LIVING CARBONOMICS: TRACKING FOOTPRINT AND STORAGE DYNAMICS ABOVE AND BELOW GROUND

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ABSTRACT

THE OBJECTIVE OF THIS STUDY IS TO EVALUATE CARBON DYNAMICS IN THE RESEARCH AREA BY ASSESSING BOTH ABOVEGROUND AND BELOWGROUND CARBON STORAGE, AS WELL AS NET PRIMARY PRODUCTIVITY (NPP) AND PERSONAL CARBON FOOTPRINTS, UTILIZING THE NON-STANDARD SITE CARBON CYCLE PROTOCOL FOR MEASURING CARBON DYNAMICS.

THE MEASUREMENTS INCLUDE:

1. CIRCUMFERENCE AT BREAST HEIGHT (CBH) OF TREE TRUNKS, THE HEIGHT OF SHRUBS OR SAPLINGS USED IN ALLOMETRIC EQUATIONS TO CALCULATE BIOMASS AND WEIGHING HERBACEOUS COMPONENTS FOR DETERMINING ABOVEGROUND CARBON STORAGE.
2. PERIODIC VEGETATION GROWTH ASSESSMENTS FOR EVALUATING NPP.
3. SOIL CHARACTERIZATION, STAR-PATTERN SOIL MOISTURE, DEPTH PROFILE SOIL MOISTURE, SOIL BULK DENSITY PROTOCOLS, AND ORGANIC CARBON CONTENT FOR CALCULATING BELOWGROUND CARBON STORAGE.

THE PERSONAL CARBON FOOTPRINT DATA IS GATHERED AND EVALUATED USING THE INTERNATIONAL STANDARD ISO 14064-1:2006 FOR GREENHOUSE GAS QUANTIFICATION AND REPORTING.

INTRODUCTION

THE INCREASING GLOBAL TEMPERATURE IS A CONSEQUENCE OF HUMAN-INDUCED DISRUPTION TO THE BALANCE OF CARBON DIOXIDE IN THE WORLD.

GREENHOUSE GASES (GHG) RESULT FROM BURNING BIOENERGY, CHEMICAL PROCESSES, LAND USE, LIVESTOCK FARMING, AND FERTILIZER/ANIMAL MANURE USE.

THESE GASES IN THE ATMOSPHERE CAN TRAP, ABSORB, AND RE-EMIT INFRARED RADIATION FROM THE SUN.

HYPOTHESIS

- Large trees lead in carbon storage, followed by shrubs and grasses.
- Tree age, height, and diameter at breast height (DBH) exhibit a positive relationship.
- Carbon storage in trees positively correlates with biomass.
- Higher NPP leads to greater carbon sequestration over time.
- Large trees dominate aboveground carbon storage, while grasses contribute more to belowground carbon storage.
- Soil carbon storage is expected to equal aboveground carbon storage at the site.
- Our carbon footprint might exceed vegetation's storage capacity.
- Electricity stands out as the primary carbon footprint contributor.

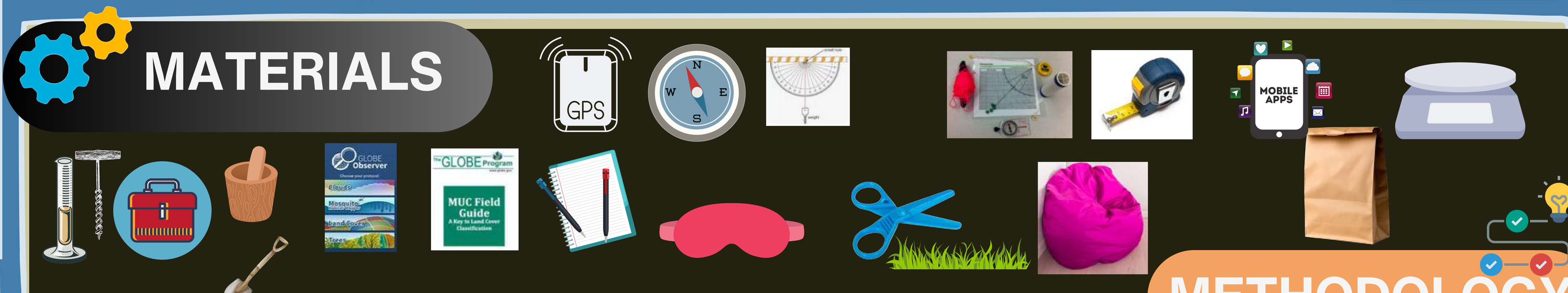
OBJECTIVE

To quantify and compare our carbon footprint with the capacity of both the vegetation and soil to store carbon.

