Version June 2011

RCC Guideline 3.2

Promoting Use of Disaster Risk Information in Land-use Planning

Under the Regional Consultative Committee on Disaster Management (RCC) Program on Mainstreaming Disaster Risk Reduction into Development (MDRD)

Regional Consultative Committee on Disaster Management (RCC)

RCC Members: Islamic Republic of Afghanistan, People's Republic of Bangladesh, Kingdom of Bhutan, State of Brunei Darussalam, Kingdom of Cambodia, People's Republic of China, Georgia, Republic of India, Republic of Indonesia, Islamic Republic of Iran, Hashemite Kingdom of Jordan, Republic of Kazakhstan, Republic of Korea, Lao People's Democratic Republic, Government of Malaysia, Republic of Maldives, People's Republic of Mongolia, Union of Myanmar, Federal Democratic Republic of Nepal, Islamic Republic of Pakistan, Independent State of Papua New Guinea, Republic of the Philippines, Democratic Socialist Republic of Sri Lanka, Democratic Republic of Timor-Lesté, Kingdom of Thailand, Socialist Republic of Viet Nam

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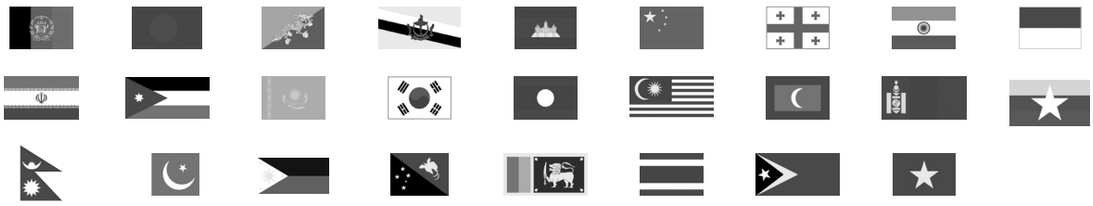

RCC Members: Islamic Republic of Afghanistan, People's Republic of Bangladesh, Kingdom of Bhutan, State of Brunei Darussalam, Kingdom of Cambodia, People's Republic of China, Georgia, Republic of India, Republic of Indonesia, Islamic Republic of Iran, Hashemite Kingdom of Jordan, Republic of Kazakhstan, Republic of Korea, Lao People's Democratic Republic, Government of Malaysia, Republic of Maldives, People's Republic of Mongolia, Union of Myanmar, Federal Democratic Republic of Nepal, Islamic Republic of Pakistan, Independent State of Papua New Guinea, Republic of the Philippines, Democratic Socialist Republic of Sri Lanka, Democratic Republic of Timor-Lesté, Kingdom of Thailand, Socialist Republic of Viet Nam

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Section 1

Introduction

1.1 Background

The Regional Consultative Committee (RCC) on Disaster Management comprises of heads of the National Disaster Management Offices of 26 countries from Asia and the Pacific region. ADPC acts as the secretariat to the RCC and its program on Mainstreaming DRR into Development.

The RCC under its program on mainstreaming disaster risk reduction into development (MDRD) have identified agriculture, education, housing, health, urban planning and infrastructure, as priority sectors to initiate mainstreaming disaster risk reduction (DRR) into development.

The RCC MDRD Program has five components namely:

1. Undertaking Priority Implementation Partnership on Mainstreaming DRR into **National Development Planning Processes**
2. Undertaking Priority Implementation Partnerships on Mainstreaming DRR into **Sectoral Development Planning Processes**
3. **Advocacy** for building awareness and political support for Mainstreaming DRR into Development
4. **Knowledge Management** Platform for Mainstreaming DRR into Development; Showcasing good practice and lessons learned
5. **Capacity development** for mainstreaming DRR into development

One of the strategies identified under the program is to develop RCC Guidelines on Mainstreaming DRR into national and sectoral development planning processes. The primary objective of the RCC Guidelines is to provide general directions to the RCC members and concerned sectoral ministry/ agency on possible approaches for mainstreaming DRR in the concerned sector. The Guidelines are based on the experiences of the RCC member countries undertaking Priority Implementation Partnership (PIPs) under the RCC MDRD Program as well as their experiences with other partners on similar topic.

This Guideline is specific on promoting use of disaster risk information in land use planning. While national development plans, sectoral plans and poverty reduction strategy papers (may collectively be referred to as socioeconomic development plans), are utilized by governments to define their road map for achieving sustained economic growth and poverty reduction, land use plans regulate the use of land to maximize the interaction of man and its land resources towards achieving socioeconomic development

objectives. Ideally, land use plans are long-term in timeframe (at least 10 years) to guide the locational dimension of short-to-medium term socioeconomic development plans, programs and projects, based on projected population levels and development trends. Land use plans specify the location of residential areas, economic activities such as agriculture, industries, tourism development areas, public facilities and services, and protected areas, and transportation networks that interlink all of these areas. Land use plans comprehensively cover the territorial jurisdiction of a specific planning unit, both rural and urban areas.

In DRR, however, urban areas and megacities are critical, since these areas are where population, economic activities and critical infrastructures are concentrated. These areas are at higher risks (more lives lost, more property damaged) when a disaster happens. Thus, this Guideline is also part of the theme on urban planning and infrastructure of the RCC mainstreaming program.

1.2 Purpose of the Guideline

In general, the Guideline aims to strengthen proactive disaster management efforts of RCC member countries by making it an instrument for building familiarity on the role of land use planning in DRR and appreciation of risk-sensitive land use planning. While this Guideline suggests routines to streamline particular land use planning processes, it is still up to individual countries to adopt mandatory procedures or protocols based on their individual requirements to ensure that disaster risk information are properly integrated in land use planning and that the resulting risk-sensitive land use plans ultimately reduce the vulnerability of people to hazards.

The Guideline specifically aims to:

- Improve understanding of the **role of land use planning in disaster risk reduction**
- Highlight **importance of incorporating disaster risk information in land use planning**
- Provide guidance on **how to incorporate disaster risk information in land use planning**
- Identify **enabling factors** for incorporating disaster risk information in land use planning
- **Present Examples from RCC member countries** where initiatives have been undertaken to incorporate disaster risk in land use planning at different scale
- Provide a base for interested RCC member countries to **develop similar guidelines in their country context and use it for facilitating dialogue with external development partners** on the need to incorporate disaster risk information in land use planning

1.3 Target group

The document is primarily aimed for:

- **Government officials** (land use planners, physical planners, township planners, transportation planners, architects, engineers, economists, sociologists, sectoral planners, etc.) **in RCC member countries working in national and local government agencies involved in development, revisions and enforcement of land use plans**
- **Officials from the national disaster management agencies** in the RCC member countries for advocating with their counterpart agencies (at national and local levels) on the issue related to incorporation of disaster risk information in land use planning.
- **Government officials** involved in aspects related to river basin planning, ecosystems based management, environmental management
- **Government officials** involved in monitoring, mapping and information dissemination of natural hazards

1.4 Scope of the document

The scope of this Guideline in two aspects, namely land use planning and disaster risks, needs to be well-defined so that target users would be able to know whether it could be immediately applied within country practices or necessary fine tuning and paradigm shifts may have to be initiated.

The field of public policy that is referred to as land use planning in this Guideline has various corresponding terms, which are sometimes used interchangeably. Some of these are: physical planning, town planning or spatial planning. Depending on the country and context where the term is used the meaning of the term varies.

Land use planning takes place at various levels of Government, usually with increasing levels of detail with decreasing administrative scale:

- At the highest administrative levels such as federal or national level, in the form of national land use policy, framework plan or planning framework that define broad directions for the development and management of land that guide all concerned development authorities at all levels
- At the state, district or similar level (such as regional or provincial level), in the form of local land use plans specifying development goals and required land uses under its jurisdiction
- At the local or city/municipal level in form of comprehensive land use plans with detailed allocation of particular land parcels to specific uses or specific planning application procedures to be followed for different zones. These plans layout strategies to manage land development in a community. It becomes the basis for zoning ordinances and the grant of building or construction permits for land using activities.

To take into account the varying political structures of RCC member countries, the Guideline shall use planning area to mean the political unit that adopts the strategy of mainstreaming DRR in land use planning.

Even though varying in emphasis at different levels, land use plans contain policies and elements on settlements, production and economic development areas, community infrastructure (schools, hospitals) and transportation, utilities and other services, housing/settlements, cultural heritage, environmental resources and conservation sites, among others.

It is at the lowest level of administration (i.e., local or city/municipal level) where land use planning controls are implemented. Local or city/municipal governments are the primary decision-makers for land use management, supported by power to enforce building codes, zoning, and other regulatory tools. The land use plan and the accompanying zoning ordinances, serve as a foundation for the community to address development concerns in high-risk areas.

This Guideline will be most useful to local governments: help them think through their own needs and opportunities for incorporating disaster risk information in their land use plans and allow them to identify activities that can be implemented.

However, there is a strong need for involvement of higher-level governments. Risks, in most instances, have to be addressed beyond political or administrative boundaries. Many issues are better resolved by evaluating hazards more comprehensively by coordinating at the higher levels of government, or even at environment resource level, say to look at watersheds and river systems in order to effectively address floods. Thus, multijurisdictional or inter-local planning should be encouraged to address common hazards and define complementary risk reduction measures.

