Nepal Hazard Risk Assessment

Progress Report July-August 2010

This Progress report is submitted by ADPC to the World Bank & MOHA to highlight the progress in the execution of Nepal Hazard Risk Assessment (NHRA) project as a part of the project deliverables.

Methodology for Hazard and Risk Assessment

The overall methodology for the project has been presented in the flowchart shown in figure 1.

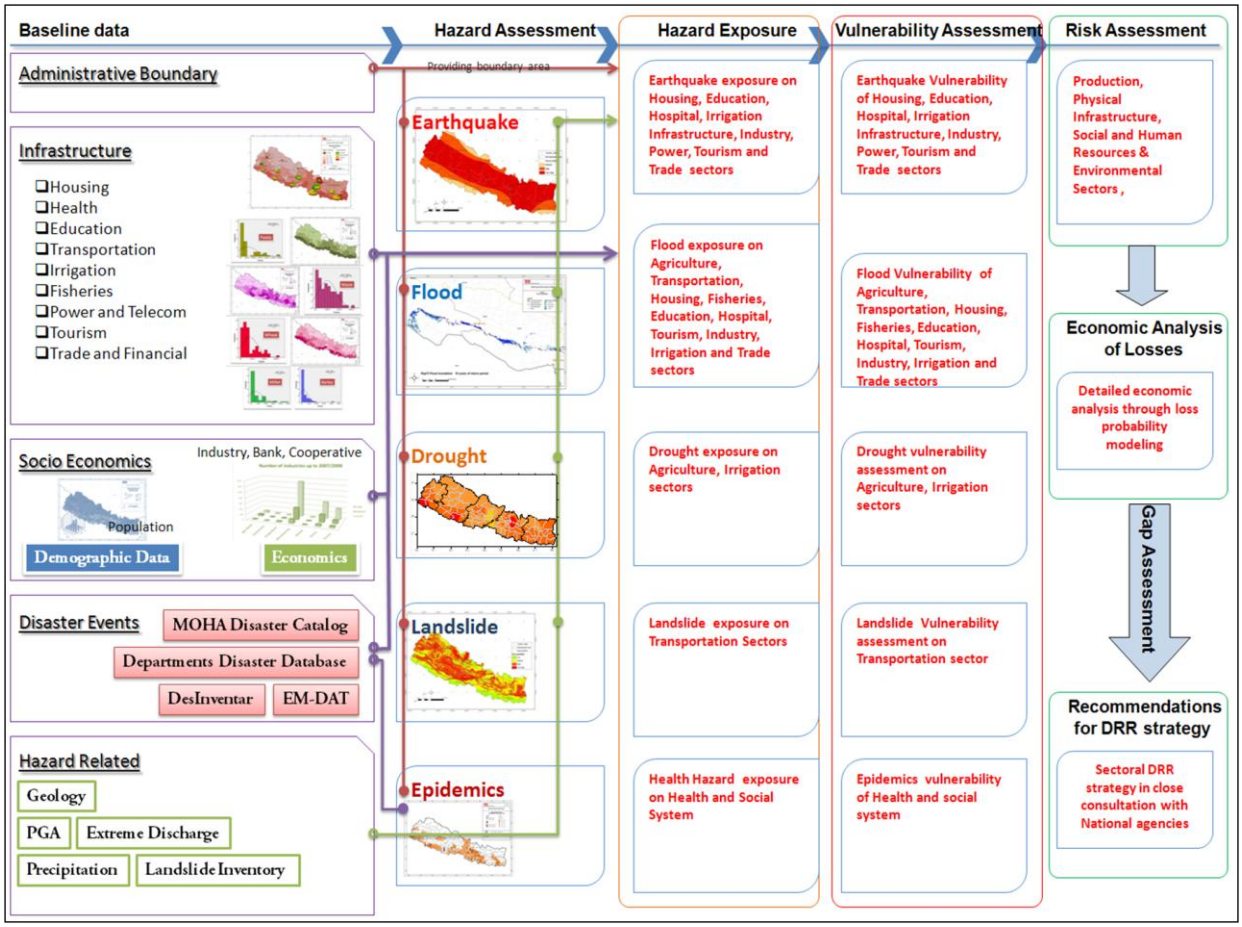

Figure 1: Flowchart showing methodology of the project

ACTIVITIES CARRIED OUT AND COMPLETED

1. Hazard Assessment

The Hazard and susceptibility modeling and mapping for five major hazards including earthquake, Floods, Landslides, Epidemics and drought has been carried. The modeling and mapping has been carried out based on well established technical and scientific methods. The details are as below:

