

Sustainable Approaches towards Combating Land Degradation in the Central Highlands of Sri Lanka in the Face of Climate Change

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Summary

Central highlands in Sri Lanka are a great asset to the nation as it provides many economic, social and environmental benefits to the people. Soil erosion and declining soil fertility have been the major land degradation issues in the central highlands particularly in lands exposed for human use. Recent climate change effects have aggravated both above land degradation problems. In order to ensure continuation of soil conservation in farming lands, a sustainable approach has been introduced by the Natural Resources Management Center of the Department of Agriculture in collaboration with other relevant organizations. The soil conservation approach includes conducting research to generate technology, establishing technology demonstrations, training farmers and technical officers on new technology, making farming community aware on the importance of soil and water conservation, providing farmers with cash and material incentives to establish conservation measures and making use of the legal provisions under the soil conservation related acts to control illegal earth excavations. As a success of this sustainable soil conservation approach, at present, land related development projects are implemented under the guidance of the Natural Resources Management Center on soil conservation and storm water management. Declining soil fertility has become the second most land

degradation process in central highlands. It widely occurs in vegetable and tea lands mainly as a result of nutrient loss through soil erosion and inadequate or over use of fertilizer in crop management. As a sustainable approach to this issue, a Soil Testing Service has been established for different crop sectors by relevant government organizations to help farmers for testing their soils and making appropriate nutrient management recommendations. As a success of the Soil Testing Service introduced by the government organizations, at present, farmers are aware on the need of getting their soils tested when degradation problems exist in their farming lands. Dominant climate changes related to central highlands include severe variability in seasonal rainfall volumes and the occurrence of rains, and increasing trends in average annual temperature. Water harvesting and organic farming technologies have been identified as primary measures to mitigate such climate change effects. In addition, making favorable land use changes helps sustaining the productive capacity of land resource base in central highlands of Sri Lanka.

1. Introduction

Over the last few decades, mountains have become of growing international concern. The Rio conference in 1992 and the International Year of the Mountains 2002 are proof of the above concern. In Sri Lanka, the country has a total land mass of 6.5 m hectares and a mountain mass known as central highlands located towards south central part of the island. The remaining area surrounded by the central mass is a plain mass. Having a highland component in the country is a great asset to the nation as it provides many ecological and other benefits to the people. The highland component in Sri Lanka known as central highlands has greater diversity in topography, soils, agro-ecology, biological resources and as a result it gives opportunities for diverse land uses. The central highlands capture high energy water with a very high potential for transfer to downstream plain areas. This highland component has a greater capacity for producing world class black tea, high value soft vegetables, export class cut flowers, organically grown spices and high standard dairy products. It has many tourist destinations such as water falls, natural forest reserves, mountain tops, wildlife reserves and tea plantations. Further, the country people have greater social preferences to central highlands for living. Not like many other countries in the world, this highland component is located almost centered in Sri Lanka with a great opportunity for providing its ecological and other functions in an equal strength to almost all surrounded downstream inlands and coastal plains.

Global assessments based on expert opinions indicate that the soil resource base in an extent of 1964.4 million hectares in the world has been degraded due to human inducement. In Sri Lanka, soil erosion and declining soil fertility have been the major land degradation issues in central highlands particularly in lands exposed for human use. Hence, in order to control soil erosion and ensure sustainable use of lands, a conservation area has been declared under the provision available in the Soil Conservation Act, No 25 of 1951 which was subsequently expanded in 2007 to an extent of about 10,618 sq. km (16 % of the total land area in the country) covering the entire central highlands based on findings of scientific studies. Declining soil fertility exists scattered almost all agricultural areas in the country inclusive of central highlands. Soil test based fertilizer use has been recommended by relevant organizations to address this issue in a sustainable manner. This paper briefly discusses the land resources available, present status in their degradation, climate change effects on land degradation and approaches presently adopted to ensure sustainable use of lands in central highlands of Sri Lanka.

2. Land Resources in Central Highlands, their Degradation and Conservation

In Sri Lanka, 14 land degradation processes have been identified as significant issues which are soil erosion, soil fertility decline, pollution, salinization, alkalization, dystrofication, eutrofication,

compaction, crusting and sealing, water logging, lowering of the soil surface, loss of productive functions, loss of active land surface and aridification. Out of those, soil erosion and soil fertility decline are the two main degradation processes taking place in the country. Recent estimates indicate that 50 % and 30 % of agricultural lands in Sri Lanka have been degraded due to soil erosion and declining fertility, respectively. In the central highlands too, both processes are dominant in uplands but only the latter is visible in lowlands cultivated with rice.

