

CHAPTER X

SOIL AND WATER MANAGEMENT

Sikkim is wholly a hilly state having only 15.37% of the total area under operational holdings and 11.04% of the total area as net cultivated area⁽¹⁾. Even the cultivated land in Sikkim has slopes ranging from 10% to 80% going as high as over 100%. There is practically no land with land capability class of I to III and cultivation cannot be done without the risk of soil erosion. The annual rainfall is high upto 3620 mm, but concentrated between May to August. In other words, it means that the intensity of rainfall is high leading to a very high peak discharge causing tremendous soil erosion⁽²⁾. The peak discharge of the main rivers of Sikkim like La-Chenchu, La-chungchu, Rangrangchu, Rongnichu, Rangpoochu, Rangit river and Singhik are 5250 cusecs, 2655 cusecs, 948 cusecs, 2198 cusecs, 1740 cusecs, 7193 cusecs and 3744 cusecs respectively⁽³⁾.

Not only intensity of rainfall, but indiscriminate destruction of protective forests for fuel and fodder by the ever growing population has been responsible for soil erosion. Nature required about 1,000 to 2,000 years to build 2.5 cm. top soil⁽⁴⁾.

Soil Erosion —

Soil erosion is the wearing away of land surface by the action of wind and water. The common type of soil erosion are as follows —

I. Geologic Erosion -

It is a natural process in the sense that formation and removal of soil is always in equilibrium. This process is very slow and not normally marked.

II. Accelerated Soil Erosion -

This type of soil erosion takes place wherever certain areas get denuded of their natural vegetation by human beings and animals. From such denuded areas removal of surface soil takes place. This is a serious type of soil erosion.

III. Wind Erosion -

In arid and semi arid regions surface soil gets blown off by wind as dust-storms.

IV. Water Erosion -

Wearing away of surface soil by water is water erosion. It is caused in three ways- (a) Sheet erosion- when it rains, a very thin layer of surface soil gets removed uniformly from large areas.

(b) Rill Erosion

If sheet erosion is not checked in time, the silt-laden run off forms clear finger shaped groves over the fields, it is called rill erosion.

(c) Gully Erosion -

Rill erosion if remains unchecked, forms wider and deeper channels and cut off large fields into small fragments, it is called gully erosion.

V. Land slides or Slip Erosion -

Outward and downward movement of the slope forming materials composed of rocks, soil etc. forms the land slides. This may be caused by heavy rainfall or earthquake. This type of erosion poses a serious problem in Sikkim⁽⁵⁾.

VI. Stream bank Erosion—

During heavy rainfall in catchment areas the streams and torrents get swollen with flood and soil and the stream banks get washed away. It is known as stream bank erosion. This type of erosion is extremely serious in the Tista and Rangeet catchment areas.

Extent of Soil Erosion -

Sikkim being a mountainous state there is no land which is not subjected by soil erosion. In Sikkim, severe erosion occurs in sub-humid and perhumid areas due to high rainfall and improper management of soil and water, 5-7 cms. of top soil is washed away from the soil every year during rainy season. Land slides and land slips are very serious problems caused by improper management of soil and water⁽⁶⁾.

Loss of Soil Fertility -

Because vegetation being the strongest of the natural forces that produce soil, the type of farming practised and its influence on the type and character of vegetation are important factors determining the extent of fertility loss. Soil fertility or plant nutrient may be lost or removed from the soil in four different ways —

1. By erosion, namely wearing away of land by washing, or by wind action.
2. By removal of crops that have drawn plant food of the soil into themselves in the process of growth.
3. By leaching or percolating of water downward through the ground carrying plant good beyond the reach of vegetation.
4. By volatization—

Ordinarily erosion and crop removal account for the greatest losses in soil fertility. Certain systems of farming cause a considerable portion of the earth's surface to be exposed in a loose form particularly subject to erosion. Some type of crops require much more plant foods than others. Although leaching and volatization are ordinarily of minor importance and determined mostly by natural forces, leaching is influenced by irrigation practices in areas where water is applied artificially. If excessive irrigation water is applied on certain type of soil considerable loss of plant nutrients results, because of severe washing out of mineral salts, while in some areas where drainage is particularly

poor, excess water may collect in low spots and evaporate leaving soil so saturated with additional mineral salts that fertility is greatly reduced⁽⁷⁾.

Conservation and need for conservation —

Conservation means protecting land resources against wasteful exploitation. Waste be defined as socially uneconomic use of resources resulting from failure to combine factors of production to obtain maximum net return, or from failure to evaluate properly social costs and benefits. Conservation in a narrow sense means preserving earth's resources in an unimpaired efficiency, or as nearly unimpaired as wise exhaustion, or the nature of the particular case allows.

Flow resources occur periodically over time such as sunshine, precipitation, water flow and fertility resulting from the action of solutions and organisms in soil combined with organic matter formed by growth of roots. Conservation means using these resources in such a way that physical waste is minimised and involves an increase in the rate of use⁽⁸⁾.