National government should be able to provide guidance in terms of guidelines and policy directions. In some countries ratification of local land use plans is the responsibility of a national government body, and therefore, it would be important that national governments undertake technical trainings related on risk sensitive land use planning, to emphasize the expectations from local governments in terms of development and DRR objectives. In particular, national government should ensure that local governments have a well thought out process for mitigating or avoiding future damages before approving future projects or any other development activities

It is also important for national government to provide local governments with knowledge and skills in the form of analytical tools, science-based information, and base and hazard maps to help them in their planning work. When appropriate, government may also provide mitigation fund options that local governments can avail of to implement their risk management projects. Concerned national government agencies responsible for watershed and river basin management, specific hazard monitoring and mapping, development and land use planning, among others should anticipate the requirements of local governments for effective land use planning.

As more and more information are generated by RCC member countries on climate change impacts on existing natural hazards, on sectoral development concerns such as in coastal areas, agriculture and natural resources, water and health, these should be considered in risk-sensitive land use planning.

Section 2

Why use disaster risk information in land use planning

2.1 Development Trends, Land Use and Disaster Risks

Land plays a significant role in society. It is an important factor for production needed for agriculture, industry, and other economic activities. But it also serves as a principal instrument in fostering "social justice, development, provision of decent dwellings, and health conditions, and therefore should be used in the interest of the society as a whole" *(UN Conference on Human Settlements, 1976)*.

The way man uses land, therefore, would have a decisive influence on the overall development prospects of societies, not only for this generation but for future generations as well, consistent with the principles of sustainable development. Certain global development trends such as population growth and rapid urbanization lead to land use conflicts, increased vulnerabilities and disaster risks.

World population is estimated at about 6.8 billion in 2010 (UN: 2008). A hundred years ago it was under 2 billion and UN predicts that there would be two billion more by 2025. About half of this number are in cities. Cities in developing countries are expected to absorb 95 percent of the total population growth expected worldwide in the next two decades. The urbanization process results in land pressure as migrants from outside move into already overcrowded cities so that the new arrivals have little alternative other than to occupy unsafe land such as alongside major rivers, construct unsafe houses or work in unsafe environments (Havlick: 1986). These people often incur greater risks from natural hazards such as flood and landslide as a result of having to live in very closely built structures. This uncontrolled development has consequences on the flow of water, either by accelerating water runoff or by obstructing the natural drainage system which could lead to large scale flooding or landslides with serious human and economic consequences (WMO:2007).

A study (see box) in 2010 by Asian Disaster Preparedness Center (ADPC) on three hill towns (Rangamati, Bandarban and Khagrachari) of Bangladesh shows that the towns are horizontally developing in the unsafe places with potential exposure to landslide, earthquake liquefaction effects and urban flood.

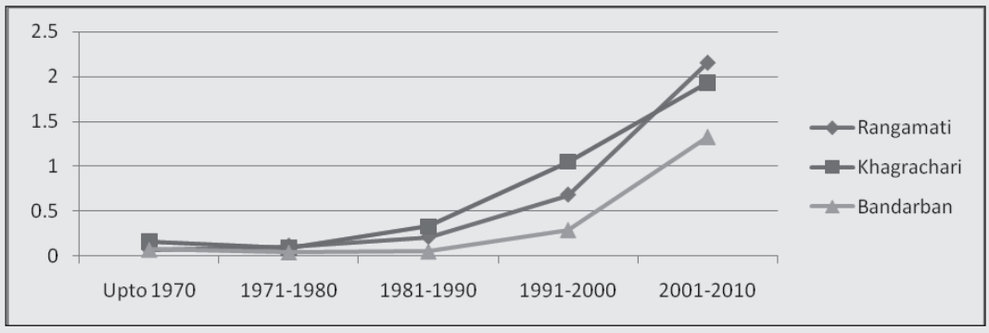
Rangamati municipality in Bangladesh has developed as the hub of Hill Tract over last four decades. This town's built-up area has expanded 0.40 sq. km annually over last four decades and at a rate of 0.158 sq. km over last ten years. Annual growth rate in this town has decreased over the years due to non-availability of land for new settlement. About 46% of the total area of the municipality is covered by lake. The present population of the town is 90,770, which will be 166,317 at the end of the projected year in 2030. If the current net density is to be maintained in the year 2030, it will require additional 1689 acres of land to accommodate the additional population. The current vacant land in the municipality is 547 acre, which is less than the area required to accommodate the total population at the end of the target year. Since water bodies surround the town, there is no scope of horizontal expansion. Current settlements are taking place on the slope of the hills with mass hill cuttings and without any consideration of natural settings.

Table 1 Growth Trend of Rangamati, Bandarban and Khagrachari Town

Year	Rangamati		Khagrachari		Bandarban	
	Increased Area (sq km)	Total Area	Increased Area (sq km)	Total Area	Increased Area (sq km)	Total Area
Upto 1970	0.07	0.07	0.16	0.16	0.07	0.07
1971-1980	0.11	0.18	0.09	0.25	0.04	0.11
1981-1990	0.21	0.39	0.33	0.58	0.05	0.16
1991-2000	0.68	1.07	1.05	1.63	0.29	0.45
2001-2010	2.15	3.22	1.93	3.56	1.33	1.78

Source: Analysis by the study team based on the year of construction of buildings identified during base map preparation during December 2009 to January 2010

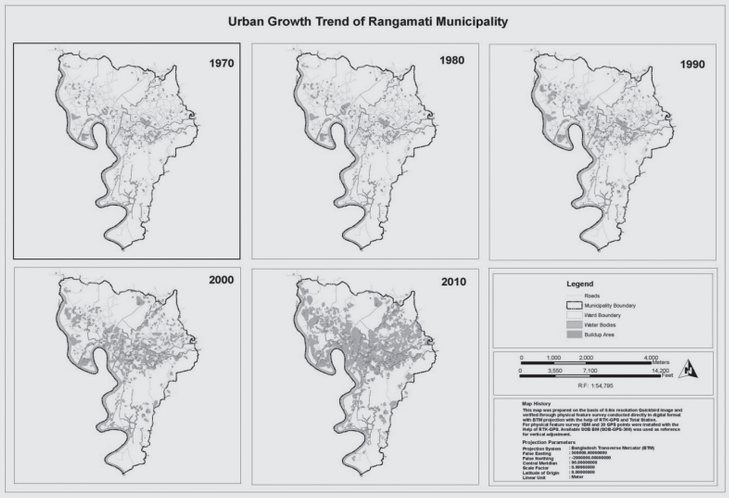
Figure 1. Trend of Rangamati, Bandarban and Khagrachari over last four Decades (1971-2010)



Current population of the town of Bandarban is 43,744, which is projected to be 90,155 in the year 2030. If the present density is considered, it will require 943 acres of land to accommodate additional population. The spatial development (non agricultural use like residential, commercial etc.) of the town has taken place at the rate of 0.17 sq. km annually over last four decade and at the rate of 0.27 sq. km during last ten years. The development rate over last decade increased due to immigration from nearby sub-towns. If the current rate of development continues, about 5.4 sq. km areas would be developed by 2030. However, the development is taking place on the hills and at the slope of the hills which making the town vulnerable to possible landslide events in the future.

The gross density of Khagrachari town is 21 per acre. This is because of the suitability of living condition since the town is located on a valley. The current population of the town is 71,250, which will be 246,356 at the end of the year 2030. The average spatial growth rate of the town is 0.23 sq km per year over last four decades. The spatial growth rate has increased to 0.53 sq km over last ten years. Analysis of the spatial growth trend of the town indicates that the future development would take place towards the south on the marshy lands with possible effects of earthquake liquefaction effects.

Figure 2. Urban growth trend of in Khagrachari Municipality



Yellow Marked areas show the settlement in Khagrachari Town at the end of each decade. The settlements are identified based on the year of settlement establishment obtained during land use Survey by the Study Team

Urbanization can also stretch the capacities of local governments to monitor the appropriate location and quality of structures. In areas prone to seismic hazards, the large number of building of variable quality, many of which poorly constructed or badly maintained, will pose high risk to lives. The vulnerability of people living or working in such structures is bound to be high.

New settlements on the Marshy Lands on the south of Khagrachari Town. Similar settlements will grad more agricultural and vacant lands in the coming decades and will make the town Vulnerable to Earthquake Liquefaction effects.

River Sangu at Bandarban: Still use as one of the major mode to carry bamboo from other upzilas of the District

A growing population can likewise put pressure on natural resources such as agricultural lands and forests. With the limited land for food production, it may result in the opening or encroachment of forestlands, not only for food production but for settlements as well. Deforestation can result to increase in landslide hazard intensity or frequency in the long run.

Settlements on the foot of the hills at Khagrachari where thousands of migratead Settlers are living in vulnerable condition with possible landslides.

Typical house on slope land in Rangamati. Hundreds of houses of this type are constructed through the municipality that are under the threat of earthquake and landslide

2. 2 Disaster Risk Reduction oriented Land Use Planning

Knowledge of the relationships of development, land use and disaster risks provide planners a deeper understanding of what drives people to locate themselves in high risk areas. The location of residential areas, industries, critical public facilities and services are important parameters that define the vulnerability of communities to hazards. In this context, land use planning is instrumental in addressing the challenges posed by natural hazards on built environment. Through land use planning, vulnerability parameters can be modified to reduce risks. With its array of regulatory and non-regulatory techniques and mechanisms, land use planning can become an effective tool for disaster risk reduction.

