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A Case Study of Soil Erosion Impacts in Chena Cultivation Areas in Pottuvil DS Division

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Abstract: Pottuvil DS division is located in Dry Zone of Sri Lanka. Based on the soil types, slopes, soil depth and erodability of soils in this D.S. Division is categorized in to clusters Sengaman, whole Komari 1 and Northern Komari 2 and Hijra Nigar and small portion of Southern Komari 2. In general soil organic matter content in top soil was less than 1% in majority of chena fields in Pottuvil. Chena cultivated area has been restricted in research area due to the security problem. However, none of the Chena lands have used soil conservation measures to reduce erosion or organic manure for enrichment soil organic carbon content and soil fertility. No incorporation of organic matter (residues) to soil is practiced; instead burn them before land preparation. Majority of farmers do not know about soil conservation and their positive impacts. Even the few farmers who possess some knowledge about soil conservation or have heard of this, they are not practicing soil conservation or organic matter addition to their Chena fields. Soil conservation measures are required especially for certain areas (Sengaman and Komari-1 Cluster) and immediate attention should be given to implementation of such measures. In most cases, cost effective best conservation measures are to establish earth bunds and live hedges.

Keywords: Chena cultivation, Soil Erosion, land use.

Introduction

Soil erosion is an extensive problem in upland cultivation areas in Pottuvil DS Division, where traditionally large extents of land cleaned by filling and burning prior to the onset of the north east monsoon for chena cultivation. The cleared areas are subsequently planted with fast growing crops (e.g. ground nut, cow pea, chilly, green gram, corn). Lack of any kind of soil and water conservation techniques results in the heavy monsoon rains washing away a thin layer of top soil every year. In the research area, this situation is exacerbated as the predominant soil types are Reddish Brown Earths and Non Calcic Brown; soils which because of their poor physical characteristics, are inherently vulnerable to soil erosion. The annual loss of soil from agricultural lands results in serial losses of soil fertility. Further, the environmental damages caused by the eroded soil, which increases sediment loads discharged into rivers, lagoons and coastal water bodies, negatively affect aquatic resource as well. Farmers in these regions are not adopting any conservation or soil improvement measures mainly because they are unaware about these problems and given any training to upgrade their knowledge on the same

Objectives:

- To identify the soil erosion in Chena cultivation Areas
- To identify the causes of soil erosion
- To identify the impacts of soil erosion areas
- to make recommendation for the soil erosion in Chena cultivation Areas

Methodology

Basic information about the DS Division of Pottuvil from Ampara Divisional Secretariat, Field survey at the Pottuvil DS Division were collected from farm families currently practicing Chena. They were

selected for the detail investigation. Chena lands of the listed farm families were visited and information was collected. These farmers were interviewed and their social and cultivation related information was recorded. On site Chena farm evaluation was carried out and physical characteristics of the lands such as slope, erosion status, soil types and their aggregate stabilities and other physical characteristics were evaluated. In selected Chena farms soil profiles Detail collected from collected soil sample. Data collected were analyzed using appropriate statistical tools. Relevant recent digital maps showing geographical and administrative boundaries, agriculture and land-use patterns, soil types, and Chena cultivated areas have been used to create map using Arc GIS software.

Results and Discussion

Causes of erosion in Chena cultivation area

1. Soils type:

The dominant soils in the area are Reddish Brown Earths (RBE) and Low Humic Gley on undulating terrain, Non-Calcic Brown (NCB) soils on old alluvium & Solonets on undulating terrain, Alluvial soils of variable drainage and texture on flat terrain and Regosols on recent beach and sand dunes. Most of the Chena lands in the area are located in well drained upper and mild slopes of the undulating terrain with Reddish Brown Earths. The best expression of coarse textured NCB soils occur towards inlands of the study area. Success of rainfed upland cultivation on NCB is less compared to that on RBE, due to its low nutrient availability and moisture holding capacity, thus there are no significant extents under Chena, i.e. rain fed up land cultivation, in these soils. The DS divisions under consideration consist of alluvial soils and those are mainly restricted to flat flood plains as well as to valley depressions.Sandy Regosols's texture of the soil material ranges from fine sand to moderately coarse sand. Generally, these soils show no structure development and both the surface soil and subsoil are single grain, structure less and with a loose consistence. The infiltration rates are high and the moisture holding capacity is less. However, the infiltrated water is in the underlying static lens of fresh water, which permits growth of deep rooted trees or irrigated agriculture with the use of ground water resources.