a. Earthquake Hazard Assessment

Earthquake hazard assessment has been carried out based on Modified Mercalli Intensity Scale. The Peak Ground Acceleration map developed by Department of Mines and Geology has formed the basis for earthquake zoning. The attenuation relationship has been developed based on Trifunac (Trifunac and Brady, 1975). Other methods like Wald (Wald et al., 1999) and Probabilistic seismic Hazard Assessment Map (PSHA) have been compared with developed hazard map, validated and finalized. The study proposes three zones of earthquake namely "Very High",,"High",

and "Medium" severity. The zoning map has been prepared for various return period i.e, 50 years, 100 years, 250 years and 500 years. The maps are shown in figure 2.

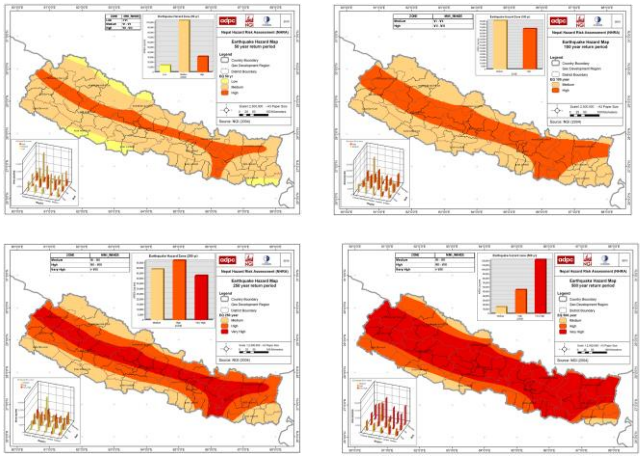

Figure 2: Earthquake hazard maps for various return period (Daft Version)

b. Landslide Hazard Assessment

The developed landslide hazard maps are classified into rainfall and earthquake induced landslide hazard. Landslide hazard, defined as the annual probability of occurrence of a potentially destructive landslide event, was estimated by an appropriate combination of the triggering factors (mainly extreme precipitation and seismicity) and susceptibility factors (slope, lithology, and soil moisture). The weights of different triggering and susceptibility factors were calibrated to the information available in landslide inventories and physical processes. The general approach used in the present study is a modified and improved version of the approach used by Nadim et al. (2006). The landslide hazard maps are categorized into high, medium, low, and negligible severity. The landslide hazards maps are shown in Figure 3(a, b).

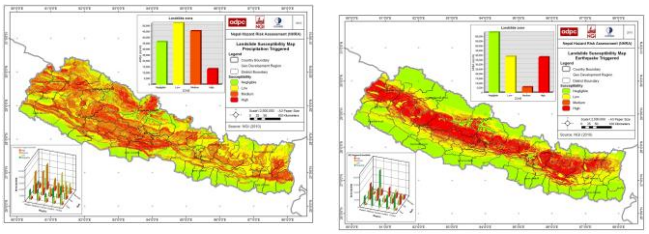

Figure 3(a,b): Landslide Hazard Maps: Rainfall and earthquake triggering factors(Daft Version)

c. Flood Hazard Assessment

Floods are regular phenomenon and affects broadly central and southern region of Nepal. There are several perennial rivers, contributing regular floods like Bagmati, Rapti, Kamala, Kankai, Tinau, Karnali, Babai and Narayani etc. These rivers are contributing major losses to life and other economic sectors. The study aims to carry out desktop based flood hazard assessment for selected rivers. The hazard assessment has resulted in defining inundation area and depth using one dimension model namely "HECRAS". The Flood scenario has been developed for various return periods of 10 years, 25 years, 50 years, 100 years and 500 years. The flood hazard assessment is further cross checked with established and official data and information. A national level technical team is also been consulted while finalizing the flood hazard assessment maps. A flood hazard map for Rapti River basin has been shown in Figure 4(a, b, c, d & e).