Through the use of disaster risk information in land use planning, planning units would be able to:

- Identify areas
  - that are of high risk from impacts of hazards such as flood prone areas
  - that need lessening of effects of hazardous events such as water retention areas
  - where it is necessary to ensure effectiveness of response activities such as escape routes
- This identification would help in restricting location of human settlements and choosing suitable economic activities. For example flood prone areas might be allowed for agricultural use but not for human settlements.
- Understand the area of land actually available for development (considering development is not allowed in areas prone to natural hazards) and thus find options of how to meet the demand over time and accordingly set development goals and objectives.
- Provide guidance in formulating suitable risk reduction policies and zoning regulations such as building codes.
- Provide guidance in adopting suitable risk reduction measures in the development projects in the area.

Section 3

How to incorporate disaster risk information in land use planning

3. 1 Definitions

First, it is important to lay down the concepts associated with incorporating disaster risk information in land use planning. There must be a common understanding of the term risk or disaster risk and the elements associated with it, namely, hazard, exposure and vulnerability.

These concepts are understood through their definition below:

Terminology	Definition
Hazard	A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. *Comment*: The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "… hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.
Exposure	People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. *Comment*: Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.
Vulnerability	The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. *Comment*: There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure.
Disaster risk	The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period. *Comment*: The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least.

Sources: UNISDR, 2009

For purposes of this Guideline, hazard shall refer to natural hazards: flooding, rain-induced landslides, sea level rise, earthquake-induced landslides, liquefaction, earthquake, volcanic hazards, ground rupture and tsunami.

3. 2 Disaster Risk Assessment

To generate disaster risk information relevant to land use planning, disaster risk assessment or DRA is undertaken. DRA can be done using formal analytical quantitative methods or through qualitative risk perception. Whatever approach is used, a disaster risk assessment process involves four steps, generally adapted from the experience of the Philippines, (1) hazard characterization; (2) consequence analysis; (3) risk estimation; and (4) risk evaluation.

The four-step process is presented below. Both quantitative and qualitative approaches are woven in the discussion.

Step1: Hazard characterization

Hazard characterization of the planning area is the foundation upon which disaster risk-sensitive land use planning efforts are built. It provides an understanding of the potential threats facing the planning unit. By pinpointing the location, extent and magnitude of past disaster events, it is possible to determine the probability of such events occurring.

Basically, this step answers the questions: What types of hazard can affect your planning area? How often do they occur? Where did they occur? How many lives were lost? How much damage to property reported?

The planning unit should consider all types of hazards affecting the area. A multi-hazard perspective will result in better identification of risk management options that will address multiple hazards. For example, following a volcanic eruption, the deposition of volcanic sediment may disrupt river flows causing floods or water build up (dam effect). When this dam breaches, large-scale flooding can occur.

It is also important to understand the impact of climate change on the frequency and intensity of existing hazards. For example, projected in creases in rainfall could possibly trigger more rain-induced landslides or flooding.

In most instances, hazard events are described by their severity – e.g., magnitude or intensity for earthquake, or through time-dependent probabilistic statement such as 40-year flood. Note that a hazard event is a specific occurrence of a particular type of hazard.

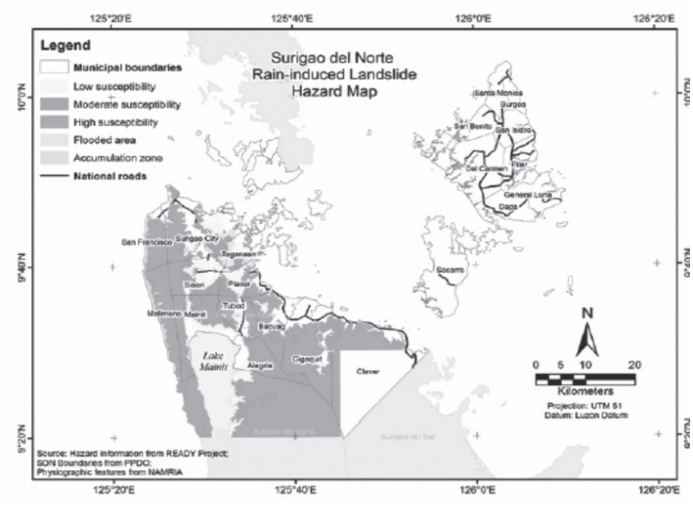
Data collected could be quantitative, qualitative or geo-referenced and in map form. The most basic input for disaster risk assessment is the hazard map produced by concerned government agency – the volcanology office for volcanic hazards, the meteorology office for flooding, the geosciences office for landslides. Hazard maps are essential for understanding what locations are subject to hazards and the risk posed. Mapping both the physical peril and the exposure and vulnerability of people to hazards can help guide decisions about where to locate critical infrastructure and human settlement (e.g., avoid development in high risk areas) and other mitigation measures that might be appropriate.

Table 2 Sample Matrix for Data and Maps Needed for Hazard Analysis

Hazard	Hazard Event		Hazard Map			Others	
	Description	Source of Information	Available	Scale	Source	Map/Data	Source
Flood Earthquake Tsunami Rain-induced landslide Earthquake-induced landslide Liquefaction Ground rupture Hazards from volcanic eruptions (i.e., ash fall, lava flow, debris	Indicate date of particular hazard events, (e.g., June 1986) Describe hazard event by severity e.g., magnitude or intensity for earthquake, or through time-dependent probabilistic statement such as 40-year flood. 10 deaths; $ 2 million dollar	• Members of community • Newspaper • Experts from academe, professional groups • Disaster management office • Responsible government agency (e.g., departments of public works, social welfare, agriculture, health, housing, etc.) • Existing plans and reports • Internet	Yes	1:10,000	National mapping agency Volcanology office for earthquake and volcanic hazards Meteorologic office for floods Geosciences office for landslides	Boundary map	Mapping agency

It is desirable that these maps contain information on return period or frequency of occurrence given the magnitude. For example, in the Philippines, hazard maps define the susceptibility levels, high susceptible area (HSA), moderate susceptible area (MSA) and low susceptible area (LSA); or prone and not prone areas. An example is Figure 1 below which is a rain-induced landslide map of Surigao del Norte, Philippines (READY Project, Philippines). Return periods were assigned for each of the susceptibility levels as a rough estimate of probability of occurrence

Figure 3 Rain-induced Landslide Hazard Map, Surigao del Norte, Philippines

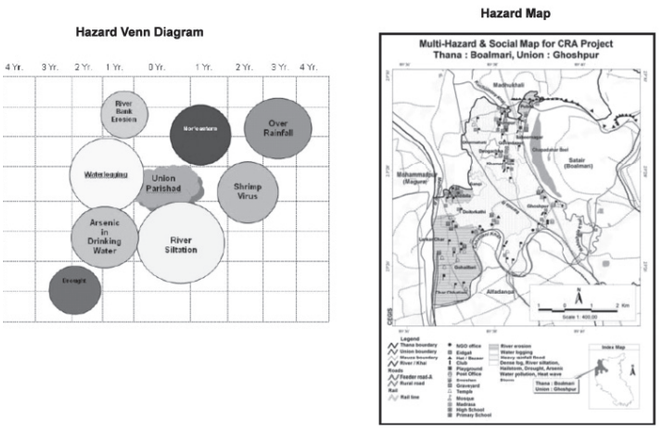


Source: NEDA-UNDP-EU Guidelines on Mainstreaming DRR in Subnational Development and Land Use/Physical Planning, 2008

and initial approach to come up with quantified disaster risks. The agencies monitoring the hazard may also provide the necessary advice on return period.

The hazard maps are overlain on the boundary map of the planning unit to determine what areas are affected.

Figure 4 Community-based Participatory Hazard Mapping



Source: Ministry of Food and Management, Bangladesh: The information relevant at this stage are summarized in Table 1.

In the absence of hazard maps, community-based hazard mapping have been undertaken in some countries. For example, in Bangladesh, a hazard venn diagram was used to identify and analyze the hazards in a locality, their magnitude and probability of occurrence. Through a participatory process, people from the community identify the hazards, and map out in a graph representing the boundaries of the locality with the use of art pieces, the bigger the size of which means the bigger the intensity and damage. These areas are then delineated in the actual boundary map of the locality.

The information relevant at this stage are summarized in Table 2.

Step 2 : Consequence Analysis

Knowledge on where a hazard event can affect the planning unit is derived from Step 1. The second step, Consequence Analysis, involves understanding who and what can be affected by a hazard event.

In the risk equation, consequence analysis is the product of the exposed elements, namely population and property, and their vulnerability for loss and damage. Given the probabilistic nature of hazards, consequence in terms of number of deaths and property damage are computed based on factor for fatality and factor for property damage. These factors essentially seggregates that portion of population and properties that would be potentially affected by the hazard, given their vulnerability.

A rough estimation would be, based on historical data (gathered in Step 1), use the proportion of actual number of deaths to total population in the affected area as factor for fatality and the proportion of the replacement value of damaged property to total value of properties in the affected area as factor for damage for property.

To illustrate, past events may indicate that in a 100-year flood event, a particular building could suffer damage at a level equal to 50 percent of its total replacement value. This

can be used as the factor for damage. The expected factor for damage numerically represents the "vulnerability" of the building to damage.

