Assessment of risk and vulnerability of water induced disaster: A case study of Tinau Watershed, western Nepal

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The Himalayas as a whole is tectonically very active and geomorphologically very unstable. It is highly vulnerable to water induced disasters like soil erosion, landslides, floods, glacial lake outburst flood etc due to its high relief, steep slopes, active geology, and intense monsoon rainfall. Moreover, rapid growth of population and consequent changes in land use and land cover, development of infrastructures and man-induced changes in runoff are also responsible for increased events of landslide and flood hazards. The loss of life and properties from these hazards has been increasing. The livelihood options of the people have been threatening. There is urgent need to develop and implement disaster management activities in order to reduce the loss of life and properties and sustain development activities in this area. An assessment of hazard, risk and vulnerability and its mapping could provide basis for the development of effective disaster management activities. It is in this context, an attempt was made to identify different types of water induced disasters and map and assess its risk and vulnerability. Tinau watershed was selected for this study.Tinau watershed with the total area of 234 sq km lies in Palpa district in western Nepal. The elevation ranges from 330 m at the confluence of Tinau river and Jhumsa khola (stream) to 1893 m at Ghustung Lekh.

Both the secondary and primary information have been used. Aerial photographs taken in 1996 were interpreted with field verification in order to identify the areas prone to different types of water induced disasters. Local people were consulted and interviewed to gather information for risk and vulnerability assessment. The field-work was carried out in September 2003. A total of eleven parameters like lithological units, lineaments, slope gradient, slope shape, slope aspects, relative relief, drainage density, water table and drainage condition, land use, vegetation cover, and distance from the road were used for landslide and flood hazard mapping. These information were derived from available analog maps such as toposheets, land system, land utilization, land capability prepared in the past with modification after field verification. GIS tool was used to analyse above mentioned parameters and prepare hazard, risk and vulnerability maps. Hazard areas were categorized into three groups according to the probability of occurrence of hazards such as high, moderate and low.

The landslide hazard map shows that about 17.6 % land lie in the high hazard zone and 36.7 % area in the moderate hazard zone In terms of flood hazard zone 11.5% of the land falls under the high and moderately high hazard zone and 4.7 % of land falls under the moderate hazard zone. As reported by focus group discussion out of 6716 households in the watershed, 2327 households are exposed to hazards of different types. Mostly affected people form river bank cutting, channel shifting and flood in this area are poor landless tenant families. The damage of road due to landslide is common. During the past three years the total value of Highway repair after the damage by landslide was Rs. 714,400.

Attempt was also made to evaluate disaster mitigation and management activities carried out in the watershed. The strategies adopted by household to minimize the risk of landslide, flood and other geomorphic hazards include evacuation from hazard area to other area, construction of small structure to control rive bank cutting and landslide, retaining wall, and tree plantation. The strategies adopted by other GOs and NGOs are mostly post disaster measures and relief distribution. The failure of past relief and post disaster management activities shows the lack of participation of local people in the entire processes. There is a lack of local level institutions/organizations responsible for disaster preparedness. Efforts should be made to create awareness among the local people, involve them in the entire processes of disaster preparedness. The response and recovery capacity of local people at present to cope with landslide and flood disasters which are common in the watershed is very low due to mass poverty, illiteracy, low level of off-farm activities and poor service facilities such as health. In this context, it is necessary to improve response and recovery capacity of local people through provision of education, training, off-farm employment opportunities and infrastructural services. Emphasis should also be given to develop construction standards for building and other infrastructures and regular monitoring and maintenance of already constructed infrastructures.

Early warning system has not yet been developed. Keeping in view the lead-time of flooding between highland and lowland areas, it is essential to develop a mechanism of community-based warning system. The magnitude of landslide, debris flow, and flood events can be reduced if strong conservation measures are implemented.

This study shows that the GIS and remote sensing tools can fruitfully be used for landslide and flood hazard and risk assessment. The risks indicated by the combination of vulnerability maps (based on population, economic value of the property, and infrastructure) with hazard maps could be useful in prioritizing areas for the implementation of disaster preparedness plans and mitigation measures.