A Research Proposal on Carbon Storage potentiality of *Acacia* trees in SUST Campus.

TITLE : Carbon Storage potentiality of *Acacia* trees in SUST Campus.

ABSTRACT:

One of the most important worldwide issues of our day is climate change, which is being made worse by rising carbon dioxide (CO_2) levels. It is impossible to overestimate the significance of carbon sequestration through afforestation and reforestation programs as a component of the solution. In order to further scientific knowledge and useful applications for sustainable campus management, this study proposal seeks to examine the carbon sequestration capability of *Acacia* trees in the campus environment. The proposed study will evaluate the ability of *Acacia* trees to sequester carbon in a campus environment using a combination of modeling and field data. Using non-destructive sampling techniques, the biomass, carbon content, and growth rates of the trees will all be measured in the field. Furthermore, measurements of the carbon content of the soil and other pertinent environmental factors will be made in order to comprehend the overall carbon dynamics in the campus ecosystem.The research's conclusions will have applications in academia as well as in real life. Academically speaking, it will add to the expanding corpus of information about urban forests' significance in reducing climate change. Urban planners and campus managers will also be informed by the research findings about the possible advantages of *Acacia* tree plantations for carbon sequestration and ecosystem resilience.

KEYWORDS: Carbon sequestration, anthropogenic, biomass.

INTRODUCTION:

The effects of rising CO_2 concentrations on the climate and the health of the environment worldwide are subjects of great scientific, social, and political interest. The potential for global climate change posed by the rapidly rising atmospheric concentration of carbon dioxide is the main cause for concern today. Raising CO_2 levels have a negative impact on how well the world's biological and physical systems operate. Reducing the need for energy can lead to a decrease in the atmospheric CO_2 concentration, and changing the way energy is used and raising the rates at which carbon dioxide from the atmosphere is removed through carbon sequestration. Greenhouse gas emissions raise the risk of global warming. The necessity to identify ecosystems with significant carbon sink capacities as a substitute mitigation method for terrestrial carbon sequestration has increased due to gas emissions from anthropogenic activities.It is commonly established that using sustainable farming and forestry techniques would boost the amount of carbon trapped in the soil and vegetation. The impact on forests, tree cover, and land use overall has increased due to the presence of nearly 800 million people and 400 million livestock [2].Several tree-based systems lower the net global warming potential (GWP) in comparison to pasture and annual cropping systems. The capacity of biomass production to absorb CO_2 from the atmosphere through photosynthesis is indicative of its contribution to mitigating climate change.Plantations are regarded as a practical means of mitigating climate change. Underplantations occupy 1.4% (187 million hectares) of the world's land area, with 36% of that area located in tropical regions and 64% in nontropical ones. The tropical plantations have an impressive annual growth potential of

8.6%. Plants of the tropical nurse tree species *Acacia auriculiformis.* are found in India and Southeast Asia. Among its noteworthy qualities are quick early growth and highquality wood.Its short roots and open, spreading crown complement its thick foliage. This species is grown for its aesthetic qualities, as a shade tree, and for fuelwood in plantations in Sudan and southeast Asia.Its wood works well for crafting tools, furniture, and paper.Because of its quick growth and ability to tolerate extremely low soils, it is also playing a significant part in the commercial supply of tree products.Since biomass energy is the main renewable energy source and provides 77.4% of the world's renewable energy supply and 10.4% of the world's total energy, plantations have received a lot of attention lately in India.Because of the species' rapid growth, *A. auriculiformis* plantations can offer environmental services including carbon sequestration. Because the timber is intended for commercial use, acacia plantations are usually cleared for construction within a short amount of time after planting. Thus, the problem is the lack of long-term biomass and carbon allocation characterisation.

OBJECTIVES:

Some objectives of my research proposal willing to conduct in my campus:

To quantify Carbon Sequestration Rate: Measure and quantify the carbon sequestration rate of *Acacia* trees in the campus environment through field measurements and analysis.

To assess Biomass Accumulation: Evaluate the biomass accumulation patterns of *Acacia* trees over time to understand their contribution to carbon storage in aboveground biomass.

To investigate Soil Carbon Dynamics: Study the impact of *Acacia* tree presence on soil carbon dynamics, including soil organic carbon content, microbial activity, and decomposition rates.

