Carbon Sequestration Potential and Uses of Dendrocalamus srictus

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CARBON SEQUESTRATION POTENTIAL AND USES OF *DENDROCALAMUS STRICTUS*

- A case study from Baglung District Sigana V.D. C, Nepal

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Carbon sequestration (CS) refers to the provision of long-term storage of carbon in the terrestrial biosphere, underground, or the oceans, to regulate the building up of carbon dioxide (the principal greenhouse gas) concentration in the atmosphere. But in another word, it can be defined as the removal of carbon (C) from the atmosphere by storing it in the biosphere. About two-thirds of terrestrial carbon is sequestered in the standing forests, forest under storey plants, leaves and forest debris, and in forest soils (Sedjo *et al.* 1998).

Forestry is the most important means of offsetting carbon emission for sequestrating carbon in biomass and giving positive effects on livelihood of the rural farmers because of its cost effectiveness and associated environmental and social benefits. Forestry system has more biodiversity and density of biomass than agro forestry and annual cropping systems. In Nepal, many studies have been conducted on agro forestry and agricultural crops for their benefits whereas very few studies have been done on the intangible benefits like carbon sequestration (Gautam 2002). The carbon sequestration benefits of forests can be perceived to be more important at the global than at national or local levels (Sharma 2000).

Bamboos are tall, perennial, arborescent and common grasses, which not only provide direct production benefits but also indirect environmental benefits in the form of abating global warming and climate change through conserving atmospheric CO_2. The potential carbon sequestration of *Dendrocalamus strictus* forest can contribute to setting levels of possible compensation to countries that are obliged to conserve forest beyond its own needs. Estimation of total plant biomass and soil carbon sequestered in any forest system is very important as it gives ecological and economic benefits to the local people. But this work is very much lacking in in any forest like Community Forest, Collaborative Forest Management or natural forest. There is yet any study on carbon sequestration of bamboo forest.

It is assumed that the fast growing species like *Dendrocalamus strictus* can fix the atmospheric carbon in above and below ground biomass more rapidly than those slow growing species.
However, the actual carbon sequestration potentiality of *Dendrocalamus strictus* has not so far been assessed in Nepal. But *Dendrocalamus strictus* can be found at many different elevations, and widely spread in Nepal making the assessment of total carbon sequestration potential of such forests important.

Objectives of the study

The general objective of this study was to estimate carbon sequestration by *Dendrocalamus strictus.*

The specific objectives of the study were to:

i) estimate above and below ground net carbon sequestration potential in bamboo forest system.
ii) assess the uses of bamboo in the study area
iii) estimate demand and supply of the bamboo species.

Methodology

Primary Data collection.

Sampling - Simple random sampling was carried out to collect the biophysical data of bamboo. The samples were taken randomly from the study area representing the whole area. The bamboos are measured in culms. Circular plots of radius 5.64m were laid out in the field and the area of one plot comes to be about $100m^2$. This makes it easier to calculate biomass and measure bamboo too within the plot.

Biophysical measurements **-** One bamboo from each plot was felled to measure the length and take the samples for carbon analysis.

Soil samples **-** Soil samples were taken from soil profile up to 1m depth at five different levels (0-20cm, 20-40cm, 40-60cm, 60-80cm, 80-100cm). A profile was dug at each plot.

Social survey -The household survey and key informant survey were conducted to determine demand and supply as well as to assess the uses of bamboo in the study site. There were altogether about 90 households of which about 30 household were interviewed. Focus was given to those household who had bamboo plantation in their private lands. In addition, key informant survey was also conducted to know more information about bamboo.

Data analysis
To estimate the carbon content in different parts of bamboo, the samples were oven dried at 75°C for 72 hours. They were burned in muffle furnace at 400°C and organic carbon content was calculated using relationship (Negi *et al.* 2003):
Carbon content (%) =100 - {%ash weight + molecular weight of O_2 (53 in $C_6 H_{12}O_6$}

Biomass estimation
The biomass of tree includes all parts such as stem, branch, roots, leaves and undergrowth biomass. It can be divided as above ground biomass and below ground biomass.

