THEME 2

LDN – a way forward to enhance SOC storage to mitigate land degradation and climate change - Bhutan

Karma D. Dorji

National Soil Services Centre (NSSC), Ministry of Agriculture & Forests, Royal Government of Bhutan

INTRODUCTION

Bhutan as a LDN Country
Bhutan has been one of the fourteen Land Degradation Neutrality (LDN) pioneer countries and implemented the LDN program of the United Nations Convention to Combat Desertification (UNCCD) in 2014. Following the LDN pilot phase, Bhutan volunteered to be a LDN country in 2016. The LDN activities are continued at the sites selected for the pilot phase.

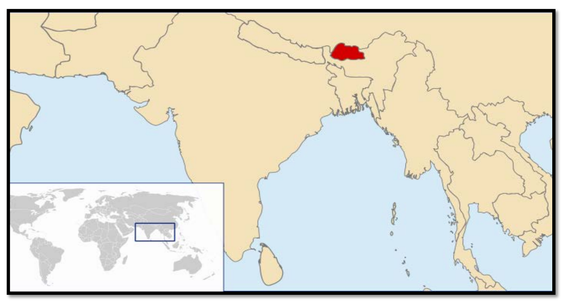

Fig . 1: The Country
Area: 38,394 sq. km
Population: 0.76
Farming community: 60%

A carbon neutral/negative country:
About 72% of the country is under the pristine forest cover. "Bhutan is not merely carbon neutral, it's also a carbon sink-making it one of the few countries in the world to have negative carbon emissions" Mellino, C. (EcoWatch, 2016) & P. Vaishnavi, (ScienceABC, 2016). As a carbon sink, Bhutan absorbs over 6 million tons of carbon annually while only producing 1.5 million tons. Conservation of Environment is one of the four pillars of Bhutan's development philosophy of Gross National Happiness (GNH) (Fig 2).

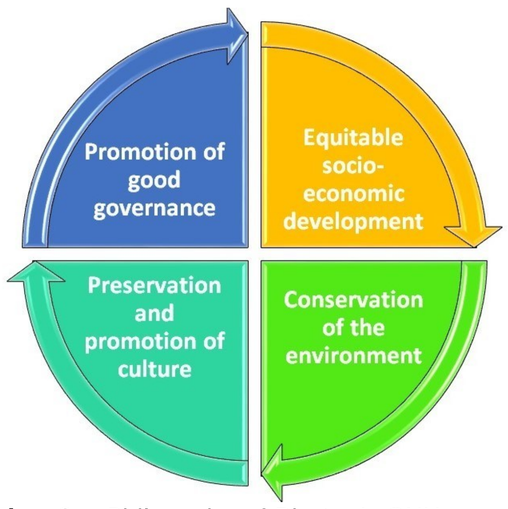

Fig . 2a: Philosophy of Bhutan's GNH Index (Climate Inst, 2016)

OBJECTIVES

Why adopt LDN concept?
Above ground carbon stock is well monitored and maintained, however the below ground carbon stock has not been studied well. As the monitoring of the carbon stock in the soil is one of three indicators of LDN, as an LDN country, the opportunity to put a greater emphasis on soil carbon stock is provided.

Management of the country's 7.8% of the available arable land with SLM practices is considered important to prevent and mitigate land degradation locally and contribute to climate change mitigation at the global level. Green house gases emission from agricultural practices has been estimated to be comparatively high largely from livestock and irrigated paddy fields. Implementation of simple SLM technologies is required to put the LDN concept into practice which can address numerous questions of food security, poverty reduction and improved conditions of terrestrial ecosystems. SLM technologies such as mulching, zero tillage and water harvesting, enhance soil carbon levels (Pivotal Carbon, Science-Policy Brief, SPI).

LDN Sites and SLM Technologies implemented: The following figures show the initial four LDN sites of about 200 ha and some important SLM technologies implemented at these sites.

