

SOIL EROSION INTENSITY ZONES IN KASHMIR VALLEY.

T. A. KANTH and M. S. BHAT, Srinagar.

ABSTRACT: The problem of soil erosion at present is one of the most serious battles that mankind is fighting with. In the valley of Kashmir where only 29.13 percent of land is cultivated, the problem of soil erosion is compounded by the low man land ratio (0.12) ha/head as against the national figure of 0.20 ha/head). Nearly one third area of the valley is subject to moderate to severe erosion with the rates of soil loss ranging between 16 tons/ha/year to 900 tons/ha/year (computed by the universal soil loss equation — USLE). This high intensity of erosion is mainly due to the slope characteristics, loose texture and poor organic matter content of the soil. The present paper makes an assessment of the magnitude and extent of soil erosion hazards within the frame work of four erosion intensity zones.

INTRODUCTION

Soil erosion is a quiet crisis, not widely perceived but gradually unfolding as a serious threat to human well being. It has assumed dangerous dimensions in recent years with the fast shrinking land base and declining agricultural productivity on one hand and the increasing demand for food arising from the rapid growth of population on the other hand, thus posing a serious threat to the food security. The gravity of the problem is more apparent in the developing countries like India, where about 6×10^9 tons, averaging 16.4 tons/ha of soil is being eroded every year. The seriousness of the problem in the state of Jammu and Kashmir is apparent from the fact that the State imports food grains from other states of the country as only 29.13 percent of the land is cultivated. This imbalance in terms of availability of land for agricultural utilization has further been complicated by the paid growth of population

that resulted in the decline of man land ratio from 0.23 hectares in 1951 to 0.12 hectares of cultivable land in 1986, while at the state level it is 0.14 hectares and at national level it is 0.20 hectares. By the end of the year 2000, when the population of the state is expected to touch the 10 million mark, hardly 0.08 hectares of cultivable land will be available per head. Thus it looks imperative to make the optimal use of land resources with efficient conservation strategy for the maximum benefit on long term basis.

Besides lowering the food productivity, the immediate consequences of soil erosion is increased siltation and rise of level of rivers, reservoirs and dams followed by the floods as a natural consequence. As against one flood in every three years in 1950's and one flood in every two years in 1980's, the valley now experiences floods almost every year, thus triggering off an adverse chain reaction on the state economy.

The valley of Kashmir being hilly and mountainous its physiographic disposition is highly vulnerable to soil erosion hazards. The problem is encountered both on agriculture as well as non-agricultural lands. The high rate of population growth both human and livestock has resulted in over exploitation of natural resources to meet the ever increasing demand for food, fodder and fuel. The increasing competition on the same lands for these three essentials is resulting in widespread damages to forests, pastures and waste lands, agricultural and fallow lands as well.

Assessing of soil erosion hazards in Kashmir valley is a complex problem because of its great diversities existing in physio-climatic conditions and farming systems. The erosional hazards in the valley are largely the outcome of the interaction of various factors viz; climate, relief, erodibility, deforestation and land use practices.

Climate

Regarding the climatic erosivity, the intensity of rainfall is an important factor in terms of erosive capacity. The valley receives a fair amount (754 mm mean annual) of precipitation both in form of snow and rainfall. However, it has low intensity per rainy day, with average intensity varying from 5.08 mm to 26.27 mm (based on fifty years data, 1901-1951), with Doru recording the highest intensity throughout the valley.

Relief

The relief aspect in view of erosion have been measured by two parameters, altitude and slope characteristics of the valley. These two parameters in general

indicate the relief differences between various regions.

Altitude

The diverse relief conditions of the valley play an outstanding role in inducing soil erosion processes in the Kashmir valley, as there is a regular increase in altitude almost in all the directions from the valley bottom to the surrounding uplands and mountains. The valley bottom with an average altitude of 1500 to 1800 metres has somewhat flat topography characterized by aggradational features. The bordering karewas and sloping uplands to the valley bottom, with an elevation ranging between 1800 to 2400 metres are dominated by erosional topography. The mountain ranges enclosing the valley from all sides produce a variety of slopes through their descendance to the valley floor, thus providing ideal conditions for erosion by sub-areal agent of denudation.

Slope

Among the slope factors, slope gradient is an important factor governing the efficacy of splash erosion and also influencing soil erosion through its impact on physical and chemical properties of soil, land use and possibilities of irrigation. The valley presents varied slope characteristics from gentle undulating to high steep slopes. Raza et al. (1978), dividing the Kashmir valley into six slope regions. However for the purpose of the present study, these six regions have been condensed into the following four broad slope regions.