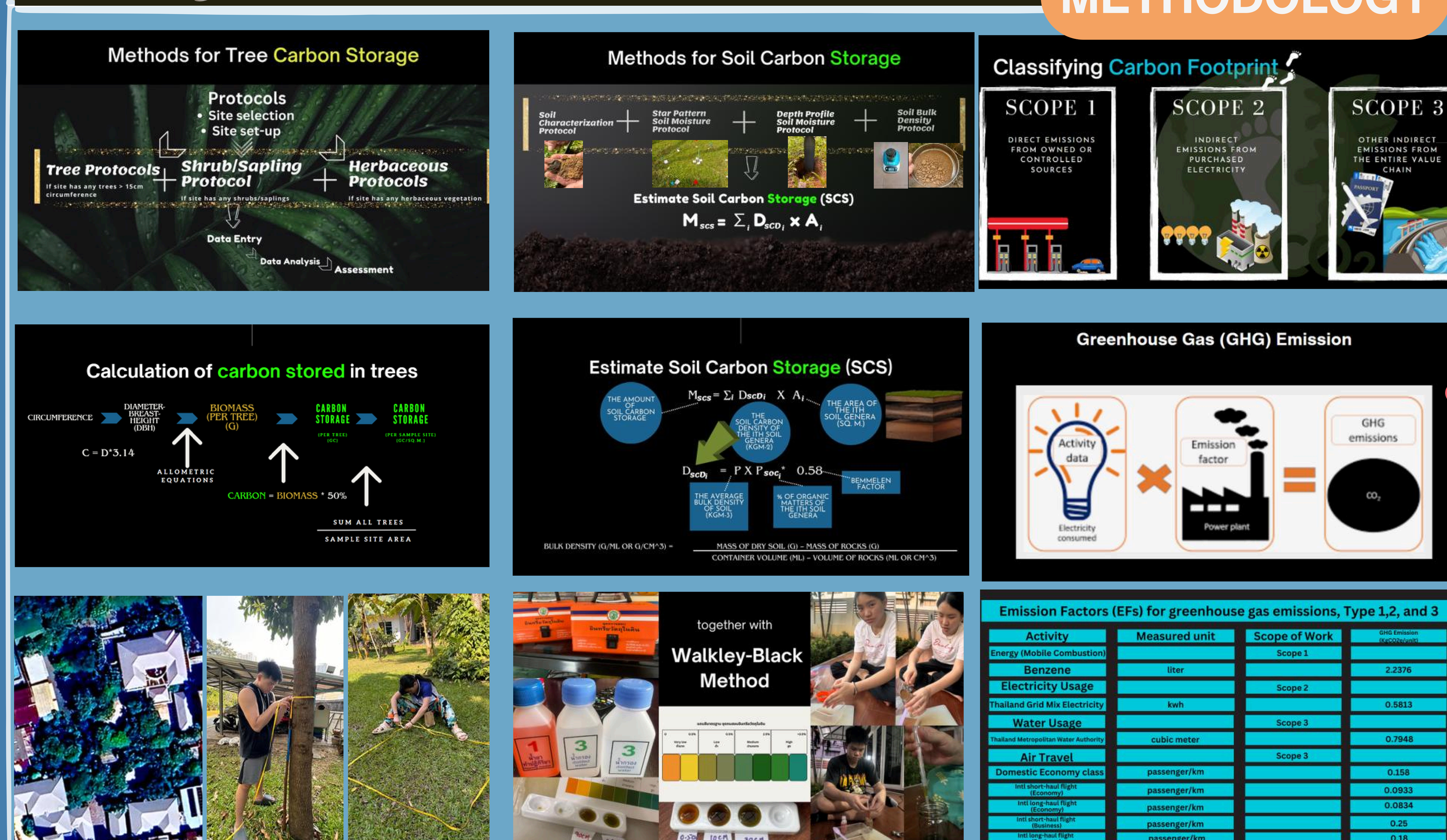
Research Questions

- How does carbon storage in large trees compare to shrubs & herbaceous?
- How do tree age, height, DBH correlate with carbon storage?
- How does vegetation biomass relate to carbon storage potential?
- How does NPP correlate with biomass and carbon storage?
- How do aboveground and belowground carbon storage vary across ecosystems and methods?
- How does the carbon footprint compare to storage capacity, and what are the main contributors?