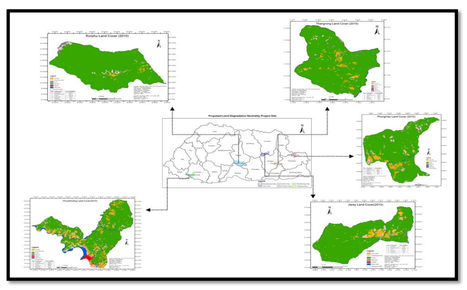

Fig. 2b: LDN sites and SLM technologies

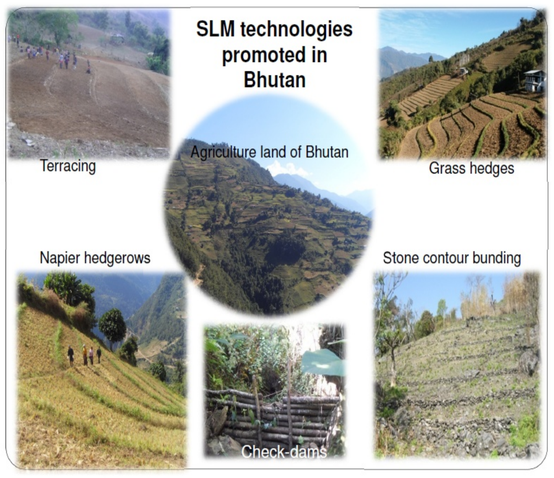

Fig. 3: SLM technologies

MAIN RESULTS

LDN and SOC
Although, the country lacks technical expertise and resources, every effort is being made to generate information on soil carbon stocks. Therefore monitoring soil carbon stocks is given a high priority within the LDN program of the country. A SOC Study Findings: A systematically conducted research for Soil Organic Carbon (SOC) of various land use type soils, the SOC density has been reported to be highest in fir forest soils (41.4 kg m^{-2}) and lowest in paddy land (12.0 kg m^{-2}) Dorji *et al.*, (2014) as shown in Fig. 4.

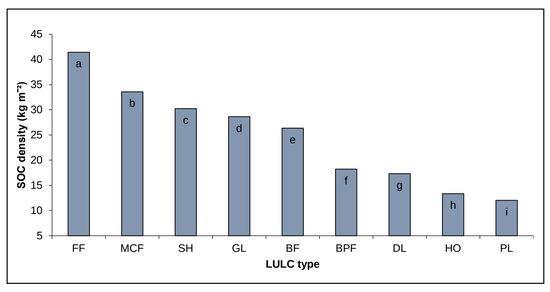

Fig. 4: The mean SOC density of different LULC types. FF fir forest, SH shrubland, GL grassland, MCF mixed conifer forest, BF broadleaf forest, BPF blue pine forest, DL dry land, HO orchard, PL paddy land (Dorji *et al.*, 2014)

In the same study, the SOC density and concentration were shown to be decreasing with increasing depths under all land use and land cover (LULC) types as shown in Fig 5 below for SOC concentration.

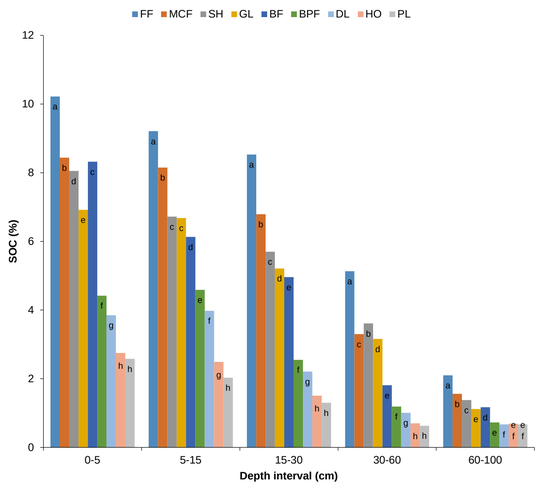

Fig. 5: The mean SOC concentration values under different LULC types at different depth intervals. FF fir forest, SH shrub land, GL grassland, MCF mixed conifer forest, BF broadleaf forest, BPF blue pine forest, DL dry land, HO orchard, PL paddy land (Dorji *et al.* 2014)

The overall findings of this study indicate that the conversion of even a fraction of forest to other LULC types could lead to substantial loss of SOC stocks. This loss of SOC stock is even greater when there is a decrease in above ground biomass.

Appropriate management of the agricultural land was recommended to increase their sequestration of atmospheric CO_2.

Fig. 6: Citation
Fig. 7: "Planting trees with thousands of volunteers to celebrate the birth of HRH. This country isn't just carbon neutral — it's carbon negative" (PM, 2016)

CONCLUSION

In the absence of any immediate convenient methods to measure and or monitor SOC for Bhutan, the method including the regression kriging used in the SOC research by Dorji *et al.* (2014) will be adopted for SOC measurement and or monitoring under the LDN program. The results generated by this study can also be extrapolated to places with similar climatic conditions i.e. rainfall, temperature, etc. For Bhutan, with the current forest cover of 72%, the country is able to sequester more carbon then it is being generated and this capacity will be enhanced further through the country's LDN initiatives on SOC monitoring.

Main Challenges:

- Inadequate and scattered soil information ;
- Limited technical and institutional capacities for a detailed study of SOC;
- Difficult terrain for detailed SOC study