- (i) Region of low relief to gentle slope which consists of low lying plains and the adjacent terraces having

- a slope varying between 0° to 10° .
- (ii) Region of gentle to moderate slope consisting of lower foot hills and flat topped karewas having a slope between 10° to 20° .
 - (iii) Region of moderate to steep slope consisting of sloping karewas and steep forest slopes with a slope varying between 20° to 30° .
 - (iv) Region of steep slopes and escarpments with a slope of more than 30° covering rocky slopes and glacial zones.

Erodibility

The soils of the valley show great diversity in the physical and chemical properties leading to significant differences in their erodibility status. The soils which are having a rich content of clay are resistant to erosion as compared to the soils which are poor in clay.

Erosional problems vary according to the land use practices. In Kashmir valley only 29.13 percent of land is cultivated out of the total land in which 13 percent is irrigated and 3.12 percent of the total area is under pastures. Assuming that the irrigated area and permanent pastures which together constitute 16.12 percent of the total area is well protected and has no soil erosion problems, the remaining 82.88 percent of land area is facing one or the other land degradation problems.

Deforestation:

In the forest areas of the valley, the cultivated lands have very perceptibly eaten into the forest land in areas where

the habitation is nearby resulting not only in the general degradation but also physical shrinkage of forests. A survey of Zowara forest has shown an extreme case of encroachment in forests, though at other places the position is a real problem to be reckoned with. In this particular case the encroachment has increased from 10% in 1963 to 42% of the forest area in 1987. Almost without exception all forest dwellers and nearby inhabitants depend on forest related products for their livelihood. To them food, fuel, fodder, fertilizer and construction materials are entirely provided by the forests. In most of the villages 90% of the fuel demand is met by the wood consumption.

Besides these factors, industrial activities like brick manufacturing activities have also caused continuous degradation of large areas. One of the worst examples of the accelerated erosion through these activities in the Kashmir valley can be cited from Budgam district, the worst hit area in the valley. The magnitude of the destruction can be visualised if one happens to travel through the localities of Padshahibag, Lasjan, Summerbug, Rakhshalina, Chattergam etc., the main centres of brick manufacturing activities in the valley. The entire area gives a devastating look which once had been a highly productive and fertile land. The calculations have revealed that nearly 27×10^4 tons of soil are being eroded annually from these areas and nearly ten thousand hectares of land have been already damaged and left uncultivated. These brick manufacturing activities are now fast expanding to other areas of the valley, thus posing a serious threat to the land resource base of the valley.

On the basis of these factors and other numerous observations an estimate of the magnitude and extent of soil erosion hazards in the Kashmir valley is possible within the framework of four erosion intensity zones, whose spatial distribution is shown in Fig. 1. and the relationship of these four erosion intensity zones with other physical factors is given in Table 1. The rates of soil erosion for the four intensity zones in which the valley is divided have been computed with the help of Universal Soil Loss Equation — USLE (Wischemier and Smith 1965, Fournier 1972). The USLE equation is given below :

$$P = RKSLCP$$

Where

P_a = is the potential soil loss per unit of area.

R is the rainfall erosivity factor

K, the soil erodibility factor

LS, the topographical factor

C, the cropping management factor

and

P, the erosion control practice factor.