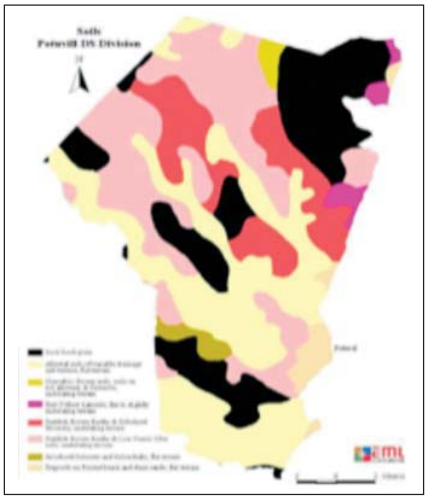

Figure 1: Soil types

2. Land-uses:

Predominant land-use in Pottuvil DS divisions is natural forest and scrub jungles. Agricultural lands primarily used for paddy cultivation, human settlements, scrubs, water bodies and lands utilized for chena or rainfed upland cultivation are the other dominant land uses occurring in the area. Coconut plantations are commonly found land-use type in Pottuvil DS Division. Different land uses and their extents in DS division are given in Table - 01.

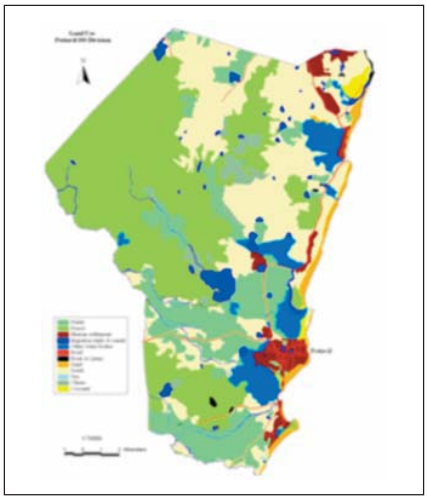

Figure 2: Land use of Pottuvil area

3. Depths of soil profile

The depth of the soil layers and the slope of the landscape were proneness to soil erosion. Shallower depths of soil profile indicates an eroded soil profile, and its further erosion can make a drastic negative impacts compared to the erosion effect on a soil profile with a higher depth. At the same time, it is considered that the higher the slope of the land, higher the vulnerability for soil erosion and vice versa. Survey results in the Pottuvil DS division revealed that soils in southern section of Komari 2 consists of Red-Latosols which are less prone to soil erosion under existing condition as their soil profiles are comparatively deep. However, the slope is around 4 – 5% thus erosion threat is more. In contrast the soil profile in general is deeper. The northern section of the Komari 2, the whole of Komari 1 and Sengaman can be considered as one cluster in terms of soil erosion management.

Table 01:
Land Use Type and extents in Pottuvil DS Division

Land Use Type	Pottuvil (Area ha)
Forest	10537
Scrub lands	7190
Chena	554
Coconut	191
Human Settlement (home Garden)	875
Irrigation tanks and canals	901
other water bodies	1615
Road	247
Paddy	4618
Rocky Areas	58
Sand Dunes	461
Total	27247

Source: *1:50000, Based on the digital topographic data, Survey Department of Sri Lanka)*

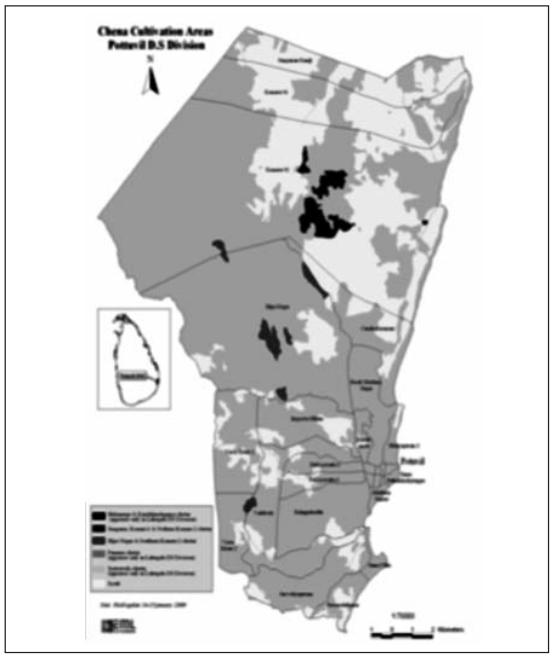

Figure 3:
Chena cultivation Area in Pottuvil

The area dominantly consisting of RBE soils, though other soils such as NCB is also prevailing. However, most of upland Chena lands are on RBE soils where the soil profile is not so deep. The soil depth is limited to 40 to 50 cm. The slopes of the area ranges between 3 – 6%. Since the soil profile is not deep, greater attention should be given to curtail soil erosion, the only measure would be earthen bunds coupled with vegetative hedgerows.

