



RESEARCH ARTICLE

Documentation of Soil Related Environmental Issues and It's Contributing Factors: A Study among the Hilly Tribes of the Nilgiri District

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ABSTRACT

India is vulnerable to several environmental threats. An ever growing population is over straining the natural resources and put the natural environment under severe threat. Tribes are the first victims of environmental degradation and disproportionately affect their life because those issues pollute the most essential resources they depend on. Hence, the present study was taken up to document the soil related issues occurring due to the changes in the natural environment and to identify the probable causes of factors responsible for each issue. For this study, the Nilgiri district of Tamil Nadu was selected considering the highest proportion of the tribal population in the district. Ex-post facto research design was used. Totally five major issues have been documented viz., loss of soil fertility, loss of soil beneficial microbial activity, subsoil compactness, the incidence of frequent soil erosion, unsuitability of the soil to raise a profitable crop. For the above-identified soil related issues, responsible factors were also identified and ranked by employing Garrett ranking method.

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INTRODUCTION

Ever since man appeared on the earth, he has been harnessing the natural resources to meet his basic requirements. Reference to the soil, water and air as basic resources, their management and means to keep them pure is mentioned in Vedas and Upanishads, the ancient Hindu literature. The phenomenal increase in the population of both human beings and animals in the last centuries have overstrained the natural resources which are getting degraded much faster than before. With the advent of high yielding varieties, augmentation of irrigation facilities, increased use of fertilizers, adoption of improved agronomic practices, concerted efforts of researchers, planners, government and above all the farming community, the green revolution was brought about in the mid-1960's. This led to the quantum jump in food grain production from 51 Mt in 1950-51 to a record figure of 203 Mt in 1998-99. With the adoption of intensive agriculture to meet the growing demands for food, fuel, fiber and cattle fodder, the natural resources have been put under intense pressure resulting in fast degradation and lowering of production efficiency.

Among the natural resources, the soil is a finite, non-elastic and non-renewable asset. The dwindling

per capita availability of land that decreased from 0.5 ha in 1950-51 to 0.15 ha in 1999-2000 and likely to reduce further to 0.08 ha in 2020 AD because of population escalation (Arunachalam and Seetharaman, 2004). Conversion of farmland and forests to urban development reduces the number of lands available for food and timber production (Lubowski *et al.*, 2006). As per the land use statistics 2014-15, the total geographical area of the country is 328.7 million hectares. Out of total geographical area, the net sown area is 140.10 million hectares and the gross cropped area is 198.40 million hectares with a cropping intensity of 142 per cent. The net area sown works out to be 43.00 percent of the total geographical area. The net irrigated area is 68.40 million hectares. Continued and excess application of chemical inputs and erosion due to wind and water have made our soils unproductive and nearly unfit for cultivation of crops.

The majority of the world's soil resources are in only fair, poor or very poor condition and that conditions are getting worse in far more cases than they are improving. Further, 33.00 per cent of land is moderate to highly degraded due to issues like erosion, salinization, compaction, chemical pollution and acidification of soils (FAO and ITPS,

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2015). Further, it is also reported that annual cereal production losses due to erosion have been estimated at 7.60 million tonnes lost each year. If action is not taken to reduce erosion, a total reduction of over 253 million tonnes of cereals could be projected by 2050. This yield loss would be equivalent to removing 1.50 million square kilometers of land from crop production – or roughly all the arable land in India

Bhattacharyya *et al.* (2015) pointed out that every year erosion carries away 25 to 40 billion tonnes of topsoil, significantly reducing crop yields and the soil's ability to store and cycle carbon, nutrients, and water. In India, soil degradation is estimated to be occurring on 147 million hectares (Mha) of land, including 94 Mha from water erosion, 16 Mha from acidification, 14 Mha from flooding, 9 Mha from wind erosion, 6 Mha from salinity and 7 Mha from a combination of factors.

