievements of the neighborhood to be safer has been the development of structural works and services to prevent landslides and flood (37%), but a high percentage also thinks that there are no achievements that can be identified (25%). A less percentage of community leaders identified as achievements the establishment of communitarian police unites in the neighborhood, the development of actions to reduce crime and violence, awareness-raising training programs and neighborhood organization and regularization.

Figure 22 Major achievements of the neighborhood to be safer

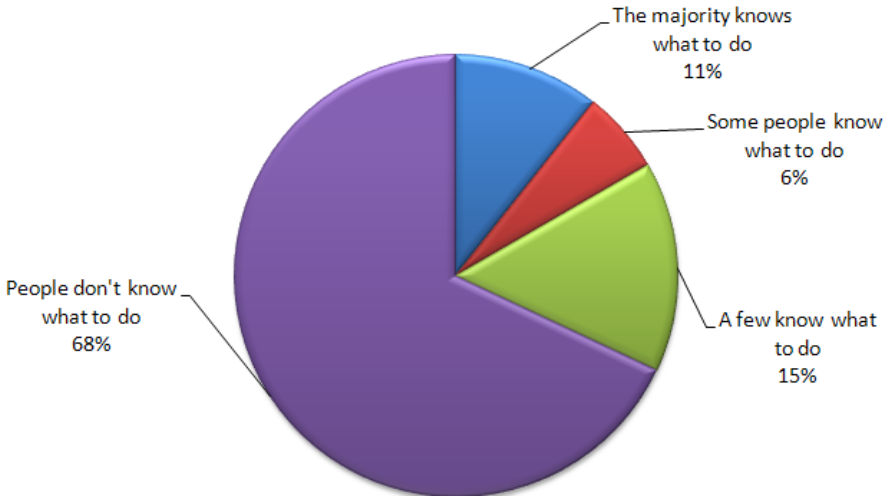


When asked if people would be willing to be relocated to a safer place, 49% believe families are not willing to be relocated for three reasons: most of them feel safe, for other their houses are their only patrimony, and a few don't trust the Municipality's offers of the Relocation Program. 27% think that the families are willing to be relocated, and 24% say that maybe the families are willing to be relocated under certain conditions: if they are located in a safer zone or if they are given the same conditions of space and construction.

Emergency preparedness and disaster management

Most of the community leaders believe that the members of the community don't know what to do in case of a landslide, and the people that reported they know what to do, state that they would basically go to a safer place. Only 40% of the community leaders mentioned that there is a warning system or a community alarm. However this community alarm is mainly use for crime and violence (47%), followed by any type of emergency (22%). The interviews showed that only 8% of the alarms are use for natural events.

Figure 23 Community knowledge during a landslide emergency

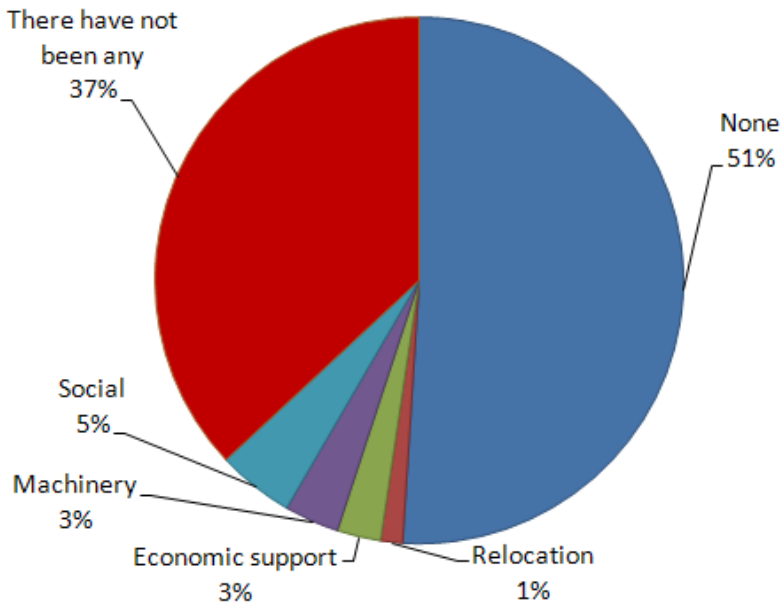


In the same line of emergency preparedness, drills were identified to be implemented in only 23% of the neighborhoods. In those neighborhoods, 44% of the drills were done only once, 27% are done every year, 12% every month, and the remaining 17% are done more frequently. The drills are mainly for security control (53%), followed by drills for natural disasters (24%), fires (15%) and to test the community alarms (8%).

Recovery and reconstruction

In terms of recovery after an adverse event, half of the community leaders reported that affected families have not received any support to recover, 37% mentioned that there has not occurred any natural disaster. The rest 11% answered that the affected families have received physical, social or economic support. Only 1% has been relocated to a safer place.

Figure 24 Support after a natural event



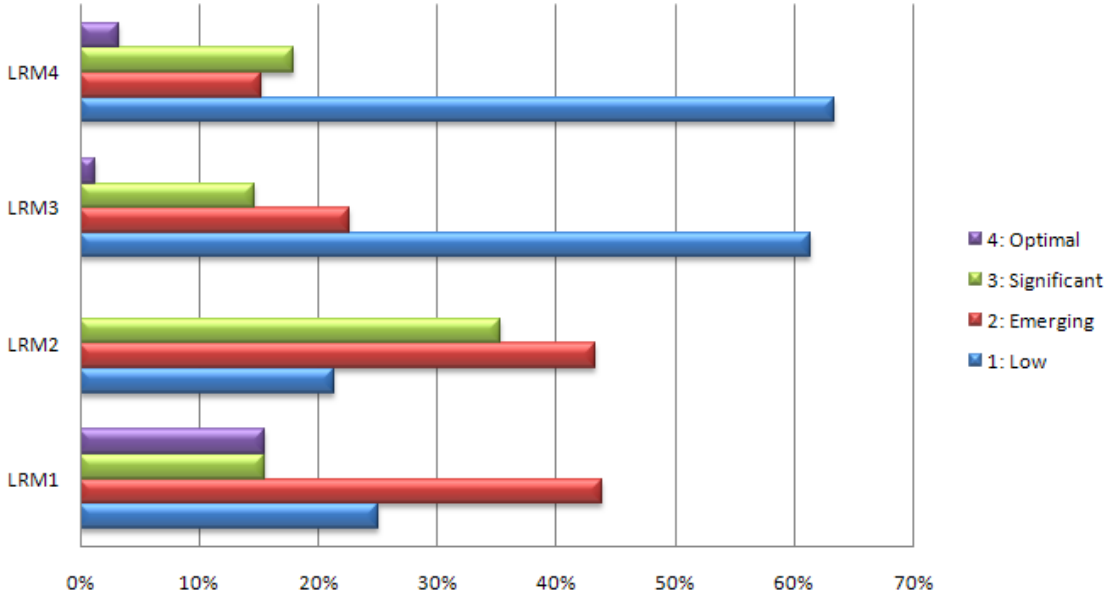
Performance level

The indicators developed for community landslide risk management were used to measure the level of performance in the 150 neighborhoods studied. The following table and figure 25 presents the percentage of neighborhoods that belong to each of the four levels of performance for community landslide risk management (low, emerging, significant and optimal) according to the four sub-indicators of community landslide risk management: risk consideration in land use and construction; mitigation and risk reduction measures implementation; emergency preparedness and disaster management; and recovery.

Table 8 Community landslide risk management

Level of performance	Community Landslide Risk Management				Total performance
	LRM1	LRM2	LRM3	LRM4	
1	25%	21,3%	61,3%	63,3%	43%
2	43,9%	43,3%	22,7%	15,3%	31%
3	15,5%	35,3%	14,7%	18%	21%
4	15,5%	0%	1,3%	3,3%	5%

Figure 25 Community landslide risk management



As it can be seen, for the first sub-indicator, risk consideration in land use and construction, almost 69% of the neighborhoods show a low and emerging level of performance, whilst the remaining 31% present an adequate and optimal performance. In the case of mitigation and risk reduction measures implementation, most of the neighborhoods (79%) were found to be in the two intermediate levels: insufficient for the existing level of risk, but emerging (43,3%) and adequate performance, but with restrictions (35,3%). None of the neighborhoods showed an optimal performance. Emergency preparedness and disaster management as well as recovery are the most underdeveloped activities of landslide risk management. The majority of the neighborhoods were found in the lower performance level, 61,3% and 63,3%, respectively.

As a consequence, a higher number of neighborhoods show a total performance level for landslide risk management that belongs to level 1: low or inexistent performance. The reasons why there are such low levels of landslide risk management have to do with the community capacities in place as well as the institutional capacities that provide the enabling environment for a successful management. These aspects will be immediately discussed.

6.3.3. Community capacities' performance for landslide risk management

A top-down or bottom up approach?

The practical responsibility for disaster risk management falls on the level of government closest to the communities, which are the Administrative Zones of the Municipality and it is mainly a top-down approach. 63% of the interviewed believe that the Administrative Zones are present in their neighborhoods. Out of that percentage, the community leaders recognize that the Administrative Zones work either implementing works for the neighborhood improvement (57%), providing talks and training programs related with security (16%) or supporting them with the regularization process (3%). However 24% of the people consider that the Administrative Zones don't do anything for the neighborhoods.

But when asked if they believe that the Municipality considers their neighborhoods in themes related to the development of the city, only 44% answered positively. According to their answers, their neighborhoods are considered in the development of the city because they have support, training courses and advice for community development as well as works for the neighborhood. But 56% don't feel they are included in this development due to the following reasons: lack of work in the neighborhood, the fact that it is an irregular settlement, lack of organization within the neighborhood, and lack of communication.

Debates about top-down and bottom-up argue the relevance and empowerment of the bottom-up, community based view, instead of the command and control top-down approach (King, 2008). But the reality is that landslide risk management executes and plans different events, through a layered and hierarchical system. According to King (2008) the effectiveness of such management may not necessarily be the complete opposite, but the extent to which it integrates and engages all level of community, managers and stakeholders in developing their own risk management (King, 2008). This is way community capacities are a key aspect to be considered.

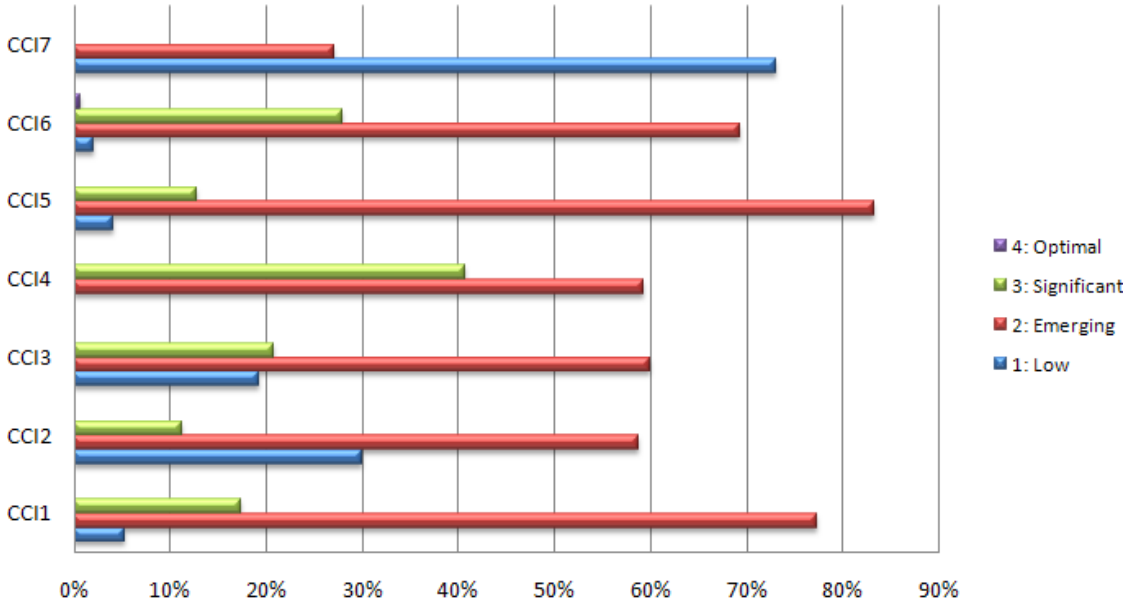
Community capacity performance

All of the variables obtained from the surveys applied were categorized in order to measure the seven sub-indicators for community capacity. These sub-indicators are: community organization; community training in landslide risk reduction and management; access to risk and risk management information; public awareness; responsibility and commitment in regards to landslide risk reduction; community participation and involvement in landslide risk management; and coordination among different local actors. The following table and figure 26 presents the percentage of neighborhoods that belong to each of the four levels of performance for community capacities.

