

SEASONAL ASSESSMENT OF BIOMASS AND CARBON SEQUESTRATION OF HERBS AND LITTER IN HOMEGARDEN AGROFORESTRY SYSTEM OF SHUATS CAMPUS, PRAYAGRAJ.

ABSTRACT

An increase in greenhouse gases (GHGs) in the atmosphere, such as CO₂, is what drives global warming. Strong carbon management is the first step in helping to stop climate change, safeguard human health, and create profitable businesses. A key strategy for lowering GHG emissions is carbon capture and storage. The study aimed to investigate the carbon sequestration potential of the herbaceous vegetation and litter layer in homegarden agroforestry systems during the rainy, winter, and summer seasons in the SHUATS Campus, Prayagraj. The total dry weight of the herbaceous layer and litter layer was measured, and the corresponding carbon sequestration values were calculated. During the rainy season, the herbaceous layer exhibited a total dry weight ranging from 0.31 kg m⁻² to 0.36 kg m⁻², resulting in carbon sequestration values ranging from 1.83 Mg C ha⁻¹ to 2.13 Mg C ha⁻¹. The litter layer had a total dry weight ranging from 0.13 kg m⁻² to 0.16 kg m⁻², contributing to carbon sequestration values ranging from 0.76 Mg C ha⁻¹ to 0.92 Mg C ha⁻¹. In the winter season, the herbaceous layer demonstrated a total dry weight ranging from 0.22 kg m⁻² to 0.28 kg m⁻², resulting in carbon sequestration values ranging from 1.29 Mg C ha⁻¹ to 1.65 Mg C ha⁻¹. Similarly, the litter layer exhibited a total dry weight ranging from 0.18 kg m⁻² to 0.216 kg m⁻², contributing to carbon sequestration values ranging from 1.05 Mg C ha⁻¹ to 1.25 Mg C ha⁻¹. During the summer season, the herbaceous layer displayed a total dry weight ranging from 0.303 kg m⁻² to 0.361 kg m⁻², resulting in carbon sequestration values ranging from 1.76 Mg C ha⁻¹ to 2.10 Mg C ha⁻¹. The litter layer had a total dry weight ranging from 0.16 kg m⁻² to 0.24 kg m⁻², contributing to carbon sequestration values ranging from 1.00 Mg C ha⁻¹ to 1.32 Mg C ha⁻¹. The results indicate that the herbaceous layer and litter layer of homegarden agroforestry systems in the SHUATS Campus, Prayagraj, have the potential to sequester significant amounts of carbon during different seasons. This highlights the importance of homegardens in mitigating climate change and promoting sustainable land management practices.

Keywords: Carbon Sequestration, Herbaceous Vegetation, Litter Layer, Homegarden Agroforestry, Rainy Season, Winter Season, Summer Season.

INTRODUCTION

Carbon dioxide, a trace gas found in Earth's atmosphere, is necessary for photosynthesis, the greenhouse effect, and the marine carbon cycle. One of the many greenhouse gases that are in

the earth's atmosphere is this one. Carbon appears throughout life in numerous ways. Carbon is a chemical element, just like hydrogen or nitrogen, and an essential component of biomolecules. It exists on Earth as a solid, dissolved substance, or gas. For instance, gaseous carbon dioxide (CO₂) is created when carbon and oxygen interact; this chemical is also present in graphite and diamond. Animal cells and other structural components are primarily composed of organic substances that sustain cellular processes. Life as we know it would not exist without the presence of carbon. The oceans have 48,000 Gt of the planet's total carbon, of which 39,000 Gt are in the seas. Only 6,000 Gt of fossil C, the second-largest deposit, is available. Furthermore, the amount of terrestrial carbon (C) stored in the world's forests, plants, and soils is only 2500 Gt, as opposed to the 800 Gt in the atmosphere. As a result of human activity, the normal movement of carbon compounds between the atmosphere, the oceans, and terrestrial ecosystems is currently being changed. The annual emissions from the use of fossil fuels, including the manufacture of cement, are 6.3 Gt of carbon dioxide, of which 2.3 Gt is taken up by the seas, 0.7 Gt is used by terrestrial ecosystems, and 3.3 Gt is added to the atmosphere. [Hairiah et al. \(2009\) ?](#)

Two major issues that humans are currently facing—the loss of biodiversity and rising atmospheric CO₂ levels—both eventually result in a change in the planet's climate (Kumar, 2011). An increase in greenhouse gases (GHGs) in the atmosphere, such as CO₂, is what drives global warming. Strong carbon management is the first step in helping to stop climate change, safeguard human health, and create profitable businesses. A key strategy for lowering GHG emissions is carbon capture and storage. One technique that researchers use to postpone the effects of climate change is learning how to absorb and store carbon dioxide. The significance of this approach in the fight against climate change is becoming more widely acknowledged by the scientific community.

