Assessment of Erosional Hazards in the Himalayas : A Case Study of Chamoli District in Uttar Pradesh (India)

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Abstract

Chamoli is an administrative unit in the state of Uttar Pradesh in India. Being located on the lofty heights of sharp and precipitous slopes, the area is most vulnerable to hazard due to intense thunderstorms; high rainfall; structurally crushed; folded, and faulted rock strata; and highly erodible poor soil subjected to faulty land-use practices. Chamoli, being also located in a geostrategic and sensitive area bordering on China, has come in for great attention. Efficient communication roads are being constructed on its high and steep mountains. Given the ecological vulnerability and cardinal location of the area, whose fundamental resource is soil, erosional hazards in the district of Chamoli have been taken as the topic of this research.

Introduction

The study area lies in the Indian Himalayas between the latitudes of 30° and 31°N and longitudes of 79° and 80°E. It has an area of 9,125sq.km. and is situated in the north-west of the state of Uttar Pradesh (Fig. 1). The district stretches across snow-free narrow I and V-shaped valleys of skycraping peaks covered with perpetual snow and glaciers.

Data used for this study on erosional hazards were collected, on both a primary and secondary level. Data on sociological and human aspects were collected from the *District Gazetter* and *District Census*. Primary data for the study were collected through personal observation, interviews, and a questionnaire. A multistage clustered random sampling as a technique of data collection was carried out by means of a questionnaire. Cartographic and statistical techniques were employed to illustrate relevant information. This paper aims to identify the erosional hazards in Chamoli district and their causes. Human intervention impacting the age-old, land-man equilibrium in the region has also been discussed.

Physiography

Glaciofluvial processes have evolved variegated landscapes in Chamoli, including river confluences, narrow agricultural terraces in a few constricted intermittent valleys, steeply sloping cliffs and escarpments with occasional gently to moderately sloping ridges, incised meanders with interlocking spurs, and unique glacial U-shaped valleys with retreating glaciers (Saxena 1986). The upstream reaches of the Alaknanda, Birehi, Dhauliganga, Mandakini, Nandaki, and Pinder

rivers remain under snow throughout the year, and other parts remain under snow for three to four months per year. Frost wading, plucking, nivation, glacial abrasion, furrowing, cutting, and ploughing are the erosional processes.

