

Soil Erosion in different Agroclimatic Zones of India

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Abstract : *The extent and type of problem lands, major causes and soil erosion in different Agro-climatic zones in India have been brought out in the paper. The strategy for development of the zone has also been briefly indicated in the paper.*

Introduction

Most of the Indian sub-continent is situated in the tropical and sub-tropical zone, with problems of soil erosion varying greatly in different parts of the country. In India, soil erosion occurs due to water as well as wind.

Estimated Soil Erosion

In a recent analysis of annual soil erosion rates in India, it was estimated (Narayana and Ram Babu, 1983), that about 5334 m tonnes (16.4 t/ha) of soil is detached annually and of this, about 1572 m tonnes (29%) is carried away by the rivers into the sea and 480 m tonnes (9%) is being deposited in the reservoirs resulting in the loss of 1 to 2% of the storage capacity.

Iso-Erosion Rate Map

The first approximate Iso-Erosion Rate Map of India has been prepared (Gurmel Singh et al., 1990). The annual erosion rates values ranged from less than 5 tonnes/ha/year for dense forest, snowclad cold deserts and arid region of Western Rajasthan to more than 40 tonnes/ha/year in Shiwalik hills. Ravines along the bank of Yamuna, Chambal, Mahi, Tapti and Krishna rivers and shifting cultivation regions of Orissa and North-Eastern States also revealed more than 40 t/ha/yr soil loss value. The annual erosion rates of Western Ghats regions varied from 20-35 t/ha.

Extent and Type of Problem Lands

Out of total geographical area of 329 m ha of India, of which 304 is the reporting area, 264 m ha of land have potential for biotic production (after excluding areas which are under urban uses or are intrinsically unfit for production on account of being perpetually snow-bound or rocky, etc). Out of this, about 167 m ha (about 51% of total) are affected by serious water and wind erosion, erosion due to shifting cultivation and erosion of culturable wastelands. The estimated 167 m ha of total problem area includes about 127 m ha subject to serious soil erosion and 40 m ha degraded through gully and ravines (3.98 m ha), shifting cultivation (4.36 m ha), waterlogging (8.53 m ha), alkali soils (3.58 m ha), saline soils including coastal saline sandy area (5.5 m ha), riverain lands (2.73 m ha) and desert area (11.79 m ha) (Das, 1985, Gurmel Singh, 1990 a).

127 m ha subject to soil erosion includes rainfed non-paddy areas (77.88 m ha), other cultivable land including permanent pastures and cultivable wastelands (21.32 m ha), forest lands including protected and unclassified forest (19.49 m ha) and area not available for cultivation (7.93 m ha).

Major Causes of Soil Erosion

Monsoonic type and high intensity rainfall, large scale deforestation, overgrazing, up and

down cultivation on steep slopes, shifting cultivation practices, construction of hill roads, mining activities are the major causes of soil erosion. Gully erosion and ravinous lands are found along the banks of rivers like Yamuna, Chambal and Mahi etc.

Soil Erosion in Agro-climatic Zones

For balanced regional growth, agro-climatic zonal planning has been considered as an effective approach. The Planning Commission has delineated (Khanna, 1989) 15 agro climatic regions for formulation of agricultural development plans for the 8th Five Year Plan. The major characteristic of the region including soil erosion problems are given below :

Agro-climatic Zone-I

(Western Himalayan Zone)

The zone comprises whole of Jammu & Kashmir, whole of Himachal Pradesh and 8 hill districts of Western U.P. It has an area of 21.09 m ha and human population (1981) of 15.1 million. The climate varies from cold arid to humid with an average annual rainfall ranging from 165 to 2000 mm.

The soils of the zone are of recent development and are highly erodible. Up and down cultivation practices on steep slopes, faulty landuse combined with faulty forest use and loss of forest cover due to deforestation, overgrazing and other biotic interferences have been responsible for accelerated soil erosion. In the civil, panchayat and private forests, practically no forest management has been practised. Indiscriminate felling and lopping of oak forests and other **broad-leaf** species for cattle fodder has resulted in great shortage of drinking water over most of the region. Faulty road construction in the mountainous region has resulted in heavy landslides and land slips.

It has been estimated that 6.36 m ha constitute problem area out of 21.09 m ha of

the total area. Problems in the zone includes soil erosion besides water logging, landslides, stream bank erosion, road side erosion, gullies, faulty terraces, lack of protected water ways, denudation of hill sides by mining activities etc.

The strategy for development of the zone includes intensification of soil and water conservation programme through watershed management with an integrated approach to forestry, horticulture, commercial crops and fodder for animals. For the cold arid zone, wind erosion control measures, Alpine pasture management, water development and land levelling for irrigated agriculture, are to be adopted. In the temperate zone, Karewa lands are also to be treated which will include bunding, terracing, levelling and water harvesting technology.

