SOIL EROSION AND GEOMORPHODYNAMICS IN THE HIGH MOUNTAIN REGION, EASTERN CENTRAL HIMALAYA. A CASE STUDY IN THE BAMTI/BHANDAR/SURMA AREA, NEPAL

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The report deals with the Himalayan Lowland Interaction Complex, the link between the Himalayas and the lowland plains, and the effects of geomorphodynamic processes in the mountain regions on the low-lying areas within the mountains and the foothills. This cause and effect is known as the 'Himalayan Environmental Degradation Theory'.

Since the mid-eighties, there have been some quantitatively-oriented erosion studies which tried to quantify soil loss and runoff by means of testplots. The results differ greatly and seem to be influenced by regional factors as well as the project targets and layout of the testplots. Also unknown is the magnitude of human impact on soil erosion compared with natural impacts like the development of valleys and slopes and spontaneous mass movements. If human impact is slight, afforestation and man-made protection from erosion cannot affect the flooding of the lowlands. The proportion of man made and natural influences, comparing soil erosion and runoff in a quantitative way, has not been investigated anyhere in the Eastern Nepal Himalaya. The present study documents new approaches in this area.

The research area Bamti/Bhandar/Surma is located on the western slope of the Likhu *Khola* Valley, one of the large cross valleys running north-south in the Himalayas. Bamti/Bhandar/Surma, with altitutes ranging from 1,450 to 3,400 masl, offers all the altitudinally-dependent cultivation systems and crop rotations of the southern declivity of the Eastern Himalayas, from paddy-rice cultivation in the valleys to various maize-millet combinations, field-pasture shifting cultivation, and grazing at the subalpine level. Zones with differing degrees of usage were identified for investigation: Zone 1, the Bamti Zone, with a high degree of usage, is situated between 1,450 and 2,100 masl. Zone 2, the Bhandar Zone, with a medium degree of usage, is situated between 2,000-2,800masl. Zone 3, the Surma Zone, with an extremely small degree of usage, is situated between 2,200 and 3,410 masl. This division into zones reflecting varying degrees of usage makes it possible to estimate human impact in the research area.

Amounts and intensities of precipitation, temperature, and humidity were all recorded in the three main climate stations; the amount of precipitation was determined daily at seven meteorological stations and with 42 rain gauges in order to calculate the precipitation in the area. Daily soil erosion and runoff rates were measured on ten testplots during the monsoon months from May to September of 1990 and 1991. The testplots were of $14m^2$ and $28m^2$. The amount of discharge and suspended sediment concentration in the three catchment areas were recorded. The water level was continuously monitored at four water-level recording stations, and the discharge hydrograph was determined by the current metre. From April to September, water samples were taken daily (for heavy rainfall, several per hour were taken) in order to determine the suspended sediment delivery from the levels of suspended sediment concentration.

The cartography of recent geomorphodynamics represents the connection between the testplot measurements and the results of the catchment area level. A plethora of form elements were recorded in the areas of erosion and accumulation on the expanses and in the gullies. Careful watch was kept the human impact. Expansive washouts in the farmlands; gully erosion; crumbling terrace edges, especially creep in paddy rice terraces; and the construction of grazing-land borders with a ditch and wall as protection against pasture animal were also recorded.

Surprisingly small rates of erosion were observed in the areas in question, with the exception of the extensively-used field-pasture shifting cultivation land during the crop year. The pre- and early monsoon convective precipitation in the *bukma* fields in May and June cause the highest erosion rates in the test area. Determining factors are the splash-effect due to the absence of vegetative cover and high runoff as a result of insignificant infiltration in the grazed topsoil section. The *bukma* fields produce the highest erosion rates in the entire test area, but these rates are not concurrent with the highest runoff rates on the testplots, but are dependent on the splash effect and vegetative cover in the pre- and early monsoon periods. The soil erosion and runoff rates on all testplots document that the extensive field-pasture shifting cultivation (*bukma*) of the Bhandar Zone produces higher soil erosion rates and runoff rates in the crop year and first fallow year than the intensively and continually cultivated terraced land with medium slopes near the houses. The chronological difference between erosion in fields and suspended sediment delivery in the small catchment areas raises the question of the origin of the material in the rivers.

Looking at the erosion and accumulation on the fields in the High Mountain Region, a unexpectedly low geomorphodynamic process activity and density appears. Also, rainstorms with more than 100mm precipitation daily and very high erosivity indices cause rill and gully development only on a small scale. The high ground cover of dense vegetation during the main and late monsoon season in July, August and September can be seen as the main reason for this. In contrast, falls and slides are concentrated along the main riverbeds. These spontaneous mass movements happen mainly during the months of July and September, with the maximum flood discharge caused by high runoff. Hence, they influence the suspended sediment transport of the rivers to a high degree. The extensively-used grazing-land with *bukma* fields can be seen as the main factor responsible for high runoff rates. Considering the fact that 15% to 25% of precipitation becomes runoff, which is 5 to 8 times more than in forest areas, many breaks and slides along the rivers can be interpreted as a reaction to increasing incision after the clearing of forest and conversion to grazing land. However, it is necessary to mention that this process of clearing the forest started with the settlement in the area more than 300 years ago and was finished at the latest in the 1950s. Over the past 25 years, extensification of land use has been observed as well as an increase in forest and scrubland.

There was a noticeable difference between the small amounts of suspended sediment delivery in the investigated small catchment areas and that of the large rivers of Eastern Nepal. One can conclude from the data in the research area that the contribution of suspended sediment in small catchment areas of the High Mountain Region, which show the same or similar geographic features as the study area, to the sediment in the main rivers is very slight. The results show that the Himalayan Environmental Degradation Theory cannot be applied to the High Mountain Region of Eastern Nepal.