Sequestration is a method used to remove greenhouse gases from the atmosphere (Sreejesh, 2016). As a result of learning about the many advantages of agroforestry, the Indian government released an ambitious National Agroforestry Policy in 2014 to encourage planting trees on farms. To increase smallholder farmers' productivity, income, and standard of life, the strategy aims to integrate diverse agroforestry-focused policies, initiatives, and groups. When India presented the National Agroforestry plan (NAP) at the World Agroforestry Congress in Delhi in February 2014, it became the first country in the world to adopt a full agroforestry plan. Gifawesen et al. (2020) estimate that the agriculture sector is currently to blame for 25% of the world's greenhouse gas emissions. Home gardens with multi-layered canopy and a variety of floral composition can stock C ([Above-ground](#)

biomass; AGB)(incorrect statement) from medium to high levels, mimicking secondary forests, as opposed to monoculture systems with annual and perennial crops (Kumar, 2006). Agroforestry has been recognized as a promising tactic in addressing the problem since storing carbon in plants is a practical method to reduce greenhouse gas emissions in the atmosphere (Gedefaw et al., 2014).

Home gardens are considered to be climate-smart, tree-crop integrated, subsistence-level agricultural systems that are resistant to extreme climatic hazards, which is consistent with our findings (Gifawesen et al., 2020). In order to lower atmospheric CO₂ and lessen the effects of climate change, tree-based agroforestry hastens the process of atmospheric carbon sequestration (Wilson and Lovell, 2016). Trees absorb carbon dioxide through the biological process of photosynthesis and store it as carbon in their trunks, branches, leaves, and roots. Furthermore, soil serves as a significant carbon sink in forests due to the fact that it stores carbon. Natural forests, plantations, agroforestry techniques, and a number of other activities all serve as biomass and carbon dioxide (CO₂) sinks via photosynthesis (David and Crane, 2002). Standing biomass from plants, such as wood, and underground plant roots are two examples of long-living carbon pools where the carbon that plants accumulate during photosynthesis is stored. It seems reasonable that larger plants sequester more carbon since biomass is where plants store carbon. Because of this, adding trees to agricultural landscapes will unquestionably improve the capacity of agricultural systems to store carbon (Atangana et al., 2014). (should be new paragraph) Biomass is the term used to describe the entire mass of all organic stuff, both living and dead. When an area's biomass is taken into account (Kuyah et al., 2013), it is expressed in kg per unit area, and when a specific tree is mentioned, it is stated in kg per tree. Carbon makes approximately about half of plant biomass. The most straightforward and accurate pool to measure in agroforestry trees is the above-ground tree carbon pool (Raj, 2014). Deforestation and degradation have a direct impact on this pool. The challenging to quantify belowground biomass of trees is a significant additional carbon sink. The root-to-shoot ratio is often used to gauge belowground root biomass since there is a continuous relationship between the two types of biomass. Standing subterranean vegetation, shrubs, herbs, and cover crops are a few types of herbaceous and understory vegetation that absorb carbon. In sample plots, this pool is classified as damaging. According to Collins et al. (2000) and the entire carbon cycle, the dynamics of soil organic carbon (SOC) are crucial for the long-term productivity of ecosystems. Nair et al. (2009) reviewed soil carbon sequestration in agroforestry in comparison to other land-use systems, noting a general trend of rising soil organic carbon (SOC), an indicator of SCS (??), in agroforestry and ranking

the various land-use systems according to their SOC content in the following order: forests > agroforests > tree plantations > arable crops. In Indian soils, the total SOC pool is thought to be 21 Pg to a depth of 30 cm and 63 Pg to a depth of 150 cm. Lal (2004) estimates that the SOC pool in Indian soils makes up 2.2% of the global pool at 1 m of depth and 2.6% at 2 m. Lal (2004). According to Davis et al. (2017), a variety of factors, including species richness, plantation age, management rigor, spacing, and cropping type, affect the ability of plantation crops to store carbon. [Long-term CSP \(???\)](#) increases are a result of slower-growing species' wood having a higher specific gravity (Nair et al., 2010).

Due to their excellent ability to adapt to and mitigate climate change as well as their role in lowering household food security and nutrition due to rising food prices (Minanget al. 2012; Nair 2012; Galhenaet al. 2013), agroforestry systems have recently attracted increased attention. Since agroforestry systems may retain agricultural output while also capturing carbon, they are an effective alternative for environmental management (Schoeneberger 2009; Kumar and Nair 2011). Establishing links between protected forests, preserving watershed hydrology, conserving soil, increasing farm income, ensuring food security and stable land tenure in developing countries, and [restoring and maintaining above- and below-ground biodiversity \(what does ???\)](#) are some of the secondary benefits that could result (Pandey, 2002). The difficulty with agroforestry systems is preserving the benefits of various tree species while minimizing the negative effects of crop competition (Lott et al., 2000). [\(Should be a new paragraph??\)](#) Homegardens are traditional agroforestry systems that contribute significantly to local biodiversity conservation and provide various ecosystem services. [Understanding the composition and structure of homegardens is crucial for assessing their ecological significance \(out of scope\)](#). This study focuses on the Homegarden Agroforestry system of the SHUATS Campus in Prayagraj, aiming to evaluate the biomass and carbon sequestration of homegardens during the rainy, winter and summer seasons.