4. Deforestation

Most of the forest covers are decreasing because of deforestation. People are cutting trees for fuel wood therefore soil erosion are very high. it is evident that this will become a serious issue in the future. Therefore, actions must be taken to overcome the problem. Mainly to conserve existing forests.

Impacts of Soil erosion in Chena lands

1. Changes of pH value:

Chemical analysis of selected Chena lands in research area revealed that the soil pH of top soils (up to 10 cm) of all sites were at near neutral and

comparable pH level, compared to pH of a nearby forest soil which ranges between 5.5 to 6.8. Even though average pH values of Pottuvil lies within the favorable range, cultivated lands in some villages have shown higher pH values (Komari-2: pH 8.0; Kottukali: pH 7.8). This high soil pH may be due to the accumulation of salts on the soil surface due to high evaporation. Electrical conductivity values exhibited a great variability in different sites and the values are in the range which is lower than that of threshold salinity levels except for few sites where slightly higher EC levels were recorded (ie. some fields in Kottukai and Senagaman in Pottuvil DS division)

2. Soil organic matter content decreasing:

Soil organic matter contents of all Chena lands were lower, and almost all fields in Pottuvil DS Divisions were having very low (less than 1%) soil organic matter contents. Low organic matter contents in soil raise many problems such as

- Low soil fertility,
- Low soil aggregate stability,
- Increase proneness to soil erosion,
- Poor nutrient and water holding capacities

3. Low soil productivity:

Resulting low soil productivity and lower efficacy for applied chemical fertilizers. Though, some farmers were aware about the importance of organic matter addition, nobody has applied compost or organic matter deliberately to their farm fields except the crop residues of the previous crop. All farmers slash and burn residues before land preparation. In certain cases whole field was burnt before land preparation. Burning of residues drastically reduced the soil organic carbon contents and large amount of nutrients are lost permanently from fields. Soil organic matter influences

- Soil compact ability,
- Friability,
- Aggregate stability
- Soil water and nutrient holding capacity,
- Regulating air and water infiltration,
- Conserving nutrients, and
- Influencing soil permeability and erodibility

4. High cost:

Organic matter builds better soil structure and enables nutrients to retain in the soil longer. As organic matter decays, it releases nitrogen, minerals, and other nutrients that are needed by plants. This could significantly reduce cost for inorganic fertilizers.

5. Decreasing ground water level:

Presence of organic matter in soil improves the water storage qualities of the soil and helps with drainage and aeration. It makes the clay soils lighter and easier to work. It also permits the water to saturate deep down to the plant roots instead of collecting on the surface (Chen and Avnimelech, 1986). Organic matter worked into the soil and added to the beds frequently as mulch will help control weeds and many garden pests.

6. Biodiversity loss:

Soil provides an environment for soil micro-organisms that help to build healthy soil. Organic matter can help repel nematodes and suppress certain soil borne diseases (Paul and Clark, 1999). Nematodes can be a big problem for some root crops in chena such as cassava and sweet potato. When organic matter is applied to the soil as mulch or manure, they will enhance soil micro and macro organisms subsequently increasing the soil biodiversity (Paul and Clark, 1999). Therefore, addition of organic matter to Chena lands is needed and it provides numerous direct as well as indirect benefits.

7. Water shortages:

Soil erosion lead to severe water shortages. Addition of organic matter to soil increases water holding capacities and it also reduces salinity developments due to excessive evaporation. A fertile soil should contain at last 4% soil organic matter contents. By managing the residues in these areas and also with *insitu* cultivation of selected green manure species, adequate amount of organic matter could be obtained to improve soil organic matter content of these farm lands.

Soil properties of pH, EC and % organic matter contents of top soil samples of different Chena lands of selected villages in Pottuvil DS Divisions

DS Divisions	Soil pH	EC (µS/cm)	% Organic matter
Kottukal	7.80	33.42	0.338
Komari 2-1	5.98	4.27	0.541
Komari 2-2	5.55	58.92	0.263
Komari 2-3	6.66	10.01	0.608
Komari 2-4	6.16	4.72	0.811
Komari 2-5	8.00	9.58	0.811
Urani - 1	5.56	55.62	0.729
Urani - 2	4.88	28.71	0.464
Kijra Nagar -1	6.60	7.24	0.938
Kijra Nagar -1	6.63	6.95	0.967
Komari 1-1	6.01	11.32	0.947
Komari 1-2	6.34	2.67	0.772
Komari 1-3	7.34	22.00	0.676
Sengaman - 1	4.86	132.21	0.398
Sengaman - 2	7.15	14.17	0.978
Sengaman - 3	6.42	32.22	0.663

