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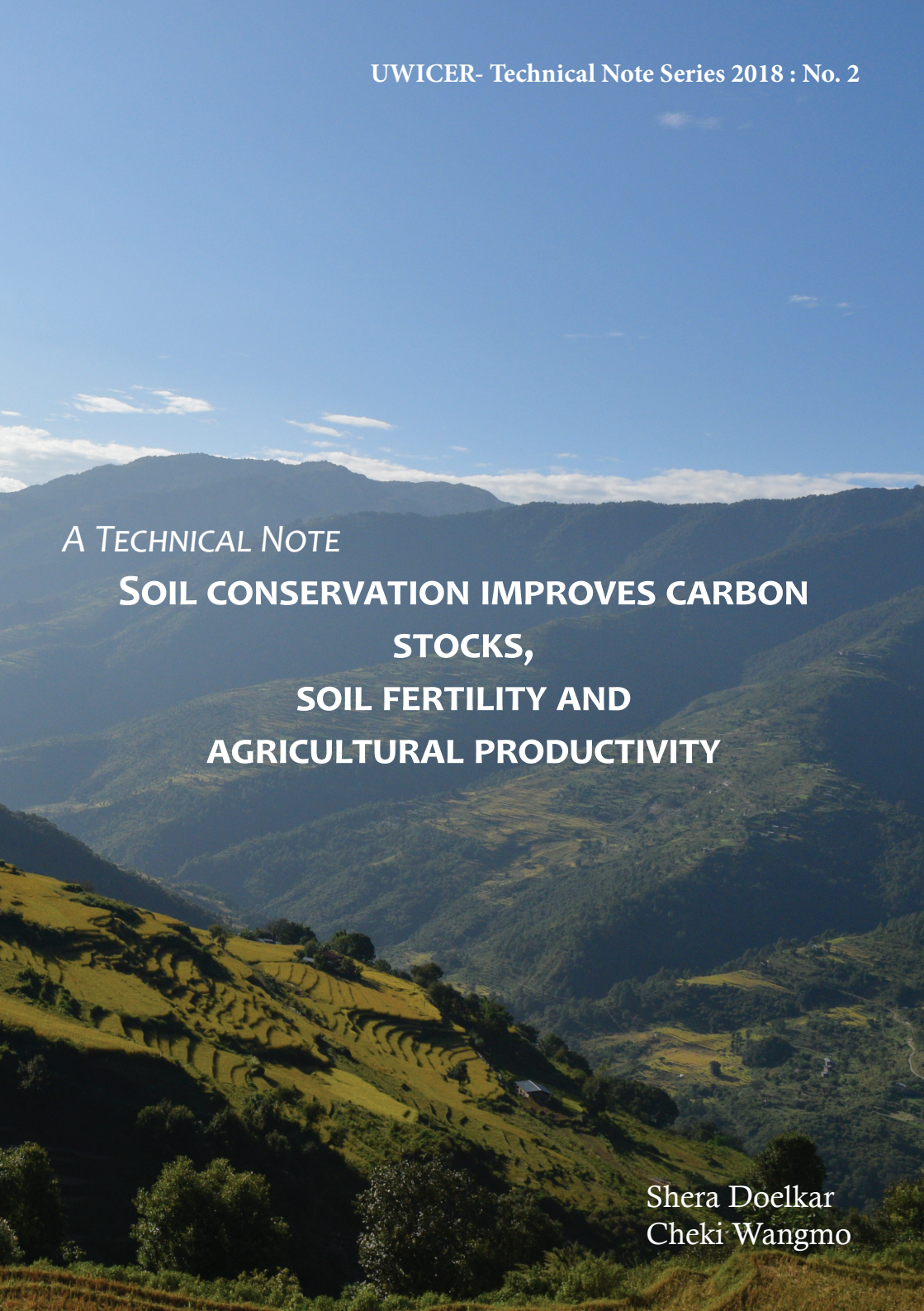

A Technical Note

Soil conservation improves carbon stocks, soil fertility and agricultural productivity

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Soil Conservation Improves Carbon Stocks, Soil Fertility and Agricultural Productivity

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Soil conservation efforts are highly effective in reducing erosion, improving carbon stocks and soil fertility in agricultural fields

Executive Summary:

Inventory of carbon and tree resources was carried out on both forest and agricultural land in Pungshi, Dagana as a pilot village to link the effect of land rehabilitation and agroforestry measures on carbon stocks. The total carbon stock of the watershed was in the order: Broadleaved forests (244 tc/ha) > Shrubland (2.46 tc/ha) > Citrus orchard (0.52 tc/ha) > Dry land (0.27 tc/ha).The most effective erosion control measure in steep areas proved to be construction of dry stone wall terracing followed by grass hedgerows and contouring, as predicted by the Revised Universal Soil Loss Equation (RUSLE). The ranges of mean specific SOC loss before terracing was between 446.1 – 826.2 kg/ha/yr and after terracing was 153.8 – 284.8 kg/ha/yr from the dominant soil type sandy loam and considering all the crop types. The crop with the lowest predicted soil loss was sugarcane followed by dried pulses, chilies, potato, maize, while soybean predicted the maximum soil loss. This study recommends the practice of agroforestry system and soil conservation measures as an approach to reduce greenhouse gas emissions, increase carbon stock, control agricultural soil erosion, improve soil fertility, increase crop productivity and enhance livelihood.

Introduction

Soil erosion is a principal threat in Bhutan due to its steep terrain and heavy erratic rainfall that results in poor soil fertility and reduced agricultural productivity. Agroforestry practice which integrates plantation of fruit and fodder trees in combination with crops in the landscape, will increase the crop production; generate more income, increase the biodiversity in terms of providing ecological services and increase the carbon stock of the area. Land management intervention like terracing, hedgerows and countering are effective measures to reduce soil erosion and to increase carbon stock. Quantification of above ground and below ground carbon by agroforestry intervention is necessary to know how much the trees outside forest contribute to the carbon pool.

Photo: Problematic fields of the farmers

Photo: Terraces after construction in one of the farmer's field in Pungshi.

Methodology

To determine the carbon content of the area, an inventory was carried out in Pungshi chiwog on both forest and agricultural land focusing on the carbon status of different land use types as a baseline for assessing potentials of increasing carbon by intervention of agroforestry.

The soil loss before and after soil conservation was predicted using the RUSLE model. Soil samples were collected to determine the soil organic carbon and total nitrogen content in the soil and to compare the effect of soil conservation measures.

For improving the degraded fields through sustainable land management approach a detailed planning was carried out with farmers for implementation of agroforestry interventions.

RUSLE Model

$$A = R * K * LS * C * P$$

Where A is the computed spatial average annual soil loss, usually on yearly basis (t/ ha^{-1} /y^{-1}); R is the rainfall-runoff erosivity factor (MJ mm/ha^{-1}/ h^{-1}/ y^{-1}); K is the soil erodibility factor (t/ ha/h /ha^{-1}/MJ^{-1} mm^{-1}); LS is the slope length (L) steepness (S) factor (dimensionless); C is the cover management factor (dimensionless); and P is the conservation practices factor (dimensionless).

Results

- The result of the assessment of aboveground carbon stock in the four land use types of the study site showed that the potential carbon sequestration of the watershed is 247.3 tons C/ha.

- The result also showed that there are very few trees on the agricultural fields. The estimated carbon sequestration value of the study area can improve the above ground carbon stock by 0.66 tons C/ha by agroforestry intervention and the below ground by 0.5 to 3.5 tons C/ha by controlling soil erosion considering the different crop type and soil types.

- The most effective support practice in steep slopes was dry-stone wall construction as it reduces the slope length factor followed by grass margin and contouring.

- The estimate cost for dry stone wall construction ranged from Nu. 12,000 - Nu. 1, 44,000 for constructing 18 m^3 - 232 m^3 wall respectively.

- The model predicted a significant increase in soil nutrients such as SOC, Ntot and SOM by 190%, 172% and 65% respectively through the soil conservation measures.

- The increase in SOM can ultimately improve the available water capacity and increase the agricultural productivity of the degraded area.

This study recommends the practice of agroforestry systems coupled with soil conservation measures as an approach to reduce greenhouse gas emissions, increase carbon stock, control agricultural soil erosion, improve soil fertility, increase crop productivity and enhance livelihood.

The study also recommends dry stone wall construction as the most effective measure to control soil erosion in steep areas where there are plenty of stones available. Grass hedgerows and contouring can be adopted where there is shortage of stones. Combination of dry stone wall and grass hedgerows can provide additional protection to the dry stone wall and furthermore provide cattle fodder as an additional benefit.