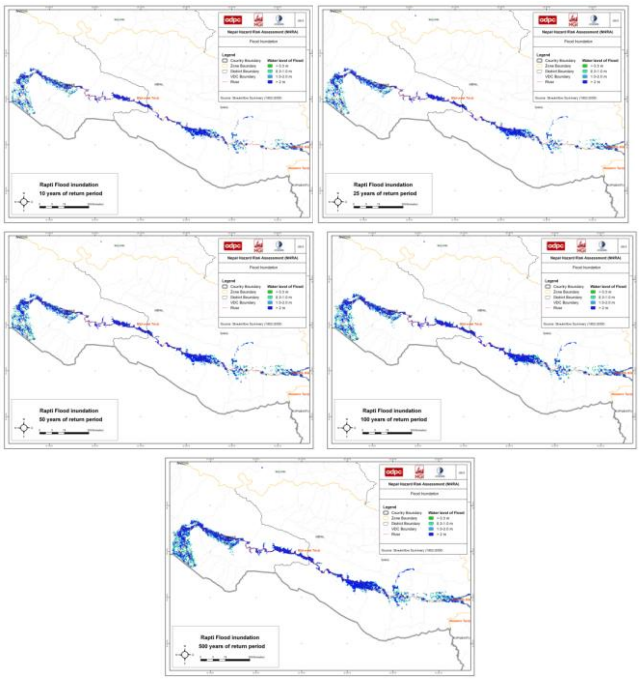

Figure 4: Flood Hazard Assessment for Rapti River Basin(Daft Version)

d. Drought Hazard Assessment

In recent past, drought has been frequent occurring disasters in the country. Due to climate changes, rapid degradation of environment and exploitation of natural resources, the drought situation has been aggravated. The drought hazard assessment has been carried out using well established tools i.e. Standard Precipitation Index (SPI) and Soil Moisture Index (SMI). The drought susceptibility map has been shown in Figure 5.

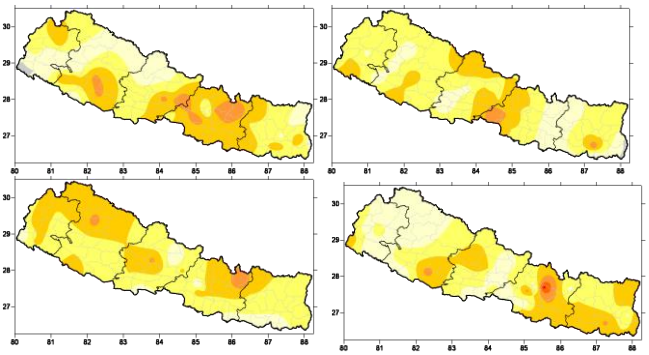

Figure5 Moderate drought susceptibility maps for (a) Winter (b) Premonsoon (c) Monsoon and (d) Postmonsoon seasons (Daft Version)

e. Epidemics Hazard Assessment

The health hazards is classified as diseases and outbreaks. The health hazard mapping include Diarrhoea, Kalazaar, Hepatitis, Influenza, Typhoid, Acute Respiratory Infection, Malaria, Sexual Transmitted Infection, Filariasis, Gastroentri Tuberculosis, and Leprosy. For each disease and outbreak, Incidence index have been developed. Further trend analysis has been carried out to understand severity of the problems. The disease susceptibility maps are shown in figure 6.