Agroclimatic zone-II

(Eastern Himalayan Zone)

The Zone comprises of Sikkim and Darjeeling hills, Arunachal Pradesh, Meghalaya, Nagaland, Assam, Manipur, Tripura, Mizoram and parts of West Bengal (Jalpaiguri and Coochbehar districts). The zone has an area of 17.70 m ha. The climate varies from per-humid to humid with an average annual rainfall ranging from 1840 to 3528 mm.

Rainfall being very high and of severe intensity on these hilly sedimentary soil mass, causes disposal of soil particles. Shifting cultivation (Jhum) has caused denudation and degradation of soils. Problem area include landslides, torrent, gullies and riverine lands.

Adoption of soil and water conservation measures on watershed basis can overcome the problem. Bench terracing for agricultural crops, half moon terrace for horticulture and contour trenching for afforestation are some of the soil conservation measures to be adopted in the zone. The integrated farming system approach is important for this region.

Agro-climatic Zone-III

(Lower Gangetic Plains)

The zone consists of Basin plains, central alluvial plains, alluvial coastal plains and Rarh plains. The zone has an area of 11.18 m ha and the average annual rainfall ranges from 1302 to 1607 mm.

Gully erosion, stream bank erosion, water logging and coastal salinity are the problems of the area. Adoption of proper water management practices, adequate drainage system and water harvesting techniques will result in good productivity of crops

Agroclimatic Zone-IV

(Middle Gangetic plains)

The zone comprises of 12 districts of eastern U.P. and 27 districts of Bihar plains. It has an area of 16 m ha and a high population of 85 millions. The climate varies from moist sub-humid to dry sub-humid with an average annual rainfall from 1211 to 1470 mm. In Bihar plains the flood prone area is estimated at about 1.7m ha and the problem areas of Diara lands account for another about 1m ha.

Water management practices are to be adopted, for improving the productivity of rice crop.

Agroclimatic Zone-V

(Upper Gangetic plains)

The zone consists of 32 districts of Central North-West and South West U.P. The climate varies from Dry sub-humid to semi-arid, with an average annual rainfall ranging from 720 mm to 980 mm.

In this zone, the problem area (about 1 m ha) includes saline alkaline lands, water logging and riverine lands.

Problem area can be reclaimed, adopting latest technology and special programmes have

to be initiated for cultivating fruits and vegetables in scientific manner. Scope for Animal husbandry improvement exists.

Agro-climatic Zone-VI

(Trans-Gangetic plains)

This zone consists of Punjab, Haryana, Union territory of Delhi, Chandigarh and Sriganganagar district of Rajasthan. The climate of the zone varies from extreme arid to dry sub-humid and has an average annual rainfall ranging from 360 to 890 mm.

Problems in this zone includes torrents (Cho) erosion from denuded Shiwaliks, and saline alkali lands.

Soil conservation technology for denuded shiwalik hills may be adopted, and saline alkali lands can be reclaimed by adopting latest technology. Water management programmes may be improved.

This zone has witnessed a remarkable agricultural revolution, the programmes and policies may be geared to achieve productivity levels comparable to those of advanced countries.

Agro-climatic Zone-VII

(Eastern Plateau and Hills)

The zone consists of the following sub-regions :

(i) Sub-region of Wainganga and Orissa Inland, (ii) Orissa northern and M.P. eastern hills and plateau. (iii) Chotanagpur south and West Bengal hills and plateau and (v) Chattisgarh and south-western Orissa hills.

The climate of the region varies from moist sub-humid to dry sub-humid and has an average annual rainfall ranging from 1270 to 1440 mm.

Problems of the zone are sheet erosion, over-grazing, gullies, improper technology for crop husbandry and land management and recurring drought.

Water harvesting techniques have to be adopted (*in situ* as well as installing more tanks). Wherever the soils are acidic, application of lime is necessary. Animal husbandry, fisheries and Silvopastoral programmes are to be improved. The rehabilitation of degraded peripheral forests must be undertaken on a large scale.

Agro-climatic Zone-VIII

(Central Plateau and Hills)

This zone comprises 46 districts of Madhya Pradesh, Uttar Pradesh and Rajasthan. The climate of the zone varies from semi-arid to Dry sub-humid and average annual rainfall ranges from 490 to 1570mm.

The area suffers from soil erosion in hills, gully erosion, overgrazing, recurring droughts and ill drained soils.

Since 75% of the area is rainfed, a water shed management programme is necessary. Sinking of wells, tube wells and crop diversification are to be taken up. Ravinous area reclamation is necessary for the socio-economic uplift of the local people.

Agro-climatic Zone-IX

(Western Plateau and Hills)

This zone comprises major part of Maharashtra, parts of M.P. and one district of Rajasthan. This region forms a major part of peninsular India, with an average annual rainfall ranging from 600 to 1040 mm and the climate is mostly semi-arid.