Consequence to the building for the 100-year flood event, would then be calculated by multiplying the replacement value of the building by the expected percent damage (or the factor for damage).

Note that a meaningful risk assessment takes into account all hazard events not just a single event. Thus, risk is computed for all other flood events such as 10-year, 40-year, etc. Further, replacement value just represents the value of the structure. As more data are gathered, losses in terms of content of the structures as well as losses from disruptions in its functions may also be calculated.

In the absence of information on factors for fatality and property damage, consequence analysis can proceed from the inventory of the number and value of buildings, structures, critical facilities and other community assets; and profiling the population in the affected areas in terms of their socioeconomic vulnerability. These information can give an indication of who and what can be potentially damaged should a particular hazard event happens.

The same approach may be applied for factor for fatality. The factor for fatality (percent of deaths to total population in affected area) is considered a macro level analysis of vulnerability (NEDA-UNDP-EU Guidelines:2008). A deeper understanding, or micro vulnerability analysis, on how affected population are able to cope with disasters based on their socioeconomic conditions will be done qualitatively and should enrich the analysis of the planning environment, and later development objective setting and risk management options identification.

Planning units should endeavour to build their exposure database both for number of specific structures and replacement value in order to come up with risk estimates in a systematic manner. This exposure database can make use of existing information systems in the planning unit such as those for property tax, land registration, or can be built in future regular censuses such as for population and housing.

The probable consequence of a hazard event measured in terms of potential lives lost and property damage is computed.

Table 3 Sample Matrix of Inventory of Data for Consequence Analysis

Population & Property / Assets	Sources of Information	Description / Characteristics	Replacement Value
Population	Statistics office Survey	Special population groups: elderly, physically challenged, women, children, indigenous peoples Income levels Access to basic services	
School building	Education department	Two-storey; four-classroom; concrete building; constructed in 1988; 150 pupils aged 6-12 years	$ 0.10 million

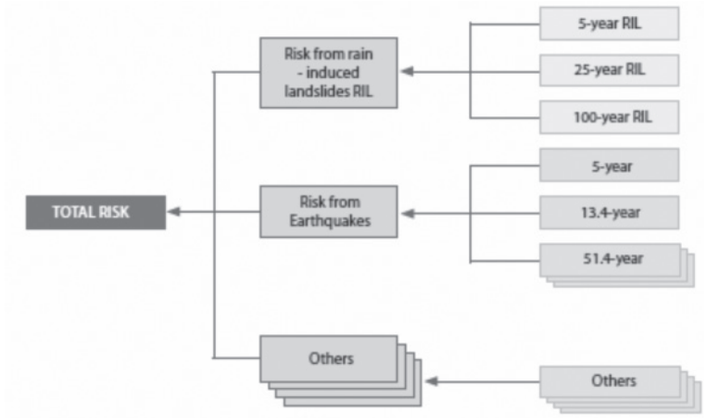
Population & Property / Assets	Sources of Information	Description / Characteristics	Replacement Value
Road	Public works	10 kilometer; paved; traversing flooded areas	$0.25 million
Bridge	Public works	Critical facility; 100 lineal meters; connecting town center to airport; constructed in 1970	$0.25 million
Hospital	Health department	25-bed hospital; two-storey; only hospital with surgical facilities; critical facility	$2.5 million
Historic lighthouse	Preservation society; lighthouse management office	Historic structure	$0.15 million
Commercial building	Building management; real property tax office	20-storey; concrete; constructed in 2005; houses banks, securities agencies and financial brokers; employs 5,000 local population	$90 million
Prime agricultural lands	Agriculture department	Irrigated; supplies 90% of food requirements of community; source of livelihood of 50% of population	$0.50 million (crop replacement)
Electric power plant	Power plant management office	base load plant; 1,200 MW; diesel-fired; lifeline utility system	(sales losses and production losses by customers)

Source: NEDA-UNDP-EU Guidelines on Mainstreaming DRR in Subnational Development and Land Use/Physical Planning, 2008

Step 3 : Risk Estimation

This step answers the questions: How will the planning unit's properties or assets be affected by a hazard event? How many lives will be lost should a hazard event happen? In step 2, consequence analysis, we identified who are the population and what are the properties that will be lost or damaged from a particular hazard event. We do this for all possible events for a particular hazard.

Figure 5 Schematic Illustration for Estimating Total Risk



Source: NEDA-UNDP-EU Guidelines on Mainstreaming DRR in Subnational Development and Land Use/Physical Planning, 2008

Recall that risk is defined as the likelihood of losses. In this stage, the risk to fatality (in terms of lives lost) and risk to property damage (in terms of replacement value) for individual hazards and individual hazard events are computed. From the risk equation, risk in terms of loss of lives is computed by combining the frequency of occurrence of hazard event, factor for fatality based on historical data and the number of potentially affected population revealed by the overlay of the hazard and population maps. Risk in

terms of damage to property is computed by combining the frequency of occurrence of a hazard event, factor for property damage and the replacement value of property exposed to the hazard revealed by the inventory of assets undertaken in step 2.

Risks from all hazards and hazard events. are summed up to come up with overall value of risks. The diagram below illustrates how total risk is estimated (NEDA-UNDP-EU: 2008).

Should information on frequency of occurrence of a hazard event (generated in step 1) and factors for fatality and damage are not available, due to absence of historical records, the information generated from Step 2, Consequence Analysis can be used for determining damage and losses of a particular hazard event. For example, a 100% damage would mean that the calculated replacement value of all properties in the affected area would represent the risk in terms of property damage.

Step 4 : Risk Evaluation

It is at this stage when decision makers deal with acceptable or not acceptable levels of risk. This is generally a very political process that would involve determining or setting benchmarks for acceptance of certain levels of risk. Conceptually, the As Low as Reasonably Practicable (ALARP) principle (Tonkin and Taylor: 2004) is generally used as guide, i.e., high risks are generally not acceptable while negligible risks are generally acceptable. But there is a certain level of risk between these two extremes that are tolerated on the basis that risks are kept as low as reasonably practicable using benefit and cost analysis.

In terms of lives lost, zero deaths may be set as a policy which implies that any levels of risk in terms of fatality would not be acceptable. It is important for policy makers to understand the implications of this policy, e.g., the need for pre-emptive evacuation which may require, among others, additional resources in terms of providing for the requirements of evacuees, such as food, water, medicine.

In the Philippines, computed risks have been used as a means to prioritize areas that require priority attention in terms of improving risk levels. Using the criteria for declaration of calamity by the disaster management office, composite indices are computed and areas are ranked accordingly as urgent priority, high priority and priority. Apart from determining what areas will be evaluated based on a multi-hazard perspective, prioritization in terms of what hazard to give priority attention is through the use of a risk matrix. In a risk matrix approach, various parameters of risks such as severity, frequency, human loss potential and economic loss potential are placed in the left most column. Qualitative evaluation can be expressed through terms such as high, medium or low likelihood of occurrence. These could reflect either expert judgments or societal perceptions of risks about a particular hazard.

Another approach for risk evaluation is through “as is” and “desired state” analysis of vulnerability. The “as is” state is the description of the vulnerability that existing hazards present while the “desired state” is the level of vulnerability that the planning unit is willing to accept. The levels of vulnerability for the two states may be stated in terms of structures affected or total loss in monetary value. This evaluation scheme will likely work for assessing damage to assets but not to lives since the level of vulnerability for this would be definitely zero for most societies.

3. 3 Mainstreaming Disaster Risk Assessment Results in the Land Use Plans

The disaster risk assessment results form the basis for understanding implications of current and future land use management and development. The DRA provided information on what areas in the planning unit are susceptible to each hazard, where the higher losses and damages will occur, how much a hazard may cost were it to occur, and how the lives and quality of life in the planning unit might be affected in the aftermath of disaster. In terms of implication to land use, the following questions will determine what changes are needed to the existing land use plan.

- Should current development strategy remain? e.g. should residential buildings continue to be built in the area? If not, should current ones be retrofitted? Should houses not be built at all in the area?
- How do the risks impact socio-economic conditions?
- What are the alternative land use development strategies?
- How do the physical changes interact with other areas (e.g. nearby towns, municipalities, provinces, regions), physically and economically?

The analysis of risk impacts to land use guides planners and policy makers in determining where and what development could be further undertaken in their localities, as well as what could be done to improve current development conditions, thereby reducing risks to population and properties. Critical here would be understanding the vulnerability of population and assets since by addressing these vulnerabilities, coping mechanisms are improved and the possibility that hazard events do not turn to disasters is improved. By reducing the vulnerability handle eventually leads to reducing risks.

The goals and objectives of land use plans should reflect this analysis and translate them into the planned specific programs and projects, structural and non-structural in nature.

The approach for integrating disaster risk information may vary depending on the status of land use plans. In the preparation of new land use plans, disaster risk information can already be made part of the plan formulation process. In the case of updating, enhancements on specific aspects can be done, for example, in determining the key issues and challenges to be addressed by the land use plan, changes in the land use framework given disaster risk information that may alter the desired land use patterns, and in the specific land use interventions, especially new structural measures or land use controls will be implemented.