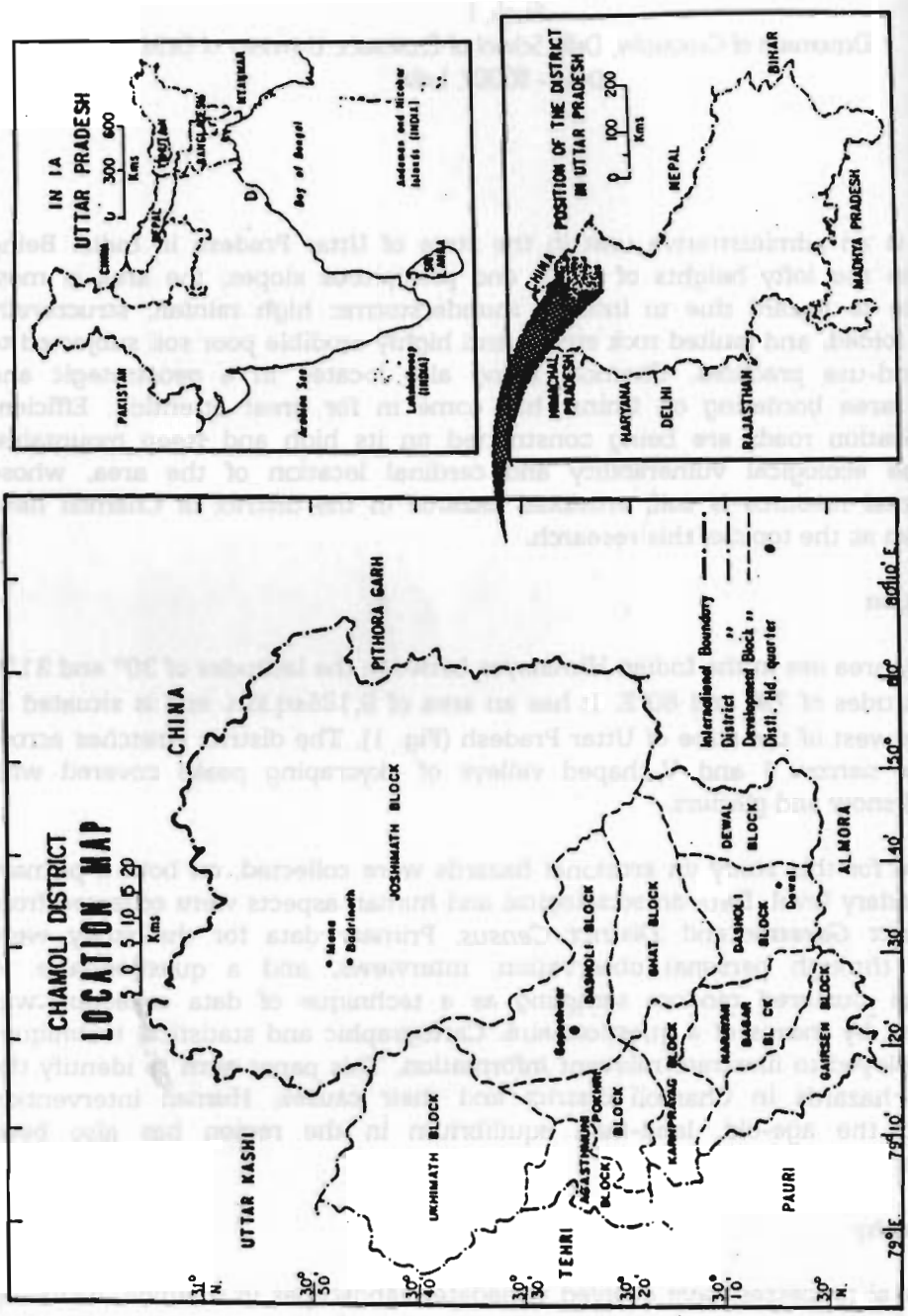

Figure 1: Location Map of Chamoli District

Chamoli undergoes heterogeneity climatic conditions, mainly due to altitudinal differences and physiographic complexities. Climatic conditions change from the tropical climate in the valleys to the cool temperate and tundra zones in the upper elevations. Five distrinct climatic zones are present in the district (see Fig. 2)

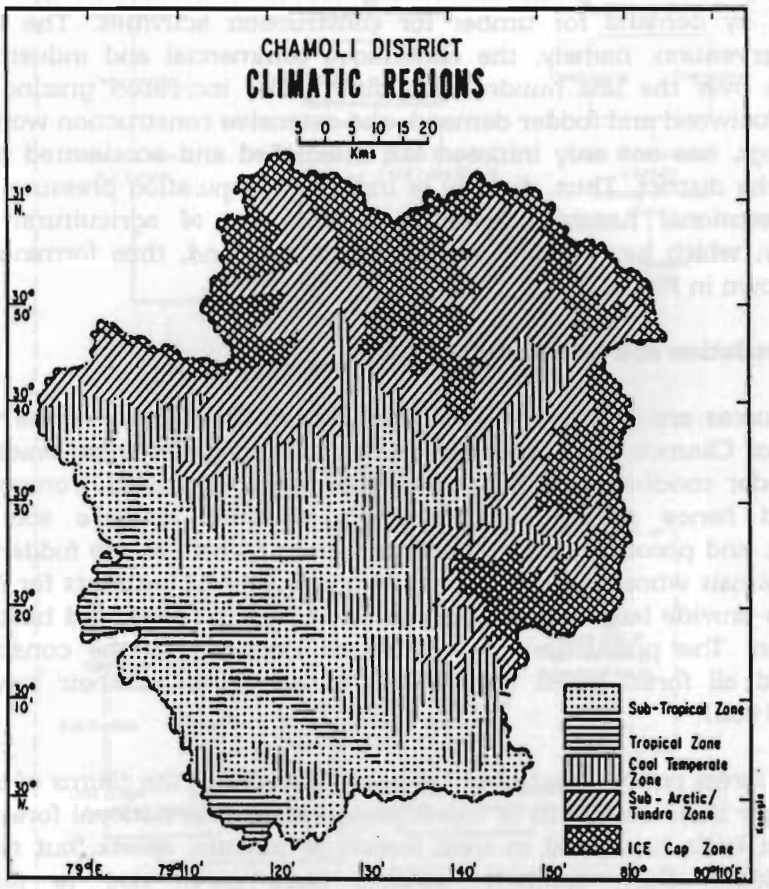

Figure 2: Climatic Regions of Chamoli District

Population

The population of the district has increased rapidly from 145,670 to 454,871 over a period of 90 years (1901-1991) due to the introduction of modern health care and medicine. The percentage of rural and urban population in the district is 91.99 and 8.01 respectively. About 95 per cent of the working population is engaged in the farming sector. Some 966 persons are nomads, 57 are mining labourers, and 4,909 are in business. Therefore, Chamoli has an agrarian and rural economy, with 96 per cent of the population involved in primary activities directly linked with land. The increasing food demand associated with the growing human and livestock population is being met by expansion of agricultural land via encroachment over less productive and steeply sloping marginal land and by clearing forests. Both of these activities are detrimental, as they augment erosional hazards by making the land less productive, robbing it of its soil