EXPERIMENTAL METHODOLOGY

Direct method involving sampling area i.e. as mentioned above (Homegarden Agroforestry system in SHUATS Campus, Prayagraj) and also based on secondary data.

[EXPERIMENTAL FINDINGS AND DISCUSSION ????](#)

MATERIALS AND METHODOLOGY

Study Area: Prayagraj is located at 25.87° North, 81.15° East, and has an elevation of 78 metres above sea level. The study was conducted in SHUATS Campus, Prayagraj. [Total six plots and 24 sites were taken for data collection \(**is it sample size?\)](#).

Climate: In the South-East of the U.P., (**confuses the reader) have a subtropical climate with both seasonal temperature extremes—winter and summer—predominates. In extremely cold winters, it can get as cold as 32°F in December and January, while in extremely hot summers, it can be as hot as 115°F in May and June. Frost in the winter and sweltering summer winds are also frequent. The annual average rainfall is about 1013.4 millimetres, with the rainiest months being July through September and the winter months seeing sporadic showers(**No references, and seems story).

Data Collection: The dry weight of the herbaceous layer and litter layer was measured in each plot during the rainy, winter, and summer seasons. Harvest the aboveground biomass of each sampled plant, separating leaves, stems, and flowers when applicable. Dry the biomass samples in an oven at a specified temperature until constant weight is achieved. Weigh the dried samples to determine the biomass of each plant component. Randomly select a specified number of litter sampling points within each garden. Collect the surface litter material from each sampling point by systematically sampling a defined area. Remove any non-litter materials (e.g., rocks, twigs) from the collected litter samples. Dry the litter samples in an oven at a specified temperature until constant weight is achieved. Weigh the dried samples to determine the litter biomass. For Carbon Content Analysis take subsamples of the dried biomass and litter samples. Grind the subsamples into a fine powder using a mortar and pestle or a grinding mill. Analyze the carbon content of the subsamples using a carbon analyzer or similar equipment. Calculate the carbon content of the biomass and litter samples(**under data collection harvesting of litter, sampling of plots, collecting of carbon data and others are mentioned in mere way and please try to rewrite; the sampling of plots, collecting of litter for both herbs and litter are not clearly stated) .

Data Analysis: Calculate the average biomass and carbon content for each herb species and litter across all homegardens. Calculate the total biomass and carbon sequestration potential of herbs and litter for each homegarden and the entire sample. Analyze the data statistically using appropriate methods (e.g., t-tests, ANOVA) to identify significant differences between herb species, garden sizes, or management practices(**what is the significances of this section? It is too shallow for the readers).

Methodology:

For the purpose of calculating the biomass and carbon content of the understory herbaceous vegetation and litter layer, destructive sampling (***is it a type of sampling or data collection??? please take care) were employed. Four subplots (quadrats of 1 m x 1 m area) were sampled for herbaceous vegetation and litter layers at a distance of 1 m from the mainplot's exterior boundary in each of the four cardinal directions: N, E, S, and W (***confusing; written in carelessness). An aluminum/wooden square frame measuring 1 m × 1 m will be used (*** the manuscript is not at the propose stage) to sample the litter layer and herbaceous material at these four subplots (diameter 5 cm). A digital scale were used to weigh and record each sample of plant material and litter. After thoroughly mixing the samples, 100g of each subsample will be obtained (propoesal??) to determine the moisture content (*** the sampling technique is vague; very shallow,).

The samples that were obtained were dried in an oven and by air(****why dried by oven and air? For what reason? Why didn't you dried in similar technique??).***The samples will be (boring!!)dried in the oven for at least 48 hours or until they reach their stable weight, with the temperature set between 65 and 70 °C. In order to calculate the total dry weights, the oven-dryweights of subsamples will be calculated (Hairiah et al., 2001):

$$\text{Total Dry Weight (kg m}^{-2}\text{)} = \frac{\text{Total Fresh Weight (kg)} \times \text{Subsample Dry Weight (g)}}{\text{Subsample Fresh Weight (g)} \times \text{Sample Area (m}^2\text{)}}$$

Carbon Content Analysis: A small sample (2 grams) of each one of the herbaceous vegetation and litter layer were powdered using a mortar and pestle or a grinding mill(****different fonts)and 0.5gm same sieved and weighed(****why? What is the importance of grinding? Which one is grinded- air dried or oven?) .sample kept in muffle furnace for five hours at 550⁰C. weight of the ash was taken for calculating ash% or carbon content . Calculate the carbon content of the biomass and litter samples (***no references, and that made it story tell) .

$$\text{carbon content \%} = \frac{\text{weight of the ash}}{\text{Subsample Dry Weight (g)}} \times 100$$

$$\text{Conversion Factor} = (100 - \text{ash\%}) \times 0.58$$

Carbon storage in herbaceous vegetation and litter layer will be computed using the formula (Lascoet al., 2006):

Carbon Sequestration/Carbon Density in Herbaceous Vegetation and Litter (Mg C ha^{-1})

$$= \text{Total Dry Weight (Mg ha}^{-1}) \times \text{Carbon Conc. \%}$$

[Where, Total Dry Weight = Mg/ ha; Carbon Conc. (%) = g C/ 100 g biomass]

RESULTS AND DISCUSSION

CARBON SEQUESTRATION OF HERBACEOUS VEGETATION AND LITTER LAYER OF HOMEGARDENS DURING RAINY, WINTER AND SUMMER SEASONS

Carbon sequestration of herbaceous vegetation and litter layer of homegardens during Rainy(????)

