BIOGEOHYDROLOGICAL DATA AND GIS AS DECISION SUPPORT SYSTEM FOR NATURAL HAZARD MANAGEMENT IN HIMALAYAN WATERSHED

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The hydrological system as a linking element between mountains and plains is very sensitive to unsustainable and unadapted anthropogenic activities in the highlands as well as lowlands. There is no doubt that the Himalayas have undergone a most dynamic change in land use due to the rapid increase in population. Subsequently, natural hazards cause a great deal of harm and damage every year and they have generally increased over the last decade. The complexity of the problem arose due to declining land-man ratio, nonavailability of additional arable land, compulsion of increasing intensity of land use, and careless application of technology. The occurrence of hazards, such as landslides and other types of mass wasting, are becoming a common feature in the Indian Himalayas. It is very difficult to say that hazards are mainly produced by the natural fragility of the region or biotic degradation and land-use practices which are more significant for the hydrological processes. Thus, there is a need for process understanding by developing multidimensional and integrated biogeohydrological databases at micro-levels in order to understand complex geosphere-biosphere interaction. This includes the identification of key databases, such as geographical, glacial, hydrological, meteorological, geological, biospheric, anthropogenic, land use, and sociocultural. The standardisation and user-friendly format should be an integral part of such databases. The appropriate geoinformatic technology should be applied, providing the latest information about products and systems in the fields of space technology, image processing, GIS, GPS, and expert systems. High-resolution satellite data and low-resolution satellite data for specific purposes should be compiled in a multitemporal database to support local projects.

Ecohydrological studies are required to analyse phenomena, processes, and their interaction throughout space and time. The hydrological information system has to be considered as multidimensional, i.e. it should include attribute dimensions, spatial dimensions, and temporal dimensions. Geographical Information Systems (GIS) offer such capablities as they integrate multisector, multi-level, and multiperiod databases. The present paper discusses the various components and principles of GIS. Subsequently, GIS can be used as a decision-support system, identifying, integrating monitoring, and predicting natural hazards, i.e. landslides, soil erosion, and floods, which are the major environmental risks. Natural hazards, the result of complex interaction between various natural systems, modify topographic gradients and anthropogenic activities on a spatio-temporal scale. Any change in the physical configuration of a watershed directly affects its environmental sustainability. The combination of type and casual processes is the basic condition for the classification of hazard risks and critical zones in a watershed.

The degree of criticality is determined by the magnitude, frequency, and type of hazard/risk. Most of the risk zones are confined to the slopes with less vegetative cover and densely populated regions. Few of the important particuliarities are high steep slopes, rapid bioclimatic gradients, local avalanches, lithologically weak structures, population density, irrigated and terrace agriculture, tourism-based economies, and construction activities. Some severe hazards are considered moderate because they occur away from human habitation. Human-induced hazards are prominent around excavation works for construction activities. Construction especially causes erratic runoff making the area locally prone to mass wasting. The paper also suggests that GIS technology should become an integral part of the decision-support system in mountain disaster monitoring and mitigation studies, on the basis of empirical evidence, using the ERDAS system for predicting soil erosion hazards and suitability for various land uses such as agriculture. Similarly, the model and method may be applied for the study of other similar watersheds.