Table 9 Community capacities performance

Community Capacities	Level of performance			
	1	2	3	4
CCI1	5,3%	77,3%	17,3%	0%
CCI2	30%	58,7%	11,3%	0%
CCI3	19,3%	60%	20,7%	0%
CCI4	0%	59,3%	40,7%	0%
CCI5	4%	83,2%	12,8%	0%
CCI6	2%	69,3%	28%	0,7%
CCI7	73%	27%	0	0
Total	19%	62%	19%	0%

Figure 26 Community capacities performance



For the highest percentage of neighborhoods, all of the community capacities, with the exception of coordination among different actors, the level of performance is the second one, which is insufficient for the existing level of risk, but is emerging. Almost none of the neighborhoods showed an optimal level of performance of the community capacities and just a few had a significant performance. In the case of coordination capacity among different local actors, this was the least developed capacity as 73% of the neighborhoods showed a low level of performance and none of them had a level 3 or 4.

Community training and access to information for public awareness

In a scenario of increased landslide risk vulnerability, such as the one in the neighborhoods of QMD, it is imperative to use the community's potential in its fullest form through proper awareness raising and capacity building. Some good practices have shown that through sustainable community disaster education it is possible to reduce the risk of landslide and thereby make cities safer to geological and hydro-meteorological hazards and more resilient communities (Shaw & Takeuchi, 2008).

The low percentage of awareness-raising training programs received by the community is reflected in the low level of knowledge about the risks that the population is exposed to and the low relevance landslide risk management is given by the community itself. As most of the talks and campaigns given to the community focus on what to do in case of a natural disaster, not many people is aware of the underlying causes of vulnerability and risk and how their own behavior can change this situation.

More formal and systematic awareness-raising programs need to be constructed and deliver to the communities, but these programs should also be participatory so that the knowledge is not only disseminated but also internalized by the community. In this way prevention can become an integral part of everyday social practice. Shaw and Takeuchi (2008) argue that disaster education needs to focus on the process of restructuring communities of practice, and not only on the transfer of knowledge and skills. This means, to establish communities in which educators and learns can participate together and create, for instance, a community disaster prevention network that involves students, teachers, the school system, parents, community people and the city in general (Shaw & Takeuchi, 2008).

In some Japanese cities "town watching" has been implemented as a participatory technique used in community or neighborhood planning in the contexts of larger administrative units in order for residents to recognize problems as a group and put forward solutions together guided by at least one expert or professional in community planning (Shaw & Takeuchi, 2008). Through a series of continue actions, this participatory techniques help develop disaster resilient areas. These type of initiatives need to be developed in QMD.

Other alternatives are to establish knowledge centers specifically to provide information of disaster risk management, mainly of the risks that affect each locality, and to collect and transfer village information. It is true that advanced technology and knowledge production is an important tool for the protection against landslides. However, technology does not reduce disaster impacts unless institutions, communities and individuals know how to interpret this knowledge into actions, use and adapt technology effectively and organize socially and politically to structure landslide risk reduction (King, 2008). Through these knowledge centers, members of the community could be trained in different topics and then they could continue as community Security Promoters. This would require the involvement of different actors within the community so that the community wouldn't rely all the responsibility on the Municipality, but rather become active participants.

Empowering aware communities

In general the communities living on slopes are aware that they line in a landslide prone area and make clear links between steep slopes, heavy rains and landslide events. Some of them also make clear connections between deforestation and the absence of sewer systems and the consequences of heavy rains. But in spite of this, the sample households were seen to attach less importance to landslide risk and other natural hazards, and more to everyday livelihood concerns which are viewed as more immediate threats than relatively infrequent landslide events.

According to Winter and Bromhead (2008), the affirmation all over the world that we live in a "risk-averse society" is becoming a common viewpoint and implies that the willingness to accept or tolerate risk is low. This is evident in this case, as more than half of the population doesn't recognize landslide risk as a serious threat. The statement of a "risk-averse society" is part of a broader context that includes the willingness (and ability) of societies, communities, organizations or other stakeholders, to pay for risk reduction measures and the willingness to alter the environment in order to accommodate such measure (Winter and Bromhead, 2008). This could perfectly be the case in many neighborhoods in Quito where risk reduction measures can be too costly.

Oven and collaborators (2008) argue that the "no action" behavior, risk rejection and passive acceptance of risk may be driven by a lack of awareness of the hazards, but it may also be an indicative of powerlessness or a positive decision to do nothing having considered the alternatives.

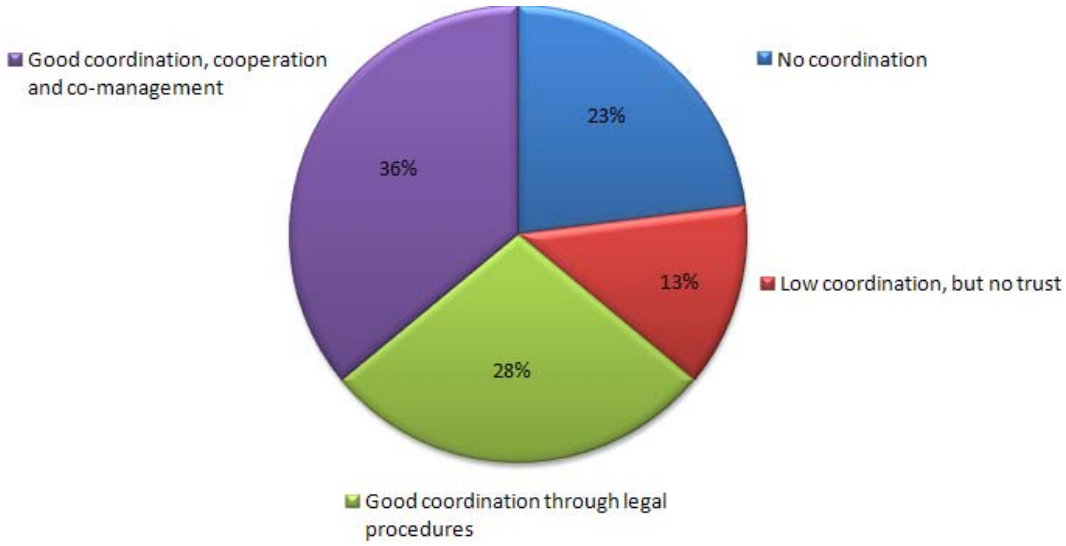
In the case of the neighborhoods in QMD, most of the population considers landslides to be beyond their control and rely mainly on the local government to provide external control and do something to lessen the impact of the landslide events. In this context it is necessary to consider that the social and economic influences have a major effect upon the willingness to accept risk. Moreover, there are other social problems that can be given more attention, such as crime and violence, which was found to be one of the most important concerns, not only of the community, but also of the municipal actors. King (2008) argues that landslide risk management is a political process in competition with other priorities and issues. Hence, strengthening stakeholder and community involvement is the strongest need in risk management.

The importance of communication and coordination among different local actors

Poor communication and coordination has been highlighted as one of the main constrains to develop community empowerment. The lack of communication reaching both down to, and up from, the community level is a limitation and also a source of frustration and lack of accountability. Well-trained communities that have been provided with the means and resources necessary for landslide risk management can significantly contribute to efforts done by the Municipality to implement landslide risk management policies and become active participants. In order for this to be accomplished, good coordination and communication between the neighborhoods, the municipality and other stakeholders involved is required.

In the DMQ, 23% of the sampled community leaders believe there is no coordination at all between the neighborhoods and the Municipality; 13% consider there is low coordination but they do not trust them; 28% believe there is good coordination through legal procedures, papers and meeting with the community representatives; and 36% not only recognize good coordination and dialogue with the municipal instances, but also co-management and cooperation from all the community.

Figure 27 Communication and coordination between the neighborhoods and the Municipality



More communication and coordination is needed in order to achieve not only good coordination but also cooperation and co-management between the community and the other actors. A failure to achieve this is part of the power and political process that instead of creating bridges build barriers.

In this context, Andyani and collaborators (2008) argue that for disaster risk mitigation and reduction what is required is the establishment of institutional frameworks for community empowerment in order to include multi stakeholders with an inter-discipline approach involving more social disciplines. Throughout the surveys it was not possible to identify a lot of institutions conducting some efforts for community empowerment with respect to landslide risk reduction. Therefore the establishment of a framework to facilitate coordination, communication and cooperation among stakeholders which incorporates various stakeholders from the private sector, potential funding institutions, universities, professionals, non government organizations, mass media, and the representatives from the government institution is an alternative to improve landslide risk management.

This is not an easy task. Obtaining strong commitment from each institutional member and facing the financial constrains has been identified by some authors as the main challenge to maintain the sustainability of such institutional frameworks (Andyani et. al. 2008). They argue

that most of the mitigation efforts have a minimum consideration of the socio-cultural aspects and therefore the countermeasures cannot be effectively implemented and operated by the community, limiting in this way their involvement and active participation.

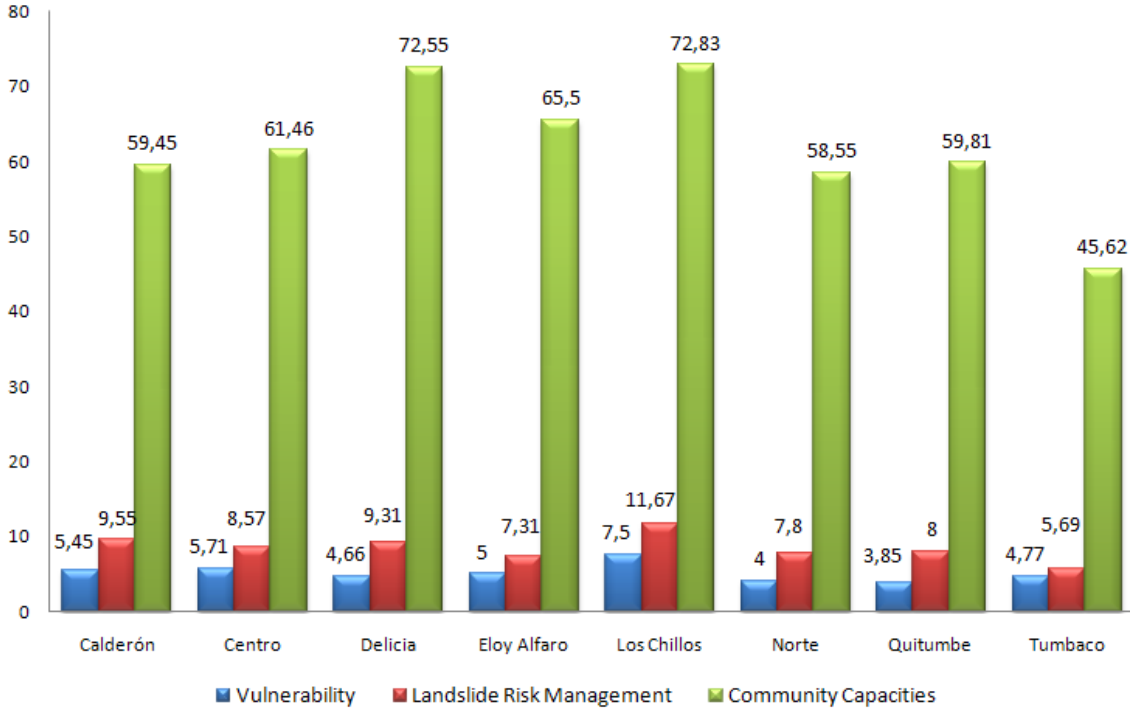
As a way to solve this issue, Andyani and collaborators (2008) suggested to establish a more systematical approach and mechanism to include socio-cultural and economic considerations in disaster risk reduction. They showed an example of community-based early warning systems for landslide events which proved to be successful due to appropriate investigation on socio-cultural characteristics of the community. That allowed the involvement of different stakeholders that consisted of schools, women organizations, the community, local red cross, local teams of Research and Rescue, local police and NGOs.