Table-1 depicts the data relevant to the calculation of carbon sequestration of herbaceous vegetation and litter layer in homegardens across selected areas of the SHUATS Campus, Prayagrajin Rainy season

TotaldryweightofherbaceousLayer (Kg m^{-2}) and litter layer in Rainy season (???)

Highest value was observed in Intermediate College(0.36 kg m^{-2}) followed by Yesu Darbar South(0.35 kg m^{-2}) Chapel South(0.34 kg m^{-2}) Yesu Darbar North(0.33 kg m^{-2}) Chapel North(0.32 kg m^{-2}) Yesu Darbar east (0.31 kg m^{-2}) Similar results were also reported by (Liu *et al.*, 2017). Highest value was observed in Chapel North(0.161 kg m^{-2}) followed by Intermediate College(0.150 kg m^{-2}), Chapel South(0.146 kg m^{-2}), Yesu Darbar South(0.142 kg m^{-2}), Yesu Darbar North(0.133 kg m^{-2}) Yesu Darbar east(0.130 kg m^{-2})(*** table should be here; table is not referred).

Carbondensityofherbaceousand litter layer(MgCha^{-1}) Rainy season

Results revealed that highest carbon density of herbaceous layer were observed in Intermediate College(2.13 MgCha^{-1}) followed by Yesu Darbar South(2.06 MgCha^{-1}) Chapel South($1.98 \text{ Mg C ha}^{-1}$) Yesu Darbar North($1.92 \text{ Mg C ha}^{-1}$) Chapel North($1.89 \text{ Mg C ha}^{-1}$) and Yesu Darbar east ($1.83 \text{ Mg C ha}^{-1}$). Results revealed that highest carbon density of litter layer were observed in Chapel North($0.92 \text{ Mg C ha}^{-1}$) followed by Intermediate College($0.87 \text{ Mg C ha}^{-1}$), Chapel South($0.84 \text{ Mg C ha}^{-1}$), Yesu Darbar South($0.82 \text{ Mg C ha}^{-1}$), Yesu Darbar North($0.77 \text{ Mg C ha}^{-1}$), Yesu Darbar east($0.76 \text{ Mg C ha}^{-1}$)(****why it was highest in one sample site while lowest in other? Is there any reason as researcher??; table and figure are not referred).

Table1: Carbon Sequestration of Herbaceous and Litter Layer of Homegarden Agroforestry System during Rainy Season in SHUATS Campus, Prayagraj

Plots	Total dry weight of herbaceous layer (kg m^{-2})	Carbon Sequestration of herbaceous (Mg C ha^{-1})	Total dry weight of litter layer (kg m^{-2})	Carbon Sequestration of litter (Mg C ha^{-1})
Yeslu Darbar North	0.33	1.92	0.133	0.77
Yeslu Darbar South	0.35	2.06	0.142	0.82
Yeslu Darbar East	0.31	1.83	0.130	0.76
Chapel North	0.32	1.89	0.161	0.92
Chapel South	0.34	1.98	0.146	0.84
Intermediate College	0.36	2.13	0.150	0.87
F-test	S	S	S	S
CD@5%	0.019	0.011	0.016	0.009
SE(m)	0.006	0.004	0.005	0.003
SE(d)	0.009	0.005	0.007	0.004