Soil and Water Conservation Measures —

The practical methods of soil and water management practiced in Sikkim can be broadly classified into, (i) Agronomic Practices (ii) Mechanical Practices.

1. Agronomic Practices

At present various agronomical measures are being adopted for soil conservation. They are as follow-

1. Contour Farming-

During monsoon Sikkim receives excessive rainfall. The soil cannot absorb all the rain water so that it flows down the slopes causing erosion of soil. The practice of contour farming across the slope, keeping the same level as far as possible has beneficial effects. The ridges and the rows of the plants placed across the slope form continuous barriers to the water flowing over the soil surface. These barriers help in reducing run-off, soil erosion and loss of plant nutrients. Bunding is usually done to reduce the length of the slope and cultural operations done parallel to these bunds.

2. Mulching-

It is done mainly for the following purposes-

- a) To prevent surface soil from being blown off or washed away.
- b) To reduce evaporation.
- c) To increase infiltration.
- d) To improve soil structure.
- e) To keep down weeds.
- f) Eventually to increase crop production.

It is to be noted that surface mulching of drip area on orange, guava and other orchards as well as cardamom during winter is essential to conserve soil moisture in Sikkim.

3. Growing of crops —

Crops provide the maximum cover, reduce run off and soil loss. Among crops especially leguminous crops provide better protection to cultivated land against erosion than other crops.

4. Strip Cropping —

This cropping practice includes several good farming practices, such as crop rotation, contour cultivation, proper tillage stubble mulching, cover cropping etc.

5. Contour Strip Cropping—

This is allowing the growth of soil protecting and erosion permitting crops in strips of suitable widths across the slopes on contour, alternating with strip of soil protecting and erosion permitting crops. The erosion resisting crops reduce run off erosion, shortens the length of the slope and absorb rain water. Generally leguminous crops such as soybean, cow-pea and other pulses are cultivated resisting soil erosion.

6. Mixed Cropping —

The objectives of mixed cropping are better and continuous coverage of land, protection against erosion and assurance of one or more crops in rain fed areas to the farmers.

7. Orchards and Garden Land Cropping —

In the slopy lands orange, guava and any other orchard intercropped with soybean. Other pulses and fodder plants on strips,

or maize cultivation may prove better soil conservation and economic cultivation (9).

Mechanical Measures of Soil Erosion

Mechanical or engineering measures play a vital role in controlling erosion of agricultural land. The amount and kind of engineering work necessary are determined by the type of erosion and the degree to which it has developed, character of the soil, and sub-soil amount and distribution of rainfall, vegetative cover and the use to which land is put.

Mechanical measures are adopted to supplement the agronomical practices. These measures have the following objectives —

- I. To increase time of concentration by intercepting the run-off and thereby providing an opportunity for the infiltration of water.
- II. To divide the long slope into several ones so as to reduce the velocity of the run off and thus prevent erosion.

The mechanical measures adopted in Sikkim are the following —

I. Basin Listing —

Basin listing consists in banking of small interrupted basins along the contour. It helps to retain rain water and is effective on retentive soils of mild slopes.

II. Sub-soiling —

The breaking of the land and impermeable sub-soil by a sub-soiler to conserve more rain water is called sub-soiling. This improves the physical condition of the soil.

III. Contour Bunding —

This practice consists in making narrow based embankments across the slope of the land on a level along the contour. This measure conserves soil and water in arid and semi-arid areas with high infiltration and permeability.

In arid and semi-arid areas, land should be left in a rough, cloddy, open condition during winter and spring so that as much water as possible will sink into the ground and effects of wind and erosion will be reduced to minimum.

In areas of heavier rainfall, serious soil washing may develop if the surface is left clean, free from crop residues and worked down finely.

IV. Bench Terracing —

This consists of a series of platforms with suitable vertical drops along contours or on suitably graded lines across the general slope of the land.

For Sikkim having heavy rainfall, fair permeability and steep slope, contour bench terracing with inward slope and a width of 250 to 360 cm is recommended. The land with more than 50% slope

is not suitable for bench terracing. Such land should have contour terracing for fruit plantation and recommended for orchards and garden land cropping.

Bench terracing helps to retain the soil moisture, manure and fertiliser and facilitates irrigation if available. The state needs immediate bench terracing of about 80% of its cultivable land⁽¹⁰⁾.

V. Amendment of Acid Soil

All the soils of Sikkim are acidic, the acidity ranging from 4.5 to 6.00 requiring liming material at the rate of 2.5 tonnes per hectare on an average to neutralise the effective acidity, whereas the requirement to neutralise the total acidity is as high as 20 tonnes per hectare. The trials conducted in all the locations of the state and even the I.C.A.R. centre at Tadong has established that the use of high input becomes possible only with the use of liming material to neutralise the effective acidity.

6. Water harvesting/Conservation

The state though endowed with high rainfall, is spread only in few months and for some months the rate of rainfall is very low. Accordingly water conservation through construction of tanks for storing the run off water will be continued.

