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# Soil Erosion Problems in the Nilgiris

*by*

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**Introduction:** The Nilgiri district in the Madras State lies between latitude 11°—7′ and 11°—40′ N and longitude 76°—15′ and 77° and has an area of 989 squire miles. It is bounded on the north and south by the rivers Moyar and Bhavani and by Coimbatore district on the east and Malabar—Wynaad on the west. The whole of the district has a very undulating topography with mostly very steep and long slope and was once covered with dense vegetation such as forest, grasses, bushes, etc. But the introduction of potato during the latter part of 19th century and leasing of Government lands for its cutivation led to extensive clearance of these areas. During the grow more food campagin, a large extent was still further brought under potato cultivation through the extensive destruction of the protective cover. During the last 40 years the area brought under cultivation has practically doubled. At present more than 1,20,000 acres are being cultivated with semi-permanent and annual crops.

This indiscriminate cutting of the luxurious vegetative growth and continuous cultivation have resulted in loss of a huge quantity of productive soil from vast areas. It has been observed that a greater portion of the areas under cultivation has lost top soil altogether and the yields obtained now are mainly through the application of high doses of fertilisers. In this present paper it is proposed to discuss these problems and suggest some ways and means to prevent the collosal loss of soil.

**Soil Erosion Problems:** Soil Erosion is influenced by many factors among which topography, climate, rainfall, soil ground cover, and present farming practices are of major importance. It is therefore necessary to study these factors before any remedial measures are suggested.

**Topography:** The entire district can be divided into tow major tracts; namely (1) The Nilgiris Plateau and (2) The South East Wynaad, having an average elevation of between 6,500 feet and 3,000 feet M. S. L. respectively; and consists of numerous hillocks of varied undulations with practically not even a square mile of flat land. The general slope varies from about 5% (1 in 20) along lower fringes of hillocks to over 100% (1 in 1) along high slope, while the length of

the slope varies from 300 feet to 1,000 feet and above. In view of this, most of the soil is washed down to the streams during heavy rainfall.

**Climate and Rainfall:** The climate on the higher elevation is fairly equitable, the average maximum temparature being 73·7°F while the average lowest being 45°F. At the lower elevation the summers are very hot. During November to January the higher elevation experiences heavy frost which cuts most of the vegetation very badly, thus leaving the areas bare and susceptible to erosion. During June — August the wind velocity is fairly high (over 40 miles per hour) but this does not give rise to wind erosion as the soil is practically wet and fairly covered with some crop. However, it affects the growth of potato crop to a great extent due to damages of their haulms and crowns and other indirect effects of wind erosion.

On the higher elevation of the district the average annual rainfall is 71·42 inches, out of which nearly 31·54 inches are received during south west monsoon (June to September) and 20 inches during north east monsoon (October to December). On the lower elevation towards the west, rainfall is comparatively heavy with an average of 101·35 inches. The rainfall received during north east monsoon is very erratic and ill-distributed, and therefore there is much of accelerated erosion during this period. The rainfall is influenced by the high hills called Dodabetta Range having a maximum elevation of 8,640 feet M. S. L. and lying north south of plateau. In the south east Wynaad the soil erosion is great during the south west monsoon.

**Soils:** The soils of the plateau regions are derived from gneiss which gives rise to ferrogenous clay. The major soil types are clay, clay-loam and loam. The soils are highly acidic, the pH being round about 4·6 and are generally deficient in N. P. and K.

**Ground Cover:** The district can be divided into three regions on the basis of the vegetation:

1. Lying at the elevation round about 3000 feet above M. S. L. having deciduous vegetation, tropical trees and shrubs.
2. Having large scrub and evergreen forests on an elevation between 3,000 feet and 4,000 feet above M. S. L.
3. An area having an elevation over 4000 feet above M. S. L. covered with Sholas (Native forest) in small patches and short and coarse grasses covering a large part of area.

Most of the vegetation from the above regions is being cleared regularly for annual and semi-permanent cultivation. A list furnishing the important vegetation growing at different regions is appended.

**Farming Practices:** In Coonoor and Ootacamund taluks the principal crop grown is potato. This is grown in three different seasons normally taking only one crop per year on the same land. The irrigated crop is sown in January and harvested in May — June. The second crop is sown in August — September and harvested in December — January. The main crop is sown in March — April and harvested in August — September. The cultivation is done mostly by manual labour. The potato is sown by forming ridges and furrows along the slope 6 to 10 feet in length, the ridges being staggered in the adjacent patch lower down. Sometimes a shallow and oblique trench is excavated at a sloping distance of 10 to 15 feet. A few patches are even terraced in odd bits; but mostly these terraces are straight oblique and sloping outwards. Such cultivation practices and the inevitable fallowing after harvest of second crop of potato which coincides with the period of north east monsoon leads to an enormous loss of soil during the rainy season.

