

Article

A Comparative Study of Frequency Ratio, Shannon's Entropy and Analytic Hierarchy Process (AHP) Models for Landslide Susceptibility Assessment

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Abstract: Landslide susceptibility maps are very important tools in the planning and management of landslide prone areas. Qualitative and quantitative methods each have their own advantages and dis-advantages in landslide susceptibility mapping. The aim of this study is to compare three models, i.e., frequency ratio (FR), Shannon's entropy and analytic hierarchy process (AHP) by implementing them for the preparation of landslide susceptibility maps. Shimla, a district in Himachal Pradesh (H.P.), India was chosen for the study. A landslide inventory containing more than 1500 landslide events was prepared using previous literature, available historical data and a field survey. Out of the total number of landslide events, 30% data was used for training and 70% data was used for testing purpose. The frequency ratio, Shannon's entropy and AHP models were implemented and three landslide susceptibility maps were prepared for the study area. The final landslide susceptibility maps were validated using a receiver operating characteristic (ROC) curve. The frequency ratio (FR) model yielded the highest accuracy, with 0.925 fitted ROC area, while the accuracy achieved by Shannon's entropy model was 0.883. Analytic hierarchy process (AHP) yielded the lowest accuracy, with 0.732 fitted ROC area. The results of this study can be used by engineers and planners for better management and mitigation of landslides in the study area.

Keywords: landslide susceptibility mapping; AHP; Shannon's entropy; frequency ratio; landslide inventory



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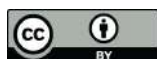
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1. Introduction

Hilly regions are frequently affected by landslide disasters. Landslides are responsible for huge loss of life and damage to infrastructure [1,2]. A landslide is the result of movement of a slope under the effect of gravity, but the movement can be triggered by the factors such as rainfall, earthquakes, erosion, etc. [3,4]. The accurate prediction of landslides can help in the planning and management of landslide hazards, and can ultimately be used for the reduction of risk [5]. Landslide susceptibility maps help in the identification of landslide prone areas. Landslide susceptibility maps can be very efficient tools for planners and risk managers [5]. The occurrence of landslides is a complex phenomenon which depends upon various factors. Geological factors, drainage characteristics, land-use of the region, construction activities, etc., can all be responsible for the occurrence of landslides [6]. Anthropogenic activities and the development of infrastructure in landslide prone areas can disturb natural slopes, resulting in massive disaster [7,8].

The study area selected in this study is the Shimla district in Himachal Pradesh (H.P.), India. The study area is developing at a very rapid rate. Anthropogenic activities have been increasing in the study area, resulting in the instability of natural slopes. Landslide occurrence is very frequent in the study area due to rugged topographic and the typical climatic conditions in the region. Therefore, there is a need for the preparation of a landslide susceptibility map for the region which can be used by planners and engineers.