It is also important to note that in the aftermath of large-scale disasters, rehabilitation of affected areas should follow the principle of building back better or building back elsewhere, which have very strong land use implications. This will require a rethinking of existing land use plans, much earlier th.an the prescribed period of planning and updating

3. 4 Land Use Planning Options

Land use planning options provide a wide array of options on how to treat risk and address vulnerabilities to a particular hazard. These options would involve the application of both regulatory and non-regulatory measures. Land use controls are available to local authorities to help restrict the use and development of land based revealed information on risks. Some of these options are shown in Table 3, but the list is not exhaustive though.

A good starting point would be the "desired state" defined in the risk evaluation as basis for determining the best solution on how to mitigate hazards, reduce risks, and address vulnerabilities.

Table 4 Land Use Planning Options and Measures

Land Use Planning Options	Description	Specific Hazard Applicability	Specific Structural and Non-structural Land Use Measures
Density control	Applying occupancy and density ceilings for allowed land uses	Flooding	Limit occupancy load and floor area ratios in higher population density exposed to flooding (the higher the population density, the potential for property damage is greater)
		Fault	Allow only low density, single family residential land use in buffer zone (usually 5 m to the left and right of fault line)
Site selection and development controls	Keeping inappropriate land use and development out of hazard areas	Flooding	Avoiding areas where development will increase the likelihood of risk or level of impact. Keeping development out of high-risk and extreme-risk zones. Flood proofing in medium- to high-risk areas.
		Fault	Restrict any new construction within the surface faulting zone Require geologic studies and foundation designs for proposed structures within fault zones Mandate abatement or retrofitting of existing buildings within surface zones Encourage voluntary retrofitting as one goes farther away from the fault zone
		Ground shaking	Allow only low-intensity land uses in high risk areas where there is potential for land failure due to landslide or liquefaction Restrict high-rises and high-occupancy residential buildings and offices in high risk areas underlain by soft soils Require special geological studies, site investigations and special foundation designs.
		Landslide	Slope stabilization with protective structures and natural means such as covering the slope with vegetation. Engineered retaining walls with drainage built in front of houses. Adequate surface drainage.

Land Use Planning Options	Description	Specific Hazard Applicability	Specific Structural and Non-structural Land Use Measures
Design and building regulations	Application of appropriate building controls	Flooding	Building controls in terms of elevation (e.g., lowest floor of residential structures must be above the 100-year flood level), high foundation walls, stilts, pilings, setbacks, minimum lot size depending on risk levels.
		Ground shaking	Enact and adopt building code regulations that adequately represent the seismic hazards Building code provisions should encourage regular building shapes, which minimize torsional effects in the building. Limit building appendages or reinforce them, if constructed. Limit signs and billboards or require reinforcements, if constructed.
		Landslide	Foundations founded on bedrock should be required
Strengthening and retrofitting of existing buildings	Reinforcing existing buildings and structures in hazard areas	Ground shaking	Legally require retrofitting for high-risk areas and highly vulnerable buildings due to intense ground shaking. Promote voluntary retrofitting of identified hazardous buildings.
Protection for lifelines	Critical facilities are ensured of their functionality during disasters	Flood	Construct overhead service lines Protect water and sewer lines Electric meters placed above flood line.
		Ground shaking	Move highly vulnerable emergency facilities, hospitals, and schools out of high-risk areas. Provide redundancy in emergency services distributed throughout the planning unit.
Open space preservation	Specific areas used for low intensity and low density use to minimize property damage	Flood	Flood plains used only for agricultural use Maintain riparian vegetation to prevent erosion Wetlands created as a means to absorb peak flows from floods
		Volcano	Danger zones, say 6-kim radius could
Land acquisition	Purchase by government of land in hazard areas and provide alternative locations	Fault	Buy out of existing critical facilities (schools, ospitals) within fault zones and convert to low risk land use
		Ground shaking	Purchase high-risk lands and use for open spaces and areas for emergency operations.
Relocation	Mandatory or voluntary relocation of affected families to safe areas	Landslide	Relocating families and communities at-risk to landslides would be the ideal option to eliminate landslide risk.
Financial Incentive	Scheme for risk sharing through tax incentives	Fault	Real estate tax holidays to owners who do not develop their lands within fault zones
Public disclosure	Owners are compelled to reveal information related to hazards in their property	Fault	Require property owners and developers who are selling land on the fault zones to disclose the risk of fault rupture to the property in question

Section 4

Enabling environment for incorporating disaster risk information in land use planning

This section explains some of the key factors, which would provide an enabling environment for realizing the potential of incorporating disaster risk information in land use planning to reduce disaster risks.

4. 1 Having in place a legal framework for effective land use planning toward disaster risk reduction

The legal regime governing land use planning frames the effectiveness of using it as a tool for reducing risks. The legal framework, usually embodied in a national land use policy, should define the principles that will (a) guide the rational use of land; (b) provide policies governing land uses such as for urban and rural settlements development, utilization of land for production and economic activities, protection and preservation of critical resources, and control of development or management of geohazard areas; (c) lay down the basic parameters for resolving possible land use conflicts; and (d) define an integrated and participatory process and structure for land use planning at all levels.

The overall principle that guide rational use of land is sustainable development which generally means development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Thus, interrelationship of environmental, economic and social actions must be considered in the way governments determine optimum allocation of land and resolve conflicts within existing uses. The national land use policy should be able to unify sector-specific land use policies such as for prime agricultural lands, forest management, housing and settlements, ancestral domain, mineral and energy lands, coastal zones, among others.

Recognition of natural and geographic boundaries within which to make decisions must also be pursued. Flood modeling is an example of this approach since some river basins cut across political boundaries. This is also in relation to the principle that hazards do not respect political boundaries. As such, joint or multijurisdictional planning should be encouraged for political units sharing the same hazard. This will result in common and compatible land use planning regulations and controls.

4. 2 Strong partnerships among agencies

Disaster risk reduction and land use planning are both multi-disciplinary arenas; they require a multi-stakeholder participation. Within government, both are collaborative endeavors that need to be undertaken together by various ministries/departments. For example, Table 5 presents the various government agencies involved in land use planning and related activities in Sri Lanka.

Table 5

Institution	Type of Activity
National Physical Planning Dept.	National Physical Planning Policy and plan
Land Use Policy Planning Division	National Land use policy
Dept. of Survey	Preparation of Base Maps
Dept. of Irrigation	Mapping of Flood Prone Areas/ Reservations/ Flood Levels of Tanks/ Rivers/ Canals/ Streams
Dept. of Coast Conservation	Mapping of Coastal Areas, Prone to Coastal Flooding/Sea Erosion/ Removing of Sand Dunes, Storm Surges
Dept. of Meteorology	Providing data & information regarding Wind, Rainfall, Climatic & weather Changes in the country.
National Building Research Organization	Hazard and vulnerability mapping of landslide prone areas
Disaster Management Centre	Coordination and facilitation
Central Environmental Authority	Mapping of Sensitive Areas
Urban development Authority	Local Development Plan
Local Authority	Fire/Effluent/Emission, etc

Land use planning goes beyond inter-ministry and agency collaboration, from the national to the local levels of government. As land use is an arena of competing interests, planning requires the participation of communities, e.g. farmers, urban settlers, environmental managers, indigenous peoples, as well as developers. Land use planning also requires technical expertise, more so as it moves towards explicit articulation of its role in disaster risk reduction. As such, technical experts e.g. scientists, planners from institutions outside government, e.g. academe, NGOs, would be among those who could contribute to a DRR sensitive land use plan. It is therefore important for a government to design a multi-stakeholder committee to ensure the incorporating of disaster risk information in land use planning process.

4. 3 Establishing integrated planning information system

With mainstreaming of disaster risk reduction in national development, sectoral and land use plans being a priority agenda, a common planning information system should be put in place. The planning information system should combine the socioeconomic and physical and natural resource endowments indicators with data relevant for disaster risk reduction such as exposure data (for consequence analysis of disaster risk assessment) and disaster risk damage and losses data, among others. Thus, the integrated information system may include the following information:

Items	Data
Population	Size, density, growth rate, urban-rural distribution, age, gender
Physical Resources	Environment and natural resources Land area Characteristics of land resources (hydrology, geology, slope aspects) Land use, land suitability, land classification Land tenure Weather patterns Transportation (roads, ports, airports) and communication facilities Existing and proposed facilities, routes, service coverage
Economic Activity	Key sectors Agriculture, fishery, production forestry Manufacturing Trade, industry, services Tourism Data needed for each sector Employment, income,or value of production per sector Export products, markets, volume by sector Existing and proposed support infrastructure
Income and Services	Employment • Employment/unemployment rates Income and poverty • Average family income • Poverty indicators Services and facilities covering: • Basic social services: Housing, health, education, sanitation, security • Public works, water supply, drainage, solid waste • Power Data needed for services and facilities • Existing and proposed facilities • Levels of service of basic social services
Hazard Data (including damage and losses of past hazard events)	From Table 3 of this Guideline
Hazard Exposure Data	From Table 4 of this Guideline

Source: NEDA-ADB Guidelines on Provincial/Local Planning and Expenditure Management: 2008, Philippines; FAO (UN) Guidelines for Land Use Planning: 1993

Since disaster risk sensitive land use planning requires identification and delineation on the ground of the spatial coverage of hazards and potentially affected areas, an intensive mapping program should be pursued. Maps for each administrative unit at appropriate scales shall include topographic or base maps, boundary maps, hazard maps, land use classification maps, among others. Thematic maps to depict lifelines, critical facilities, infrastructure, road and transportation networks would also be needed for disaster risk sensitive planning.