Estimation of Aboveground biomass - The model used was:

$W=a + bX (D^2L)$

Where, W is above ground oven-dried weight of bamboo culms in kg,
d is the diameter at 15 cm in cm. and
a, b are parameters estimated by Oli and Kandel (2006),

Estimation of Belowground biomass -
Rhizome biomass = 5% 0f culms biomass
BD (gm/cm3) = (oven dry weight of the soil)/ (volume of the core)
OCC was obtained by titration method.
The Walkey-Black method (Jackson 1958) was applied to measure the soil organic carbon percent. Total soil organic carbon was calculated using the formula given below (Chabbra *et al.* 2002):
SOC= Organic carbon content (%) x soil bulk density (kg/m^3) x thickness of horizon (m)

Estimation of net carbon content -
Total above ground biomass organic carbon
= {(total culms biomass x 33.27%) + ((total leaves biomass x19.54%)}
Total below ground organic carbon
= (total rhizome biomass of bamboo) x 33.27 % + total soil organic carbon.

Result and Discussion

Laboratory analysis of culms and leaves for carbon content showed 33.26% and 19.53% carbon content in culms and leaves, respectively. The above and below ground biomass carbon sequestration in bamboo was found as 1.66 t/ha and 0.08t/ha., respectively, whereas the soil carbon sequestration was found to be 230.32 t /ha.

Finally, the total carbon sequestration in bamboo forest was found to be 232.06 t/ha. The demand and supply was found to be 1600 culms per household per year and 2600 culms per household, respectively. Similarly, the bamboo was used in bioengineering, fodder, fuel wood, food, fencing, making bamboo products like doko, muda, etc., and props for house construction.

Further research on different climates, soils, localities, aspects, latitudes and elevation ranges in *Dendrocalamus strictus* forest are needed to fully assess carbon sequestration potential of bamboo forest.

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Table 1. Carbon content in different parts of *Dendrocalamus strictus*

Part	**Sample No.**	**Mean Carbon %**	**SE**
Culms	36	33.27	1.627
Leaves	12	19.54	1.129

Note SE: Standard Error

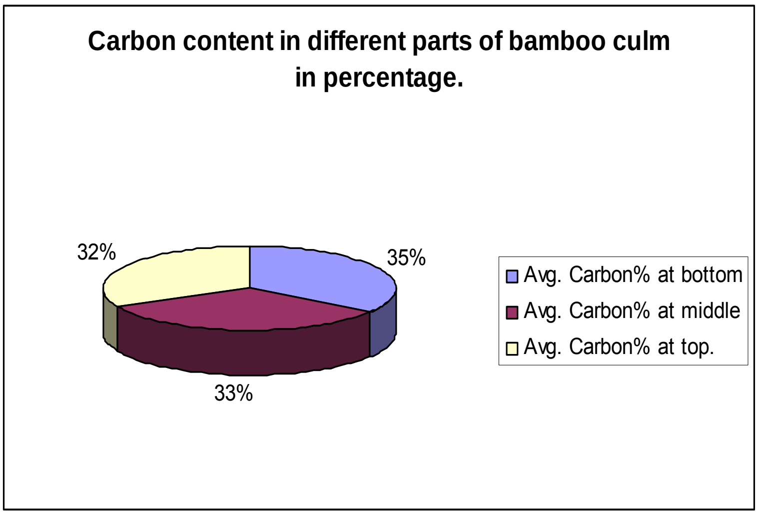

Figure 1. Carbon content in three parts of bamboo culms in percentage.

Table 2. Biomass table of bamboo

Plots	Mean biomass(t/ha)		**Total Biomass(t/ha)**
	Culms	**Leaves**	
1	5.61±0.60	0.81±0.063	6.42
2	5.58±0.51	0.81 ±0.069	6.38
3	4.17±0.57	0.6±0.078	4.77
4	4.29 ±0.36	0.63±0.045	4.92
5	3.54±0.09	0.54±0.246	4.08
6	5.46±0.81	0.78±0.105	6.24
7	4.53±0.54	0.66±0.072	5.19
8	3.72±0.48	0.54±0.060	4.26
9	4.77±0. 42	0.72±0.057	5.49
10	3.48±0.48	0.51±0.066	3.99
11	3.96±0.51	0.6±0.069	4.56
12	5.67±0.57	0.81±0.075	6.48
Mean	**4.59**	**0.69**	**5.24**