The four erosion intensity zones are as following —

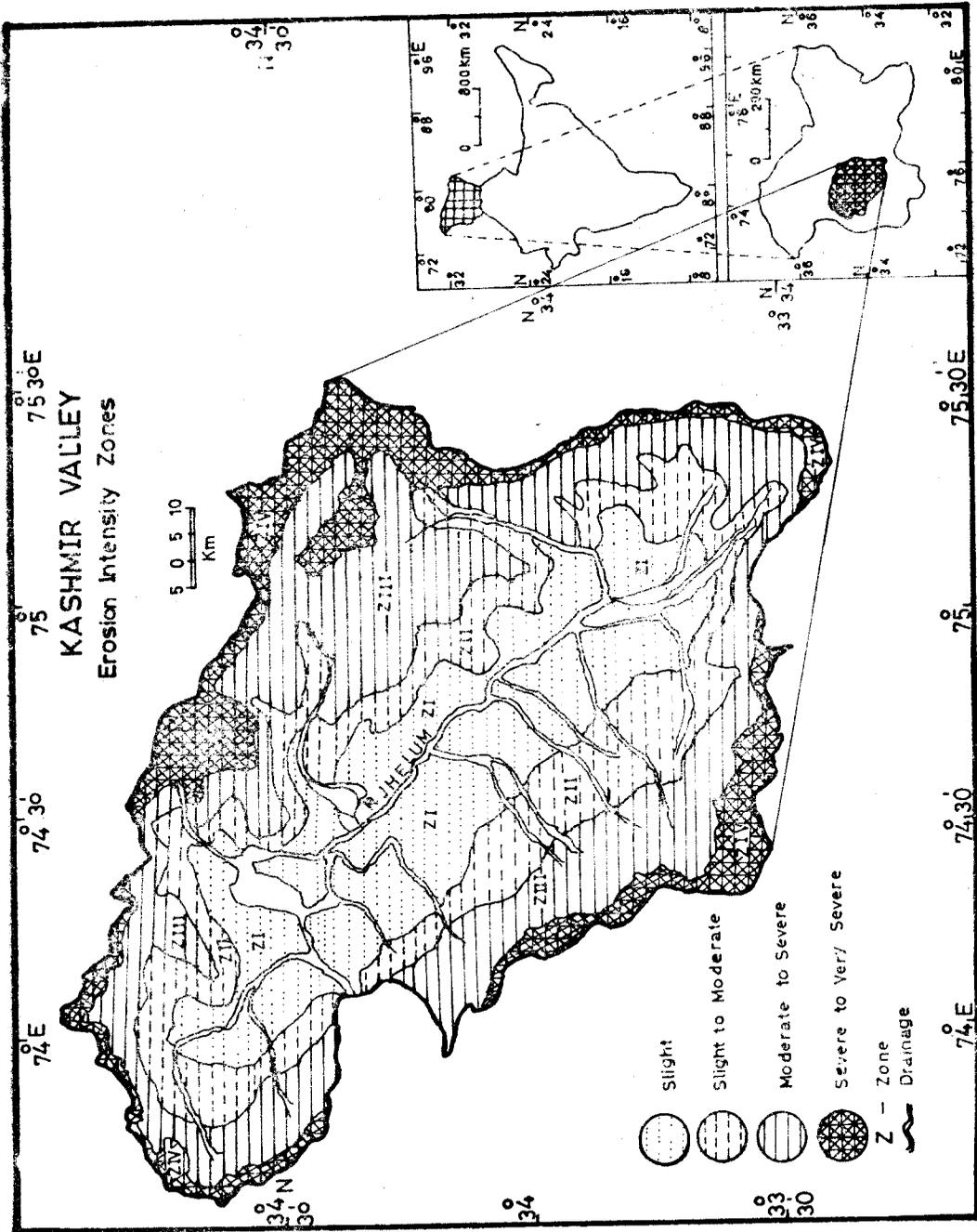
- I. Slight erosion intensity (the valley bottom and the adjoining paddy growing zone).
- II. Slight to moderate erosion intensity (Flat topped karewas and the forested slopes)
- III. Moderate to severe erosion intensity sloping karewas and the pasture lands).
- IV. Very severe erosion intensity (steep high hill slopes).

Zone I

This zone consists of valley bottom and the adjoining paddy growing zone. The intensity of erosion in this zone is very low with rate of erosion less than 16 tons/ha/year and the damage to the top soil at some places is as much as 25 percent. The low intensity of erosion is because of its levelled topography with the slope gradient ranging between 0 to 10°, with an average altitude ranging between 1500 to 1800 metres. The soils of this zone which are alluvial in origin have a rich content of organic matter ranging between 2 to 4 percent, due to which the erodibility of soils is of lower order. The slopes in the adjoining paddy growing zone have been successfully terraced and put to cultivation, thereby ruling out the erosional problems. However, the slopes facing the river beds are subjected to some erosion especially during heavy rainfall and floods. This zone is predominantly put to cultivation of rice which further rules out the erosional problems in this zone. However, a considerable portion of the upper part of this zone is devoted to dry farming with maize as the dominant crop. This zone covers an area of 5.59 lakh hectares or 37% of the total area of the valley.

Zone II

This zone forms a linear belt all along the valley bottom, consisting of forested slopes and flat topped karewas with an average altitude ranging between 1800 to 2400 metres. The soils of this zone have slight to moderate soil erosion due to the slopy nature of terrain which varies between 10° to 20°. The erodibility of soils in this zone is of a relatively higher order because of the coarse texture of the soil and its poor organic matter content, resulting in the



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Table 1 : Extent and magnitude of erosion hazards and relationship of erosion intensity zones with other physical factors.