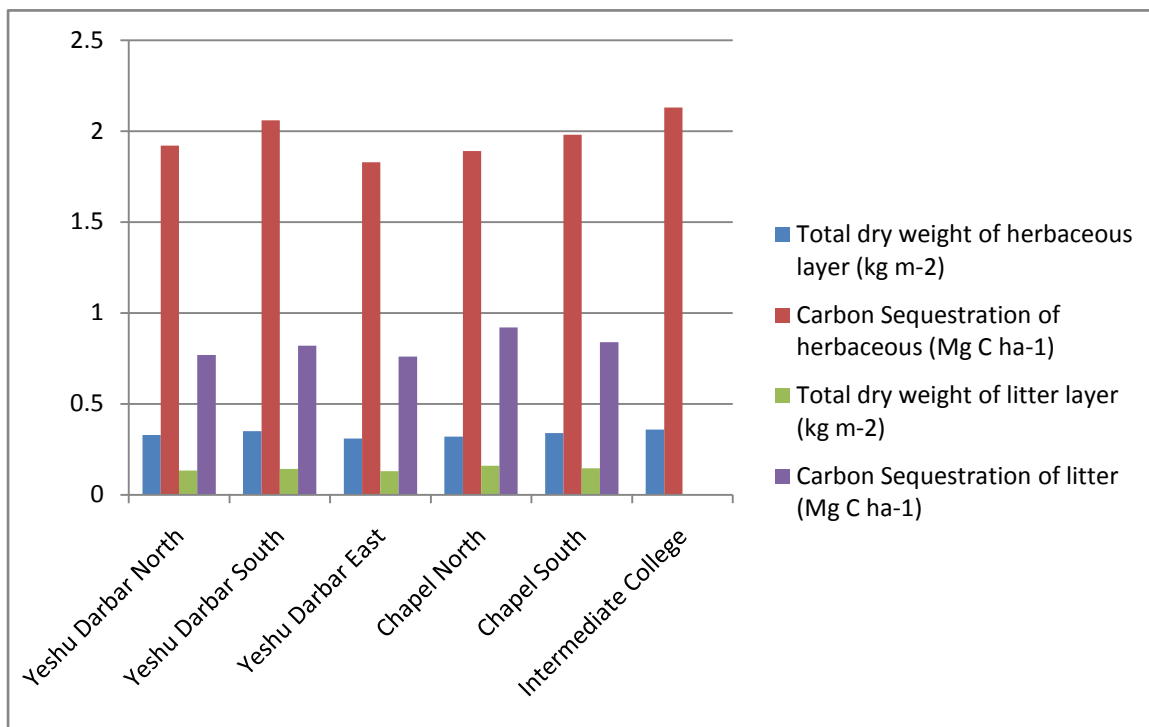


Fig.1: Carbon Sequestration of Herbaceous and Litter Layer of Homegarden Agroforestry System during Rainy Season in SHUATS Campus, Prayagraj.

CARBON SEQUESTRATION OF HERBACEOUS VEGETATION AND LITTER LAYER OF HOMEGARDENS DURING WINTER SEASON (the months of seasons should be listed in the paragraphs because of the seasons variation between northern and southern hemispheres)**

Total dry weight of herbaceous and Litter Layer (Kg m⁻²) in Winter season

Highest value was observed in Intermediate College (0.28 kg m⁻²) followed by Yeshu Darbar South (0.26 kg m⁻²) Chapel South (0.25 kg m⁻²) Yeshu Darbar North (0.24 kg m⁻²) Chapel North (0.23 kg m⁻²) Yeshu Darbar east (0.22 kg m⁻²). This is shown in table 2.

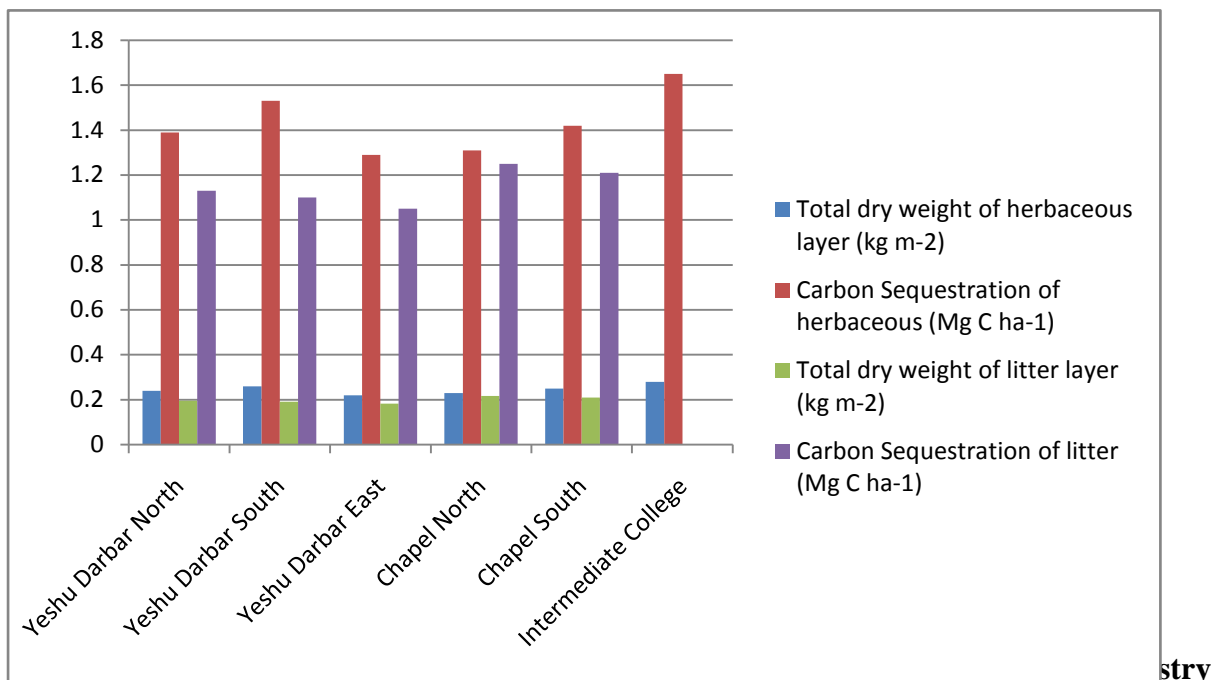
Similar results were also reported by (Liu *et al.*, 2017). Litter Layer Highest value was observed in Chapel North (0.216 kg m⁻²) followed by Chapel South (0.209 kg m⁻²), Intermediate College (0.205 kg m⁻²), Yeshu Darbar North (0.195 kg m⁻²), Yeshu Darbar South (0.191 kg m⁻²) Yeshu Darbar east (0.183 kg m⁻²). Surface litter was higher in the AFS system when compared with monoculture, possibly due to an additional litter deposition by the shade trees. However, one-time biomass samples do not reflect the dynamics of litter fall in the systems (** what are months of winter season??).