Black soils occurs in most of the area and sheet erosion is prevalent. Recurring droughts, ill-drained soils and improper technology for crops and fodder are some of the problems of the area.

Graded bunding and inter terrace treatment like organic trench ridging reduces runoff and soil loss and increases crop productivity by 65%. Checkdams and community tanks have

great scope. Water saving devices such as sprinkler and drip irrigation are to be adopted. Development of minor irrigation can be taken up with peoples participation.

Agro-climatic Zone-X

(Southern Plateau and Hills)

This zone comprises 35 districts of Andhra Pradesh, Karnataka and Tamil Nadu which are typically semi-arid and the average annual rainfall ranges from 670 to 1000 mm.

Red soils occur in most of the area and sheet erosion is common. Gully erosion, recurring drought, improper crop husbandry, lack of fodder and fuel are some of the problems.

Soil conservation measures alongwith adoption of proven dryland technology in the watershed areas should aid agriculture in this area. Minor irrigation programmes (dug wells and bore wells) have scope in the area. Crop diversification has to be intensified and crops which require low moisture in soil should be preferred. The fodder supply system for livestock is to be augmented.

Agro-climatic Zone-XI

(East Coast Plains and Hills)

This zone consists of six sub-zones: (i) Orissa coastal, (ii) North coastal Andhra and Ganjam, (iii) South coastal Andhra, (iv) North coastal Tamil Nadu. The climate of the area varies from semi-arid to dry sub-humid and the average annual rainfall ranges from 780-1290 mm.

In tribal areas, the practice of shifting cultivation is to be replaced by an integrated horticultural programme for better economic returns. About 0.5m ha of saline and alkaline soils are found in the coastal areas, which need reclamation. Waterlogging is quite common. Integrated irrigation cum drainage systems have to be developed for delta areas to save the rice

crop from recurrent flood during the kharif season.

Programmes such as desilting tanks, strengthening of bunds and structure and improvement of field channel need to be taken up through a community approach.

Agro-climatic Zone-XII

(West coast plains and hills)

The zone runs along the west coast, covering parts of Tamil Nadu, Kerala, Karnataka, Maharashtra and Goa. This is an important zone for plantation of crops and species. The climate of the zone varies from dry sub-humid to per humid with an average rainfall ranging from 2230 to 3640 mm.

Soil erosion, wind erosion as well as problems of coastal sand dunes and flooding of cultivated lands by sea water or rain water are observed in the region.

Harvesting and storing rain water in ponds and tanks for supplementary irrigation has to be adopted. Soil conservation measures and sand dune fixation technology are to be implemented.

Agro-climatic Zone-XIII

(Gujarat plains and hills)

This zone consists of 19 districts of Gujarat. The climate ranges from arid to dry sub-humid with an average annual rainfall varying from 340 to 1800 mm.

Overgrazing, improper land management and extreme moisture stress and drought are some of the problems of the area.

Integrated watershed development programme including rain water harvesting and management has to be undertaken.

Suitable technology for dry land farming has to be evolved. Water management has to be done, to maximise production per unit of land and water. For wasteland development

agro-forestry and arid-horticulture have to be developed.

Agro-climatic Zone-XIV

(Western Dry region)

This desertic region comprises nine districts of Rajasthan. The climate of the area is arid to extremely arid with an average annual rainfall of 390 mm.

Wind erosion, shifting sand dunes, extreme moisture stress and drought overgrazing and improper land management are the problems of the area.

A strategy for careful resource use is needed. Efforts are to be concentrated on silvi-pastoral and energy plantations, to meet the scarcity of fuel and fodder and to stabilise partially the sand dunes. Tree cover has to be increased in denuded forest.

Agro-climatic Zone-XV

(Islands region)

This zone covers the island territories of the Andaman and Nicobar islands and Lakshadweep, which are typically equatorial. The climate is humid with an average annual rainfall ranging from 1500 to 3080 mm spread over 8 to 9 months.

High intensity rainfall, undulating to highly rolling topography, overgrazing, clearing vegetation from steep slopes and practising up and down cultivation, burning of crop stubbles led to accelerated soil erosion in the zone. As per survey, it has been estimated that 57% of the area is seriously eroded, 23% moderately eroded and about 14% is gullied land.

The main thrust in development of this zone should be soil conservation measures on sloping land, water management and crop improvement.

Thus, in each of the Agro-climatic zones, soil erosion by water or wind alongwith, land

degradation due to waterlogging or salinity and alkalinity etc. have been observed. Hence the need of implementation of soil and water conservation measures on watershed basis exist in each zone, due to remarkable synergism between Land and Water resources. The holistic approach of managing all type of land within the watershed as per their problems, conservation needs and land suitability for specific purposes is crucial, to obtain maximum protective and productive benefits.

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