This type of initiatives and methodologies need to be developed for the neighborhoods of QMD in order to develop cultural willingness and preparedness for landslide and other disasters mitigation and reduction.

6.3.4. Relation between community capacities and resilience to landslides in the different Administrative Zones

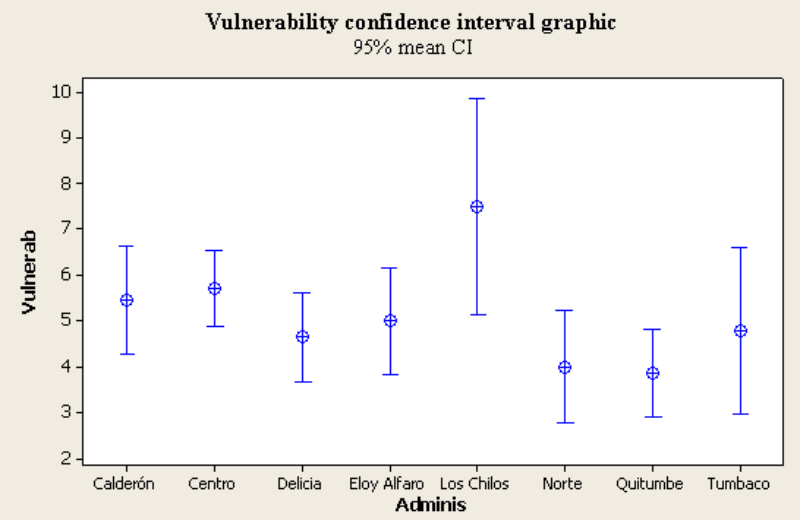
The vulnerability, landslide risk management and community capacities were compared between the neighborhoods located in the 8 Administrative Zones to find out if there are significant differences among them. Figure 28 shows the respective values for these three variables according to the numbers given to the indicators that corresponded to them.

Figure 28 Differences between Administrative Zones



With a mean comparison analysis it resulted that there is a significant difference in the vulnerability of the neighborhoods located in the 8 Administrative Zones. The neighborhoods that belong to Los Chillos show the highest vulnerability as well as a large standard deviation, probably because of the low number of neighborhoods selected from this Administrative Zone.

Figure 29 Vulnerability mean comparison analysis

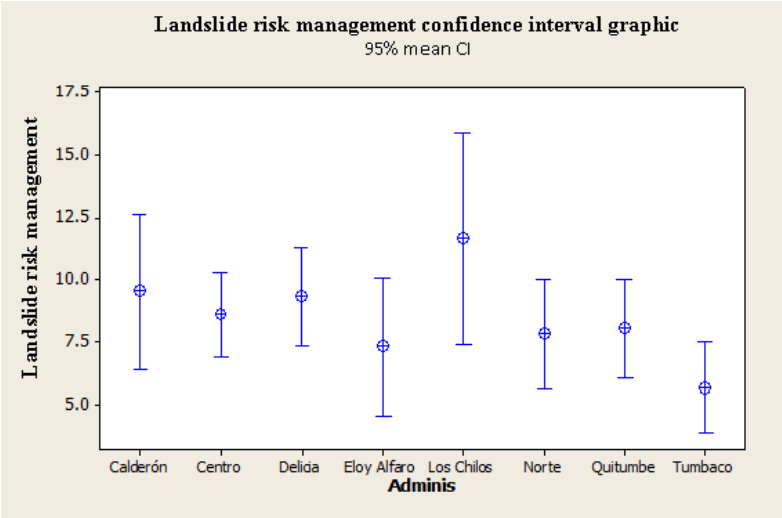


Although the entire city is located in a risk area and is exposed to earthquakes and volcanic activity, Los Chillos is located just 60km from the active Cotopaxi Volcano which since 1534 has had 13 big eruptions. Those past eruptions have produced mudflows, ash fall and floods, destroying many populated zones. In the case of the communities living in Los Chillos, disaster risk is a serious issue considered by the population and the Municipality because they have experience them. That is the main difference between the rest of the neighborhoods in the other Administrative Zones, who have not suffered major disasters.

This same analysis showed that in the case of landslide risk management, there is no significant difference in the level of performance between the neighborhoods located in the 8 Administrative Zones (figure 30). According to those results, landslide risk management performance, from the highest to the lowest level, for the 8 Administrative Zones is the following: Los Chillos, Calderón, Delicia, Centro, Quitumbe, Norte, Eloy Alfaro and Tumbaco.

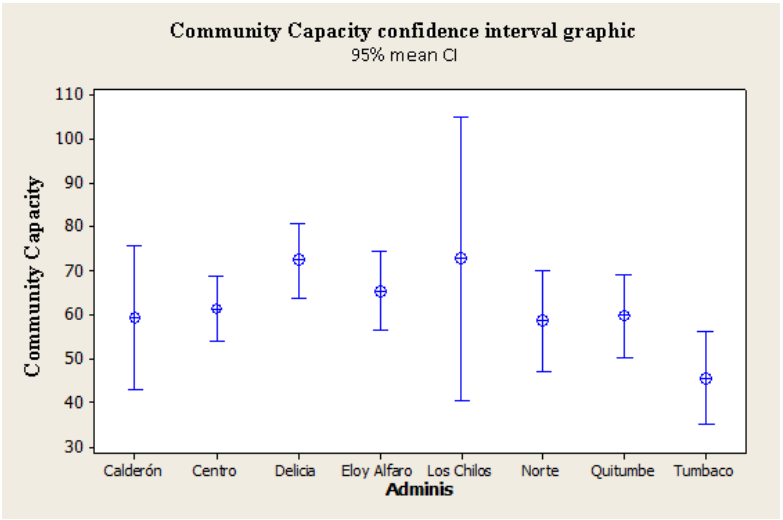
Due to the same reason exposed previously, los Chillos is one of the Administrative Zones that has been intensively working in disaster preparedness. Although total landslide risk management did not show significant difference between the Administrative Zones, the mitigation and risk reduction measures implementation sub-indicator was the only one to show a significant difference between the neighborhoods.

Figure 30 Landslide risk management mean comparison analysis



Finally, in the case of community capacity' performance, there is a significant difference between the 8 Administrative Zones (figure 31). The sub-indicators that showed a significant difference were organization capacity, public awareness, and community participation and involvement in landslide risk management. The rest of the sub-indicators did not show significant difference. From the highest to the lowest level of community capacities performance, the Administrative Zones are: Delicia, Los Chillos, Eloy Alfaro, Centro, Quitumbe, Norte, Calderón and Tumbaco.

Figure 31 Community capacity mean comparison analysis



The differences in community capacities among the Administrative Zones are influenced by several aspects such as the local context and history of the locations. For instance, in the

specific case of community organization capacity some of the reasons why there are significant differences can be found in the origin of the different neighborhoods, how long ago they were created, and different moments that they had to go through. On the one hand, old neighborhoods that are irregular tend to have more community organization in order to organize themselves to regularize it. On the other, neighborhoods that have a long time of being regular and that have access and coverage of basic services, usually are less organized because they don't have a common objective to work on.

In the same way, neighborhoods that have experienced difficulties or natural hazards have had to organize themselves and work together by themselves or with external actors in order to reestablish and recover. Or it may also be that in different periods some neighborhoods have had the influence of external actors, national or international, in specific topics and funding to develop projects. This variety of situations, experiences and history of the neighborhoods influences their organization capacity and it can also influence public awareness and community participation, the other two sub-indicators with significant differences.

But not only the local context influences these differences, the Municipality and other external actors also play a role shaping community capacities. Some Administrative Zones may have more committed and accountable people working directly with the communities and organizing training programs to increase public awareness; or they can have more financial resources or external support to carry out different activities that influence positively the capacities of the community to respond to disasters and participate in different activities. Other Administrative Zones may be a step behind because they are recently formed. For instance, Calderón and Tumbaco have the lowest levels of community capacity and this can be explained by the fact that both of them were previously rural zones, not included in the urban development process of the city.

But as important as determining which community capacities are significantly different between the Administrative Zones is determining if there is a clear relation between the community capacities in place and the community landslide risk management in such a way that resilience is improved. This was done through a regression analysis to define the relation between community landslide risk management, defined as the dependent variable, and the community capacities, defined as the independent variable.

The results obtained showed that there is a significant relation between five of the seven sub-indicators of community capacities and the performance of landslide risk management. The capacities that according to these results make the difference between a landslide event and a landslide disaster are: access to risk and risk management information; public awareness; responsibility and commitment in regards to landslide risk reduction; community participation and involvement in landslide risk management; and coordination among different local actors. The two capacities that didn't show a significant relation were community organization and community training in landslide risk reduction and management.

However it resulted difficult to determine which community capacities are responsible for improving community resilience to landslides without having a model neighborhood with an optimal landslide risk management performance. As it was shown previously, there were no significant differences found between neighborhoods in relation to landslide risk management,

so it is not possible to compare what capacities make the difference between a community exposed to landslide risk and a resilient community.

In any case, it can be accepted that community organization and community training in landslide risk reduction and management do not have a significant impact on the resilience of a community. In the first case, community organization plays a key role in neighborhoods fighting for regularization and to obtain basic services, which anyway improves the living conditions of the community and reduces their vulnerability, but for the rest of the neighborhoods it was not possible to probe that this capacity increases resilience. The fact that only 29% of the neighborhoods included in the study are forming security committees and that this initiate is emerging and developing, doesn't allow to see the results and the influence in resilience right away.

For community training in landslide risk reduction and management, which according to the results is not a community capacity that has a direct relation with landslide risk management, it can be argue that community training per se is a mean to achieve other community capacities that influence directly community resilience, such as public awareness, corresponsibility, and participation in landslide risk management. In fact community training and access to information is better understood as the enabling environment that allows other capacities to develop. Both of them are provided by external actors according to emergent moments or emergency periods as well as to available funds and methodologies. The ability of the community to make use of such opportunities, participate and get involved is the right capacity to be measured and exploited to its fullest potential.

Public awareness, corresponsibility and commitment, community participation and involvement, and coordination among different local actors remain as the community capacities that can increase resilience for an effective landslide risk management. However in the context of QMD it is important to consider several aspects. Not much work to measure public awareness has been done. The trend has been to transmit, inform and get a momentary response from the community. What has been evident throughout this research is that the level of awareness has been evolving slowly. First of all within international organizations, then within public institutions that progressively involves the civil society to slowly reach the public and the communities.

In this sense, public awareness is emerging and evolving and this influences corresponsibility, commitment and community participation. The trend here has been that the neighborhoods assign representatives who are responsible for managing the relation with the Municipality in a pyramidal and hierarchical process. There is a lack of work and investment for the entire community to operate and participate. Again, slowly there are now evolving communication channels, commissions, communitarian alarms, but this is not yet something well planned and structured. Moreover, this long process has been moving forward in a disarticulated way, without involving and coordinating with other actors.

Although at the institutional and municipal level the way to manage disaster risk has changed from a reactive to a proactive approach, at the community level, the reactive approach is the one still operating.

CHAPTER 7: CONCLUSIONS

In the context of rapid urban growth and increased frequency and severity of natural disasters worldwide, and in a scenario of increased vulnerability due to increasing occupation of risk zones, the main objective of this research was to analyze what governance structure, institutional and community capacities are needed to reduce landslide risk and increase the likelihood of improving community resilience. It was not possible to probe the hypothesis proposed and determine which community capacities are responsible for improving community resilience to landslides mainly because an effective LRM model in the neighborhoods included in the research was not found.

Through the development of LRM indicators, institutional capacity indicators and community capacity indicators, general recommendations and guidelines were made. These recommendations are useful to motivate stakeholders and decision-makers to work together in the development and implementation of policies and strategies for landslide risk reduction and to promote the sustainable use of land in Quito Metropolitan District, a city where hazards and vulnerability combine to create risk, particularly as the city continues to grow and new settlements occupy the slopes of the mountain zones.