nutrients. The increase in population has also led to a parallel escalation in fuelwood demand, as more than 95 per cent of the energy consumption depends on biomass. The domestic animal population has also undergone an almost parallel increase in number with the human population. Fuel and fodder demands result in forest and grassland degradation leading to soil erosion, and this is further augmented by demand for timber for construction activities. The large-scale human intervention, namely, the continuous commercial and industrial timber exploitation over the last hundred and fifty years, increased grazing pressure, escalating fuelwood and fodder demand, and extensive construction work on roads and buildings, has not only initiated but intensified and accelerated the rate of erosion in the district. Thus, directly or indirectly, population pressure has led to increased erosional hazards, resulting in the loss of agricultural land and productivity, which has again put pressure on the land, thus forming a vicious circle as shown in Figure 3.

Forest Degradation and Government Policy

Forest resources are critical ecological elements in the balance of the vulnerable ecosystem of Chamoli. They play the central role in maintaining water and soil stability under conditions of heavy torrential seasonal rainfall. Forests decrease runoff, and hence reduce erosion. Roots of trees increase soil strength, granulation, and porosity. Green leaves and grass constitute the fodder supply of the farm animals whose dung provides the only source of nutrients for food crops. Forests also provide large amounts of fruit, edible nuts, fibres, and herbs for local consumption. The production of agricultural implements, the construction of houses, and all forest-based industries are dependent on their raw material (Aggarwal 1982).

India's first forest policy, enacted in 1894, stipulated that the claims of agriculture were stronger than the claims of forest preservation. The national forest policy of independent India continued to treat forests as national assets, but not as local need providers. Such apathetic policies have given rise to far-reaching consequences. Firstly, large-scale felling has upset the equilibrium between water and soil, resulting in frequent hazardous events. Secondly, national policies have ignored the needs of the local people for fodder, fuel, and food. Thirdly, loss of community ownership has induced a lack of enthusiasm among villagers in executing preservation and improvement measures towards village forests. Fourthly, these policies have strained relations between villagers and forest conservators to the extent of generating perpetual misunderstanding and non-cooperation, and this hinders effective forest resource management. There is a heavy fuelwood demand in the district. An average of 10kg of wood is required per day for a family of five persons. Farming equipment is made by farmers themselves. Some areas have also been facing the problems of soil dryness and invasion of xerophytic plants due to excessive deforestation. Forest fires have been more common, with trees up to the age of three or four years being most affected. Although, officially, 57 per cent of the land is estimated to be under forests, actually it is only 28.5 per cent. Forestry has to be integrated with agriculture, rural development, and land-use policy.