The information system should also be supported by a research agenda directed towards building up a science-based disaster risk reduction program. Flood modeling which looks at the river basin approach should be an important component of this research agenda. This would allow for a more comprehensive understanding of the problem of flooding from the water uptake to downstream flows. Projected rainfall increases in some areas due to climate change may be factored-in in these studies especially if the these increases are significant and relevant to the period covered by the land use plans.

4. 4 Multi-stakeholder involvement

A good understanding of stakeholders and beneficiaries requires land use planners to foresee who will be affected by the inclusion of disaster risk information into revised or newly developed land use plans or whose interests will be at stake. Amongst these will be residents, people working in high- risk areas or living in unsafe structures, developers, urban or rural planners, contractors and the public works department, to name a few. Input from these people will ensure plans are more holistic in approach, incorporating opinion from a wide range of interest groups so that when plans are implemented, it will be done more smoothly and with best effect.

Community participation can crucially determine what approaches will be most effective in context to the local situation and will help physical planners understand the level of risk that is acceptable to the community and how to act tactically in view of this. Community level participation enables concerns to be raised regarding localised hazard vulnerabilities so that hazard prone land can be prioritised for zoning and suggestions can be made as to how national level plans can be applied to the local context.

Together with government agencies, professional groups, nongovernment organizations, business groups, communities should be involved in the entire planning process.

It is also important that authorities and agencies/departments who will be affected by changes in land use planning approach, understand the rationale and purpose of incorporating disaster risk information into land use maps and raising their awareness of risk factors is undertaken.

Section 5

Case Studies from RCC member countries

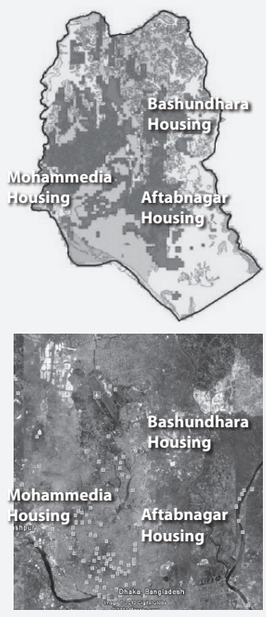
1. Hazard Characterization: the Case of Dhaka City, Bangladesh

Dhaka is expanding gradually towards different directions on marshy lands. This phenomenon is common for eastern fringe, western areas and southern periphery. The eastern part goes under water during rainy season quite regularly. This part also serves as the retention area to hold the run off of rain water for a large portion of the city through a number of natural drains. Most of the lands are submerged during this season. During last decade about 19 housing projects have been initiated in the eastern fringe. It is expected that other housing estates will be implemented within next 10 years (Rahman, 2007).

In the southern part of river Buriganga, RAJUK (the capital development authority) initiated a residential project on an area of 381 acres. The project site used to remain under water most of the period of the year. The site is demarcated as a water retention pond in Dhaka Master Plan. This site has been filled by sand over last 2 years for housing development. Apart from this t is evident that about 3000 sq meter natural water bodies have already been disappeared during the development Riverview Housing Estate in the southern fringe on the bank of river Buriganga. There was a natural canal through the site of river view housing estate in the past (Rahman, 2007).

A comprehensive study by Comprehensive Disaster Management Program on Liquefaction Susceptibility (Earthquake Hazard Map) on Dhaka City indicates that Easter and South-Western part of Dhaka is within the range of high to very high Liquefaction Susceptibility. The identified areas by the study are the same places where recent development has taken place filling marshy lands. CDMP study also has identified several active faults within Bangladesh based on the historical events and evidences of geological investigations. Madhupur and Dauki faults which is about 90 and 230 miles respectively from Dhaka is among the faults identified by the experts. During Mexico City earthquake in 1985 there was a considerable amount of damage even the source was 240 miles from the city.

In the case of Dhaka an earthquake either from Madhupur or Dauki may cause severe liquefaction effects to buildings especially that are developed



Liquefaction Susceptibility Map of Dhaka City and Surrounding Areas (left) shows Liquefaction susceptibility ranges in different areas. On the right is the Aerial view of Dhaka City represents the areas with possible Liquefaction Susceptibility effect to earthquake where development is taking place on marshy lands.

(Source: Seismic Hazard Map of Dhaka, CDMP, 2009 and Google Earth Map)

on the marshy lands in eastern and western fringe. It requires proper land use control mechanism to ensure the future development considering the possible liquefaction effect of earthquake in the east, west and southern periphery of Dhaka. In depth study and research in this regard would be helpful for the preparedness of Dhaka's development in the coming decade.

Newly developed Earthquake Hazard Map has been recognized by the city Development Authority of Dhaka and would be incorporated/ considered for landuse plan preparation in the future. The integration of the Hazard Map into landuse plan will be helpful to identify the areas under high-medium to low risk and accordingly landuse clearance would be giving for the respective land users. This initiative will be very much useful for Disaster Risk Reduction.

2. Rajshahi City, Bangladesh, Incorporating disaster risk information at local level land use plan

For preparation of Landuse plan for the city of Rajshahi City, comprehensive survey was undertaken on demography, socio-economic situation, transportation, housing, economy, environment, soil, hydrology, land value and land ownership. This data was collected from a range of sources started from field survey and relevant information from respective departments; for example land ownership and land value data from ministry of land, population data from Bangladesh Bureau of Statistics and land ownership maps from Department of Land Records and Survey.

During the process of land use planning for Rajshahi City, Master Plan was used as a framework to guide future development of the city and all development proposals were compared to this to ensure compatibility. A review of existing laws, rules and administrative procedures governing planning and building activities was undertaken and the importance of legislation to secure adherence to structure and local plans was understood. A guide was prepared to highlight the development restrictions to be imposed within each area, together with justification for this and a review of the existing division of responsibilities for guiding and controlling development was undertaken along with recommendations for any procedural changes needed to improve coordination between involved agencies.

A number of maps were developed for preparation of the land use plan and these include: contour map; drainage map (natural drainage channels, ponds, tanks, navigable waterways, canals, average annual and ten year flood levels, areas of erosion and sedimentation, major embankments and ground- water levels); utility services map indicating water supply, sanitation, electricity and telephone lines; transport map indicating roads, railways, bridges and major culverts; current land uses and topographical maps showing housing, commercial activities, industries, social and administrative provision, agriculture and vacant land; and land ownership boundaries.

A number of specific activities were carried out including: an estimated projection of population growth and demographics, migration trends, future economic activities, employment sectors and workforce as well as an analysis of the city's economic role and output. An assessment was

carried out for the establishment of an integrated traffic and transport system and all projects and proposals affecting the city were plotted on to a map for analysis of their implications to development. Various land use structure options were proposed for future city growth including an inventory of housing areas showing proposed services, sanitation, drainage, population density and housing conditions.

The specific steps for developing the Rajshahi City land use plan are shown below:

- Seven technical reports were prepared by relevant specialists in the areas of: physical features, transport, economy, geology and hydrology, socio- economic situation, demographics and environment. Hazard risk information was incorporated in both the environmental and geological, hydrological study reports.
- These technical reports were then considered by urban/rural land use planners and based on the findings a draft 'interim' plan was prepared.
- The interim report was then presented to the Technical Committee for comments.
- The plan was revised to incorporate these comments before being taken to community level by the planning team, for further comment, when applied to a local context. This is another entry point for integrating hazard risk information as the plan is adapted to the local hazard situation and community consultation is key to this part of the process.
- Based on the comments received from the community, the plan was again revised and presented to the Technical Committee for approval. The Technical Committee is composed of heads of different institutes within the city/town.
- Once the plan was approved it was kept at the planning office for 60 days whilst a public hearing took place for more comments to be put forward. The plan was then once more revised.
- The Final Report was then presented to the Inter- Ministerial Committee for approval. This committee is composed of Secretaries from all Ministries of the Government.
- Once the plan was officially approved by the Inter- Ministerial Committee is was sent to the Ministry of Law for Gazette Notification, after which the Land Use Plan became a legal document.[1]

A successful approach used in this process, was holding consultations at national and local level, at each stage of which hazard risk information was incorporated into the plan, either in a scientific/ technical capacity or through comments made at community level based on the reality of hazards experienced and vulnerabilities identified.

1 *Referenced from: Structure Plan for Rajshahi City 2004-2024, Rajshahi Development Authority (RDA)*

3. Ratnapura, Sri Lanka: Hazard vulnerability and zonation mapping

Sri Lanka is prone to many hazards including landslides, floods, droughts and cyclones. Landslide zonation mapping was introduced by the National Building Research Organisation to determine the areas of land most vulnerable to landslides so that appropriate mitigation measures could be put in place. Between 1990- 2007 the program 'Landslide Hazard Zonation Mapping Project' was undertaken in various phases and different areas to reduce the vulnerability of people to landslides, with technical and financial support provided by UNDP and UNCHS.