There is no definite rotation followed in these tracts. Sometimes the land is kept fallow or the land is put to Samai *(Panicum miliare)* or Wheat *(Triticum spp.)* or Korali *(Setaria glauca)*. In recent years due to very attractive price for the potato, the land is even repeatedly sown with potato, taking two or three crops a year in the same land. Thus the land gets exhausted at a rapid rate. These destructive practices lead to soil erosion and depletion at a very rapid rate. Yet, the ryots of the Nilgiris by their normal practice of applying heavy doses of chemical fertilisers (2000 lbs. per acre average), do not easily realise the magnitude of the loss and destruction to their lands.

In Gudalur taluk in South East Wynaad region, Paddy which is the principal crop is grown on fairly levelled and bunded lands and the loss of soil from these lands is negligible. On steeper slopes round about the valleys and swamps dry crops such as Ragi *(Eluesine coracana)* Samai *(Panicum miliare)*, Tapioca and Ginger are grown. This and the normal practice of shifting cultivation adoped in this tract lead to extensive sheet, rill and gully erosion.

Thus most of the areas in the district are either highly eroded or getting badly eroded due to the extensive and intensive cultivation carried out on any slope and without proper soil conservation measures.

**Extent of Erosion:** The experiments conducted in controlled plots at the Agricultural Research Station, Nanjanad in Ootacamund Taluk have given some valuable information regarding the soil and water loss taking place under different covers, viz., grass cover, potato and clean cultivated land. These figures, given below, though tentative in character, yet reveal comparable data regarding the extent to which erosion has been taking place in this district.

| Soil Cover | Slope 1 in 5 (20%) | | Slope 1 in 10 (10%) | |
|---|---|---|---|---|
| | Soil loss Tons/acre | Runoff water inches | Soil loss Tons/acre | Runoff water inches |
| 1. Ryots method of potato cultivation | 3·27 | 11·92 | 1·06 | 2·72 |
| 2. Fallow through out the year | 6·32 | 36·91 | 2·40 | 6·31 |
| 3. Indigenous grass cover | 0·49 | 2·47 | 0·34 | 1·56 |

A preliminary reconnaissance soil conservation survey of the district has indicated that nearly 10% of the total area and lying along the lower fringes of hillocks and adjoining streams is moderately eroded ( nearly 50% of the productive soils is lost ) and the remaining area is highly or severely eroded ( nearly 75% and more of the top soil is lost ). The areas lying on steeper slopes is practically devoid of any top soil and cultivation is therefore carried out on subsoil by applying very heavy doses of fertilisers. The extent of erosion can be gauged also by the way in which the streams and reservoirs are getting silted up. Stream bank and bed erosion and road side erosion is also a feature in this district.

**Remedial Measures:** The remedial measures to control soil erosion and build up the soil fertility can be divided under the following four categories, considering the peculiar local conditions.

(1) Agronomical (2) Agrostological (3) Afforestation and (4) Mechanical.

**Agronomical:** At present the cultivation is done along the slope. This has to be stopped and cultivation along the contour has to be introduced. All the operations such as ploughing, making the

ridges and furrows, planting have to be done on contours. Further a systematic crop rotation is an essential requisite for not only controlling land against erosion but ensuring permanent preservation and maintenance of the fertility of the land and thereby a sustained yield. It is therefore suggested that two or three year crop rotation such as potato — lupin or potato lupin — cereal at present advocted at the Agricultural Research Station, Nanjanad may be adopted. The fertiliser mixture containing ingredients at the rates of 500 lbs. of groundnut cake, 350 lbs. of bone meal, 200 lbs. of ammonium sulphate, 672 lbs. of super phosphate and 224 lbs. of potassium sulphate per acre of land, with a basal dose of 2½ to 5 tons of cattle manure or compost, suggested by Agricultural Research Station, Nanjanad, can be conveneintly adopted. Thus contour cultivation, proper rotation and judicious manuring would be able to prevent colossal soil loss.