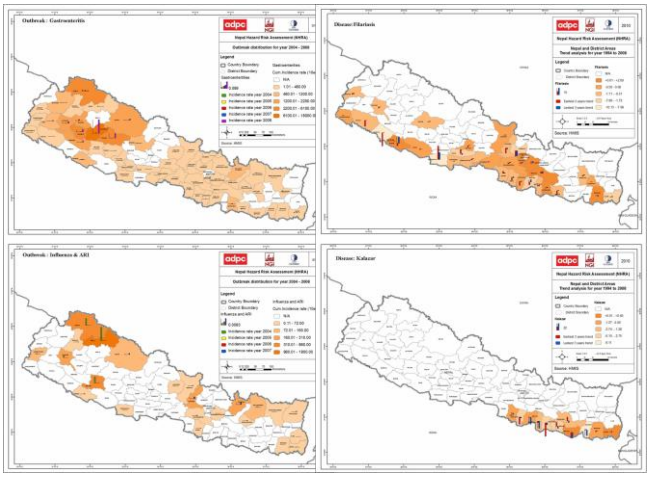

Figure 6: Map showing disease ad out break susceptibility (Daft Version)

2. Exposure Assessment

In the project, Exposure(UN/ISDR 2009) is defined as People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses" The important sectors, contributing to the economy has been considered for exposure and vulnerability assessment. The major sectors including housing, education, health, transportation, agriculture, industry, Irrigation infrastructure, power, tourism, trade and power has been considered for exposure assessment. The exposure analysis has been carried out for all five types of hazards.

3. Vulnerability and Risk Assessment

a. Earthquake Vulnerability and Risk Assessment

Project scopes for earthquake vulnerability assessment of various priority sectors. For study purpose two scenarios are considered I.e. 500 years and 50 years return period. For each hazard scenario, vulnerability assessment has been carried out considering sectors including Housing, Education, Health, Transportation, Tourism, Power and Irrigation. The methodology includes collection of physical infrastructure data, reclassification of building and infrastructure type suit to vulnerability modelling, hazard exposure analysis, define vulnerability criteria and establish vulnerability assessment matrix. The Vulnerability is further characterised by setting up fragility functions as shown in Figure 7. The direct cost of damage to various sectors for various severity has been calculated.

b. Flood Vulnerability and Risk Assessment

The Flood vulnerability assessment has been carried out for specified sectors including agriculture, housing, health, education, industry, transportation, fishing and tourism. The methodology for Vulnerability assessment has been established based on expert opinion of disaster management experts and hydrological modelling experts. The damage depth has been developed for floods. The details are shown in Figure 8. The direct cost of damage has been calculated based on depth damage ratio. Figure 9 shows the approach for flood vulnerability and risk assessment for agriculture sector.

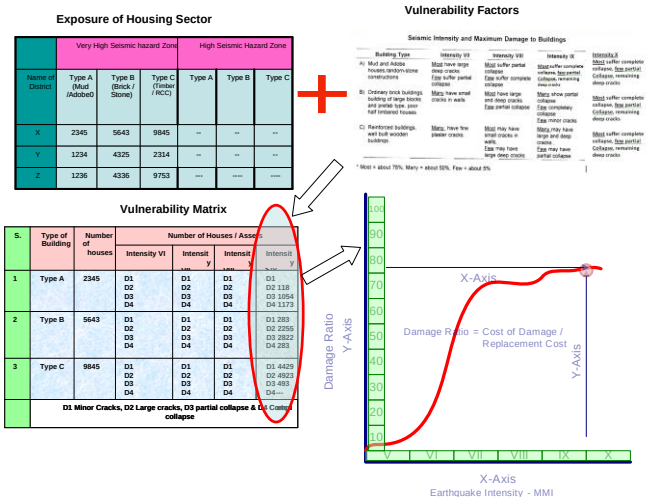

Figure 7: Flowchart showing vulnerability and risk assessment for earthquake

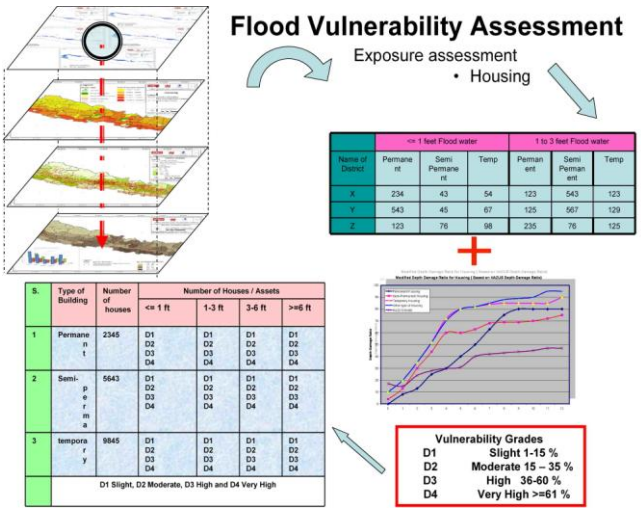

Figure 8: Flowchart showing the methodology for Flood vulnerability and risk assessment

