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Fruit based system

A viable alternative for carbon sequestration

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INTRODUCTION

Carbon sequestration is the process of capturing, securing and storing carbon dioxide (CO_2) from the atmosphere. The most dreaded problem of the new millennium caused by the impact of human activity is global warming. Anthropogenic activities like enhanced fossil-fuel consumption coupled with deforestation are causing serious public and political concerns on greenhouse gas (GHG) emissions and their consequences on loss of biodiversity and climate change. An option for augmenting the emission of GHGs is to enhance the carbon stored in perennial trees through sequestration. Carbon sequestration has several benefits like it helps to increase crop Production, improved soil health, climate change mitigation, water conservation, reduced soil erosion, potential income from carbon credits, enhanced biodiversity, etc. The fruit trees provide an alternative to sequestration by forests in addition to meeting the food requirements of communities and therefore, assessment of the potential of fruit trees under different management options is necessary to allow comparison with stocks of the traditional trees as a starting point for dialogue on their inclusion in carbon trading.

BRIEF REVIEW OF RESEARCH WORK

Potadar and Patil (2016) carried out a study on ten tree species. They found that *Ficus benghalensis* has a great potential to sequester CO_2 (1333.44 kg tree^{-1}) whereas, *Annona squamosa* has least potential of carbon sequestration among selected tree species.

Shreshtha and Malla (2016) studied orchards of different fruit crops and noted the amount of stored carbon 2.17 t in mango tree, 2.73 t in litchi tree, 1.63 t in wood apple tree and 3.5 t in gooseberry tree.

Bhagya *et al*. (2017) carried out field experiment on coconut based cropping system. Among the different cropping systems, coconut (*Cocos nucifera*) + jamun (*Syzygium cumini*) system sequestered the maximum above ground carbon (60.93 t/ha).

Panchal *et al*. (2017) studied different agroforestry practices. Data records of them showed that among seven agroforestry system, highest carbon (tree + intercrop) was sequestered by ASS system (47.87 t ha^{-1}). Most viable agroforestry system on the basis of Net Present Value (NPV), Benefit Cost Ratio (BCR), Equivalent Annual Income (EAI) and compounded revenue was ASH system followed by AHS.

Talukder *et al*. (2019) investigated different ecosystem of Bangladesh and calculated their carbon sequestration potential. Significantly total highest carbon stock was recorded in terrace ecosystem (207.6 t ha^{-1}).

Zade *et al*. (2020) collected twelve different orchard soil samples. Highest SOC recorded in mango orchard soils (18.43 g kg^{-1}) followed by orange and pomegranate orchards soil.

Kamini Gautam *et. al*. (2021) conducted an experiment on 10 year old rainfed based hortipasture system (*Psidium guajava* + *Cenchrus ciliaris* + *Stylosanthes hamata*). They

found that total tree carbon stock in guava ranged between 7.92 t ha^{-1} to 11.34 t ha^{-1} (Cultivar: Shweta-10.24 t ha^{-1} and Lalit-9.20 t ha^{-1}).

Naik *et al.* (2021) carried out a study on guava crop to evaluate attribute wise stored carbon at different age. They noted highest amount of stored carbon (11.54 Mg ha^{-1}) in tenth year of age in all the attributes.

Parmar *et al*. (2021) carried out an investigation in four main districts of the south Gujarat region to estimate the carbon sequestration potential of different horticulture-based agroforestry systems. The maximum carbon sequestration potential was recorded in mango + amorphophalus + dioscorea + turmeric based horti–tuber crops system in Navsari district (35763.44 kg ha^{-1}).

Das *et al.* (2022) studied the different nineteen fruit based agro forestry systems and revealed that *eucalyptus*+ mango + green gram-toria based cropping system generates maximum total carbon stock (59.79 t ha^{-1} $year^{-1}$ and 62.33 t ha^{-1} $year^{-1}$ in year 2017-18 and 2018-19, respectively).

Martin (2022) observed that undisturbed forest soil contained the highest amount of carbon (91.5 t ha^{-1}) followed by blueberry grass inter row system which fixed 68.66 t carbon per hector.

Murali *et al.* (2022) evaluated the carbon sequestration potential of ten different mango cultivars after 10 years of planting. They noted high carbon sequestration potential in Jehangir (3.493 t ha^{-1}) followed by Langra (3.223 t ha^{-1}).

Wambede *et al*. (2022) noted higher carbon stocks in mango trees (74.57 t ha^{-1}) as compared to citrus. He also reported higher carbon stocks with the different management practices i.e. intercrop in mango (134.41 t ha^{-1}) and inorganic fertilizer in citrus (20.21 t ha^{-1}).

Singh *et al.* (2024) studied seven agro-ecosystems based on horticulture based agroforestry. The result indicated that the guava-PO system exhibited significantly ($p<0.05$) higher C sequestration (2.11 t C ha^{-1} yr^{-1}) and CO_2 abatement (7.76 t CO_2 ha^{-1} yr^{-1}) rate compared to other systems.

CONCLUSION

Pure orchard and agri horticulture system particularly guava and mango systems played a key role, offering a unique combination of carbon sequestration, CO_2 mitigation and the generation of carbon credits. Mango and Eucalyptus based agro forestry system could stock higher carbon than other AF and cropping system in comparison. The B: C ratio was higher in mango based agro forestry system as compared to sweet orange mono tree and other cropping system. Maintaining grassland cover between rows of productive plants, adding long duration woody plant species in the form of windbreaks and hedge rows can sequester carbon in the soil in soft fruit production system. At the age of 10 years, grafted mango variety Jehangir showed higher CO_2 sequestration potential. AGB, BGB, management practices and age of the plant affects the carbon sequestration potential in mango and citrus. Guava based horti pasture system store good amount of carbon stock especially with 30 cm pruning in top portion of one or more year old guava plants. The amount of carbon stored in different parts of the plant also increased with the increasing age of the guava plant. Among the different horticulture based agro forestry cropping systems, mango + amorphophallus + dioscorea + turmeric system proved to be most successful for carbon sequestration. Mango pure orchards able to store highest amount of carbon in soil when compare with pure orchards of other fruit crops. The amount of carbon stored in plant is affected by the different ecosystems as like jackfruit and guava store higher carbon in terrace ecosystem, mango and litchi store higher carbon in barind ecosystem while jajube proved best in hill ecosystem. When compared ASHS, ASS, AHS and HPS with each other most viable agroforestry system on the basis of Net Present Value (NPV), Benefit Cost Ratio (BCR), Equivalent Annual Income (EAI) and compounded revenue was ASH system followed by AHS.

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