7. Soil Survey —

The soil survey and resources mapping have been completed in collaboration with the National Board for Soil Survey and Land Use Planning, Nagpur. But detailed survey of the potential areas and problematic areas at large scale mapping including in depth studies will be continued, besides conducting surveys for preparation of projects covering micro details (11).

It is evident that management of soil and water in an economic ecological system of nation is essential. The development and prosperity of a nation depends on the proper management and utilisation of these two basic resources.

Soil Conservation Schemes —

Sikkim lies along the lower Himalayan belt and is extremely susceptible to soil disturbances due to seismic factor. Further the torrential rain it experiences also has a very severe impact on the soil structure. This is aggravated additionally by the high pressure on land for producing food and the immense impact of the various developmental activities. Land slides and landslips are, therefore, a recurring phenomena. In order to tackle the situation, the Land Use And Environment Cell of the Forest Department has been implementing a number of Soil conservation Schemes in the 30 identified water sheds on the basis of priority in an integrated manner. The consolidated schemes undertaken are the following —

1. Soil Conservation in Watersheds —

The Watershed Management Programme is the major scheme which is being implemented in 30 identified watersheds involving works of

mechanical and biological in nature. Under the integrated approach, all the required measures in the selected watersheds are identified and programmes taken up jointly in a phased manner. The items of work include afforestation, protective works (engineering works), maintenance of plantation and nursery etc. During 1989-90 terracing which formed the major item of work have been transferred to Agriculture Department. The area covered by various programmes under these watersheds from 1985 till date are the following —

Table 10.1

Items of work	Area in hec.	Year
1. Afforestation	6230 hec.	1988-89
2. Terracing	5320 hec.	-do-
3. Horticulture plantation	240 hec.	-do-
4. Fodder plantation	430 hec.	-do-
5. Protective measure	5120 hec.	-do-

A sum of Rs. 548.00 lakhs has been spent so far under the watershed Scheme ⁽¹²⁾.

II. Other Soil Conservation Measures

In areas not covered by the 30 identified watersheds, other Soil Conservation Measures are in operation like providing protective measures to prevent speedy soil erosion in process initiated by small land slides. The major portion of this scheme is controlled by the District Co-ordination Committee throughout the state.

III. C.S.S. of Soil Conservation in R.U.P. and Operation Soil Watch

Besides the two State Schemes mentioned above, Sikkim has C.S.S. of River Valley Project and Soil watch Scheme where specific measures are undertaken in respect of two major river basins (Rorochu and Rangpochu) which serve as the catchment areas for rivers which feed the Power Projects built in the area. A physical achievement of 8735 hec. approximately has been covered under the two CSS schemes with a total expenditure of Rs. 479.48 lakhs.

C.S.S. of strengthening of State Land Use and Environment Board-

A total amount of Rs. 3.50 lakhs was granted during 1988-89 and spent in the purchase of machinery and equipments, During 1989-90 a sum of Rs. 3.84 lakhs has been earmarked for serial photography for proper land use planning.

B. Environmental Programme —

Environmental Protection and Conservation activities are under execution relating to the creation of biosphere, setting up of parks and gardens, participation of school children besides sanitation improvement in places frequented by visitors like monasteries, **temples** etc. The Jawaharlal Nehru Botanical Garden at Rumtek is being further improved which provides for the conservation of genetically rare species of plants and others facing extinction. Fencing and beautification works around Enchey Monastery and the establishment of a Pinetum are some of the major programmes being implemented by the department ⁽¹³⁾.

Soil and Water Management in La-chen and La-chung

In La-chen and La-chung cultivation is done in small arable plots of land which are scattered at different places. Such arable plots of land, are, moreover mountainous.

On the La-chen side, a few places where cultivation is being done with great difficulty are-

- (1) Munshithang
- (2) Peubia
- (3) Lattong
- (4) Jelep
- (5) Jorepool
- (6) Chhappel
- (7) Chhaten

These arable plots of land are located to the south of La-chen at lower elevations. The arable plots of land in higher altitudes are Yathang, Thanggu and Chhota.

All these plots of land being narrow and rocky, agronomic and mechanical measures of soil and water conservation as practised in other parts of the state cannot be undertaken here.

On La-chung side, the places where cultivation is done are the following-

- (1) Maltin
- (2) Khadum
- (3) Beumnalla
- (4) Luiten
- (5) Lema

(6) Bichu

(7) Singrik.

These arable plots of land are a little broader and more favourably located than that of La-chen. Among agronomic practices of soil conservation, strip cropping can be practised⁽¹⁴⁾.

Summary

Sikkim being a hilly state does not possess land with land capability class I to III. The net cultivated area mounting to 11.04% of the total area of the state, has steep slopes ranging between 10% - 80% cultivation, in the state, therefore, cannot be done without soil erosion.

Soil erosion has caused land deterioration and loss of soil fertility. In Sikkim, land slides and landslips are the most serious form of soil erosion.

After the establishment of Agriculture Department in 1976, a number of agronomic and engineering measures are being adopted by the government to control soil erosion.

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