Considering the critical situations discussed above, it is very much essential to organize a detailed study to find out such location-based soil/land related issues, as because, the mismanagement of the land/soil resources vary in line with the local land use pattern. In the high intensive cropping zones, the pressure on such land resources is very much enormous than the less and moderately cultivated localities. Also, several studies confirm that the pressure on the land resources in the hilly tribal ecosystem, especially in the Nilgiris of Tamil Nadu is greatly observed, as it is a prominent tourism important locality in south India. Hence the present study entitled “Documentation of Soil Related Environmental Issues and Its Contributing Factors: A Study among the Hilly Tribes of the Nilgiri District” has been taken up with the following specific objectives,

- To document the soil-related environmental issues in the selected hilly tribal ecosystem
- To find out the basic causes for such documented soil-related environmental issues.

MATERIAL AND METHODS

The present has been carried out in the Nilgiris district of Tamil Nadu considering the following reason

- Nilgiri district had the highest percentage of (4.50 %) scheduled tribe population in Tamil Nadu
- The Nilgiris, a part of Western Ghats has been identified as a biodiversity hotspot, and feature a high level of species endemism. All the forests of Nilgiri District are covered under the UNESCO Nilgiri Hills Biosphere Reserve, established in 1986.

- The Nilgiri district has become an important tribal ethnic zone as it is the only district having all the six primitive tribal groups of Tamil Nadu.

In the Nilgiris district, the study has been conducted in all four blocks. The following methodologies have been adopted to document the soil-related environmental issues and also to assess the factors responsible for the documented issues.

Documentation of the environmental issues

The soil-related environmental issues affecting the hilly tribal ecosystem were documented by having elaborate discussions and interactive meetings with different stakeholders, environmentalists, social workers and local residents. There were totally 5 major soil related issues were documented under this study.

The issues are presented in the table.

Identification of the factors responsible for the documented environmental issues

For each and every soil-related environmental issues, the possible contributing factors were identified by reviewing relevant literature and also by having an elaborate discussion with the environmentalists, social scientists and officials of the local environment based NGOs. Such identified issue wise contributing factors are given in the table.

Finally, these identified issues were ranked by thirty judges/scientists having vast expertise in environmental research and natural resource management.

The results were analyzed by employing Garrett ranking method in order to rank the probable causes and meaningful interpretations were made.

$$100 \times (R_{ij} - 0.50)$$

$$\text{Per cent position} = \frac{\quad}{N_j}$$

Where,

R_{ij} = Rank given for i^{th} item in j^{th} individual

N_j = Number of items ranked in j^{th} individual

RESULTS AND DISCUSSION

There were five different types of soil-related issues identified in the tribal ecosystem (study area) as a result of over-exploitation of natural resources and consequent environmental issues. Following are the issues documented in the study area.

- Loss of soil fertility
- Loss of soil beneficial microbial activity
- Subsoil compactness
- Incidence of frequent soil erosion
- The soil becomes unsuitable for profitable crop

The issue-wise causes are presented in their rank order in the table.

Loss of soil fertility

There were six causes identified for the loss of soil fertility in the study area. Among them, the indiscriminate use of fertilizers and pesticides was considered as the most important cause for making the soil unfertile with the average Garrett score of 152.43. Soil erosion by erratic rainfall

(147.13) and soil transportation for construction and developmental purposes (138.57) was the next important causes for making the soil unfertile. Cultivation of exotic trees (134.77), mono-cropping (118.67) and intensive cropping (109.87) were also identified in the next rank order for the above issue.

All the above six issues are the prominent issues having the capacity to make the soil sterile either in single or in combination.

Table Soil related issues and the contributing factors

S.No	Soil related issues and the contributing factors	Average Garrett score	Rank
1	Loss of soil fertility		
	Indiscriminate use of fertilizers and pesticides	152.43	1
	Soil transportation	138.57	3
	Soil erosion	147.13	2
	Intensive cropping	109.87	6
	Mono cropping	118.67	5
	Cultivation of exotic trees	134.77	4
2	Loss of soil beneficial microbial activity		
	Loss of soil organic matter	81.93	2
	Repeated application of plant protection chemicals and synthetic fertilizers beyond the recommended level	82.43	1
	Indiscriminate use of synthetic chemicals	75.53	3
3	Subsoil compactness		
	Indiscriminate use of synthetic chemicals	173.00	2
	Changes in local natural cropping pattern	165.30	3
	Soil transportation	136.10	6
	Reduced tillage operation	146.00	5
	Cultivation of exotics	149.00	4
	Use of heavy farm machineries / heavy vehicular movement	210.73	1
4	Incidence of frequent soil erosion		
	Excessive irrigation	92.87	7
	Land resettlements	152.27	2
	Shifting cultivation	134.07	4
	Heavy rainfall	106.43	6
	Increased wind speed	151.10	3
	Loss of natural vegetation	170.83	1
	Road construction	114.67	5
5	Soil become unsuitable for a profitable crop		
	Loss of soil nutrients	116.03	1
	Mono cropping	87.47	4
	Disturbance in healthy soil biological process	104.93	2
	Soil Contamination due to pesticides	92.10	3