2.1. Soil Erosion

Regarding erosion in central highlands, excessive quantities of soils are lost due to cultivation of some erosion inducing crops such as tea, potato, tobacco and vegetables without adopting adequate soil conservation measures. In contrast in the same environment, soil erosion losses are negligible in some other lands having well managed tea, pasture, Kandyan forest gardens and natural forests. Hence, selection of appropriate land uses and adoption of recommended soil conservation measures has become a sustainable approach in checking soil erosion in central highlands. However, many social constraints exist for such a land use change. Therefore, adoption of appropriate soil conservation measures has been recommended for existing agricultural lands as a sustainable approach. The measures such as stone bunds, lock and spill drains, tree and shrub hedgerows, terraces, individual and common flat forms are more suitable for farming components of uplands in central highlands. Agronomic measures such as contour plowing, quick land preparation, contour planting, mulching, organic manure use, use of controlled irrigation systems and crop residue management are also recommended to check soil erosion. In addition, structures such as conversion drains, leader drains, main drains, check dams, drop structures, side walls and retention dams are widely used for conservation of off farm areas. The above off farm soil conservation structures and bio-engineering measures developed for cut slope protection are widely used for soil erosion control in non agricultural land uses.

In order to ensure continuation of satisfactory adoption of above soil conservation measures on farming lands, a sustainable soil conservation approach has been introduced by the Natural Resources Management Center of the Department of Agriculture in collaboration with other relevant organizations. The approach includes conducting research to generate technology, establishing technology demonstrations, training farmers and technical officers on new technology, making farming community aware on the importance of soil and water conservation, providing farmers with cash and material incentives to establish conservation measures and making use of the legal provisions under the soil conservation related acts to control illegal earth excavations. Present research work concentrates on development of bio-engineering measures for on farm soil conservation, off farm soil erosion control, gully stabilization, identification of suitable tree species for adoption of sloping land technology and development of technologies for storm water management. The technology demonstration program includes establishment of regional field models for showing measures suitable for conservation of sloping lands at watershed level. The farmer and officer training includes identification of measures suitable to the site, designing specifications of the conservation measures, field demarcation of measures, preparation of soil conservation plans and land maintenance work. Farmer awareness on land degradation related issues is also low particularly in rural poor communities. Hence, it shows the need of continuing awareness programs in the forms such as radio and television programs, poster campaigns, distribution of leaflets and conducting public lectures. Under incentives schemes, cash is given in most cases field conservation work performed. In addition in some cases, material incentives such as providing hoes, quality seeds, planting materials are also provided in place of cash. Numerous provisions have been embodied in different enactments to control land degradation in general and soil erosion in particular. The more important enactments are Forest Ordinance (1907) and amendments, Land Development Ordinance (1935) and amendments, Fauna and Flora Protection Ordinance (1937)

and amendments, State Lands Ordinance (1947) and amendments, Soil Conservation Act (1951) and amendments, Rubber Control Act (1956) and amendments, Tea Control Act (1957), Water Resources Board Act (1964), Land Grants Special Provisions Act (1979), State Lands (Recovery of Possession) Act (1979), Agrarian Services Act (1979) and amendments, Mahaweli Authority Act (1979) and amendments and National Environment Act (1980) and amendments. Among the above 13 Acts, the Soil Conservation Act No 25 of 1951 dominates in making legal provisions to control land degradation in central highlands.

In the past in this country, technologies related to soil conservation were introduced to farm lands in considering individual farmer plots. As a result, off farm technologies were not adopted at satisfactory levels. Since few decades back, the integrated watershed approach has been accepted for technology adoption and there have been many foreign funded projects involved in soil erosion control. Most of such projects promoted the above watershed approach in soil conservation. Therefore, equal emphasis has been given for both on farm as well as off farm soil conservation work. As a result of the implementation of watershed approach, formation of community based farmer organization, networking institutions involved in soil conservation related activities and implementation of regulatory work have been in practice at satisfactory levels. Presently, major institutions involved in soil conservation and watershed management in the central highlands are the Natural Resources Management Center of the Department of Agriculture; Provincial Departments of Agriculture in the Central, Uva and Sabaragamuwa provinces; Department of Export Agriculture; Forest Department; Department of Agrarian Development, Irrigation Department, Department of Animal Production and Health; Department of Agrarian Services; Tea Research Institute, Rubber Research Institute, Tea Small Holder Authority, Hadabima Authority of Sri Lanka and some Non Government Organizations. As a success of this sustainable soil conservation approach, at present, land related development projects are implemented under the guidance of the Natural Resources Management Center in the Department of Agriculture on soil conservation and storm water management. The common land related development projects include blocking out of lands for expansion of human settlements, tree felling for timber harvesting, stream water diversion for power generation, mining mineral resources for various uses.