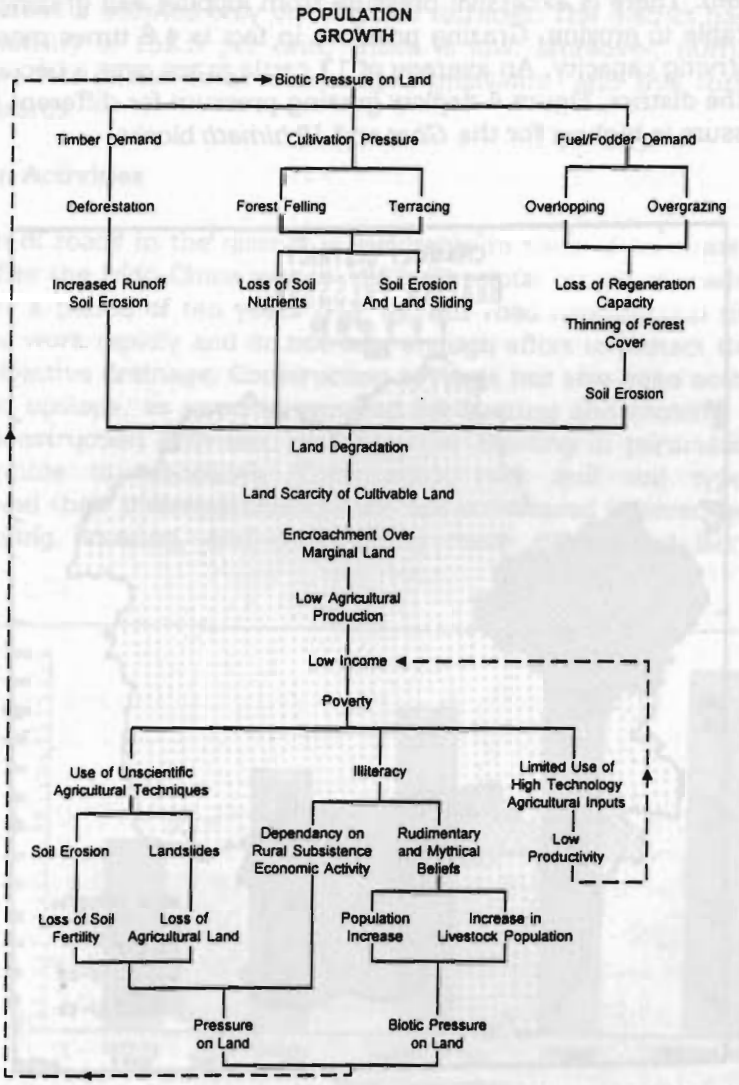

Figure 3: Model for Population - Environment Interaction System in Chamoli

Overgrazing

Intensive grazing over the years, combined with the removal and degradation of forest products, has left the district with a rudimentary vegetation cover not capable of holding the soil. To a farmer with nutrient-poor land, livestock provide both goods and services in the form of food, dung, farm work, transport, and cash income. The cattle population is encouraged to grow in the district as a matter of prestige, and cows in particular are kept for religious reasons. The increased number of cattle is escalating the demand for fodder in the district. One fourth of

the fodder is obtained from cultivated by-products and from trees in the area (Tucker 1986). There is excessive pressure from lopping and grazing, leaving the land vulnerable to erosion. Grazing pressure in fact is 4.8 times more in Chamoli than the carrying capacity. An average of 13 cattle graze over a hectare of grazing pasture in the district. Figure 4 depicts grazing pressure for different development blocks. Pressure is highest for the *Ghat* and *Ukhimath* blocks.

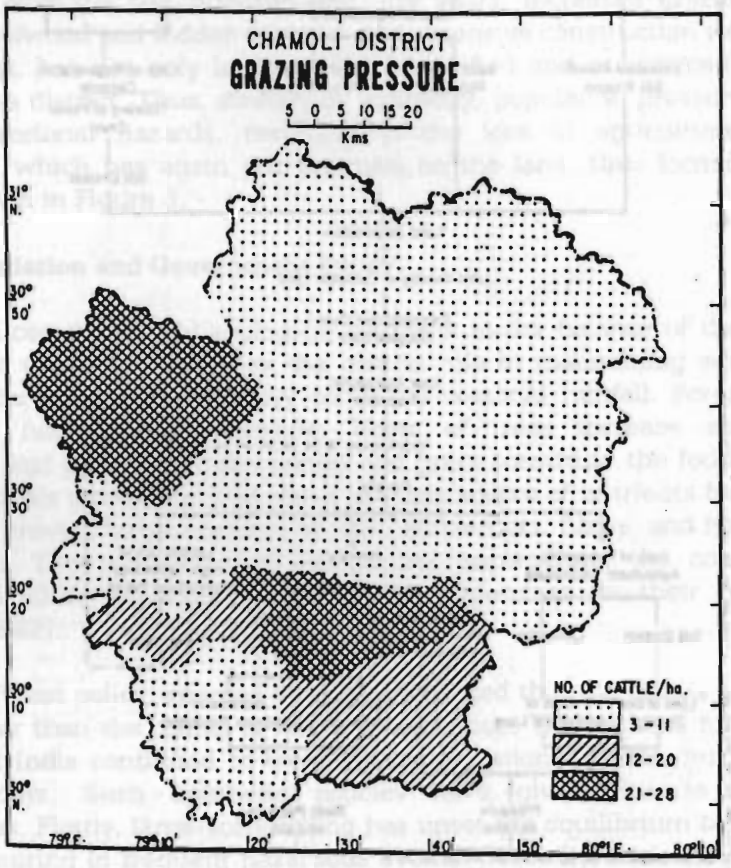

Figure 4: Grazing Pressure in Chamoli District

Agronomic Practices

Agricultural development and growth in the district lag behind on account of the combined effects of local conditions and erosional processes. Ignorance and poverty cause farmers to depend on age-old agricultural practices that yield just sufficient harvests to survive. Low-yielding indigenous varieties of crops are commonly grown. Chemical fertilizers are hardly used; most of the population depends on cow dung. All in all, with the population increasing but not the production of crops, people are forced to encroach on less productive and steeply sloping marginal forest lands. Only 5.7 per cent of the total sown area is irrigated. Terraces, especially on higher rainfed slopes, are often poorly constructed with