Landslide disasters are not only linked to the characteristics of the landslide events produced by heavy rains, such as their magnitude, frequency and duration, but also to the vulnerabilities of the exposed elements and the capacities within the society to cope with them. In this sense, landslides in urban areas are socio-environmental events that result of socially constructed risk, and therefore it was necessary to analyze the ability or inability of the society to cope with it. In order to do this, the community capacities were assessed to determine which of them reduce the potential negative impacts of a landslide and improves their resilience. However communities' resilience is not only influenced by their own capacities, but also by capacities outside the community, referred as the institutional capacities that create an enabling environment for LRM.

With the current proactive approach to deal with disasters based on disaster risk management and disaster risk reduction, the new paradigm is focused on a systematic process to identify, assess and reduce the risks of disaster and the socio-economic vulnerabilities, and to implement strategies, policies and improved coping capacities to lessen the adverse impacts of hazards. This integral multisectoral and multidisciplinary process of planning and implementing pre- and post- disaster activities requires a collective response from different stakeholders and a governance structure that articulates themes such as planning, regulation, integration, institutional systems, partnerships and accountability, all of which have a positive influence on landslide risk management and reduction.

LRM and reduction efforts in QMD have started to be developed during the last 10 years and is now emerging. Much of the progress to date relates to the development of policies, regulations and institutional changes that slowly has been taking place in the capital city, but has not yet reached the community level that still has a reactive and passive approach towards natural disaster risk. This is a long process that needs to further develop and improve the current practices and strategies in order to achieve an effective landslide risk management with appropriate prevention mechanisms and mitigation measures of the severity or consequences of disasters that are currently implemented; reliable preparedness actions as well as rapid and

effective response to disaster that take place; and effective recovery and reconstruction that takes lessons learned into account with a long-term perspective.

However it is important to mention that although landslide risk management is improving, these natural events are expected to continue due to an increased urbanization and development in landslide-prone areas, continued deforestation on slope areas, and increased precipitation caused by climatic patterns.

In this sense, managing landslide risk has to include both short-term prevention, mitigation, preparedness, response and recovery from the immediate effects of landslides, and structural reforms that seek to address the factors that define people's vulnerability to those landslide events to begin with, such as the lack of available and safe places to live which are at the root of the vulnerabilities that keep the poor living in poverty. This must involve a broad number of stakeholders within the state, private sector and community as well as across different scales of decision-making.

To address this issues and to improve the current landslide risk management system in QMD, local government, together with the private sector and civil society, needs to develop a better understanding of landslide hazards, to make rational decisions on allocation of funds for landslide risk management and to look for ways to get financial support and overcome the economic constrains that limit its performance. This requires a pluralistic approach to risk identification, risk reduction, emergency preparedness and emergency response and for decision making that includes the nature of landslides and the nature of human activities in such a way that the social realities that influence the willingness of the society to accept risk can be considered.

There is also the need to establish systems to exchange information between the sources and the receivers who are the decision makers and the community. The challenge facing QMD is to better understand the meteorological processes leading to landslide and determine how new technology and techniques might be applied to reduce the risk of landslide to people and transfer this knowledge. But in regards to access of information it is not enough to transmit and inform this knowledge, but to internalize it in order to have aware citizens and develop the culture of preventions for resilient communities.

Efforts have to be made to bring relevant stakeholders together and to achieve community involvement and a sense of co responsibility. In this sense, landslide risk management has to focus on organized and planned participatory processes that create strategies for communities to internalize and comprehend the risks they face, and the role they play in the causes and consequences of those risks. Those processes also need to create channels for community involvement and empowerment in order that empowered citizens look for ways to ensure their own safety and work in cooperation with the local authorities and other actors. This could be a way to overcome the lack of implementation of measures that don't have available control mechanisms. Approaches that are inclusionary, participatory, accountable, and democratic are more conductive to the creation of an empowered citizenry where the role of the local government is no longer limited to assistentialism and the role of community is broken form the clientelist systems.

The effectiveness of an integrated risk management system depends on the extent to which it engages all level of community, managers and stakeholders; it builds up strong institutional and community capacities; and it mobilizes public and private sector and civil society organizations at different levels to participate actively in the design and implementation of locally relevant disaster risk management strategies.

Considering that disasters perpetuate poverty and hold back the trajectory of development, this effort to determine how to increase communities' resilience and how to achieve landslide risk and vulnerability reduction of people and communities living in risk areas contributes to achieve sustainable development in the context of rapid urbanization. This is particularly useful in the regards to the poor and marginalized people forced to live in risk sites and with bad living conditions due to necessity and lack of opportunities.

Understanding what is the current governance structure, the legal, policy and institutional framework that exists in the QMD as well as the gaps between what ought to be an effective landslide risk management and what is actually happening at the municipal and community level gives space to advance and improve the performance of this system. This type of information and analysis provides an opportunity to look for ways to modify the aspects that increase the vulnerability and exposure to landslides, to alter the characteristics of the exposed unites, and to find out how to influence the community capacities and coping mechanisms identified in this study.

The information generated in this research serves as a baseline study valuable for the Municipality of Quito Metropolitan District. Very few studies have been done in the city to understand the community capacities and coping mechanisms to reduce the impacts of natural disasters. As part of the Disaster Risk Reduction Program implemented by the Municipality, one of the objectives is to design a methodology with which the Municipality can work with the communities incorporating the prevention topic in their daily lives in order to develop a culture of prevention. The results obtained here provide a scenario of the culture of prevention that now exists in the city as well as the limitations and opportunities to further develop it.

This research also serves as the starting point of other future researches that can begin to develop methodologies for community based disaster risk management that can be applied effectively by the communities living in risk zones and that are suited to the specific requirements and context of each neighborhood. For this it would be required to understand how is landslide risk perceived and understood in each location. Moreover, it is necessary to explore the ways in which local understanding can be developed and combined with outside specialist knowledge to increase community resilience.

Understanding how communities perceive the risks is a first way to consider the role of human agency and alternative framings of risk. Therefore, the challenge is to look towards devising interventions which reduce landslide risk whilst meeting the basic needs of the exposed populations. This type of methodologies should develop all the procedures for community based disaster risk assessment, planning and management; landslide information campaigns and community mobilization; monitoring, revision, implementation and evaluations of the plans.

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ANNEX 1: INDICATORS FOR KEY ISSUES OF DRM

Key issue 1: Risk identification

- Risk and vulnerability assessment at district level
- District hazard and risk profile assessment
- Socio-economic impact assessment
- Typology establishment of the most vulnerable people
- Criteria establishment for levels of alert for different types of disaster risk
- Hazard monitoring
- Resource allocation for disaster risk assessment

Key issue 2: Prevention

- DRM planning related to district risks and vulnerabilities
- Participatory planning with NGOs, community organizations, local leaders and at-risk groups
- DRM and DRR project and program implementation
- DRM plans implementation and monitoring
- Resource allocation for DRM planning and monitoring
- Communication of risk and vulnerability information to planning departments, sectors and organizations
- Dissemination of risk information to the public
- Establishment of community awareness-raising and training programs
- Incorporation of academic and education programs regarding DRM into formal education
- Establishment of DRM training programs
- Resource allocation for awareness-raising and dissemination of risk information

Key issue 3: Mitigation

- Establishment of sectoral mandates and responsibilities for disaster risk mitigation
- Establishment of guidelines for disaster risk reduction practices
- District mitigation planning
- Establishment of structural mitigation measures
- Land use planning and management
- Urban planning and human settlements
- Environmental natural resource management
- Socio economic development
- Resource allocation for disaster mitigation

Key issue 4: Preparation

- Emergency planning
- Immediate response planning
- Execution of evacuation exercises
- Establishment of early warning systems
- Establishment of rescue groups
- Establishment of training programs for immediate response
- Establishment of communication and information systems for preparedness
- Preparedness systems monitoring

- Resource allocation for emergency preparedness

Key issue 5: Response
- Operationalization of emergency plans
- Emergency assistance
- Food, water, shelter distribution
- Establishment of standards for relief emergency assistance
- Resource allocation for immediate response and relief assistance
- Monitoring of human and economic impacts as they unfold
- Damage and loss assessment
- Resource allocation for damage and loss assessment

Key issue 6: Recovery
- District recovery planning
- Establishment of mandates for disaster relief
- Resource allocation for recovery
- Establishment of strategies for insurance coverage and loss transfer strategies of public and private assets
- Establishment of criteria to identify beneficiaries
- Establishment of programs for social, physical and economic recovery
- Resettlement of affected families

Key issue 7: Reconstruction
- Reconstruction for development planning
- Establishment of development planning
- Resource allocation for reconstruction and rehabilitation
- Mainstreaming of disaster risk management into development planning
- Establishment of linkages between disaster risk management and other sectors of development
- Establishment of mechanisms to incorporate good disaster risk management practices
- Establishment of mechanisms for cooperation and coordination at the district level

ANNEX 2: LANDSLIDE RISK MANAGEMENT INDICATORS AND PERFORMANCE LEVELS

INDICATOR 1: LANDSLIDE RISK IDENTIFICATION (LRI)

LRI.1 Systematic disaster and loss inventory
1. Some genial data about historic landslide events that have affected the neighborhood.
2. Continual registering of landslide events but incomplete, with limited information on losses and effects.
3. Systematization of current landslide events with their social, economic and environmental effects.
4. Complete inventory of landslide past and current events; detailed inventory and systematization of social, economic and environmental effects and losses.
LRI2. Landslide monitoring and forecasting
1. Minimum and deficient instrumentation to forecast landslide events.
2. Basic instrumentation networks to monitor and forecast landslide events with technology updating problems and continuous maintenance.
3. Some networks with advanced technology in particular areas; improved prognostics and information protocols.
4. Landslide monitoring system with instrumentation and advanced research that determines places of active landslide process development on the basis of occurrence, geophysical parameters, slope stability assessment and impacts.
LRI3. Landslide evaluation and mapping
1. Superficial evaluation and basic maps covering landslide influence and susceptibility.
2. Some descriptive and qualitative studies of landslide susceptibility in specific areas.
3. Some hazard maps based on probabilistic techniques. Generalized use of GIS for mapping landslides.
4. Slope stability assessment based on advanced technology for landslide processes. Microzonation of sectors and high technical capacity for knowledge production.
LRI4. Landslide risk and vulnerability assessment
1. Identification and mapping of the principal elements exposed in landslide prone-areas.
2. General studies on physical and socio-economic vulnerability.
3. Evaluation of potential damage and loss scenarios for landslide events.
4. Detailed risk studies that consider the economic and social impact of landslide events. Analysis of the physical vulnerability of essential buildings, and social vulnerability for the population.

INDICATOR 2: LANDSLIDE RISK REDUCTION (LRRI)

LRRI1. Landslide risk consideration in land use and urban planning
1. Risk topic is considered within land use and urban planning.
2. Regulations, normative and ordinances that consider risk in territorial organization and development planning.
3. Preventive approach in the territorial organization planning, and diffusion of regulations, normative and ordinances related with risk and vulnerability reduction.
4. Effective control mechanisms for the regulations related with risk and vulnerability reduction which include land use processes and housing development restriction in landslide prone-areas, and approval of architectural and structural of buildings.
LRRI2. Hydrographic basin intervention and environmental protection
1. Inventory of slopes, valleys and basins with high environmental degradation.
2. Laws and management plans related to environmental protection processes, garbage management and surface drainage management.
3. Environmental intervention and implementation of protection plans and management of damaged slopes, streams, watersheds, sensitive areas and strategic ecosystems.