Recommendations

……..adopt agroforestry system coupled with soil conservation measures to reduce soil erosion and increase carbon stock…….

… …. .construction of dry stone wall, grass hedgerow and contouring can be an effective soil conservation measures……

……. .RUSLE model in combination with ArcGIS can be used as key conservation planning tool …..

Acknowledgment

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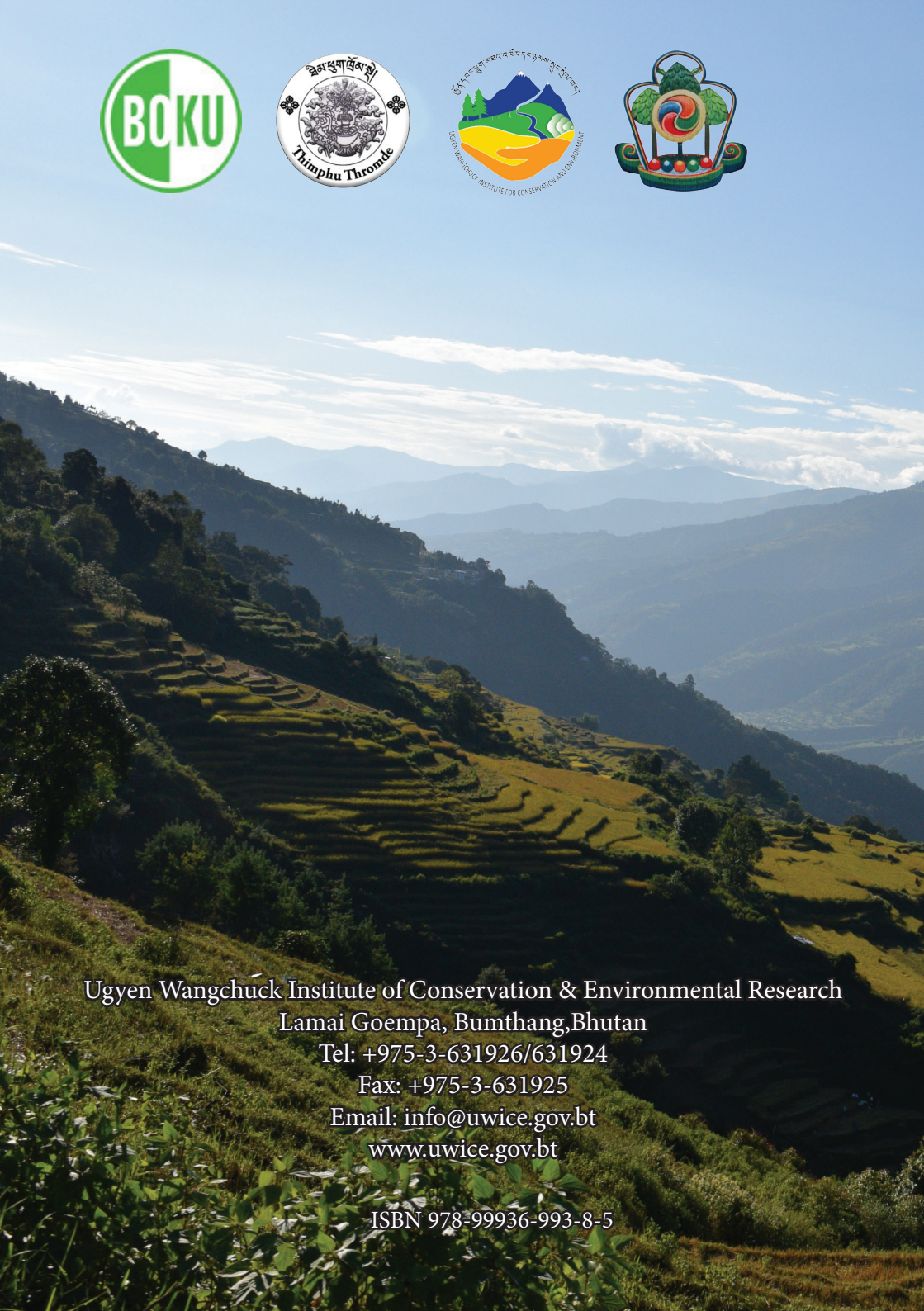

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