Carbon density of herbaceous and Litter layer (Mg Cha⁻¹) Winter season

Results revealed that highest carbon density of herbaceous layer were observed in Intermediate College (1.65 Mg C ha⁻¹) followed by Yesu Darbar South (1.53 Mg C ha⁻¹) Chapel South (1.42 Mg C ha⁻¹) Yesu Darbar North (1.39 Mg C ha⁻¹) Chapel North (1.31 Mg C ha⁻¹) and Yesu Darbar east (1.29 Mg C ha⁻¹). Litter vegetation Results revealed that highest carbon density of litter layer were observed in Chapel North (1.25 Mg C ha⁻¹) followed by Chapel South (1.21 Mg C ha⁻¹), Chapel South (1.19 Mg C ha⁻¹), Yesu Darbar North (1.13 Mg C ha⁻¹), Yesu Darbar South (1.10 Mg C ha⁻¹), Yesu Darbar east (1.05 Mg C ha⁻¹).

Table-2 Carbon Sequestration of Herbaceous and Litter Layer of Homegarden Agroforestry System during Winter Season in SHUATS Campus, Prayagraj.

Plots	Total dry weight of herbaceous layer (kg m ⁻²)	Carbon Sequestration of herbaceous (Mg C ha ⁻¹)	Total dry weight of litter layer (kg m ⁻²)	Carbon Sequestration of litter (Mg C ha ⁻¹)
Yesu Darbar North	0.24	1.39	0.195	1.13
Yesu Darbar South	0.26	1.53	0.191	1.1
Yesu Darbar East	0.22	1.29	0.183	1.05
Chapel North	0.23	1.31	0.216	1.25
Chapel South	0.25	1.42	0.209	1.21
Intermediate College	0.28	1.65	0.205	1.19
F-test	S	S	S	S
CD@5%	0.031	0.018	0.019	0.012
SE(m)	0.010	0.006	0.006	0.004
SE(d)	0.015	0.009	0.009	0.005



System during Winter Season in SHUATS Campus, Prayagraj.

CARBON SEQUESTRATION OF HERBACEOUS VEGETATION AND LITTER LAYER OF HOMEGARDENS DURING SUMMER SEASON

Total dry weight of herbaceous and Litter Layer (Kg m⁻²) in Summer season

Highest value shown in table-3 was observed in Intermediate College (0.361 kg m⁻²) followed by Yeshu Darbar South (0.35 kg m⁻²) Chapel South (0.333 kg m⁻²) Yeshu Darbar North (0.311 kg m⁻²) Chapel North (0.309 kg m⁻²) Yeshu Darbar east (0.303 kg m⁻²) this shown in table 3. Similar results were also reported by (Liu *et al.*, 2017). In litter layer Highest value was observed in Chapel North (0.228 kg m⁻²) followed by Chapel South (0.214 kg m⁻²), Intermediate College (0.210 kg m⁻²), Yeshu Darbar North (0.200 kg m⁻²), Yeshu Darbar South (0.190 kg m⁻²) Yeshu Darbar east (0.173 kg m⁻²). Surface litter was higher in the AFS system when compared with monoculture, possibly due to an additional litter deposition by the shade trees. However, one-time biomass samples do not reflect the dynamics of litter fall in the systems (****yet havent discussed with similar works).

Carbon density of herbaceous and Litter layer (Mg Cha⁻¹) Summer season

Results revealed that highest carbon density of herbaceous layer were observed in Intermediate College (2.10 Mg Cha⁻¹) followed by Yeshu Darbar South (2.03 Mg Cha⁻¹) Chapel South (1.93 Mg C ha⁻¹) Yeshu Darbar North (1.81 Mg C ha⁻¹) Chapel North (1.79 Mg C ha⁻¹) and Yeshu Darbar east (1.76 Mg C ha⁻¹) in Litter vegetation Results revealed that highest carbon density of litter

layer were observed in Chapel North(1.32Mg C ha⁻¹) followed by Chapel South (1.24Mg C ha⁻¹), Intermediate College(1.22Mg C ha⁻¹), Yesu Darbar North(1.16Mg C ha⁻¹), Yesu Darbar South(1.10Mg C ha⁻¹), Yesu Darbar east(1.00Mg C ha⁻¹).