4. Enforcement of laws related to environmental protection processes, garbage and surface drainage management. Maintenance of environmental interventions undertaken.
LRRI3. Implementation of landslide-event control and protection techniques
1. Some structural control and stabilization measures in more dangerous places. 2. Establishment of measures and regulations for landslide control and protection works. 3. Intervention in mitigable risk areas using measures of protection and control. 4. Implementation of mitigation plans and appropriate design and construction of cushioning, stabilizing, dissipation and control works to protect human settlements and social investment.
LRRI4. Housing improvement and human settlement relocation from landslide prone-areas
1. Identification and inventory of human settlements located in landslide risk-areas. 2. Programs for regularization and upgrading neighborhood and surrounding areas, development of social housing and relocation from risk areas. 3. Progressive intervention of human settlements at risk to engage them in slum regularization programs, improved housing and relocation. 4. Very good control of risk areas, relocation of most houses constructed in non mitigable risk zones accompanied by social studies, social safety net development and cases monitoring. Treatment of the areas left free.
LRRI5. Application of safety standards and construction codes
1. General construction standards. 2. Mandatory urban standards and current safety standards and building codes. 3. Control to verify that the buildings comply with safety standards and building codes. 4. Compliance with safety standards and building codes for new and existing buildings.
LRRI6. Reinforcement of public and private assets
1. Little retrofitting and sporadic adjustments to buildings. 2. Some programs for assessing vulnerability, rehabilitation and retrofitting of essential buildings. 3. Promulgation of intervention rules related to the vulnerability of existing buildings and retrofitting of essential elements. 4. Massive retrofitting of public and private buildings. Ongoing programs of incentives for housing rehabilitation lead to lower socio-economic sectors.
LRRI7. Insurance and reinsurance coverage and loss transfer strategies of public assets, housing and the private sector
1. Low percentage of private and public goods insured. Economically weak insurance and unregulated insurance industry. 2. Development of some insurance studies based on advanced probabilistic risk, using microzoning, auditing and optimum building inspection. 1. Design of collective insurance programs for public building and small businesses with automatic coverage for the poorest. 2. Strong support for joint programs between the government and insurance companies to generate economic incentives for risk reduction and mass insurance.

INDICATOR 3: EMERGENCY PREPAREDNESS AND DISASTER MANAGEMENT (EPDMI)

EPDMI1. Organization and coordination of emergency operations
1. Different organizations attend emergencies but lack resources and staff. 2. Institutional structure with roles for operational entities and coordination of emergency groups. 3. Considerable coordination between organizations working in preparation, communication systems, emergency networks, search and rescue and management of temporary shelters. 4. Permanent coordination for response operations between operational organizations, public services, local authorities and civil society organizations.
EPDMI2. Emergency response planning and implementation of warning systems
1. Basic emergency and contingency plans exist with list and information on available personnel and activity list. .

2. Protocols and well-defined operational procedures within the emergency and contingency plans. Several warning centers operate continuously. 3. Emergency and contingency plans based on comprehensive local needs and associated with information, communication and alert systems. 4. Complete emergency and contingency plans associated with information, communication and alert systems spread and socialized with the community.
EPDMI3. Endowment of equipments, tools and infrastructure
1. Basic supply and inventory of resources only in the operational organizations and emergency commissions. 2. Center with reserves and specialized equipment for emergencies. Inventory resources in other public and private organizations. 3. Emergency Operations Centers are well equipped with communications equipment and an adequate registry system. 4. Interinstitutional support networks between storage centers and emergency operations centers are working permanently. Broad scope of communication, transportation and supply facilities in case of emergency.
EPDMI4. Simulations, updating and test of inter institutional response
1. Sporadic simulation exercises for emergency situations and institutional response with the institutions operating in the community. 2. Operational simulations with the additional participation of public service entities and local administrations. 3. Coordination of simulations with the community, public sector entities, the private sector and media at the local level. 4. Testing of emergency and contingency plans and updating of operational procedures based on frequent simulation exercises with the involvement of all sectors.
EPDMI5. Rehabilitation and reconstruction planning
1. Design and implementation of rehabilitation and reconstruction plans only after a disastrous event has occurred. 2. Planning of some provisional recovery measures by public service institutions and those responsible for damages and loss evaluation. 3. Diagnostic procedures, reestablishment and repairing of infrastructure and production projects for community recovery. 4. Generalized development of reconstruction plans that address the issue of physical damage with the notion of re-building better, and social recovery based on risk scenarios before an event.
EPDMI6. Implementation of social safety nets and funds response
1. Sporadic subsidies to communities affected by a landslide event or in critical risk situations. 2. Permanent social investment funds to support vulnerable communities focusing on the poorest socio-economic groups. 3. Social networks for the self protection of livelihoods means of communities at risk and implementation of post-disaster rehabilitation and reconstruction projects. 4. Regular micro-credit programs for the rehabilitation and reconstruction aimed at reducing human vulnerability.

ANNEX 3: INSTITUTIONAL CAPACITIES INDICATORS AND PERFORMANCE LEVELS (ICI)

ICI1. Landslide risk management system organization
1. The different actors that play a role in risk management have not been identified. 2. The different actors that are part of the risk management cycle have been identified, but their roles and responsibilities are not clearly defined. 3. Roles, functions and responsibilities of those involved in risk management are defined but scattered, without an organizational framework for the system. 4. Roles, functions and responsibilities of those involved in risk management are clearly defined with an entity responsible for organizing the activities.
ICI2. Coordination between the different actors of the landslide risk management system
1. The different actors in the risk management system are coordinated internally, but there are no coordination mechanisms between them. 2. There is a body responsible for coordinating vertically the functioning and responsibilities of the actors involved in the risk management system. 3. There is vertical and horizontal coordination between different actors in the public and private sector that make part of the risk management system. 4. There is vertical and horizontal coordination between different actors in the public and private sector that make part of the risk management system, and the community organizations.
ICI3. Integration of landslide risk management approach in other sectors
1. Basic organizations mainly with a focus on emergency response. 2. Active interinstitutional risk management systems. Work in the design of public policies for vulnerability reduction. 3. Continued implementation of multisectoral risk management projects associated with environmental protection, sanitation, and poverty reduction programs. 4. Expert personal with extensive experience in integrating risk management in the planning of sustainable human development at interinstitutional and multi-sectoral level. Availability of high-tech information systems.
ICI4. Budget allocation and mobilization
1. Limited allocation of budget to competent institutions for emergency response. 2. Legal norms establishing budgetary allocation for local organizations with risk management objectives. 3. Allocation and mobilization of funds established by law for specific risk management at local level with inter-administrative agreements for the implementation of prevention projects and mechanisms to prevent misuse of funds. 4. Progressive allocation of expenditure at the municipal level for vulnerability reduction and the creation of incentives and rates of environmental protection and safety together with support from multilateral loan organizations. Mechanisms to prevent misuse of funds.
ICI5. Cooperation and support to manage landslide risk
1. Cooperative work between competent institutions for emergency response. 2. Implementation of mitigation projects and preparation of risk events by local public entities at the municipal level in charge of risk management. 3. Implementation of programs for evaluation, risk reduction and management by entities from both the public sector and private enterprise. 4. Alliances and agreements establishment between the public, private and civil society to implement progressively integrated risk management programs.
ICI6. Public participation and accountability
1. Decisions about risk management are made without taking into account the interests of the different

at risk groups. 2. Decisions about risk management are made in a democratic manner considering the needs of the population at risk. 3. There is the presence of open channels for public participation and deliberation in decisions making related to risk management. 4. Decentralized risk reduction management structures facilitate community participation during the process of mitigation planning and preparedness for landslide events during the implementation and evaluation of the measures established.
ICI7. Education and strengthening in landslide risk management
1. Incipient incorporation of hazard and disaster topics in formal education programs. 2. Progressive incorporation of risk management in the curricula with a considerable production of educational materials and training courses in risk management. 3. Expansion of the curricular reform to higher education programs. Specialized courses or risk reduction and management offered by several universities. 4. High technical capacity to generate risk knowledge. Wide production of educational material.
ICI8. Community training and awareness
1. Informative meetings with the community with a focus on emergency response. 2. Production of educational material to train communities on issues related to hazards, impact, risk reduction and emergency management. 3. Progressive community training in risk reduction and management. Awareness programs involving risk management policies, vulnerability reduction, mitigation measures, contingency plans. 4. Permanent schemes for community training in risk management with a focus on the visibility and correspondence in the generation of unsafe conditions. Involvement of neighborhood organizations and community education centers, health centers, and emergency management institutions.
ICI9. Information and communication management
1. Scattered information related to threats and landslide risk in Quito. Difficult access to information. 2. Availability of information related to threats and risks in Quito from different sources, but this information is not updated. 3. Availability of information related to the issue of risk reduction and management from different sources and systematically updated. There are clear mechanisms for exchange and access to information between different actors in the public and private sector. 4. Collection of public and private information generated in relation to threats, risks and strategies for reducing risk in systems that include information centers, databases, web sites. These information systems are accessible to communities so that the knowledge generated is disseminated and can be assimilated by the communities.
ICI10. Implementation, monitoring and evaluation
1. Low implementation of policies and measures for integrated risk management. 2. Mechanisms for monitoring compliance and implementation of policies and measures for integrated risk management. Not appropriate execution and implementation. 3. High level of execution and implementation of policies and measures for integrated risk management. Institutionalized procedures to monitor and evaluate the effectiveness and progress of the integrated risk management. 4. The risk management system includes: mechanisms and procedures to implement and execute the policies and measures for integrated risk management; indicators to monitor and evaluate the effectiveness and progress of the different phases of risk management cycle; mechanisms to identify good practices and take into account lessons learned for the continued strengthening of the efficiency and capacity of risk management systems.

ANNEX 4: COMMUNITY LEVEL LANDSLIDE RISK MANAGEMENT INDICATORS AND PERFORMANCE LEVELS (LRM)

LRM1. Risk consideration in land use and construction
1. The population does not consider disaster risk in the zones there they live. 2. The population knows about natural disaster risks they are exposed to. 3. The population knows the existing regulations, normative and ordinances that consider risk in territorial and urban planning, and in the construction codes and standards. 4. The population comply the regulations related to risk and vulnerability reduction which include land use processes and housing development restriction in landslide prone-areas, and approval of architectural and structural of buildings.
LRM2. Mitigation and risk reduction measures implementation
1. The population does not consider disaster risk in the zones there they live. 2. The population knows about landslide risk and preventive measures. 3. The neighborhood has structural mitigations works to reduce the impact of landslide events. 4. The neighborhood develops activities for environmental protection, water and superficial water management, waste management, slope management. The population works for neighborhood improvement.
LRM3. Emergency preparedness and disaster management
1. The population does not know want to do in the case of a landslide. 2. The population knows about natural disaster prevention. 3. Some members of the neighborhood know what to do in the case of a landslide. They have been involved in drills. 4. The majority of the community has been prepared and knows what to do in the case of a landslide. They have a community alarm for emergency and natural events. They regularly perform drills for natural disasters.
LRM4. Recovery
1. After a natural disaster the community has not received any support for recovery. 2. After a natural disaster the community has received support for physical recovery. 3. After a natural disaster the community has received support for economic and social recovery. 4. After a natural disaster the community has organized itself to recover in cooperation with other municipal and private institutions.