2.2. Declining Soil Fertility

In the central highlands, declining soil fertility has become the second most land degradation process. It widely occurs in vegetable and tea lands mainly as a result of nutrient loss through soil erosion and inadequate or over use of fertilizer in crop management. The major problems associated with declining soil fertility include occurrence of acidic soils as a result of acceleration of dystrification process in soil, accumulation of added plant nutrients in soil, loss of soil organic matter, and depletion of some nutrients essential to plant growth. As a sustainable approach to this issue, a Soil Testing Service has been established by government organizations such as Department of Agriculture and Tea Research Institute to help farmers for testing their soils and making appropriate nutrient management recommendations in farming. The occurrence of acidic soils is a more common problem in the wet zone portion of central highlands. Presently application of liming materials is recommended. Lime and dolomite are widely used in agriculture to correct soil reaction. Accumulation of added plant nutrients in soil has been observed in the cultivation of high value commercial crops such as potato, carrot, cabbage and leek with the use of more than recommended quantities of chemical fertilizer. The soil test based fertilizer application has been promoted in order to avoid nutrient accumulation in soil. The loss of soil organic matter in agricultural systems has been mainly confined to intermediate zone of central highlands. Farmers are encouraged to apply organic manure such as crop residues, green manure, animal wastes and compost in addition to chemical fertilizer. Depletion of nutrients essential to plant growth (mainly nitrogen, phosphorus, potassium, zinc and magnesium) is corrected with the application of chemical

fertilizers and organic manure as recommended. In addition, dolomite is applied to correct magnesium deficiencies. Further, particularly in vegetable cultivation, it has been a routine practice that the foliar application of liquid fertilizers. It avoids occurrence of limitations of many other essential plant nutrients. In addition, soil conservation in farming lands too indirectly helps maintaining soil fertility. As a success of the Soil Testing Services introduced by government organizations, farmers are now aware on the need of getting their soils tested when degradation problems exist in their farming lands.

3. Climate Change Effects on Land Degradation and Sustainable Land Management

Precipitation projections for Sri Lanka in the coming century are highly inconsistent according to the climate change literature. Most reports agree that annual volume at a national level is projected to remain consistent. However, regional and seasonal rainfall volumes and occurrence of rains are anticipated to exhibit severe variability. Further, the extreme events in rainfall have been increased. It indicates an increase in erosive rains aggravating the soil erosion problem particularly in the central highlands. As a sustainable primary approach to above situation, small scale water harvesting technologies such as establishment of farm ponds, lock and spill drains, percolation pits and terraces are promoted. As a result of regional variability of rainfall, a decreasing trend in annual precipitation in administrative districts in the central highlands has been observed. It again reveals the need of promoting rainwater harvesting technologies in central highlands in the face of climate change. It also helps storing water at high value stage with greater access for power generation, transfer for crop irrigation and distribution for human uses in downstream areas. Further, rain and surface storage are the only sources of water for agriculture in central highlands. It urges the need of adopting water harvesting technologies in farming areas.

Average annual temperature in Sri Lanka has been recorded as increasing throughout the past few decades. The increasing trend in temperature has many effects on the loss of soil carbon and increasing the vulnerability of soil for erosion. It reveals the need of paying attention on promoting organic matter application particularly on exposed lands. Presently, organic matter application to farming lands through in situ generation and brought from outside are recommended. Organic farming and biological soil conservation are also encouraged by all organizations engaged in agriculture in central highlands.

4. Conclusion

The central highlands in Sri Lanka have a threat to its land resource base from two major land degradation processes namely soil erosion and fertility decline. A sustainable approach has been adopted for soil erosion control by the Natural Resources Management Center of the Department of Agriculture in collaboration with other relevant organizations. Fertilizer use based on soil test recommendations has been adopted by the Department of Agriculture and other relevant organizations to correct soil fertility related issues. In addition, recent climatic changes have contributed to aggravate the both above problems. Measures capable of harvesting catchment water and supporting organic matter build up in soil have been identified as primary measures to mitigate climatic change effects. In addition, making favorable land use changes helps sustaining the productive capacity of land resource base in central highlands of Sri Lanka.