Source: *NECCDEP report, 2010*

Conclusion

Based on the field observations and also the information received from Grama Niladari, Agriculture officers and other key informants in the region and CBO Officers, it was revealed that Chena cultivation in Pottuvil DS division had been very much restricted due to terrorist's threats. In fact number of farmers practicing Chena during this period was very less in Pottuvil. In some villages, farmers have started Chena cultivation during the Maha season, 2008 after 28-30 years. Pottuvil regions Chena cultivation was limited mainly to roadsides of Panama to Thirukkovil. Though there are several GN divisions in the Pottuvil DS division, the Chena cultivation is being practiced only in few villages. Paddy cultivation is prominent in many areas. Chena cultivation at present is very much restricted due to security problems. Farmers do not use the forested areas for cultivation, where many of the villages had their traditional Chena lands.

Recommendations

- Immediate erosion control measures should be introduced especially to Sengaman, Komari cluster in the Pottuvil DS Divisions.
- Awareness on soil conservation and sustainable land management, low cost conservation measures (ie Alley cropping and SALT) are needed since most of the farmers are unaware of the adverse impacts of soil erosion and remedial measures. So Conduct awareness programs to educate farmers on the use of organic manure
- Government involvement is needed in providing credit facilities to implement conservation measures.
- Monitoring of successful implementation and sustainable management of proposed conservation measures by the local authorities are essential.
- Introduced regulation to prevent burning of residues and promote making their own compost.
- Promote *insitu* cultivation of green manure (introducing leguminous species such as gliricidia for hedgerows in alley cropping/SALT systems and for fences, and also growing sunn-hemp during fallowing period.
- Vegetative hedgerows coupled with earth bunds would give both cost effective and technically suitable solution for soil erosion control under such situations. As the land slope is not exceeding 5%, inter-bund spacing can be up to 30 meters but in the middle establishment of a vegetative hedgerow would be beneficial.
- Possible expansion of Chena lands based on suitability**.** Identification of lands should be based on the land suitability analysis. Farmers are eager to expand their cultivating area if the security situation becomes favorable. Since the security situation has improved, definitely cultivating extent may definitely be increased and they may even encroach in to government lands (scrub jungles).

- The land user or the farmer may have the feeling of the ownership and they could be convinced to pay more attention to protect those. the land ownership has an impact on the implementation of soil conservation measures. Most of the farmers are unwilling to invest on any soil conservation measures or even cultivation of perennial based green manure species because of the temporary and illegal nature of the farming.
- One major problem with granting ownership for the cultivating land has been the land fragmentation with time. This could be addressed by introducing strict regulations and also through maintaining farming population at a near constant by introducing alternative income generating activities such as agro-based and other industries which may wean out the pressure on farmlands.
- Soil conservation is not totally a responsibility of the farmer. It should be done, not only to protect the land itself, but to avoid offsite adverse impacts. Thus, cost of conservation should not be totally borne by the farmer himself but should be assisted or subsidized depending on the farming community. Majority of the farmers in Pottuvil DS Division is very poor and they can't afford for any kind of conservation measures, unless some assistance is provided.
- Training of trainers in the field of land and crop management is a must. In the process, soil conservation and its necessities, appropriate soil conservation techniques probably site specific, should be properly addressed. Other than training, awareness creation and attitude improvement programs particularly among farming community should be launched.

References

Topo Maps of Sri Lanka scale 1:50,000, Department of Surveys,1987.

De Alwis K.A. and Panbokke C.R. Handbook of Soils of Sri Lanka 1972, Journal of Soil Science, Sri Lanka 2:1-9.

Panabokke, C.R., 1996. Soils and agro-ecological environments of Sri Lanka. Natural Resources Series -No.2. Natural Resources, Energy and Science Authority of Sri Lanka. No. 47/5, Maitland Place,Colombo - 7, Sri Lanka.

Punyawardena, B.V.R., Bandara, T.M.J., and Munasinghe, M.K.R., Banda, N.J., and Pushpakumara, S.M.V. 2003. Agro-ecological regions of Sri Lanka. Sri Lanka Atlus, 2007.

Paul, E.A., and Clark, F.E. 1996. Soil microbiology and biochemistry. Academic Press. Inc.

Tate, R.L. 1987. Soil organic matter, biological and ecological effectors. Wiley, New York.

Steppler, H.A., and Nair, P.K.R. 1987. Agrofrestry: a decade of development. International Council for Research in Agroforestry, Nairobi, Kenya.

Wilson, W.S. 1991. Advances in soil organic matter research. The impact on agriculture and environment. R. Sco. Chem. Cambridge.