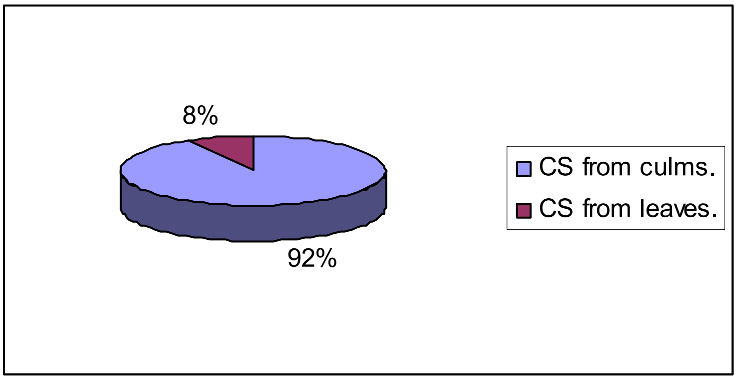

Figure 2. Total CS from bamboo parts

Table 3. Bulk density for bamboo

Depth	**No.**	**Mean BD (t/cu.m)**	**SE Mean**	**Minimum**	**Maximum**	**Range**
0-20	12	0.697	0.073	0.430	1.23	0.079
20-40	12	0.790	0.056	0.462	1.097	0.635
40-60	12	0.928	0.081	0.482	1.347	0.865
60-80	12	0.960	0.099	0.576	1.477	0.902
80-100	12	0.822	0.055	0.540	1.099	0.561

Table 4. Carbon stock in different soil profile depths of bamboo.

Depth (cm)	Sample No.	Mean Kg/m^2	SE Mean	Variance	Maximum	Minimum
0-20	12	4.479	0.295	0.954	6.633	3.091
20-40	12	4.710	0.440	2.127	6.048	2.218
40-60	12	5.001	0.681	5.095	9.562	1.913
60-80	12	4.879	0.847	7.890	10.018	1.151
80-100	12	3.966	0.637	4.457	7.875	0.324

Table 5. Carbon sequestration in aboveground biomass (culms and leaves), root and soil for bamboo

Part	Carbon Sequestration in bamboo (tonsha)
Culms carbon	1.52
Leaves carbon	0.14
Rhizome carbon	0.08
Soil carbon	230.32
Total	**232.06**

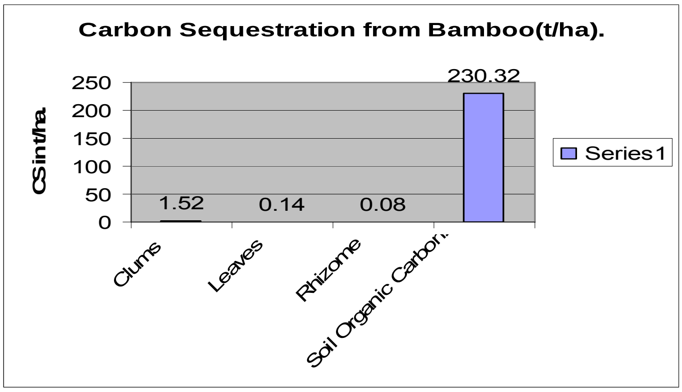

Figure 3. Total carbon sequestration from bamboo (t/ha)

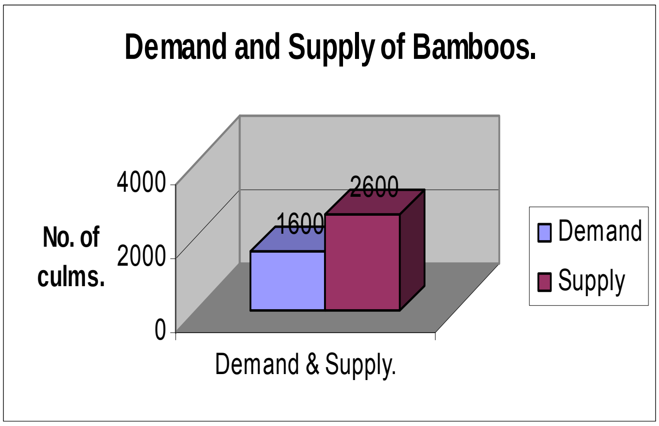

Figure 4. Demand and supply of bamboo