**Agrostological:** The lands ( over 33% in slope ) which cannot be cultivated along stream and road margins, gully sides, heads and the like should be put to permanent pastures growing suitable grasses and legumes. The most promising grasses seem to be *Pennisetum clandestinum* ( Kikiyu ), *Paspalam dilatatum* ( Dallis grass ), *Phalaris tuberosa* ( Harding grass ), *Dactylis glomerata* ( Orchard grass ). *Bromus inermis* ( Smooth Brome grass ), *Bromus catharticus* ( Rescue grass ) and *Tripogon bromoides* and so on. The legumes which can be usefully grown in association with these grasses are *Trifolium repens* ( white clover ) and clovers such as subterranean clover, Bachus Marsh, Dwalganup etc

Preliminary investigations on grasses have shown that these can be used profitably for soil conservation and field trials are in progress which indicate the efficacy of legumes in building up the fertility of the soil. These pastures can be further improved by excavating furrows of a cross sectional area of about 30 square inches at 5 to 10 feet horizontal intervals. This will help in increasing the yield of pasture as well as conserve the soil and moisture and in subsequent improvement in soil fertility.

**Afforestation:** Lands steeper than 33% can also be put under economic species of trees like *Eucalyptus globulus* ( Bluegum ) or *Acacia mollissima* ( Black wattle ) or *Acacia decurrens* ( Green wattle ). Leaves of Bluegum yield Eucalyptus oil while the bark of wattle can be used for tanning leather and as such both these species fetch a fair income to the grower in addition to affording cover

canopy protection and making the soil rich in humus content, loose and open textured to absorb and hold considerable amount of water which will gradually appear as springs or pass direct into streams in due course and thereby reduce soil erosion to a great extent. *Acacia melonoxylon* (Blackwood acacia) which is a good fodder tree supplying green fodder during frost season when many species of grasses are affected, can also be planted.

**Mechanical Measures:** Even though the agronomical, agrostological and afforestation methods explained above are useful soil conservation measures, these alone are not enough to control soil erosion in the Nilgiris. The main reason is that most of the cultivated area in this region comes under the slope group of 16%—33%. As such the above methods particularly the agronomic ones have to be supplemented with the mechanical measures. The slope being very steep, the most suitable mechanical erosion control will be to bench terrace these areas prior to bringing them under cultivation. These terraces are to be given a gradient inwards such that the inner edge is a foot lower than the outer edge and a uniform gradient of $\frac{3}{4}$% longitudinally so that the excess run-off on these terraces is collected along inner edge and conveyed safely lengthwise as rapidly as needed towards vertical drain provided with drop pits at interval. The terrace edges and disposal drains are to be protected by establishing economic species of soil binding grasses. The length of such terrace is restricted to a maximum of 350 feet and the disposal drains are constructed at every 700 feet at the maximum. The cost of bench terracing varies with the slope. Width of bench terraces being constant, the greater the slope the more will be the cost of construction. But for a constant vertical interval, the steeper the slope lesser will be the cost of construction. Construction of bench terraces and maintaining economic width will involve on an average 300 man hours per acre, if the work is carried out by manual labour and about 30 tractor hours, if the same is executed with tractor bulldozer similar to Caterpillar D4 Tractor bull dozer.

Observation on the recouperative capacity of the disturbed soil conditions due to bench terracing have shown that the mixture of soil and subsoil respond quickly to organic and inorganic manuring which the ryots normally apply in large quantities for raising potato crop. The experiments on yield have confirmed this and it was seen that during the first cropping immediately after terracing, the yield is maintained the same as before terracing,

irrespective of loss in area due to construction of terraces, and from the subsequent crop onwards the yield increases by about 40%. This measure though apparently costly obliterates the cost within about two years in view of the increased yield. Further this type of terracing helps in conserving the soil which in the long run will be able to give sustained higher yield.

**Land Use Classification:** A tentative Land-Use Classification as being recommended already is reproduced below:

| Land use suitability Broad group | Land Use Classes | Land Characteristics | Soil Conservation measures proposed |
|---|---|---|---|
| Agricultural Lands. | Class I | Slope upto 2% uneroded or slightly eroded with good soil conditions. | Crop rotation (2 or 3 years) including contour farming & improved agricultural practices. |
| | Class II | Slope from 2% to 10% moderately eroded with soil conditions fair to good. | Graded bunds or terracing with outlets and disposal drains and other agronomical methods. |
| | Class III | Slope 10% to 16% slightly, moderately or severely eroded with soil conditions fair to good. | Graded trenching with disposal drains and drop pits and other agronomical methods. |
| | Class IV. | Slope from 16% to 33% slightly, moderately or severely eroded with soil conditions fair to good and with sufficiently deep sub-soil. | Bench terracing with disposal drains and drop pits and other agronomical methods. |
| Forests or and grass Lands. | Class V | Slopes over 33% – Very badly eroded lands with soil and other conditions poor. | Graded trenching or pasture furrowing with disposal drains and drop pits and other biological methods. |

**Conclusion:** It may be mentioned that the areas in Nilgiris are getting ruined due to the pressure of cultivation. It is of utmost importance that all the cultivated areas are protected with soil conservation measures immediately and whenever the new lands are leased out the first condition should be to enforce these measures.

