Assessment of Carbon Stock and its Relationships With Forest Conditions in the Leasehold Forest User Groups (*A case study from Nawalpur district*)

Presenter

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INTRODUCTION

- With increased concern of climate change, studies on carbon is at the forefront of environmental researches.
- Forest act both as carbon source and sink (Goodman & Herold, 2014).
- Introduction and implementation of REDD+ program resulted in investigation of forest carbon from local to global scale (Aryal et al, 2018).
- Conservation and sustainable management of forest improves carbon storage capacity which in turn provides financial incentives to forest managers through REDD+ program in developing countries.

INTRODUCTION

- Carbon storage potential of forest varies with forest types (Adhikari and Ghimire, 2019), mode of regeneration (Neupane et al, 2017), successional stage or age of the forest (Thuille and Schulze, 2006), and diversity and density of trees (Dawud et al, 2016) including others.

- Past studies include quantification of carbon in different forest types (Joshi et al, 2020; and Pandey et al, 2014); management regimes (Suwal et al, 2015); and relationship of carbon stock with different environmental and anthropogenic attributes (Bhusal et al, 2019; and Aryal et al, 2018).

- Leasehold forest(LF) initiated in Nepal with the twin goal of forest restoration and poverty reduction.

INTRODUCTION

- Progress in terms of forest restoration- increased canopy cover, plant diversity, reduced soil erosion, increased ground cover and increased growing stock (Yadav et al, 2018; and Kafley and Pokharel, 2017).
- Increased environmental benefit may contribute largely in mitigating climate change through increased carbon sequestration.
- Lack of such investigation in case of LF.
- In this regard, this study carried out to quantify the carbon stock of LF and analyze its relationship with forest characteristics and disturbances factors.

OBJECTIVE

General Objective:

- Estimation of the carbon stock in the leasehold forest and examine its relationship with forest condition.

Specific objectives:

- Estimate the above ground carbon stock of the leasehold forest.
- Assess relationship between the forest disturbances (grazing, lopping and fire) and carbon stock.
- Analyze relationship between forest characteristics (forest types, plant diversity and stem density) and carbon stock.

MATERIALS AND METHODS

Study area

- Nawalpur district as it has long history of LF management.

Criteria for selection of LF:

- LF that is handed over at least before five years.
- Altogether 11 leasehold forest (three with *Shorea robusta* forest and eight with *Schima-Castanopsis* forest)

Figure 1: Map of Study Area

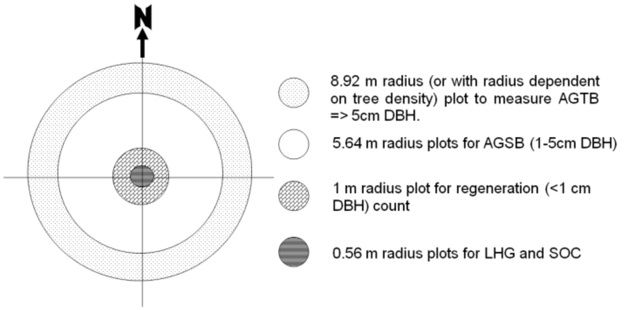
a) Nepal with districts and b) Nawalpur district

MATERIALS AND METHODS

Data Collection

- Two sample plots at each leasehold forest were randomly selected after reconnaissance survey

- Concentric circular sample plots.



- Each consisting of four circular nested sub-plots with different radii.

- At each sample plot, recording of elevation, location, slope, aspects, forest types, canopy cover and presence of disturbances (Fire, Grazing and Lopping).

- Forest carbon inventory following Subedi et al, 2010.