Table-3: Carbon Sequestration of Herbaceous and Litter Layer of Homegarden Agroforestry System during Summer Season in SHUATS Campus, Prayagraj.

Plots	Total dry weight of herbaceous layer (kg m ⁻²)	Carbon Sequestration of herbaceous (Mg C ha ⁻¹)	Total dry weight of litter layer (kg m ⁻²)	Carbon Sequestration of litter (Mg C ha ⁻¹)
Yesu Darbar North	0.311	1.81	0.19	1.16
Yesu Darbar South	0.35	2.03	0.18	1.1
Yesu Darbar East	0.303	1.76	0.16	1
Chapel North	0.309	1.79	0.24	1.32
Chapel South	0.333	1.93	0.22	1.24
Intermediate College	0.361	2.1	0.2	1.22
F-test	S	S	S	S
CD@5%	0.013	0.01	0.008	0.005
SE(m)	0.004	0.003	0.003	0.001
SE(d)	0.006	0.005	0.004	0.002

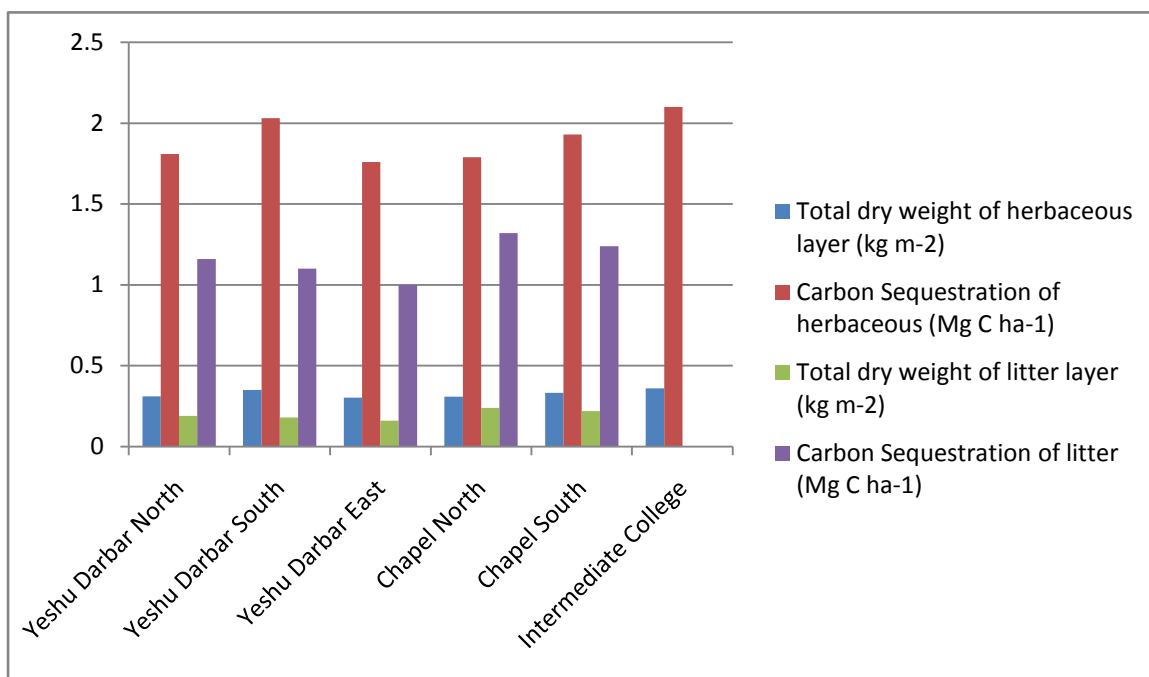


Fig.3: Carbon Sequestration of Herbaceous and Litter Layer of Homegarden Agroforestry System during Summer Season in SHUATS Campus, Prayagraj.

CONCLUSION

Homegardens can play a crucial role in climate change mitigation by sequestering substantial amounts of carbon in their herbaceous vegetation and litter layer. The homegarden agroforestry systems in SHUATS Campus, Prayagraj have significant potential for carbon sequestration. The herbaceous layer and litter layer of these systems play a crucial role in capturing and storing carbon. This results highlight the importance of these systems in mitigating climate change by sequestering carbon. From the data, it is concluded that the herbaceous layer in homegarden agroforestry systems contributes significantly to carbon sequestration during all seasons. The highest carbon sequestration values were observed in the Intermediate College plot during all seasons, indicating the potential of this system to sequester carbon. The litter layer also contributes to carbon sequestration, although to a lesser extent compared to the herbaceous layer. The carbon sequestration values varied among different plots and seasons, highlighting the importance of considering seasonal variations in carbon sequestration assessments. Further research is needed to assess the long-term carbon sequestration potential of homegardens and to explore management practices that can enhance carbon sequestration in these systems. (****the carbon sequestration among different seasons doesn't concluded for herbaceous and litter layer ?) weak conclusion; weak discussion, etc).