MATERIALS

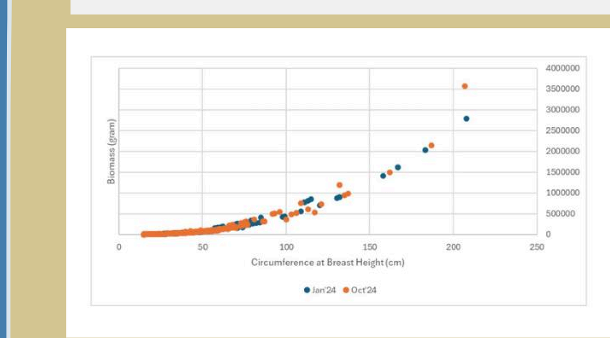


METHODOLOGY



Data Summary

Tree Circumference vs. Aboveground Biomass



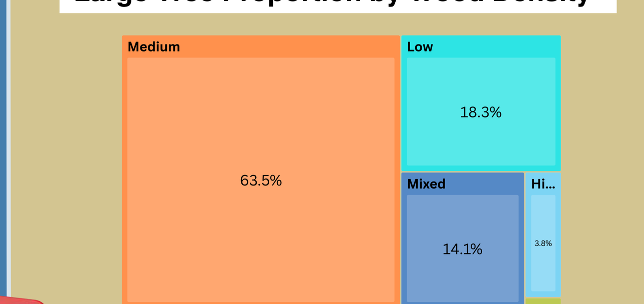
Summary of the Carbon Storage in Vegetation

	Oct-24	Jan-24	NPP
	gC/m2	gC/m2	gC/m2
Trees	1,811	1,618	193
Shrubs & Saplings	23.6	14.5	9
Herbaceous	15.5	5	11
Aboveground - CS	1,834.5	1,632.5	202

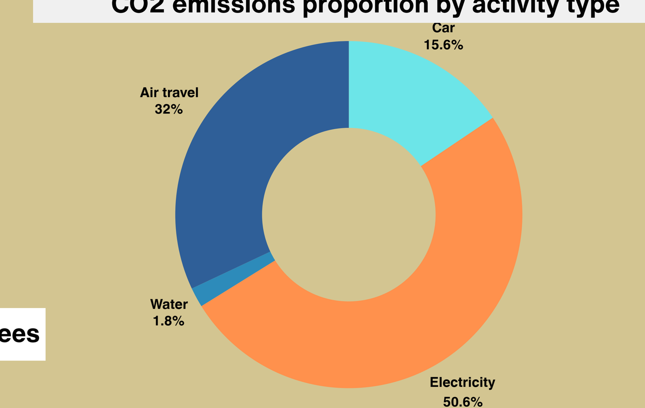
Estimation of Soil Carbon Storage

Depth	the average bulk density of soil = p	% of organic matters of the ith soil genera		the Bemmelen Factor (Bf)	Plantable areas	Soil Depth	Total Carbon Storage	
	g/mL	Min	Max		cm	cm	Min (kg)	Max (kg)
0 - 5 cm	1.19	0	0.0059	0.58	17,373,000	5	0	354.44
10 cm	1.10	0.006	0.0159	0.58	17,373,000	5	331.09	887.39
30 cm	1.10	0.006	0.0159	0.58	17,373,000	20	1,324.92	3,511.05
60 cm	1.61	0.006	0.0159	0.58	17,373,000	30	2,924.14	7,748.96
90 cm	1.64	0.006	0.0159	0.58	17,373,000	30	2,965.77	7,859.28
Estimated Belowground Carbon Storage							7,545.92	20,351.12

