The Impacts of Infrastructure Development on the Distribution of Large-scale Landslide: A Case Study from Central Nepal

Large-scale landslide, Highways, Nepal

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1. INTRODUCTION

Large-scale landslides are very common in Nepal. Extreme relief and complex geology provide favorable condition for such mass movements whereas the dynamic geology and adverse climatic condition plays vital role in the occurrence or reactivation. On the other hand, haphazard development activities, agricultural activities and landuse pattern change also largely affect the stability of large-scale landslides. In Nepal implementation of infrastructure development projects like highway projects are very necessary but lack of proper knowledge of topography and geological nature of terrain and improper way of construction based on low cost concept has made itself one of the causes of landslides hazard and also named as development hazard (Yatabe et.al. 2005). In this paper, a comparative study between infrastructurally developed and less developed areas was done to determine the effect of haphazard development in the distribution of large-scale landslides.

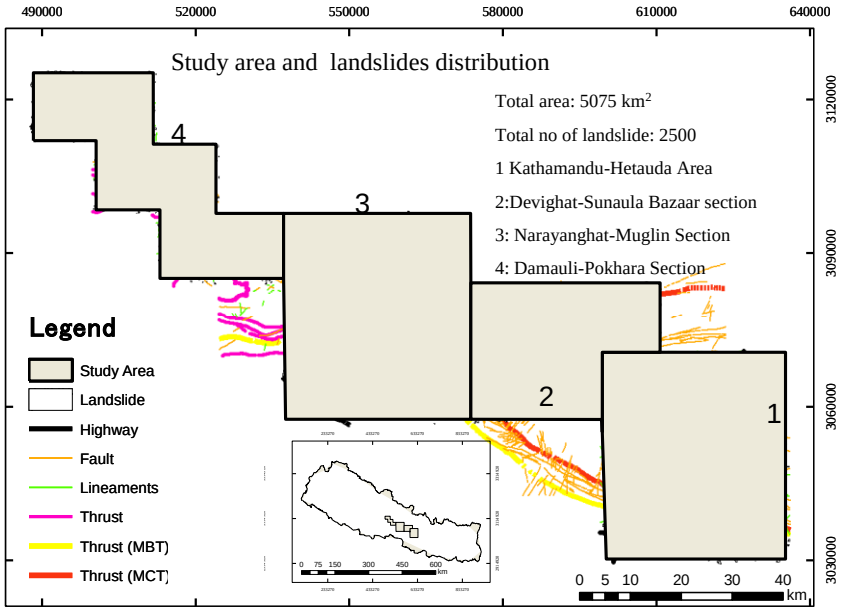

Fig.1 Study area and landslide distribution

2. MATERIAL AND METHOD

Major highways connecting the capital city of Kathmandu and to other parts of Nepal and area far from these highways are selected for this study as shown in Fig.1.

First of all, large-scale landslides in the study area were identified from aerial photo interpretation and classified into two parts either lying next to the highways or lying away from the highway. Then the density of landslides in both areas was calculated. After that, size of landslide occurring in both areas have been and compared. Similarly, the effect of toe cutting was also incorporated considering the major river system along with road system to determine the distribution pattern of large scale landslides. Finally the distribution pattern found in the two different areas was compared to determine the effect of these highways on the distribution of large- scale landslides. ArcGis 10 is used as main tool for the preparation of maps. The comparative analysis was carried in Excel.