The commencement of the Sri Lanka Urban Multi- hazard Disaster Mitigation Project in October 1997, aimed to integrate this effort with the regional and urban planning process of Sri Lanka and it involved hazard and vulnerability mapping, risk analysis, strategic planning, review of policy and procedures, training and professional development and networking. The project was undertaken in the demonstration town of Ratnapura initially, due to its frequent exposure to hazards including landslides, floods, erosion, pollution, ground subsidence and contamination of water sources. The project was then extended to Nawalapitiya Urban Council and Kandy Municipal Council, before being carried out in Rathnapura and Colombo Municipal Council areas to create flood maps. A number of informative maps were used to develop the final hazard zonation map including those displaying geological features, human settlement and infrastructure, hydrology, slope category and past landslide events. It was also acknowledged that current land- use patterns influence the stability of slopes, especially if human activity involves land clearance, deforestation, settlement, mining or cuttings, which can result in destabilisation of slopes due to changes in the internal stresses of soil, increased erosion and increased land pressures. Zonation maps can be used to identify relationships between land use and vulnerability, identifying areas of increased risk where appropriate mitigation measures are needed.[2]

2 *Referenced from: Regional Workshop on Best Practices in Disaster Mitigation: Bali, USAID & ADPC (2002)*

4. Thailand, Incorporating hazard risk information in land use plans by taking advantage of post disaster reconstruction

In response to the Indian Ocean tsunamis that hit parts of Asia on 26th December 2004, the Government of Thailand requested assistance from Asian Development Bank in developing a sub- regional development plan (SRDP) for the tsunamis- affected Andaman region. In the worst hit provinces of Krabi, Phanga and Phuket, negative trends in development had been evident proceeding the tsunamis including: uncontrolled development in tourist centres; increased pressure on the natural environment from tourism and poor coordination of planning policies in the sub- region, which following the community led efforts in the tsunamis wake has led to a call for greater empowerment of local people in decision making. Technical assistance

from ADB resulted in development of a SRDP within the time frame of 15 years (2006-20) and produced: an overall structure plan, area plans, broad key strategies, priority sector and thematic plans and detailed pilot action plans. This approach took a multi- sector view and delegated different agencies at central and local level with specific responsibilities.

One of the objectives of area plans is to establish land use control guidelines that define areas where development should be restricted in view of environmental and natural resource vulnerabilities or where it can proceed on condition that special design standards are applied in construction. The SRDP of these three coastal provinces in Thailand provides a useful illustration of how hazard information can be used to plan future land uses with the aim of mitigating risks and reducing potential hazard impacts, through use of a participatory, multi-sector approach. Although land use control guidelines will not be able to prevent extensive damage from the most extreme hazard events, it is sufficiently helpful in mitigating damage from average intensity hazard impacts. This also serves as a good practice in incorporating risk reduction in the reconstruction process following a natural disaster.

5. India: Proposed Amendment in Town and Country Planning Legislations, Regulations for Land Use Zoning, Additional Provisions in Development Control Regulations for Safety & Additional Provisions in Building Regulations / Byelaws for Structural Safety - in Natural Hazard Zones of India

In India recent earthquakes (Uttarkashi, 1991, Latur, 1993 and Bhuj 2001) have clearly exposed the vulnerability of building stocks, which has caused widespread damage resulting in loss of lives and property. It is recognized this is mainly due to faulty construction practices which do not follow earthquake resistant features complying with Codal practices.

To address this gigantic problem, the Ministry of Home Affairs constituted a Committee to develop Model Building Bye-Laws and the Review of City, Town and Country Planning Act and the Zoning Regulations vide Govt. order no.31/35/2003-NDM-II dated January 20, 2004. The Committee initiated the work from February 23, 2004 and decided to split into two Sub-Committees; Sub-Committee-I for Town and Country Planning Act and Zoning Regulations and Sub-Committee-II for looking into Development Control Rules and Building Bye-laws.

The Committee studied the Model Town & Country Planning legislation framed during 1960, based on which most of the State Town & Country legislation are enacted. Also the Committee studied the revised Model Regional&Town Planning & Development Law 1985 framed by Town & Country Planning Organisation, Ministry of Urban Development & Poverty Alleviation. This combined planning and development law was formulated to provide for planning authorities and plan implementations were combined together so that single agency could undertake both these functions. Later on, the Ministry of Urban Development & Poverty Alleviation undertook the task of Urban Development Plans Formulation & Implementation Guidelines (UDPFI). As a part of this exercise, Model Urban & Regional Planning and Development Law

was also formulated keeping in view the earlier Model Planning Legislation and incorporating various provisions of 73rdand 74th constitutional amendments.

This Committee has proposed amendments in the above mentioned documents by incorporating the various terminologies pertaining to natural hazards, natural hazard proneness and mitigation under the relevant sections. Under the natural hazards, the Committee has included the hazards due to earthquakes, cyclones, floods, and landslides. Also, under appropriate sections for land use zoning and development control/building regulations with regardto natural hazard mitigation.

The Committee observed that there are large areas where Town Planning Legislation and Development Control/Building Regulations are not applicable and the sanctioning authority in such areas are either Panchayat in the rural areas or Development Commissioner through CPWD/PWD or other such agencies. Therefore, the Committee recommended that in such areas, the sanctioning authority should be advised to take into consideration provisions regarding the structural safety in natural hazard prone areas while sanctioning development/ projects in such areas under their respective legislation.

The Report is in two volumes. Volume one contains details in the form proposed amendment in Town Planning Country legislation (chapter 2), Regulations for Land use zoning for natural hazard prone areas (chapter 3), Additional Provisions in Development Control Regulations for Safety in Natural Hazard Prone Areas (chapter 4) and Additional Provisions in Building Regulations/Bye-Laws for Structural Safety in natural Hazard Prone Areas(chapter 5). These are supplemented by details given in the Appendixes, wherever necessary. The documents studied and referred to in volume one are Annexed in Volume two.

6. The Philippines; Guidelines for mainstreaming disaster risk reduction into sub national development; land use/ physical planning in the Philippines

The National Economic and Development Authority (NEDA), with assistance from the United Nations Development Program and the European Commission Humanitarian Aid Department, has formulated the Guidelines on Mainstreaming DRR in Subnational Development and Land Use/Physical Planning as an instrument to direct natural disaster risk reduction efforts in development planning processes. The Guidelines support the comprehensive disaster risk management framework of the National Disaster Coordinating Council. It serves as a tool for enhancing subnational (regional and provincial) planning analyses by recognizing risks posed by natural hazard and the vulnerability of the population, economy and the environment to these hazards.

The Guidelines supplement the 2007 NEDA-ADB Guidelines on Provincial/Local Planning Expenditure Management (PLPEM), mainly the volume on the formulation of the Provincial Development and Physical Framework Plan (PDPFP). Development and physical framework plans guide future land use and physical developments and the location of programs, projects and activities in the province and region.

The Guidelines take the provincial level as the operational unit of analysis. Hazards are location specificand do not respect political boundaries. Provincial planning will therefore allow for inter municipal analysis. Another reason is that the province's geographic coverage makes it possible to identify specific interventions that may not be done at the regional level. Moreover, the province will be in a position to co-opt the participation of local governments in both the planning and implementation stages. The application of the Guidelines however could be extended to the regional level since the region is the "sum of provinces" or is seen as a "bigger" province. The methodologies may also be applied at municipal and city levels; although at these levels, land use planning is more precise as these are translated into zoning ordinances. The application can likewise extend to interregional and special development areas particularly in watersheds and river basins.

The Guidelines is useful in the following:

a. Identifying areas that are highly restricted to human settlements and economic activities particularly those that: (i) are highly prone to the adverse impacts of hazards, e.g., flood-prone areas, landslide-prone areas; (ii) need to lessen the effects of hazardous events, e.g., water retention areas, lahar-playing fields, buffer zones; and (iii) need to ensure effectiveness of response activities, e.g., escape routes and staging areas;

b. Highlighting the use of development criteria or indicators as measures to identify and describe vulnerability (or resilience) and their integration in the disaster risk management framework;

c. Making differentiated decisions on land uses which may involve specifying acceptable land uses based on the risk assessment results, e.g., agricultural use of flood prone areas might be allowed but not settlements;

d. Developing disaster risk criteria in land use planning and zoning. The results of the vulnerability and risk assessment will provide clear directions to cities and municipalities in the crafting of corresponding preventive and mitigating policies and measures that address the disaster risks affecting them. These can also supplement decision making on matters involving zoning regulations such as the prescription of more strict building codes like minimum elevation and heights of buildings, prohibition of basements and use of certain types of roof; and

e. Identifying all other appropriate risk management decisions depending on the Risk estimates are used to prioritize areas for further evaluation of vulnerability. In general, all DRR measures and options can be classified as avoidance or elimination, reduction or mitigation, sharing or transfer of the hazard potential or disaster risk. The do-nothing option thus becomes a purely management decision.

The Guidelines is organized as follows:

Chapter 1, Introduction, acquaints the user with the background, rationale and main features of the Guidelines. It explains the policy context and linkage to the PLPEM Guidelines, which remains as the main guide in the overall planning process. The chapter emphasizes that the DRR Guidelines enhance and do not alter the current plan formulation methodologies that planners are already familiar with. It concludes by identifying opportunities and challenges in mainstreaming DRR into planning processes and next steps.

Chapter 2, Disasters and Development: The Case for Mainstreaming DRR in Development Planning, establishes the relationship of disasters and development, and then explains how development planning can be a useful means towards reducing disaster risks.