REFERENCES

- Atangana, A., Khasa, D., Chang, S. and Degrande, A. (2014). Carbon sequestration In agroforestry systems. In *Tropical Agroforestry* (pp. 217-225). Springer, Dordrecht.
- Collins, H.P., Elliott, E.T., Paustian, K.E.I.T.H., Bundy, L.G., Dick, W.A., Huggins, D.R. and Paul, E.A. (2000). Soil carbon pools and fluxes in long-term corn belt agroecosystems. *Soil Biology and Biochemistry*, Vol. **32(2)**: 157-168.
- David, J. and Crane, E. (2002). Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution*. **116(3)**: 381-389
- Davis, P.L., Panneerselvam, S., Kannan, B., Subramanian, K.S., Shoba, N. and Maheswarappa, H.P. (2017). Study on the Characteristics of Coconut Plantation in the Western Zone of Tamil Nadu-as a Source of Carbon Sink to Mitigate Climate Change. *International Journal of Current Microbiology and Applied Science*, Vol. **6(12)**: 3477-3483.
- Galhena, D.H., Freed, R. and Maredia, K.M. (2013). Home gardens: a promising approach to enhance household food security and wellbeing. *Agriculture & Food Security*, 2013; **2(8)**:48–62.
- Gedefaw, M.(2014). Forest carbon stocks in woody plants of tara gedam forest: implication for climate change mitigation, *Sci. Technol. Arts Res. J.*
- Gifawesen, S.T., Tola, F.K. and Duguma, M.S. (2020). Review on role of home garden agroforestry practices to improve.
- Hairiah, K. (2010).Measuring carbon stocks across land use systems: a manual. Bogor, Indonesia., World Agroforestry Centre (ICRAF), SEA Regional Office
- Hairiah, K., Sitompul, S.M., Van Noordwijk, M. and Palm, C. (2001). Methods for sampling carbon stocks above and belowground (pp. 1-23). Bogoi: ICRAF.
- Kumar, B.M. (2011). Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. *Agriculture, ecosystems and environment*, Vol. **140(3-4)**: 430-440.
- Kumar, B.M. and Nair, P.R. (Eds.). (2011). Carbon sequestration potential of agroforestry systems: opportunities and challenges Vol. **8**. Springer Science and Business Media.
- Kumar, B.M. (2006).Carbon sequestration potential of tropical homegardens, Land Use and Land Cover of Sri Lanka, 2019. Land Use Policy Planning Department, Colombo, Sri Lanka. ISBN.
- Kuyah, S., Dietz, J., Muthuri, C., Van Noordwijk, M. and Neufeldt, H. (2013). Allometry and partitioning of above-and below-ground biomass in farmed eucalyptus species dominant in Western Kenyan agricultural landscapes. *biomass and bioenergy*, Vol. **55**: 276-284.
- Lal,R.(2004).Soilcarbonsequestrationtomitigateclimatechange.*Geoderma*,Vol.**123(1-2)**:1-22.
- Liu, C., Pang, J., Jepsen, M. R., Lü, X. and Tang, J. (2017). Carbon stocks across a fifty-year chronosequence of rubber plantations in tropical China. *Forests*, Vol. **8(6)**: 209.

Lott, J.E., Howard, S.B., Ong, C.K. and Black, C.R. (2000). Long-term productivity of a *Grevillea robusta*-based overstorey agroforestry system in semi-arid Kenya: I. Tree growth. *Forest ecology and management*, Vol. **139**(1-3): 175-186.

Minang, P.A., Van Noordwijk, M. and Swallow, B.M. (2012). High-carbon-stock rural development pathways in Asia and Africa: improved land management for climate change mitigation. In: Nair PKR, Garrity DP (eds) *Agroforestry: the future of global land use*. Springer, The Netherlands, :127–143.

Nair, P.K.R. (2012). Climate change mitigation: a low-hanging fruit of agroforestry. In: Nair PKR, Garrity D (eds) *Agroforestry – the future of global land use*. Springer, Dordrecht, : 31–67.

Nair, P.K.R., Kumar, B.M. and Nair, V.D. (2009) Agroforestry as a strategy for carbon sequestration. *Journal of Plant Nutrition and Soil Science*, Vol. **172**: 10–23.

Nair, P.R. (2011). Methodological challenges in estimating carbon sequestration potential of agroforestry systems. In *Carbon sequestration potential of agroforestry systems* (pp.3-16). Springer, Dordrecht.

Nair, P.R., Nair, V.D., Kumar, B.M. and Showalter, J.M. (2010). Carbon sequestration in agroforestry systems. *Advances in agronomy*, Vol. **108**: 237-307.

Pandey, D.N. (2002). Carbon sequestration in agroforestry systems. *Climate policy*, Vol. **2**(4): 367-377.

Raj, A.J. (2014) Agroforestry for carbon sequestration, climate change mitigation and adaptation. In: *Agroforestry: Theory and Practices* (eds.) Raj AJ and Lal SB, *Scientific Publishers*, India, 702-736 pages.

Schoeneberger, M.M. (2009). Agroforestry: working trees for sequestering carbon on agricultural lands. *Agroforestry systems*, Vol. **75**(1): 27-37.