Erosion intensity zone	Topographical zone	Soils	Range of slope (in degrees)	Range of altitude (in metres)	Major land use pattern	Intensity of erosion	Rate* of erosion (in tons/ha/year)	% of top soil depleted	Area (in lakh hectares)	(in per cent)
Zone I	Flood plain and adjacent paddy growing belt	Alluvial (recent & old).	0-10	1500-1800	Paddy cultivation	Slight	16	0.25	5.59	37.0
Zone II	Flat topped karewas and forestead slopes.	Alluvial (old & coarse)	10-20	1800-2400	Dry farming	Slight to moderate	16-72	25-75	2.48	16.4
Zone III	Sloping karewas and alpine pastures.	Thin soil cover	20-30	2400-3500	Dry farming and trees	Moderate to severe	72-250	75-100	4.64	30.7
Zone IV	The hilly and glacial zone.	Rocky exposure and snow	30 and above	Above 3500	No cultivation, very low bushes	Severe to very severe	250-900	Parent material exposed	2.40	15.9

* Rates of soil loss computed by the Universal Soil Loss Equation — USLE.

slight to moderate rates of soil erosion varying between 16 tons/ha/year to 72 tons/ha/year with the result that 25 to 75% of the top soil is depleted. This zone covers an area of some 2.84 lakh hectares or 16.4% of the total area of the valley.

Zone III

This zone consists of sloping karewas pasture lands at an average altitude ranging between 2400 to 3500 metres. The soils of this zone have moderate to severe soil erosion problems with the rates of soil loss varying between 72 tons/ha/year to 250 tons/ha/year as these soils occur on moderately steep to steep hill slope which varies between 20° to 30°. The low lying slopes within this zone are thinly covered with forests, while the steep slopes, especially karewas slopes are devoid of any protective vegetation cover, except some patches of grass. The slopy terrain, coarse texture, dry farming, poor organic matter and improper drainage especially in sloping karewas make these soils highly erodible. The common processes of erosion in this zone are gullying, ravine formation and sheet erosion, which is so intense that they offer enough evidence of rampant affliction. The upper most horizon of the soil profile is very thin and the damage to the top soil is illustrated by the fact that in some areas as much as 75% of the soil cover has been eroded. This zone is very prone to landslides and land slips. With slight downpour the runoff is produced which flows through cultivated and uncultivated steep slopes, cutting them in linear belts this condition coupled with weak soil and undercutting of rivers and nallahs causes the land to slide. The bare surface, loose structure of soil and absence of irrigation agriculture are

some of the causal factors contributing to this extensive devastation. This zone covers an area of 4.64 lakh hectares or 30.7% of the total area of the valley.

Zone IV

This zone has severe erosional problems with the rates of erosion varying between 250 tons/ha/year to 900 tons/ha/year. The soils of this zone occur on steep to very steep, high slopes of above 30°, with an altitude of more than 3500 metres. This zone consists of Pir Panjal and the great Himalayan ranges. The soils of this zone occurring on steeper slopes cannot support the growth of vegetation, with the result that no cultivation is done nor forests are found in this zone. This zone covers an area of 2.40 lakh hectares or 15.19% of the total area of the valley.

Conclusion

The valley of Kashmir being hilly and mountainous in physiographic disposition is subject to severe soil erosion problems. About 45% of the total area of the valley is under a critical state of deterioration with the rates of erosion varying between 16 tons/ha/year to 900 tons/ha/year.

The assessment and the magnitude of soil erosion hazards have been evaluated within the frame work of four erosion intensity zones. The Zone I covers 37% of the total area consisting of the flood plain of the Jhelum basin and the adjacent paddy growing zone. This zone faces slight erosion problems with the rates of erosion less than 16 tons/ha year. Zone II covering 16.14% of the total area includes flat topped karewas and forested slopes having undulating topography. The rates of soil erosion in this

zone vary between 16 tons/ha/year to 72 tons/ha/year. The zone III covers about 30.7% of the total area and faces moderate to severe erosional problems with the rates of erosion ranging between 72 tons/ha/year to 250 tons/ha/year. This zone comprises of sloping karewas

and pasture lands. The zone fourth which comprises of steep, high hill slopes faces very severe erosional problems with rates of erosion varying between 250 tons/ha/year to 900 tons/ha/year. This zone covers 15% of the total area of the valley.

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Addresses of the authors: T. A. Kanth and M. S. Bhat, Department of Geography, University of Kashmir, Srinagar 190 006.