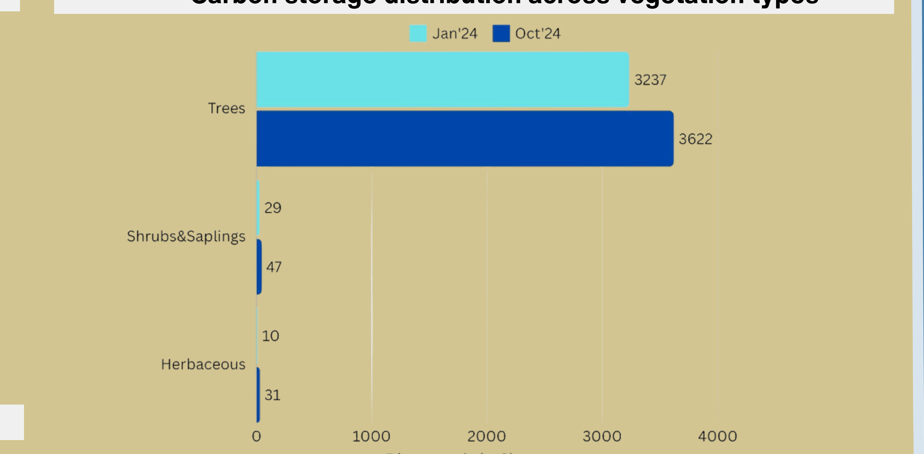
Large Tree Proportion by Wood Density



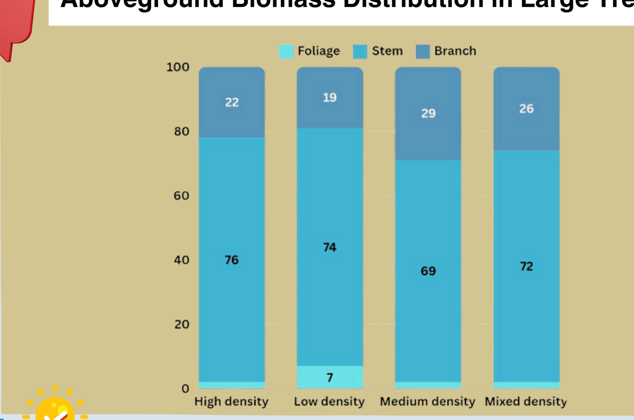
CO2 emissions proportion by activity type



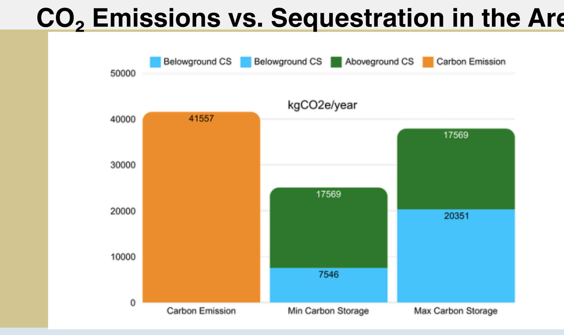
Carbon storage distribution across vegetation types

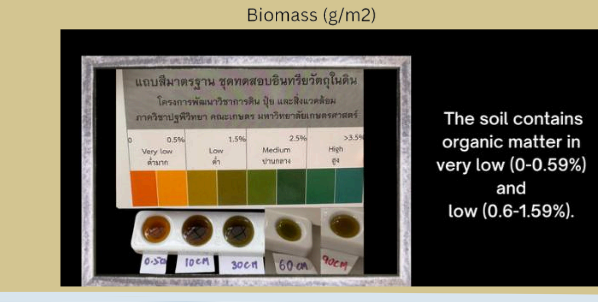


Aboveground Biomass Distribution in Large Trees



CO_2 Emissions vs. Sequestration in the Area





Conclusion

- Large trees store the most carbon at 1,811 gC/m^2, followed by shrubs (23.6 gC/m^2) and grass (15.5 gC/m^2), accounting for 98%, 1.2%, and 0.8%, respectively.
- Carbon sequestration correlates with biomass, tree age, height, and circumference.
- Carbon storage increased by 202 g/m^2, reflecting the growing biomass of vegetation.
- The area sequestered 17,569 kg of carbon in vegetation and 7,546–20,351 kg in soil, totaling 25,115–37,920 kg of carbon storage
- Our carbon footprint of 41,557 $kgCO_2e$ exceeds the maximum potential carbon storage by 10%.
- The primary contributor to the household's carbon footprint is electricity usage (51%), followed by air travel (32%), car use (15.6%), and water usage (1.8%).
- To boost sequestration, planting evergreen, dense-canopy, hardwood species like oak is recommended.
- Soil improvement can enhance carbon sequestration potential by using a formula of 1 tonne of organic fertilizer over an area of 1,600 square meters.
- Reducing the carbon footprint could involve switching to solar energy and adopting electric vehicles for a low-carbon lifestyle. Air travel with green fuels needs to be considered.

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