ANNEX 5: COMMUNITY CAPACITIES INDICATORS AND PERFORMANCE LEVELS (CCI)

CCI1. Community organization
1. The community is not organized or there is a low level of organization. 2. The community members are grouped and organized in various roles and responsibilities, with community leaders representing the interests of most people in the community, however, their responsibilities are not clearly defined and their actions are limited. 3. There is community organization with clearly defined responsibilities, linked with local authorities and other local organizations, whose actions promote disaster preparedness. 4. There is a high degree of community organization with clearly defined responsibilities, with links to local authorities and other local organizations, with the creation of mechanisms for dialogue, and groups that support or engage in risk reduction, risk management and disasters response. This community organization provides access to resources for mitigation, response and recovery activities.
CCI2. Community training in landslide risk reduction and management
1. Community members are not involved in risk management awareness campaigns. 2. Few members of the community take part in disaster awareness campaigns and training. 3. Some community members participate in ongoing risk reduction and management awareness campaigns and training. 4. The entire community has taken part in awareness campaigns and training in relevant skills for risk reduction and management such as:hazards, risk and vulnerability assessments, risk reduction and management community planning, search and rescue, first aid, shelter for emergency management, needs assessments, aid distribution, safer construction.
CCI3. Access to risk and risk management information
1. The community does not have information about risks and risk reduction. 2. The community has sporadic information focused on emergency preparedness in normal situations and more often when disaster strikes. There is no shared understanding of principles, concepts, terminology and approaches of risk reduction. 3. The community has access to information on risks and vulnerabilities affecting the area. There is a shared understanding of principles, concepts and terminology related to risk management. 4. The community has access to information generated on risk, threat, vulnerability, risk reduction and management. There is a shared understanding of principles, concepts, terminology and alternative approaches to risk reduction.
CCI4. Public awareness
1. The community members are unaware of the threats and the risks they are exposed to and how human interventions affect the natural environment. 2. A low percentage of the community knows about their natural environment, threats and risks they are exposed to, and actions to take if a disaster occurs. 3. A medium percentage of the community knows about the characteristics and functioning of the natural environment, threats and potential risks, human interventions that affect them, and actions to reduce the risk and be prepared in case of a disaster. 4. High level of awareness among all members of the community around the characteristics of the natural environment, threats and potential risks, human interventions that affect them, and the strategies and actions to reduce risk. The community members incorporate this knowledge in their everyday social practices undertaking a preventive action in the face of disasters.
CCI5. Responsibility and commitment in regards to landslide risk reduction
1. The members of the community do not have a correspondance approach in the generation of unsafe

conditions nor in their role within activities related to risk reduction and disaster response. 2. Community leaders and members of the community have a sense of personal responsibility to prepare for disasters and are committed to preparedness and response in the case of an landslide event. 3. There are community leaders committed on prevention and preparedness who work together with local authorities to build a culture of prevention and achieve a safer behavior as a result of increased awareness. 4. The community members know their rights and obligations, they have a shared vision of a prepared and resilient community. They look at risk reduction as an essential element to achieve other goals that improve their quality of life. There are community leaders committed, efficient and accountable in relation to planning and implementation of risk reduction.
CCI6. Community participation and involvement in landslide risk management
1. Low level of community participation in decisions about risk management. 2. Some community members participate in some activities aimed at disaster preparedness. Participation is limited. 3. Community members are actively involved in the implementation of activities related to prevention and risk reduction and response preparedness in case of a landslide the event. 4. There are participatory processes through which members of the community and vulnerable groups have the ability to participate in: community hazard and risk assessment, elaboration of community plans for risk reduction and management, joint planning with local and community emergency equipment and structure, questioning to external organizations around risk reduction priorities.
CCI7. Coordination among different local actors
1. Low level of coordination between different local actors involved in risk reduction and management. There are not clear responsibilities. 2. The responsibilities of the different local actors around risk reduction and management are clear but they are dispersed; not all actors involved know all actors and local organizations or their roles. 3. Half level of coordination between different actors and local organizations involved in risk reduction and management. There is a general understanding of who does what and how. 4. High level of coordination between different actors and local organizations to optimize capacity and efforts for risk reduction and management

ANNEX 6: MONITORING SHEET OF KEY PROCESSES FOR DRM AND RELEVANT ACTORS

Process		Indicators	Yes /No	Institutions involved		Comments
				Main responsibility	Supporting role	
Risk identification	Risk identification	- Risk and vulnerability assessment at district level				
		- District hazard and risk profile assessment				
		- Socio-economic impact assessment				
		- Typology establishment of the most vulnerable people				
		- Criteria establishment for levels of alert for different types of disaster risk				
		- Hazard monitoring				
		- Resource allocation for disaster risk assessment				
Prevention	Disaster risk management planning and monitoring	- Disaster risk management planning related to district risks and vulnerabilities				
		- Participatory planning with NGOs, community organizations, local leaders and at-risk groups				
		- Disaster risk management and disaster risk reduction Project and program implementation				
		- Disaster risk management plans implementation				
		- Disaster risk management plans implementation monitoring				
		- Resource allocation for disaster risk management planning and monitoring				
	Awareness-raising and dissemination of risk information	- Communication of risk and vulnerability information to planning departments, sectors and organizations				
		- Dissemination of risk information to the public				
		- Establishment of community awareness-raising and training programs				
		- Incorporation of academic and education programs regarding risk management into formal education				
		- Establishment of disaster risk management training programs				
		- Resource allocation for awareness-raising and dissemination of risk information				
Mitigation	Disaster mitigation	- Establishment of sectorial mandates and responsibilities for disaster risk mitigation				
		- Establishment of guidelines for disaster risk reduction practices				
		- District mitigation planning				
		- Establishment of structural mitigation measures				
		- Land use planning and management				
		- Urban planning and human settlements				
		- Environmental natural resource management				

		- Socio economic development				
		- Resource allocation for disaster mitigation				
Preparedness	Preparedness	- Emergency planning				
		- Immediate response planning				
		- Excecution of evacuation exercices				
		- Establishment of early warning systems				
		- Establishment of rescue groups				
		- Establishment of training programs for immediate response				
		- Establishment of communication and information systems for preparedness				
		- Preparedness systems monitoring				
		- Resource allocation for disaster preparedness				
Response	Immediate response and relief assistance	- Operationalization of emergency plans				
		- Emergency assistance				
		- Food, wáter, shelter distribution				
		- Establishment of standards for relief emergency assistance				
		- Resource allocation for immediate response and relief assistance				
	Damage and loss assessment	- Monitoring of human and economic impacts as they unfold				
		- Damage and loss assessment				
		- Resource allocation for damage and loss assessment				
Recovery	Recovery	- District recovery planning				
		- Establishment of mandates for disaster relief				
		- Resource allocation for recovery				
		- Establishment of strategies for insurance coverage and loss transfer strategies of public and private assets				
		- Establishment of criteria to identify beneficiaries				
		- Establecimiento de programas para la recuperación social, fisica y económica				
		- Resettlement of affected families				
Reconstruction	Reconstruction	- Reconstruction for development planning				
		- Establishment of development planning				
		- Resource allocation for reconstruction and rehabilitation				
		- Mainstreaming of disaster risk management into development planning				
		- Establishment of linkages between disaster risk management and other sectors of development				
		- Establishment of mechanisms to incorporate good disaster risk management practices				
		- Establishment of mechanisms for cooperation and coordination at the district level				

ANNEX 7: CUESTIONARIES AND SURVEYS

CUESTIONARY FOR INSTITUTIONS IN CHARGE OF RISK MANAGEMENT AND SECURITY

1. Is there a Risk Management System to establish the nature of binding in compliance with the disposition about risk management?
2. Does a Risk Management System that clearly defines the competences of the different organisms that work in this issue exist?
3. Is there any body with oversight role in risk management, which demands all entities the incorporation of the different variables of integrated risk management?
4. Do you think that the issue of risk has been positioned as a public policy problem that requires an interdisciplinary and inter-agency approach to understand the threats, reduce the vulnerability and guide development in not vulnerable areas?
5. Are there mechanisms for coordination between the Unit of Risk at the Security and Governance Secretariat and the area of territorial ordering and urban planning, as well as with the emergency management institutions and the private organizations? What are these mechanisms? How effective are they?
6. Does research about infrastructure vulnerability take place in relation to the hazards that exist in QMD in order to improve knowledge about the territory? ¿Which have been the most recent ones?
8. Does research about risk allow concreting an effective prevention through a Risk Management System that is responsible for translating the knowledge produced into rules and regulations?
9. What preventive measures are you making?
10. Do you think that the instruments of land use regulation reflect risk management policies?
11. Do you think that there is a clear policy of risk management from territorial ordering and urban planning? Which?
12. The Architecture and urbanism normative, ordinance 0095, corresponding to slope management, protects, regulates and conserves the slope areas from settlement and edification. Has this been accomplished? How has this normative been implemented?
13. What control mechanisms exist to avoid illegal occupation of slope areas and to stop settlement in zones with high social pressure?
14. How have these mechanisms been institutionalized?
15. What do you do with the illegal settlements located in ecological protection zones or in risk prone-areas with steep slopes? How many neighborhoods exist there?
16. Is there control from the operative entities to stop occupation of protected zones and at risk areas?
17. What is the Neighborhood Regularization Program? How is in charge of executing it and implementing it?
18. Do the regulation instruments for land use reflect risk management policies?
19. Is there a design and normative of a Management Plan for the Pichincha slopes that include complementary control measures of new settlement, of construction on slopes, of green area improvement and reserve to be used as recreation areas and avoid their invasion?
20. Has the Neighborhood Up-grading Program been institutionalized?
21. Have variables of risk management been established in the up-grading program?
22. Has a relocation plan been institutionalized as part of the municipal actions?
23. Has an Emergency Operation Committee been institutionalized? What institutions make it, what are their functions and how do they coordinate the functions?
24. How are resources mobilized for risk management?
25. What type of cooperation and support do you have for risk management?
26. How does civil society participate in decision making and implementation of measures for risk reduction?

27. Are the plans, programs, regulations and ordinances for risk management implemented? What mechanisms to assure implementation exist?
28. Does monitoring and evaluation of plans, programs, regulations and ordinances implementation take place? What mechanisms are available for this monitoring and evaluation?

CUESTIONARY FOR INSTITUTIONS IN CHARGE OF TERRITORY MANAGEMENT AND URBAN PLANNING

1. Does research about infrastructure vulnerability take place in relation to the hazards that exist in QMD in order to improve knowledge about the territory? ¿Which have been the most recent ones?
2. How do you manage to translate the knowledge produced about vulnerability and risk in norms and legal dispositions?
2. How does approval of plans occur to assure that construction is not allowed in areas that do not coincide within the categories of urban or developable, or in areas identified as vulnerable or at risk?
4. Are there construction norms and standards to reduce landslide risk? ¿Which?
5. What mechanisms exist to control and enforce those normative and standards?
6. The Architecture and urbanism normative, ordinance 0095, corresponding to slope management, protects, regulates and conserves the slope areas from settlement and edification. Has this been accomplished? How has this normative been implemented?
7. What control mechanisms exist to avoid illegal occupation of slope areas and to stop settlement in zones with high social pressure?
8. How have these mechanisms been institutionalized?
9. Are the slope commissaries still in place and functional?
10. Does a rigorous urban control of the constructions located in these zones take place? Is this institutionalized? How? Who is in charge?
11. What do you do with the illegal settlements located in ecological protection zones or in risk prone-areas with steep slopes? How many neighborhoods exist there?
12. What is the Neighborhood Regularization Program? How is in charge of executing it and implementing it?
13. Do the regulation instruments for land use reflect risk management policies?
14. What is the current situation of land regularization and construction?
15. What are the requirements to regularize land?
16. Is there a design and normative of a Management Plan for the Pichincha slopes that include complementary control measures of new settlement, of construction on slopes, of green area improvement and reserve to be used as recreation areas and avoid their invasion?
17. Has the Neighborhood Up-grading Program been institutionalized?
18. How is the up-grading program being implemented? What are the criteria to select beneficiaries? Who executes it?
19. Have variables of risk management been established in the up-grading program?
20. Is the up-grading program complemented with resettlement and housing relocation in risk prone-areas and ones they are vacant, are those areas use for recreation?
21. Have the relocation programs been institutionalized?
22. How is the relocation program being implemented? What is it about? What are the criteria to select the beneficiaries? How many families are relocated annually?
23. Do retrofitting processes and monitoring of public and private buildings take place to avoid the collapse of infrastructure during a disaster? How is this process?
24. How is the developable land managed? Who is in charge of that?
25. How is the offer of urbanized land and the provision of housing in an adequate environment been promoted and facilitated?

26. What legal, institutional and management mechanisms exist to generate a territory with sufficient urbanized land at adequate prices to satisfy the demand of the market and to assure an urban development in accordance with the structure stated in the PGOT?
27. What solutions are there for the housing problems and to reduce the qualitative and quantitative housing deficit?
28. What mechanisms exit to avoid land and housing speculation?
29. Is there offer of urban land for social housing with urban ordering that includes infrastructure and equipment provision in possible locations in accordance with the areas and uses stipulated by the PGDT?
30. Is there insterinstitutional cooperation to develop social housing?
31. Are there mechanisms to inform and broadcast municipal programs of land and housing to ensure that the population has better knowledge and takes part on them? Which?
32. Do you believe there is a Risk Management System that establishes the compulsory nature in the compliance of the dispositions about risk management within territorial development?
33. Is there a coordinated work between the Territorial Planning Secretariat and the Security and Governance Secretariat to develop community actions to implement risk reduction and management actions on the basis of risk and vulnerability maps available?
34. What is your opinion in regards to the level of integration and coordination between the institutions that generate technical and scientific information about risk and vulnerability at the district, entities that have information and manage territory, housing, services and infrastructure, population assistance (Red Cross, firefighters, policeman), and the institutions in charge of security and risk management.