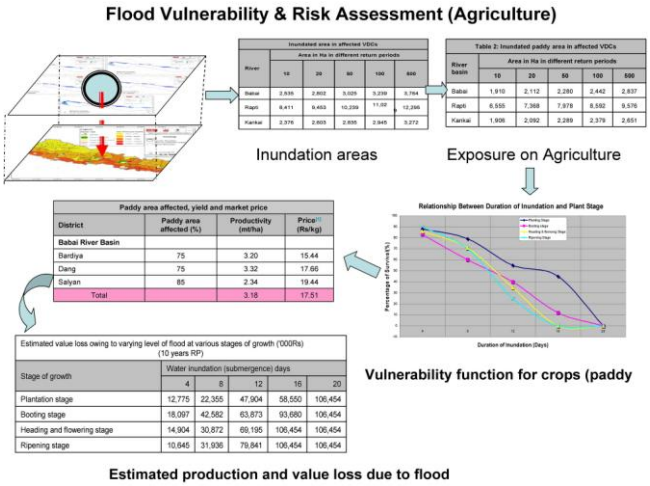

Figure 9: Flowchart showing the methodology for vulnerability and risk assessment for Agriculture sector

c. Landslide Vulnerability and Risk Assessment

The landslide largely affects transportation, housing and agriculture sectors. Landslide is affecting the community at local level, but it disconnects several part of the country to the commercial and necessary facility areas. This leads to indirect losses. The damage occurs is negligible compare to national scale Disaster loses. The aspects of indirect damage cost have been incorporated in economic modelling.

d. Drought Vulnerability and Risk Assessment

The drought largely affects the crops and agriculture. In this regard, only agriculture sector has been considered. The methodology for agriculture vulnerability and risk assessment is shown below in Figure 10.

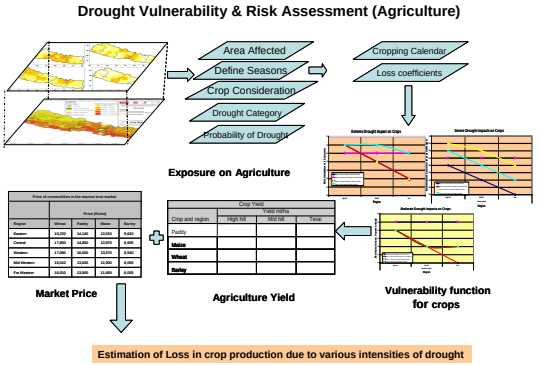

Figure 10: flowchart showing methodology for drought assessment

e. Epidemic Vulnerability and Risk Assessment

The population has been considered for epidemic vulnerability assessment. Quantification of number of people susceptible to epidemics are estimated, however the losses are not quantified in terms of money.

ONGOING ACTIVITIES

4. Assessment of Economic Risk

The economic risk assessment will be developed based on IIASA's CATSIM model. The CATSIM model will be applied to estimate the expected losses caused by various hazards. This will result in direct impacts and indirect losses. The approach for risk assessment defines five steps including assessment of direct and asset risk, estimation of fiscal vulnerability, fiscal gaps, mainstreaming disaster risk and development planning and assessing options and risk transfer options. The model further uses SAM approach for assessing multiplier effect on various sectors due to disasters. The process has been represented in flowchart which may be referred at Figure 11.