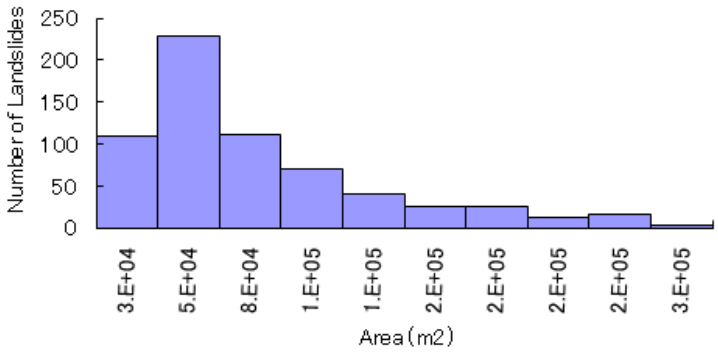

Fig.2 Landslide distribution along the highway area

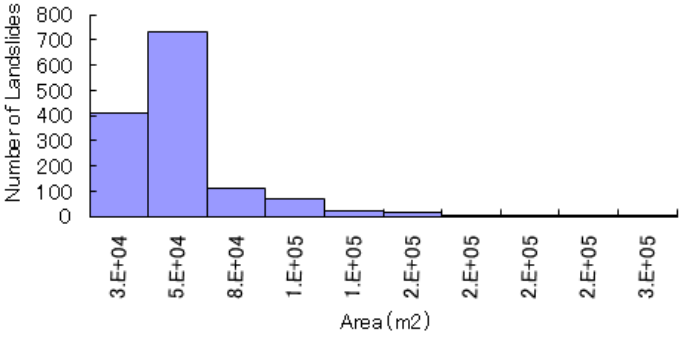

Fig.3 Landslide distribution in area away from highway

3. RESULTS AND DISSCUSSION

In this study, comparison between the landslide lying next to the major highway and landslide lying away from the highway were compared. Small district level roads are not included in the analysis. The total number of landslide lying next to the highway was 692 which is almost 30% of the total landslide i.e. 2500. But, the total area occupied by the highway was very small nearly around 519km2 which is almost 10% of the total study area. So the highway area occupying only 10 percent of total study area encompasses 30% of the total landslide indicating 3 times more dangerous than other area. Similarly, the size comparison of landslides lying in two different areas indicate that bigger landslides are distributed along the highways shown in Fig.2 and while smaller landslides are distributed away from the highway as shown in Fig.3. Even though landslides are highly distributed along the highway region, but there are some region where landslides are very few for example the Muglin-Narayanghat Highway has higher number of landslides while the Kathmandu-Hetauda Highway section have less number of landslides.. In order to determine this variation, the effect of toe cutting which is very significant in case of large-scale landslides is added along with highway. This analysis highlights that higher number of landslides are found to occur along the area where highway runs parallel with the major river system as in cases of Muglin-Narayanghat Highway due to the added effect of toe cutting effect along with highway construction. On the other hand, if we compare the location at which the highways are constructed then the stability issues of landslides can also be verified. For example, the Kathmandu-Hetauda Section of Tribhuwan highway was built along the ridge of the mountains i.e. upper side of mountains which has a little bit less effect on the stability of landslides due to mass removal from the top if construction was done of large-scale landslide area. Therefore few landslides are found in this area. But, in Muglin-Narayanghat Section, the construction was done along the river system i.e. at the lower portion of mountains and due to the removal of mass leads to the instability of landslide if constructions are done in landslides area. And the effect of toe cutting adds more disturbances to the satiability of large-scale landslides. So landslides are found higher in number along the Muglin-Narayanghat section.

4. CONCLUSION

In this paper a comparative analysis of terrains having infrastructurally developed and less developed area has been done in order to determine the effect of these infrastructures on the distribution of landslides. Landslides are found to occur in higher number along the highway region due to increase in disturbances comparing to less developed area. Nepal terrains are dominated by highly dynamic process and weak geologies, and therefore, implementing infrastructure development projects is a big challenge. A better understanding of the geological nature of terrain and the interaction of various factors is very necessary otherwise infrastructure development project itself become another cause of hazard. Such as the haphazard way of highways construction along the large-scale landslide area without proper slope protection and stabilization work has lead to the cause of landslide reactivation and losses every year along the Major Highways of Nepal. In order to reduce such development hazards, proper study of geology, topography and other various factors must be carried out first and then only proper way of construction based on the site condition must be done. Similarly in case of already built projects, first the cause of failures must be find out and then proper stabilization or protection works must be constructed.

REFERENCES

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