The State Government is taking steps already and it is hoped that with the co-operation of farmers the menace of soil erosion will be successfully tackled.

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## APPENDIX I.

*Important Vegetation on the Nilgiris.*

**I. Below Elevation of about 3000 feet M. S. L:**

1. Acacia leucophloea
2. Acacia arabica
3. Acacia latronum
4. Acacia planifrons
5. Albizzia amara
6. Albizzia odoratissima
7. Bombax malabaricum
8. Phyllanthus emblica
9. Trema orientalis
10. Gmelina arborea
11. Feronia elephantum
12. Melia azadirachta
13. Stephegyne parvifolia
14. Hardwickia binata
15. Chloroxylon swietenia
16. Scheleichera trijuga
17. Dalbergia latifolia and
    ,, paniculata
18. Pterocarpus marsupium
19. Terminalia tomentosa
20. Terminalia chebula
21. Terminalia bellerica
22. Terminalia paniculata
23. Anogeissus latifolia
24. Cedrela toona
25. Tectona grandis
26. Santalum album
27. Lagerstroemia lanceolata
28. Lagerstroemia flos reginae
29. Elaeodendron glaucum
30. Butea frondosa

**Bamboos:**

1. Bambusa arundinacea
2. Dendrocalamus strictus

**II. Between about 3000 feet and 4000 feet above M. S. L:**

1. Calophyllum tomentosum
2. Mesua ferrea
3. Poeciloneuron indicum
4. Hopea parviflora
5. Canarium strictum
6. Dysoxylum malabaricum
7. Veteria indica
8. Cullenia excelsa
9. Chukrasia tabularis
10. Aglaia roxburghiana
11. Acrocarpus fraxinifolius
12. Bassia latifolia
13. Alseodaphne semecarpifolia
14. Bischofia javanica
15. Artocarpus hirsuta
16. Diospyros ebenum
17. Lophopetalum wightianum

**III. Above Elevation of about 4000 feet above M. S. L:**

1. Michelia nilagirica
2. Hydnocarpus wightiana and
   ,, alpina
3. Gordonia obtusa
4. Ilex wightiana
5. Elaeocarpus oblongus and
   ,, Munroii
6. Turpinia pomifera and
   ,, nepalensis
7. Meliosma arnothiana
8. ,, wightii
9. Photinia notoniana and lindleyana
10. Eugenia arnothiana and montana
11. Heptaplenrum spp.
12. Vilburnum erubes and
    ,, hebanthum
13. Vaccinium leschenaulti and
    ,, neigherrense
14. Sideroxylon tomentosum
15. Cinnamomum zeylanicum
16. Litsea wightiana
17. Neolitsea zeylanica
18. Glochidion neilgherrense
19. Rhododendron arboreum
20. Ligustrum perrotteii
21. Rapania wightiana
22. Celtis tetranda
23. Daphyniphyllum glaucescens
24. Microtropis spp.
25. Symplocos foliosa and spicata
26. Ternstroemia japonica
27. Eurya japonica
28. Evodia roxburghiana
29. Euonymus cremulabus

**Under growth consists of:**

1. Berberis tinctoria
2. Hypericum mysorense
3. Dodonea viscosa
4. Rhodomyrtus tomentosa
5. Osbeckia wightiana
6. Gaultheria fragrantissima
7. Eupatorium glandulosum
8. Mahonia leschenaultii
9. Strobilanthes spp.

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# Studies on Drought Resistance in Rice*

*by*

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**Discussion:** The drought resistance of progensies of crosses between the cultivated rice and wild rice was tested in their F3 and F4 generations in the field under restricted water supply. These tests revealed that the cultivated low-land rices are unable to withstand drought whereas the hybrids between the cultivated and wild forms showed greater ability to resist drought. The progenies of crosses studied in the two generations were found segregating for drought resistance and drought susceptibility. This is in confirmation with what Ostermayer (1934) found in oats. Very little work on breeding for drought resistance in rice has been done except for the mention made by Srinivasan (1941), who obtained a few drought resistant cultures from an inter-specific cross, *Oryza sativa* x *Oryza longistaminata (perennis)*.

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* Continued from May 1957 Issue.