Loss of soil beneficial microbial activity

The table revealed that repeated application of plant protection chemicals and synthetic inputs beyond the recommended level stood in the first rank (82.43) that restrict soil healthy microbial activity.

Loss of soil organic matter (81.93) stood in the second rank order making the soil beneficial microbes sterile. For any biological process, the

presence of soil organic matter is essential. Intensive cropping and mono-cropping activities while rising the cole crops such as cabbage, cauliflower and tuber crops like radish, carrot, beetroot and potato, the soil organic matter gets depleted in the faster rate. No systematic efforts have been taken to strengthen the soil biological activity and microbial activity by adding sufficient organic manures. This would inhibit the soil beneficial microbial activity.

Subsoil compactness

It is understood from the table that the soil compactness is primarily caused by the more of vehicle movement or use of heavy farm machinery (210.73). As it is tourism importance place every day thousands and thousands of big vehicles of different sizes carrying a full load of tourists are coming inside and crossing the study area. This could have caused subsoil compactness. Further indiscriminate use of synthetic chemicals (173.00), changes in local natural cropping pattern (165.30) and cultivation of exotics (149.00, reduced tillage operation (149.00) and indiscriminate soil transportation for the developmental purpose (136.10) were considered as the cause for subsoil compactness.

Incidence of frequent soil erosion

From the table, it could be understood that loss of natural vegetation was regarded as the primary cause for frequent soil erosion with the average garret score of 170.83. Land resettlement (152.27), increased wind speed (151.10), shifting cultivation (134.07), the incidence of heavy rainfall (106.43) and excessive irrigation (92.87) have caused frequent soil erosion in the study area.

The soil becomes unsuitable for profitable crop

From the table, it could be understood that leaching of soil nutrients due to heavy run off during the times of heavy rainfall (116.03) was considered as the prime reason for making the soil unproductive.

Disturbance in the healthy soil biological process (104.93) stood in the second place making the soil unproductive. Due to the tremendous growth in the tourism industry in the study area, more and continuous addition of non-degradable wastes such as plastic and polythene materials, improper drainage management practices, more addition of high energy external inputs could have disturbed the soil biological process in a great way and hence it was considered as a third major cause for making the soil unproductive with the garret score of 92.10. Besides the addition of more fertilizers and pesticides, the raising of mono-crops (87.47) could be other reason for this issue.

CONCLUSION

From the findings of the study, the major factors such as indiscriminate use of fertilizers and pesticides, soil transportation, repeated application of chemical inputs beyond recommended level, use of heavy farm machineries, cultivation of

exotics, loss of local natural vegetation, faulty land resettlement, loss of natural wind breaks, monocropping and loss of healthy soil biological process have contributed high damage to the natural soil ecosystem in the study area.

- The local extension functionaries and agricultural scientists and environmentalists should take necessary steps to rejuvenate the natural soil biological process.
- Appropriate extension educational strategies like, training, demonstrations on sustainable soil management practices may help to solve the situation.
- Necessary support literature could help the rejuvenation process.
- The local tribes should be sensitized about the nature and cause of these issues along with appropriate recommendations
- Periodic training and workshops on such remedial strategies would solve the issue considerably

For most of the issues, the exotics and the other non-agriculture based developmental activities are the prime causes (Construction and tourism promotional activities and soil transportation). Appropriate policy measures and educational / training programmes would improve the local biodiversity and also the fertility of the soil.

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