To examine Environmental Factors: Identify key environmental factors influencing carbon sequestration by *Acacia* trees, such as temperature, precipitation, soil type, and nutrient availability.

To explore Genetic and Physiological Mechanisms: Investigate the genetic and physiological mechanisms underlying carbon assimilation, allocation, and storage in *Acacia* trees to uncover potential targets for enhancing carbon sequestration efficiency. (vi) To optimize Management Strategies: Explore and optimize management strategies, including pruning, fertilization, and irrigation regimes, to maximize carbon sequestration potential while ensuring sustainable tree growth and health.

(vii) To model Carbon Sequestration Trajectories: Develop mathematical models to simulate and predict the long-term carbon sequestration trajectories of *Acacia* trees under different management scenarios and environmental conditions.

To assess Interactions with Urban Environment: Investigate the interactions between *Acacia* trees and the urban environment, including air quality improvement, microclimate regulation, and biodiversity enhancement, to understand the broader ecosystem benefits beyond carbon sequestration.

To evaluate Economic and Social Implications: Assess the economic feasibility and social acceptability of implementing *Acacia* tree plantations for carbon sequestration within the campus context, considering factors such as maintenance costs, land use conflicts, and community engagement.

(x) To provide Recommendations for Sustainable Campus Management: Based on the research findings, develop practical recommendations and guidelines for integrating *Acacia* trees into campus landscapes to enhance carbon sequestration, promote environmental sustainability, and contribute to climate change mitigation efforts.

CURRENT LITERATURE:

Acacia trees, belonging to the Fabaceae family, are widely distributed across diverse ecosystems and are known for their ecological significance and economic value. Studies have demonstrated the substantial carbon sequestration potential of *Acacia* species in various ecosystems, including tropical forests, arid regions, and agroforestry systems. For example, Fang et al. (2017) assessed the carbon sequestration capacity of *Acacia mangium* plantations in the tropics, highlighting the importance of stand age, site conditions, and management practices in influencing carbon storage. A study aimed to estimate the biomass and carbon stock of *Acacia decurrens* under smallholding plantation using different allometric equations carried out in Fagita Lekuma. district Li et al.(2020) Reconnaissance survey was conducted prior to start field work to design the sampling. The four years old plantations were selected to measure diameter, height, and density in nine sites. In total, 2961 trees were sampled from farmer managed stands. The biomass and carbon stock were estimated using different allometric equations. The biomass estimated ranged from 1 to 38 Kg tree 1, the carbon 0.47 17.91 kg tree'1 carbon (only bole) and the CO2 varied from 1.7 to 64.5 kg tree'1 from four year old tree. The pattern o f biomass increases proportionally with increasing diameter. The result helps to understand the pool and fluxes o f CO2 in a plantation. Again, Li et al.(2016) Carbon stock potential of the plantation was assessed 229.48 Mg ha -1. Soil compartment emerged as thedominant reservoir followed by tree biomass and littercompartment with proportionate contribution of 63.08 %,35.97 % and 0.95 % respectively towards carbon stocks in the plantation of aboveground biomass estimated in the present study. Environmental factors such as climate, soil conditions, and land use history influence carbon dynamics in *Acacia* trees. Smith et al. (2020) .

EXPECTED PROGRSS OR OUTCOME WITH RESPECT TO THE CURRENT LITERATURE:

Through statistical analyses and modeling approaches, the research will identify the key drivers influencing carbon storage in *Acacia* trees, such as tree characteristics, environmental factors, and management practices.This research will help to understand the actual estimation of carbon storage or carbon sequestration *Acacia* trees can provide.

RESEARCH METHODOLOGY:

Site Selection and Characterization:

Select representative sites within the campus where *Acacia* trees are prevalent or can be planted.

Characterize each site for soil type, pH, moisture content, and other relevant environmental factors that may influence carbon storage.

Baseline Data Collection:

Conduct initial surveys to assess the existing carbon stocks in *Acacia* trees at selected sites.

Measure tree height, diameter at breast height (DBH), crown diameter, and canopy cover for each tree.

Collect soil samples to determine soil organic carbon content and other soil properties.

□□**Experimental Design:**

Implement experimental treatments to investigate management practices for enhancing carbon storage in *Acacia* trees. Possible treatments may include:

Fertilization: Apply organic or inorganic fertilizers at different rates to assess their impact on tree growth and carbon sequestration.