Chapter 3, Mainstreaming Framework, discusses the steps in disaster risk assessment and identifies their entry points in the plan formulation process. The DRA results become part of the planning analysis and are later used to assess impact to the land use and physical frame work and become the basis for identifying risk reduction strategies, programs and projects.

Chapter 4, Disaster Risk Assessment, demonstrates the DRA methodology showing in detail the computational and GIS techniques. Indicative look-up tables for return period and factors for fatality and property damage for various hazard events as well as a methodology for estimating cost of property damage per type of land use have been incorporated in the Guidelines. Surigao del Norte is used as case study. The hazard maps produced under the Hazards Mapping and Assessment for Effective Community-Based Disaster Risk Management (READY) Project were used.

Chapter 5, Mainstreaming Risk Assessment Results in the Plan, shows how the results of the DRA are utilized to enhance analyses in the various phases of the plan formulation exercise: from visioning to the analyses of the planning environment; identification of development issues, goals, objectives and targets; and their translation into development strategies and PPAs or what is termed as mainstreaming in the plan formulation stage. Case illustrations from the pilot DRR-enhanced PDPFP of Surigaodel Norte and RPFPs of Ilocos and Caraga Regions are included.

Chapter 6, Mainstreaming DRR in Investment Programming, Budgeting, Project Evaluation and Development, Monitoring and Evaluation, discusses the secondary entry points for DRR mainstreaming in plan implementation, namely: investment programming, budgeting, implementation and monitoring and evaluation, with project evaluation and development as an added tool to improveproject design and financing. Guide questions for logically framing monitoring andevaluation during implementation are presented to reveal if planned risk reductionmeasures and development programs resulted to the desired outcomes and so furtheraid in future planning decisions.

The Guidelines also include eight technical annexes as additional reference materials that can aid in the preparation of the DRR-enhanced plans.

7. Viet Nam, Principles and Practice of Ecologically Sensitive Urban Planning and Design: An Application to the City of Hai Phong

Viet Nam in recent years have streamlined its planning approach to be more responsive to new development trends, particularly promoting the sustainability of urban areas. This initiative has laid the foundation for including other development issues such as disaster risk reduction.

The country has in place a well-developed urban and regional planning system. Land use plans are produced at various scales by the Ministry of Construction. Traditionally, provincial plans provided the overall framework. Since the 2005 Planning Act, regional plans, which include provincial plans, establish the overall framework. Detailed plans are also prepared indicating precise roads, building plots, and land uses. The Ministry of Resources and Environment (MONRE) and Ministry of Agriculture (MOA) also have some responsibility for ensuring the environmental integrity of development and for protecting agricultural land from inappropriate development. They produce land use maps.

To strengthen the environmental component of their plans, technical procedures have been adopted for incorporating ecological sensitivity into the planning cycle: preparation, information gathering, plan making, plan adoption and implementation, and monitoring and evaluation.

The ecologically-sensitive planning approach basically adopts the principles of sustainable development and identifies functional land use components which will all be integrated into a single planning solution for the plan area.

The approach was piloted in the Hai Phong-Do Son Corridor, the third largest city in Viet Nam. Some indications on the compatibility of the ecologically sensitive planning with risk-sensitive land use planning are as follows:

- The area identified as green network it has been recognized that with its intensive agricultural and aquaculture activities, there is little by way of significant vegetation or landforms that might be used to develop natural areas apart from the mangrove along the coastline. These mangroves are an important element in coastal protection in the event of storm surges and typhoons.
- The area identified as human network recognizes that relocating some existing residences and in general minimizing the possibility of impacts of flooding.

There are significant prospects for risk-sensitive land use planning for areas that have adopted sustainable development practices. The Viet Nam planning model adopts the following major principles of sustainability include the recognition of the interconnectedness of environmental, economic, and social actions; a balance of present needs with future needs; recognition of natural and geographic boundaries rather than artificial or political boundaries within which to make decisions; and a locally based, participatory planning and decision making process.

With this foundation, there are bright prospects for including disaster resiliency as a component of sustainability, which is the end goal of risk-sensitive land use planning, by putting in place land use risk management options, among other interventions, to reduce disaster risks.

8. Piloting of Disaster risk reduction-Enhanced Comprehensive Land Use Plan in Surigao City, Philippines

Surigao City, Philippines is a component city **of the province of Surigao del Norte, the province where the NEDA-EU Guidelines on Mainstreaming Disaster Risk Reduction in Subnational Development and Land Use/Physical Framework Planning** was piloted. The DRR-enhanced Provincial Development and Physical Framework Plan (PDPFP) revealed that Surigao City, the administrative and commercial center of the province as well as a special zone for mineral-based industries, is exposed to floods and landslides. Two fault lines traverse through the city making it prone to earthquakes. Heavy rains recorded in 1968, 1984, 2001, and 2003 caused flooding and landslides. For 2003 alone, 15 people were killed, 78 houses, and million peso worth of property, infrastructure, agricultural crops and livestock were lost.

Geohazard maps covering flooding and landslide maps are available for Surigao City. These were prepared by the Department of Environment and Natural Resources-Mining and Geosciences Breau.

Landslides were found to be most common in most of the barangays in Surigao City. The potentially affected areas are identified in the hazard map. Of the 200 considered as geohazard sites, 47 were assessed to be critical areas. The following disaster risk information has been derived for these 47 sites, some of these are shown in the table below:

Name of Barangay / Sitio / Purok	Description of Geohazard	Number of Houses / Persons Affected	Recommendations	Possible Relocation Site
3. Cagniog: Purok 8	Debris slump – due to high angled slopes left by former quarry in weathered gravel rock formation. High risk to houses only 5 meters from the slope.	4 houses destroyed	Relocate all existing houses at the foot slope	Identification of immediate relocation site to be coordinated with local barangay and city officials
15. Lipata: Purok 1	Debris slide –recurrent slides in very steep, weak slopes, 5-10 meters away from school	School	Rehabilitate slopw to increase stability Closely monitor slope Relocate water reservoir	Short-term relocation to be identified
21. Luna: Upper Looc	Debris slump – in weathered sedimentary rock with steep slopes; only 2 meters from settlement	Settlement	Evacuation of residents during continuous heavy rainfall Medium-term goal: relocation of houses to safer ground	Medium-term relocation site to be identified in coordination with local barangay and local officials.
45. Manjagao: Purok 4	Debris slump – in highly weathered ultramafic rocks with 1-3 meters topsoil and very steep slopes 50 meters high; very risky to 14 houses at the base of the slope, confined in a narrow coastal plain.	14 houses	Reforestation on the upper slopes Provision of drainage canal to control surface run-off Residents should be prepared to evacuate during continuous heavy rainfall	Long-term relocation site should be identified in coordination with local officials

In the case of flooding, 16 sites have been identified to bee critical. Available disaster risk information for some these areas are shown below:

Name of Barangay / Sitio / Purok	Description of Geohazard	Number of Houses / Persons Affected	Recommendations	Possible Relocation Site
6. Luna: All purok along Surigao River	Flood hazard due to location on the natural active flood plain of the Surigao River	Settlements	Formulation of a Integrated Surigao River Flood Mitigation Program	
8. Danao: Purok 1, 2 and 3	Flood hazard due to the Suyok and Bongbong Creeks which have denuded watershed with numerous landslide and erosion-prone portions causing heavy siltation of creek channels and spillway	Houses within the easement zone from the riverbank	Immediate provisions of mitigating measures such as: desiltation of creek channels, revise spillway design, imposition of easement regulation of 40 meters from the riverbank, relocation of houses from the easement zone, reforestation of watershed , and construction of river dike along easement zone	Long-term relocation site to be identified in coordination with local officials.

It is the pilot area for the mainstreaming of DRR their Comprehensive Land Use Plan through a partnership of the National Economic and Development Authority, Housing and Land Use Regulatory Board, the Province of Surigao del Norte and Surigao City, under the NEDA-UNDP-AusAID Integrating Disaster Risk Reduction and Climate Change Adaptation in Local Development Planning and Decision-making Processes. The results will be documented in a Reference Manual for Mainstreaming DRR and CCA in Comprehensive Land Use Plans that will be used by provinces in providing technical assistance to their component municipalities and cities in the preparation, approval and implementation of their CLUPs. Through this initiative, the CLUPS will be effective instruments for DRR. It also intends to ensure the vertical integration of the Provincial Development and Physical Framework Plan and the CLUP.

The current disaster risk information for Surigao City, particularly for landslide and flooding is a good starting point for the formulation of DRR and CCA-enhanced Comprehensive Land Use Plan. The City also identified an Integrated Surigao City Flood Mitigation Program of address floods. This will require an comprehensive study of the inflows and outflows in the Surigao River. Zonation measures have also been identified particularly related to the establishment of easement zones to regulate settlements development in unsafe areas. There is bias though for engineering solutions to control the hazard such as construction of culverts and canals.

Areas for improvement are:

- expand hazard characterization data to include information on past events indicating damage and losses
- prepare the same analysis for earthquake hazards and undertake a multihazard perspective
- study the potential impact of changes in climate patterns, especially rainfall patterns, on the existing hazards
- build database on exposed population, property and land use for the areas identified as critical, including replacement value;
- prepare maps locating critical settlements, infrastructures, lifelines economic activities and lain over the hazard maps
- expand risk management options particularly non-structural measures such as densification of settlements in safe areas as alternative to the construction of resettlement sites

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