outwards sloping angles, and do not have bunds along the edge. A double cropping system is adopted only on irrigated terraces. The district has an average cropping intensity of 152.5 per cent, which is low. Moreover, nutrient-depleted land is being left fallow or as unmanaged grassland, and this further adds to erosional hazards.

Construction Activities

Construction of roads in the district is inevitable in view of its strategic location, especially after the Indo-China war in 1962. The total length of roads has almost doubled over a period of ten years (Fig. 5). But road construction firms have to complete the work rapidly and do not take enough effort to protect the cut slopes or provide effective drainage. Construction of roads has also been accompanied by deforestation upslope, as wood is required for heating and cooking purposes by labourers. Construction activities, and improper blasting in particular render the area susceptible to landslides. Topography, rock and soil types, geologic structures, and their interrelationships are not considered coherently and *in situ* while designing, locating, and constructing roads (Shiva and Bandyopadhyay 1986).

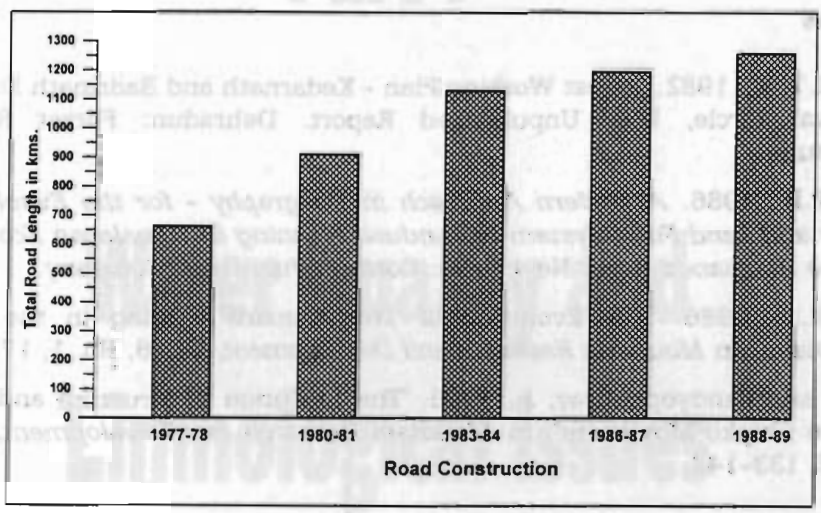

Figure 5: Development of Road Network in Chamoli District

Conclusion

Anthropogenic interventions have disturbed the intricate ecological balance of the morphologically and geologically weak mountain slopes of Chamoli district. Despite a low population density, there is high pressure on the resources of the district on account of nutrient-poor and less productive soil and the lack of flat terrain for cultivation. The 95 per cent of the population engaged in the farming sector is putting great pressure on the steeply inclined slopes of the district. Natural vegetation is gradually being damaged beyond restoration in the wake of the 683,540 cubic metres of debris discharge every year down the slopes for the

maintenance of roads. Therefore, overlopping, overgrazing, overlogging, and construction activities are augmenting the rate of hazards in the district. The nature of hazards is shifting gradually from natural to human-induced.

It is necessary to slowly convert the economy from a subsistence and agrarian one, based on primary activities, to a manufacturing and service-based economy. The development of horticulture in the district would be the best means to minimise pressure on steeply sloping marginal land. It would allow for both management of land resources and improved economic conditions of the people, so that they could at least attain self-sufficiency. Though the area has tremendous scope for growth in agro-based industries, such development is almost non-existent. The district could also foster cottage industries on a small and medium scale. The climatic conditions of the district offer conditions for the development of sericulture and mushroom cultivation. Thus, to reduce the increasing pressure of the population on primary resources and to break the link between biotic pressure on land and deforestation, measures should be taken to improve the economy by integrated scientific management, conservation, and the development of different sectors, viz., forestry, horticulture, agriculture, tourism, and hydroelectric power, through the voluntary efforts of both local people and outsiders.

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