CUESTIONARY FOR INSTITUTIONS IN CHARGE OF DISASTER MANAGEMENT

1. What functions within the risk management cycle does this institution perform?
2. Are you responsible for making contingency plans?
3. What are the risks taken into account for drawing up the contingency plans?
4. Are the contingency plans based on participatory processes with representatives of communities at risk?
5. What do contingency plans include?
6. Do contingency plans take into account municipal contingency plans and from other institutions to have a general contingency plan for the city?
7. How do you ensure the implementation of the contingency plans?
8. Is there dissemination of contingency plans? Who is involved in the dissemination?
9. How are contingency plans socialized within the communities at risk? Do you perform drills in case of an emergency?
10. Do you have transport and logistical arrangements for provision of water and food identified in case of an emergency?
11. Do you available shelters identified?
12. Have you monitored the infrastructure and resources available at the shelters?
13. Do you have an early warning system? Is this the same for the different institutions within QMD?
14. How are emergency groups informed and alerted about an emergency? How is this information disseminated to the public? Do you have different alert levels established?
15. Do you have an information and communication system?
16. How can the community inform the emergency systems of the occurrence of a disastrous event? How do emergency systems communicate among them? How do communication systems communicate with the population?
17. Is there an emergency management system?

18. Do you have rescue groups identified? What are the functions of these groups?
19. Are there standards for the provision of help for the most vulnerable people?
20. Do you conduct training programs for emergency response actors involved in the emergency management system? And for the communities? What does the training include?
21. How do you proceed in case of a disaster? How are activities coordinated between immediate response activities with the different actors?
22. Do you have a system for monitoring relief assistance operations? Do you have procedures for assessing the impact of a disaster, the damage caused, and the losses?
23. Is there a healthcare network in case of occurrence of a natural disaster? How does it work? Who is involved in this healthcare network?
24. What equipment do you have to deal with a disaster?
25. What coordination mechanisms exist between the healthcare network, the unit of risk, and emergency response groups?
26. Has there been any monitoring of the infrastructure and resources available in healthcare centers?
27. Does the healthcare network knows about contingency plans and procedures?
28. Is there a coordinated work between the institutions in charge of emergency management and the Security and Governance Secretariat to develop community actions to implement risk reduction and management actions on the basis of risk and vulnerability maps available?
29. What is your opinion in regards to the level of integration and coordination between the institutions that generate technical and scientific information about risk and vulnerability at the district, entities that have information and manage territory, housing, services and infrastructure, population assistance (Red Cross, firefighters, policeman), and the institutions in charge of security and risk management.

CUESTIONARY FOR PRIVATE ORGANIZATIONS

1. What activities related to landslide risk management are carried out by this organization?
2. With what groups do you work? What groups are the most vulnerable? How do you identify the most vulnerable?
3. How does civil society participate in activities related to landslide risk management implemented by this institution?
4. What are the funding sources for your institution's landslide risk management activities? How good are they? How can they be improved?
5. Are you involved in any landslide risk management activities organized by QMD? Do you have an active role in the implementing of district plans?
6. Is there some sort of coordination mechanism between this institution and others working on issues related to disaster risk management (NGOs or public sector)? What? How effective are these mechanisms? How can they be improved?
7. What is your opinion about the development of QMD implementing landslide risk management?

SURVEY FOR INSTITUTIONAL CAPACITY FOR SECURITY PROMOTERS IN THE ADMINISTRATIVE ZONES

RISK IDENTIFICATION

1. **Do you have an inventory and records of the landslides events that have occurred in the Administrative Zone?** Yes No

(If the answer is affirmative)

2. **What information do those records include?**

_____

3. **Is there a monitoring of landslide events?** Yes No

(If the answer is affirmative)

4. **What is the monitoring about and what instruments to monitor are available?**

_____

5. **Which of the following studies have been done:**
   - Landslide susceptibility studies based on microzonation
   - Damage and potential loss evaluation studies
   - Environmental an socio-economic impact assessments
   - Vulnerability assessment
   - Others:

INFORMATION AND EDUCATION

6. **Do you produce educational material and training courses on risk reduction and management?**
   Yes No

(If the answer is affirmative)

7. **What material and courses are produced?**

_____

8. **How often does the population receive training about risk management?**

_____

9. **Who has participated in the talks and what have been the themes?**

Who has given the talk?	Themes:

10. **In this trainings participate:** a. The entire community b. A big part c. A small part d. A minority

11. **Who are the ones that participate the most?**
a. Children b. Youth c. Adults d. Elderly e. Men f. Women g. Others:

VULNERABILITY REDUCTION

12. **Is illegal land occupation on slopes controlled?** Yes No

(If the answer is affirmative)

13. **How often?** _____

14. **How effective is it?** _____

15. **Who is in charge of the control?** _____

16. **Are constructions control to assure they respect the security and construction codes and standards?**
   Yes No

(If the answer is affirmative)

17. **How often?** _____

18. **How effective is it? _____**

19. **Who is in charge of the control? _____**

20. **What programs, projects and works are being carried out to reduce landslide risk in the zone and who is in charge of each of them?**

What?	Who has done it?

21. **Are the different actors that play a key role in risk management identified?** Yes No

(If the answer is affirmative)

22. **Who are these actors and what are their roles and responsibilities?**

Who?	Roles and responsibilities

23. **Is there a body in charge of coordinating the responsibilities of those actors?** Yes No

(If the answer is affirmative)

24. Who? _____

25. **Are there legal norms that establish resource allocation at the municipal level to reduce vulnerability?** Yes No

26. **Are there mechanisms to avoid miss use of resources?** Yes No

(If the answer is affirmative)

27. **Which _____**

28. **Do you have support of multilateral loan organizations to execute risk reduction projects and programs?** Yes No

(If the answer is affirmative)

29. **Which? _____**

30. **Are there alliances and agreements between the public, private sector and civil society for the execution of risk management programs?** Yes No

(If the answer is affirmative)

31. **Which? _____**

32. **How much does the community get involved in risk management?**

_____

33. **What channels exist for community participation in topics related to risk management?**

_____

34. **How do you qualify the implementation of programs and projects focused on risk and management reduction? _____**

35. Are there procedures to monitor and evaluate the effectiveness and progress of risk management?
Yes No

(If the answer is affirmative)
36. Which? _____

EMERGENCY PREPAREDNESS AND DISASTER MANAGEMENTE
37. When a disaster has occurred, which emergency institutions arrive first? _____

38. If there is a landslide in the Administrative Zone, what does the Head of Security do?
_____

39. Does the population know about these procedures? Yes No

(If the answer is affirmative)
40. Who knows what to do?

(If the answer is negative)
41. Why?
a. They have not been informed b. They are not interested c. Other:

42. Does an early warning system or a community alarm exist? A. Yes b. No

(If the answer is affirmative)
43. What is the alert about?
_____
_____
44. For what situations is it used?
_____
_____
45. Do you perform simulations? A. Yes b. No

(If the answer is affirmative)
46. What type of simulations, how often and who participates?

Simulation for:	How often?	Who participates?

47. Do you have subsidies or social investment funds available for affected communities in case of a disastrous event or for vulnerable communities?
_____
_____

ANNEX 8: LIST OF NEIGHBORHOODS INCLUDED IN THE STUDY

#	Administrative zone	Neighborhood	#	Administrative zone	Neighborhood
1	CALDERON	SAN ANTONIO	56	DELICIA	SAN JOSE OBRERO
2	CALDERON	PLANADA DE SAN FRANO	57	DELICIA	SEÑOR DEL ARBOL
3	CALDERON	LA LIBERTAD	58	DELICIA	ABDON CALDERON II
4	CALDERON	ECUADOR	59	DELICIA	SAN ENRIQUE DE VELASCO
5	CALDERON	MARIA AUGUSTA URRUTIA	60	DELICIA	SAN CAYETANO
6	CALDERON	BUENA VISTA	61	DELICIA	LA ROLDOS
7	CALDERON	PUERTAS AL SOL	62	DELICIA	LA ANTONIA
8	CALDERON	LA PUNTILLA	63	DELICIA	SAN PEDRO DE PISULLI
9	CALDERON	CARAPUNGO ETAPA F	64	DELICIA	SAN JOSE DE CANGAHUA
10	CALDERON	JESUS DEL GRAN PODER	65	DELICIA	SANTA ISABEL
11	CALDERON	CARAPUNGO ETAPA E BAJO	66	DELICIA	SANTA ROSA DE SINGUNA
12	CENTRO	VISTA HERMOSA	67	DELICIA	SAN LUIS II
13	CENTRO	ATACAZO	68	DELICIA	LA PAMPA
14	CENTRO	LA CHILENA	69	ELOY ALFARO	CIUDADELA 4 DE DICIEMBRE
15	CENTRO	EL ROSAL	70	ELOY ALFARO	SAN BARTOLO
16	CENTRO	NUEVA TOLA	71	ELOY ALFARO	REINA DE QUITO
17	CENTRO	NUEVA AURORA	72	ELOY ALFARO	CAMINOS AL SUR
18	CENTRO	DOS PUENTES	73	ELOY ALFARO	QUITO SUR
19	CENTRO	EL GUABO	74	ELOY ALFARO	EL CALZADO
20	CENTRO	LIBERTAD BAJO	75	ELOY ALFARO	LUCHA DE LOS POBRES ALTO
21	CENTRO	MIRAFLORES ALTO	76	ELOY ALFARO	MENA DOS
22	CENTRO	LA CANTERA	77	ELOY ALFARO	SANTA BARBARA BAJA
23	CENTRO	GUAPULO	78	ELOY ALFARO	SOLANDA
24	CENTRO	SAN LUIS DE MONJAS	79	ELOY ALFARO	ARGELIA INTERMEDIA
25	CENTRO	BALCON QUITEÑO	80	ELOY ALFARO	LA CLEMENCIA
26	CENTRO	AUQUI DE MONJAS	81	ELOY ALFARO	LUCHA POBRES BAJO
27	CENTRO	PANECILLO	82	ELOY ALFARO	AIDA LEON
28	CENTRO	LIBERTAD ALTA	83	ELOY ALFARO	STA. BARBARA 5 DE FEB
29	CENTRO	LOS ANGELES	84	ELOY ALFARO	FORESTAL ALTA
30	CENTRO	ARBOLEADA DE MONJAS	85	LOS CHILLOS	SAN RAFAEL
31	CENTRO	NUEVA ESPERANZA	86	LOS CHILLOS	CARLOS MONTUFAR
32	CENTRO	SAN SALVADOR	87	LOS CHILLOS	EL GUANGAL
33	CENTRO	PALUCO	88	LOS CHILLOS	EL BATAN DE PINTAG
34	CENTRO	LA INDEPENDENCIA	89	LOS CHILLOS	SANTA TERESITADEL VALLE
35	CENTRO	COLMENA ALTA	90	LOS CHILLOS	CHILLOJIJON
36	CENTRO	CABILDO LIBERTAD ALTA	91	NORTE	LA FLORESTA
37	CENTRO	LA TOLA BAJA	92	NORTE	LA TOLA ALTA
38	CENTRO	LAS ORQUIDEAS	93	NORTE	LUZ DE OCCIDENTE
39	CENTRO	TOCTIUCO	94	NORTE	BELLAVISTA
40	DELICIA	RANCHO ALTO	95	NORTE	COMITÉ DEL PUEBLO
41	DELICIA	PUEBLO NUEVO	96	NORTE	ANA MARIA
42	DELICIA	LUCHADOR ELOY ALFARO	97	NORTE	INCHAPICHO
43	DELICIA	RANCHO ALTO	98	NORTE	LAS PALMAS
44	DELICIA	SAN LUIS I	99	NORTE	QUINTANA
45	DELICIA	ABDON CALDERON I	100	NORTE	TANDA
46	DELICIA	RANCHO BAJO	101	NORTE	ATUCUCHO
47	DELICIA	CAMINOS A LA LIBERTAS	102	NORTE	SAN MIGUEL DE ZAMBIZA
48	DELICIA	COMUN DE POMASQUI	103	NORTE	PRIMAVERA
49	DELICIA	MENA DE HIERRO ALTA	104	NORTE	COCHAPAMBA SUR
50	DELICIA	SANTA ANA ALTA	105	NORTE	LOS PINOS LA PULIDA ALTA