FUTURE ACTIVITIES

5. Recommendations for Prioritizing the Mitigation Investments

Based on hazard, vulnerability & economic risk assessment and interaction with focal national government agencies, the recommendations will be prepared for prioritizing disaster risk mitigation and associated investments.

adpc
Asian Disaster Preparedness Center

*This report was prepared by **Project team***
Urban Disaster Risk Management (UDRM)
Asian Disaster Preparedness Center
www.adpc.net

July-August 2010

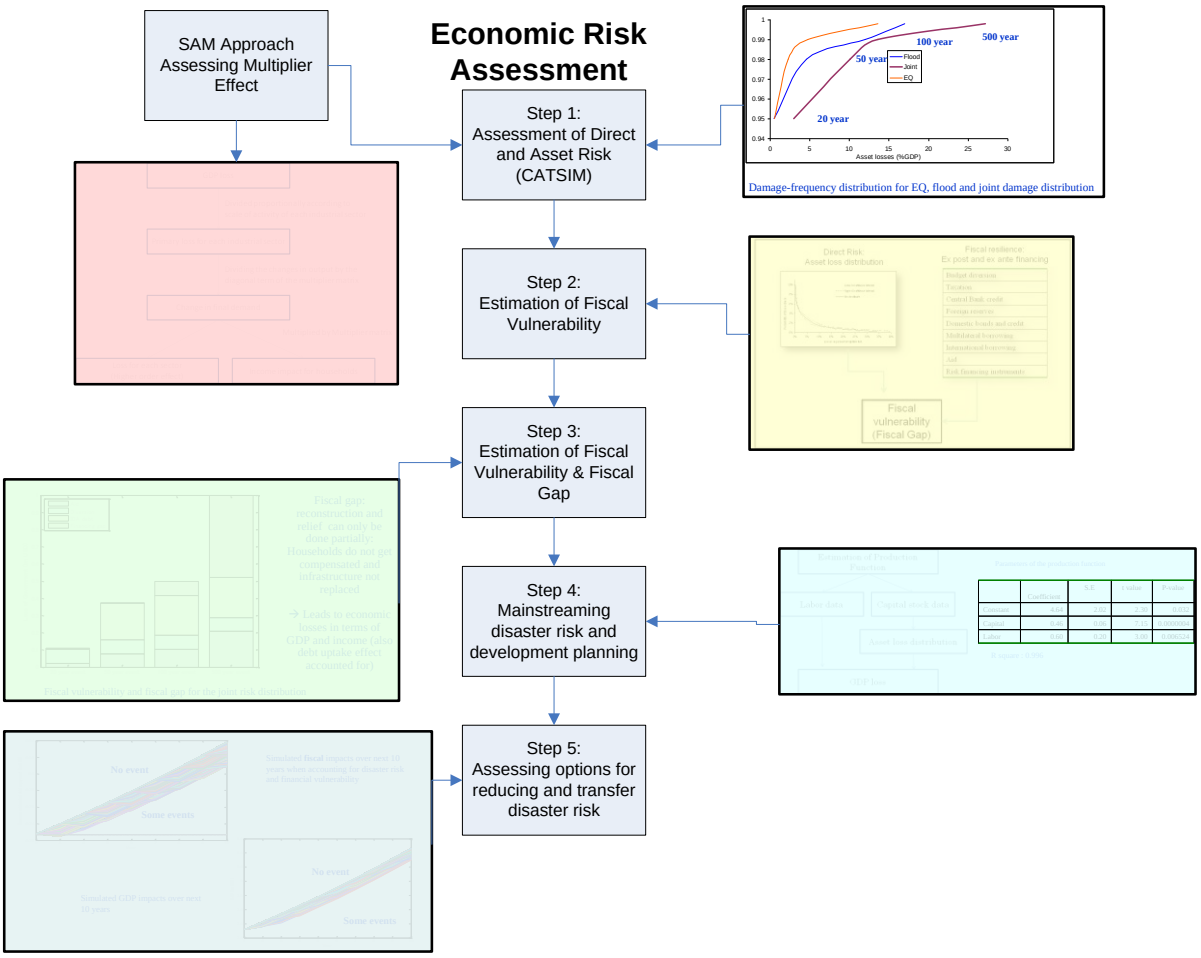

Figure 11: Flowchart showing process of economic risk assessment