Landslide Hazard Mapping Using GIS:
A Case Study from
Kulekhani Watershed, Makawanpur

A Dissertation Submitted to Central Department of Environmental Science

In Partial Fulfillment of the Requirement for the completion of

Master's Degree in Environmental Science

Institute of Science and Technology,

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Letter of Recommendation

I certify that Mr. Anurag Dawadi has worked under my guidance and supervision. He has worked actively with devotion during the field work and table work as well. The dissertation entitled **"Landslide Hazard Mapping Using GIS: A Case Study from Kulekhani Watershed, Makawanpur"** bears the candidate own work to the best of my knowledge. So, I hereby, recommend the dissertation for approval.

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Letter of Approval

The dissertation presented by Mr. Anurag Dawadi entitled **"Landslide Hazard Mapping Using GIS: A Case Study from Kulekhani Watershed, Makawanpur"** has been accepted as the partial fulfillment of requirements for the completion of Maters degree of Science in Environmental Science.

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Abstract

Kulekhani Watershed is situated in Makawanpur district of Central Development Region, and about 30 km. west of Kathmandu valley. This watershed houses storage type reservoir, one of its only kind in Nepal. Landslides occurrence is a frequent phenomena in the study area and the disaster of 1993 and preceding year wreaked havoc. So, the problem of landslide hazard and mitigation is pivotal to address development challenge.

The study aims to develop causal factor maps by verifying digital data. The various maps are Slope, Aspect, Relief, Internal Relief, River Distance, Landuse and Geology which are formed, stored and analysed using GIS. These factors then applied in methodologies based on "Bivariate Statistical Analysis" viz. Frequency Ratio, Statistical Index Method, Landslide Susceptibility Analysis, Weight of Evidence Modelling and Certainty Factor in ILWIS 3.0. The weight maps were formed from 7 factor maps through different methods and final hazard maps were created classifying into 3 hazard areas i.e. Low, Moderate and High. The analysis of the results shows that there do not lay any major differences in methods and their prediction of hazard areas and landslides are almost coherent.

The landslide susceptibility map indicates that the area covering low, moderate and high hazard class for 5 different approaches is in the range of approx. 28-31%, 32-37% and 36-39% respectively. The detected landslides in the area for the 3 hazard areas by applying abovementioned various methods are in the range of approx 8-10%, 27-29% and 62-66%. The study estimated the accuracy of landslide hazard mapping results based on criteria considering the number of landslides occurrence. Based upon this predicted results were found to be reliable. The result of the experiment has also shown that application of GIS has proven to be an effective tool in landslide hazard assessment.

Key words: GIS, ILWIS 3.0, Bivariate Statistical Analysis, Landslide Susceptibility Map

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Anurag Dawadi

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CF	Certainty Factor
C. Wt.	Cumulative Weight
DEM	Digital Elevation Model
DWIDP	Department of Water Induced Disaster Prevention
FINNIDA	Finland International Development Agency
FR	Frequency Ratio
GIS	Geographic Information System
GoN	Government of Nepal
ICIMOD	International Centre of Integrated Mountain Development
ILWIS	Integrated Land and Water Information System
IRS	Imagery Requirements Structure
LANDSAT	Land Remote Sensing Satellite
LSA	Landslide Susceptibility Analysis
LSI	Landslide Susceptibility Index
LSZ	Landslide Susceptibility Zonation
SIM	Statistical Index Method
SPOT	Satellite Pour l'Observation de la Terre
W_{ij}	Weight of i^{th} class of parameter j
WOE	Weight of Evidence Modelling
UNESCO	United Nation Educational, Scientific and Cultural Organisation