51	DELICIA	LA ESPERANZA	106	NORTE	LA BOTA
52	DELICIA	LOS ALTARES	107	NORTE	EL VALLE DE NAYON
53	DELICIA	LA COMUNA	108	NORTE	SANTA CLARA DE MILLAN
54	DELICIA	COLINAS DEL NORTE	109	NORTE	COCHAPAMBA NORTE
55	DELICIA	LA BOTA	110	NORTE	COCHAPAMBA NORTE a
111	QUITUMBE	BUENA AVENTURA	131	QUITUMBE	SAN LUIS DE CHILLOGALLO
112	QUITUMBE	ASISTENCIA SOCIAL	132	QUITUMBE	VERTIENTES DEL SUR
113	QUITUMBE	SAN GREGORIO	133	QUITUMBE	SANTA ISABEL
114	QUITUMBE	PUEBLO SOLO PUEBLO	134	QUITUMBE	LA LIBERTAD
115	QUITUMBE	SAN BLAS I	135	QUITUMBE	EL PRADO
116	QUITUMBE	TERRANOVA	136	QUITUMBE	VENCEREMOS 1
117	QUITUMBE	TURUBAMBA MONJAS BEV	137	QUITUMBE	NUEVA LOJA
118	QUITUMBE	LA COCHA	138	TUMBACO	SAN JUAN CHECA
119	QUITUMBE	AYMESA	139	TUMBACO	SAN PATRICIO
120	QUITUMBE	SAN MARTIN DE PORRAS	140	TUMBACO	CHICHE
121	QUITUMBE	STA. MARTHA ALTA	141	TUMBACO	CHINANGACHI
122	QUITUMBE	EL EJERCITO	142	TUMBACO	LUMBISI
123	QUITUMBE	SAN FRACO DE HUARCAY	143	TUMBACO	IGUINIARO BAJO
124	QUITUMBE	VIRGEN DEL QUINCHE II	144	TUMBACO	SANTA INES
125	QUITUMBE	RUMIURCO	145	TUMBACO	OLALLA
126	QUITUMBE	SAN VICENTE CORNEJO	146	TUMBACO	SAN FRANCISCO DE PINSHA
127	QUITUMBE	NUEVOS HORIZONTES	147	TUMBACO	GUADALUPE
128	QUITUMBE	PUEBLE UNIDO	148	TUMBACO	CHIVIQUI
129	QUITUMBE	TURUBAMBA MONJAS II	149	TUMBACO	SAN JUAN BAUTISTA
130	QUITUMBE	MANUELITA SAENZ	150	TUMBACO	ITULCACHI

ANNEX 9: COMMUNITY CAPACITY FOR RISK MANAGEMENT IN NEIGBORHOODS OF QMD SURVEY

Good morning / afternoon. Thanks for responding to this survey. This survey is part of the disaster risk reduction program in DMQ, within the security and governance secretariat of the municipality of Quito. The survey was conducted with representatives of 150 neighborhoods of DMQ. The objective is to know the perception of the community to potential natural hazards and threats; to know the capacities of the community to reduce vulnerability and react to disaster response; and to deepen the corresponsible work between DMQ and communities to develop a culture of prevention.

Survey no: _____ Interviewer: _____
Administrative zone: _____ Neighborhood: _____
Name(s) of interviewed: _____

Neighborhood vulnerability

A. Political vulnerability

48. What is the status of legalization of you neighborhood?

A. Legalized b. In process of legalization c. Not legalized d. Other:_____

(If it is legalized)

49. How long ago was it legalized?_____

(If it was legalized less than 5 years ago or if it is in process of legalization)

50. How long did the legalization process take or is taking? _____

(If it took more than a year)

51. Why did the process take so long?

_____
_____

(If it is not legalized)

52. Why is the neighborhood not legalized?

_____
_____

B. Social vulnerability

53. What basic services does your neighborhood have and what is the coverage?

Basic service	Yes	No	Coverage: total o partial
Light			
Drinking water			
Telephone			
Sewerage			
Access roads			
Transport			

C. Risk and vulnerability perception

54. Can you locate in the attached map of your neighborhood the following thing:

Zones and places to locate	Code	Observations
Neighborhood limits		
Unsafe zones due to antropic factors:		
- Crime and violence zones	1	
- High contamination zones	2	
- Unhealthy zones	3	
- Traffic accident zones	4	
- Housing on slope areas	5	
Unsafe zones for natural factors:		
- Landslide zones	6	
- Flooding zones	7	
- Ash fall zones	8	

- Seismic zones	9	
Safe zones		
- Community police unit (CPU)	10	
- Communal house	11	
- Shelter	12	
- Other:	13	

(If he/she identified any natural event)

55. From the events you identified, which ones are the most recurrent? _____

D. <u>Educational vulnerability about risk perception</u>

56. Have you heard about risks and hazards that affect your neighborhood? A. Yes b. No

57. And about landslides and floods? A. Yes b. No

(If he/she answer affirmative to answers 8 and 9)

58. What have you heard?

_____

_____

_____

59. How did you hear?

_____

_____

60. Does the community receives or has received talks about hazards and risks in the last 2 years?

A. Yes b. No

(If the answer is affirmative)

61. With what frecuency have your received this talks? _____

62. Who has participated in the talks and what have been the themes?

Who has given the talk?	Themes:

63. In this talks participate: a. The entire community b. A big part c. A small part d. A minority

64. Who are the ones that participate the most?

a. Children b. Youth c. Adults d. Elderly e. Men f. Women g. Others:

<u>Neighborhood organization and inclusion</u>

65. Do the members of the community get together? A. Yes b. No

(If the answer is affirmative)

66. Who gets together?

_____

_____

67. How frequently? _____

68. What are the main topics discussed in the meetings?

_____

_____

69. What local organizations support your community improvement to reduce unsafe conditions?

Type of organization	Yes	No	What do they do for the neighborhood?
Directiva Barrial			
Comité pro-mejora			
Comité de seguridad			
Brigadas comunitarias			
Coop, de vivienda			
Cooperativa de ahorros			
Administración zonal			
Otra:			

70. Do you consider that the neighborhood has been taken into account by the municipality in themes related with the city development? A. Yes b. No

71. Why?

_____

Achievements in vulnerability reduction

A) Actions at politica level

25. Do you think that the neighborhood knows and complies the norms and ordinances of land occupation and construction?

a. Yes they know and the majority complies b. Yes they know and a few comply

c. Yes they know but they do not comply d. They do not know and do not comply

72. Why?

_____

73. Are there institutions that control the compliance of security and construction norms? A. Yes b. No

(If the answer is affirmative)

74. Who controls and how do they play their role?

_____

B) Structural measures

75. When the members of the neighborhood construct any infrastructure, do they take into account landslide risk and flooding? A. Yes b. No

(If the answer is affirmative)

76. In what way do they consider it?

_____

_____

(If the answer is negative)

77. Why don't they consider it?

_____

_____

78. Have there been works to protect your neighborhood from landslides? A. Yes b. No

(If the answer is affirmative)

79. What works and who has done them?

What works?	Who has done it?

C. Community actions

80. What is your neighborhood doing to take care and protect the environment, the basins and the slopes?

_____

_____

_____

81. What are the most important improvements and achievements that your neighborhood has accomplished to be safer?

_____

_____

_____

82. How does your neighborhood related with the municipality? Are the actions coordinated to improve the neighborhood? How are those actions coordinated?

_____

_____

Achievements in prevention and emergency management

83. When there is an emergency, what emergency organisms are the ones that arrive first? _____

_____

84. In case of a landslide or flood, is the community prepared and do they know what to do?

a. Yes, the majority b. Yes, some c. Yes, a few d. No

(If the answer is affirmative)

85. Explain what would the community do, where would they go, who would be in charge of each activity?

_____

_____

_____

86. Does an early warning system or a community alarm exist? A. Yes b. No

(If the answer is affirmative)

87. What is the alert about?

_____

_____

_____

88. For what situations is it used?

_____

_____

_____

89. Do you perform simulations? A. Yes b. No

(If the answer is affirmative)

90. What type of simulations, how often and who are promoting it?

Simulation for:	How often?	Who promotes it?

91. If there is an emergency or disaster in your neighborhood, what type of support have the affected families received?

_____

_____

92. After an event, such as a landslide, what did you as a community did to recover?

_____

_____

_____

Future perspectives for a culture of prevention and security

93. Do you think that people living in risk zones would be willing to move to safer areas? A. Yes b. No c. Maybe

94. Why or under what conditions?

_____

_____

_____

95. Does the community feel safe of dangers such as landslides, floods, earthquakes and volcanic eruptions? Why?

Danger	Yes	No	Why?
Landslides			
Floods			
Earthquakes			
Volcanic eruptions			

(If they answer that they feel safe)

96. Why do they feel safe? _____

_____
_____

(If they answer that they do not feel safe)

97. How do you think the community can improve this unsafe situation? _____

_____
_____

Observations of the interviewer

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

ANNEX 10: Summery chart of the roles and responsibilities of the main institutions and actors involved in landslide risk management

Level	Actors	Pre-disaster				Disaster	Post-disaster	
		Risk Identification	**Prevention**	**Mitigation**	**Preparedness**	**Response**	**Recovery**	**Reconstruction**
International	Research Institutions: IRD, LA RED	Develop disaster risk & vulnerability analysis.	Develop a disaster inventory system.					
	Financial Institutions: PNUD, BID,EU Commission, CAPRADE	Provide resources for research programs on risk identification.	Provide resources for disaster reduction and disaster prevention programs.	Provide resources for mitigation works.	Provide resources for preparedness activities.	Mobilize financial aid in case of major disasters.	Provide resources for recovery assistance.	Mobilize financial aid for reconstruction after major disasters.
National	National government: Housing / Risk Ministries	Provide resources for national research institutions.	Establish risk management policies.	Promulgate the national construction code.	Prepare national emergency preparedness for major disasters.	Declare state of emergency in case of major disasters	Provide resources for recovery assistance.	Establish policies for development planning.
	Research Institutions: IG-EPN, INAMHI	Provide diagnostic for seismic and volcanic activity; information of weather, climate and hydrological resources	Provide an information system to communicate forecast.		Monitor seismic and volcanic activity; develop early warning systems for hydro meteorological activity.			
Municipal	Local Government (Territorial Ordering / Land, & Housing / Security Secretariats	Look for financial resources to develop research.	Define preventive planning policies and policies for disaster prevention and disaster risk reduction.	Regularize land use and security of tenure. Manage relocation programs. Provide social housing.	Determine emergency preparedness activities.	Activate de Emergency Operation Committee at the District level.	Determine recovery actions.	Establish policies for development planning.
	Administrative Zones	Identify risk zones; evaluate natural events.	Develop contingency plans for the rainy season. Develop awareness-raising and	Define structural mitigation works.	Develop evacuation plans, operational procedures during emergency. Monitor	Develop systematic registration of damages and	Determine recovery actions.	

			training programs.		natural events.	loss.		
	Metropolitan Enterprises: EMAAP, EMOP, EMASEO, Housing Enterprise.	Generate hydro meteorological information.	Develop awareness-raising and training programs.	Implement structural mitigation works. Manage drinking water, sewer and risk in the Pichincha slopes. Manage environmental resources and solid wastes. Implement resettlement program. Implement social housing programs	Develop a hydrological forecast system in the Pichincha slopes.		Implement recovery works.	
	Emergency management institutions: Firefighters, Red Cross, Police.		Develop community awareness-raising and training programs.			Perform pre-hospital assistance, communication, search & rescue, transfer of victims, damage and loss evaluation.		
	Intermediary level NGOs: CUIDAD, COOPI		Provide training to local leaders and social networks.	Implement structural mitigation works. Develop programs to improve living conditions. Facilitate access for credit for construction.			Implement recovery projects.	
	Financial Entities.			Provide credit for housing.				
Community	Community cooperatives, local leaders, social networks.		Participate in community awareness-raising and training programs.	Work for the improvement of living conditions, to obtain basic services and equipment, to be regularized.	Participate in drills and emergency preparedness activities.		Reunite communities for self-recovery.	