MATERIALS AND METHODS

Data Collection

Variables	**Data**	**Radius (m)**
Trees (DBH ≥ 5cm)	• Species name • DBH • Height • Tree quality	8.92
Saplings (1-5cm DBH)	• Species name • DBH	5.64
Regeneration(<1cm DBH)	• Species name • Count number	1
Leaf litter	Fresh weight	0.56
Herbs and grass	Fresh weight	0.56
Disturbances	Presence or absence	8.92

MATERIALS AND METHODS

Data Analysis

Biomass Estimation	Above ground tree biomass (AGTB)	0.0509*wood specific gravity*$(dbh)^2$* total height (Chave et al, 2005)
	Above ground sapling biomass (AGSB)	Log (AGSB) = a + b log (D) (Tamrakar, 2000) D = over bark diameter at breast height
	Biomass of leaf litter, herbs and grass (LHG)	LHG = $\frac{Wfield}{A} * \frac{Wsub-sample,dry}{Wsub-sample,wet} * \frac{1}{10000}$
Forest Condition Assessment	Plant Diversity	Shannon-Wiener diversity index (H')
	Stem Density	$\frac{Total\ number\ of\ \text{stems}\ in\ all\ plots}{Total\ number\ of\ plots * size\ of\ the\ plot\ (m2)} * 10{,}000$

MATERIALS AND METHODS

Data Analysis

- Obtained biomass stock densities was converted into carbon stock densities by multiplying with IPCC (2006) default carbon fraction of 0.47.

- Sapling density and stem density was calculated for assessing forest condition

- t-test was applied for analyzing differences in carbon stock between disturbed and undisturbed plot and different forest types

- Correlation of average carbon stock with plant diversity and stem density was assessed using correlation analysis

RESULTS

Forest composition

- Altogether 27 species of trees (n=183), saplings (n=112) and regeneration (n= 4) were identified and recorded from 22 sample plots.

Status of Carbon stock

- Average tree carbon stock (t/ha), sapling, below ground and total carbon was found to be 9.49, 0.42, 1.90 and 11.81 t/ha respectively.
- Lama and Mandal, 2013 estimated carbon stock of leasehold forest in Dolakha and found similar carbon stock.
- The contribution of tree carbon in total carbon was found to be 80.34% while that of sapling was 3.56%.

RESULTS

Carbon stock at three above ground carbon pools

Carbon stock(t/ha)	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Std. Error
Above ground Tree carbon stock	0	47.75	9.49	2.47
Sapling carbon stock	0	2.91	0.42	0.13
Below ground carbon stock	0	9.55	1.9	0.49
Total carbon stock	0	57.3	11.81	2.94

The lower carbon content could be due to heavy lopping by users of LFUGs as they heavily depended on trees for fodder requirement

RESULTS

Carbon stock at Individual Leasehold Forest

Forest Name	Mean Carbon Stock (tonn/ha)	
	Statistic	**Std. Error**
Barhaben	3.3	0.08
Bojhadi	17.12	8.47
Chilaunedanda	14.93	2.52
Daitegaira	0.35	0.04
Dumsilum	8.18	2.58
Jharnakhola	30.44	6.32
Jhirubhanjyang	29.67	27.63
Kajithumka	10.98	1.25
Lupchegaira	2.08	2.08
Marjheldanda	5.53	5.3
Tinkhande	7.34	1.17

- The higher carbon stock in Jharnakhola could be attributed to the presence of high number of *Shorea robusta* trees.

RESULTS

Correlation between diversity index and average carbon stock

- Correlation coefficient between diversity index and average carbon stock (t/ha) was found to be 0.535 and was statistically significant at 95% confidence interval

- Wang et al, 2013 found positive relation between diversity and carbon stock; Aryal et al, 2013 found inverse relation

- Higher carbon stock in more diverse forest in this study could be due to presence of high number of pole sized trees in more diverse forest.

Correlation between carbon stock and density of stem:

- The correlation coefficient between carbon stock and density of stem was 0.352 indicating weak relationship and this coefficient was statistically insignificant.

RESULTS

Carbon Stock Variation:

- Average carbon stock(t/ha) of fire absent plot (13.78 t/ha) was higher than those plots where fire was present (10.17 t/ha). However the value was not significantly different.
- Average carbon stock in *Shorea robusta* forest was found to be 17 t/ha and that of *Schima-castanopsis* was 10 t/ha
- Pandey et al, 2014 also found higher carbon stock in *Shorea robusta* forest.

Limitations:

- Ongoing pandemic of COVID-19 did not allow for carbon estimation of leaf litter.
- This study is still ongoing thus complete data analysis as suggested in abstract could not be carried out.

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THANK YOU!!!