Pruning: Compare the effects of different pruning regimes (e.g., thinning, crown reduction) on biomass allocation and carbon storage.

Intercropping: Plant nitrogen-fixing species or other companion plants alongside *Acacia* trees to enhance soil fertility and carbon input.

Irrigation: Test different irrigation regimes to evaluate their effect on tree water use efficiency and carbon assimilation.

□□**Data Collection and Analysis:**

Regularly monitor tree growth parameters (e.g., height increment, DBH growth) and physiological traits (e.g., photosynthetic rate, leaf area index) throughout the study period.

Periodically measure biomass accumulation in *Acacia* trees using non-destructive methods such as allometric equations or destructive sampling techniques.

Analyze soil samples for changes in soil organic carbon content and nutrient availability over time.

Use statistical analyses (e.g., ANOVA, regression analysis) to compare treatment effects on carbon storage and identify significant differences among treatments.

□□**Model Development and Simulation:**

Develop mathematical models to simulate carbon dynamics in *Acacia* trees based on empirical data collected from field measurements.

Incorporate environmental variables (e.g., temperature, precipitation) and management practices (e.g., fertilization, pruning) into the models to predict carbon sequestration trajectories under different scenarios.

Validate the models using independent datasets and refine model parameters as needed to improve predictive accuracy.

Synthesis and Interpretation:

Synthesize findings from field observations, experimental results, and modeling outputs to assess the carbon sequestration potential of *Acacia* trees in the campus environment.

Evaluate the effectiveness of different management practices in enhancing carbon storage and identify optimal strategies for maximizing carbon sequestration in *Acacia* trees.

Interpret the implications of research findings for campus greening initiatives, urban forestry management, and climate change mitigation efforts.

Report and Dissemination:

Prepare a comprehensive research report summarizing methodology, results, and conclusions.

Present research findings at conferences, workshops, or seminars to share insights with academic, professional, and community stakeholders.

Publish research outcomes in peer-reviewed journals to contribute to the scientific literature on carbon storage in urban trees and inform evidence-based decisionmaking in sustainable land management.

TIME SCHEDULE:

Month 1-2: Project Preparation and Planning.

Month 3-4: Field Data Collection.

Month 5-7: Ongoing Data Collection and Analysis.

Month 8-10: Model Refinement and Validation.

Month 11-12: Synthesis, Reporting, and Dissemination.

BUDGET:

A budget of about 50000 bdt might be required for the research to conduct.

ETHICAL ISSUES:

Ethical considerations are paramount in any research endeavor, including my proposal on carbon storage of *Acacia* trees in our campus. Here are some potential ethical issues to consider and address:

Obtaining permission from relevant authorities before accessing private land or conducting research on campus premises.

Safeguarding the confidentiality and privacy of research data, especially if it contains sensitive information about individuals or organizations.

Strive to minimize bias and ensure fairness in research design, data collection, and analysis.

Considering the potential environmental impact of your research activities, particularly if they involve experimental treatments or manipulation of natural systems.

CONCLUSION:

This research proposal aims to investigate the carbon storage potential of *Acacia* trees within the campus environment, with the overarching goal of advancing our understanding of urban forestry practices and contributing to climate change mitigation efforts. By quantifying the carbon sequestration rates of *Acacia* trees and assessing the impact of management practices on carbon dynamics, this study aims to provide valuable insights that can inform sustainable land management decisions and urban planning strategies. The findings of this research have the potential to benefit not only the campus community but also broader society by contributing to the development of evidencebased policies and practices for enhancing carbon sequestration in urban ecosystems. In conclusion, this research proposal represents a significant step towards unlocking the carbon sequestration potential of *Acacia* trees in the campus landscape and leveraging their role in mitigating climate change. Through collaborative efforts between researchers, campus stakeholders, and the broader community, this study aims to pave the way for sustainable urban forestry practices and contribute to building resilient, carbon-neutral environments for future generations.

REFERENCES:

IPCC (Intergovernmental Panel on ClimateGovernment Publishing Service, Canberra,Australia, pp. 79, 1999

Estimation of biomass and carbon stock of Acacia decurrens forest under farmers' managemnet using allometric models

International Conference on Climate Change Mitigation and Technologies for Adaptation, 2016 (IC3MTA 2016) Carbon storage potential of Acacia plantation: A viable option for climate change mitigation.