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Estimation of Carbon Sequestration potential of Bilaspur district using Computer based CO_2FIX Model

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ABSTRACT
Climate change is the burning topic for the world. Global warming is becoming a huge problem for our earth due to carbon emission in the wake of modernization and urbanization. Carbon sequestration is a phenomenon for the storage of CO_2 or other forms of carbon to mitigate global warming. Using CO2FIX model it is easy to find out the carbon sequestration potential simulation over years.CO2FIX model is the computer base model work on excel and it's the complete example of soft computing in the area of Agroforestry. Dynamic CO2FIX model v3.1 was used to assess the baseline (2016) carbon and to estimate carbon sequestration potential (CSP) of agroforestry systems for a simulation period of 30 years in Bilaspur district of Chhattisgarh. The estimated numbers of trees existing on farmer's field was 3 per hectare. The baseline standing biomass in the tree components was 1.76 Mg DM ha-1and it is expected to increase 4.87 Mg DM ha^{-1} over 30 Years and the total biomass (tree + crop) was 13.39 Mg DM ha^{-1} and it is expected to increase 16.82 Mg DM ha^{-1}in the district. The CSP of existing agroforestry systems for simulation period of thirty years was estimated to the tune of 0.08 Mg C ha^{-1} yr^{-1}.
Key Word:*CO2Fix, Carbon Sequestration*

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INTRODUCTION

Carbon sequestration is an occurrence for the storage of CO_2 or other forms of carbon to mitigate global warming. Through biological, chemical or physical processes, CO_2 is captured from the atmosphere. Carbon sequestration is a way to mitigate the accumulation of greenhouse gases in the atmosphere released by the burning of fossil fuels and other anthropogenic activities.

Trees and crops is the most appropriate solution to mitigate CO_2 from the atmosphere. Many studies have reported the carbon sequestration potential (CSP) of forest and agroforestry in India (1, 2, 3,4, 5, 6, 7, 8 and 9).In India, an average sequestration potential in agroforestry has been estimated to be 25 Mg C ha-1 over 96 million ha (10), but there is a considerable variation in different regions depending upon the biomass production (11 and 12) and method of estimation. Most of the estimates are based on biomass productivity and do not take into account contributions such as soil and others. This is mainly due to absence of a standard methodology for carbon sequestration potential in Indian context.

MATERIALS AND METHODS

STUDY AREA

Bilaspur is a city in Bilaspur District in the Indian state of Chhattisgarh, situated 133 km (83 miles) north of the state capital, NayaRaipur. The coordinate of district are 22.09°N 82.15°E. Bilaspur is situated on the banks of the rain-fed Arpa River, which originates from the high hills of the Maikal Range of central India. Bilaspur is known for its aromatic rice variety named Doobraj rice.

FIELD SURVEY

For analysis of carbon sequestration potential in the district field survey was conducted for collecting the primary data. Choose different size of tree according to DBH and categorized the trees in to three part

name slow growing medium growing and fast growing tree. And count the tree in farmer field and collect crop data from the district statistical department.

MATERIAL AND METHODS

The dynamic carbon accounting model CO2FIX v3.1 (13 and 14) was used to assess the baseline carbon and simulating the carbon sequestration potential (CSP) of agroforestry systems (AFS) in the district. CO2FIX model has been developed as part of the CASFOR II project. It is a user-friendly tool for dynamically estimating the carbon sequestration potential of forest management, agroforestry and afforestation projects. This model consists of six modules viz biomass module, soil module, products module, bioenergy module, financial module and carbon accounting module. For the purpose of simulating carbon stocks under agroforestry systems, the modules taken into considerations are biomass, soil and carbon accounting modules. CO2FIX model requires primary as well as secondary data on tree and crop components (called 'cohorts' in CO2FIX terminology) for preparing the account of carbon sequestered under agroforestry systems on per hectare basis. The primary data Includes tree species existing on farmlands and their number, DBH, crops grown by farmers on farmlands along with their productivity, area coverage etc. Whereas the secondary data includes the growth rates of tree biomass components (stem, branch, foliage, root) for various species on annual basis.

RESULTS AND DISCUSSION

Dynamic CO2 fix model was used for carbon sequestration potential for the period of 30 years. In the Bilaspur district area under agroforestry mapped by the GIS remote sensing methods. Site's climate factors viz monthly average temperature, total precipitation along with its distribution over different months, evapotranspiration etc also taken from the NIC website which is input variable in the CO2FIX model.

Average numbers of trees per hectare were 1.60, 1.29and 0.10 in slow, medium and fast growing groups respectively and clubbing to a total of 3.00 trees ha^{-1} in Bilaspur. The average age of the existing trees was 33, 18 and 7 years respectively for slow, medium and fast growing trees (Table 1). The secondary data on district wise crop productivity was obtained from NIC (National Informatics Centre, Ministry of Communications and Information Technology, Govt. of India, New Delhi) and the respective District Statistical Offices. The secondary data includes production, productivity and average yield of district along with land use pattern.

Table 1: Average number of trees and Age of tree in Bilaspur

Average number of Trees per hectare	Slow	Medium	Fast	Total Tree
	1.60	1.29	0.10	3.00
Average Age	33	18	7	

Table 2: Biomass accumulated and carbon sequestrated under agroforestry system

Parameters			Observed number of existing trees per hectare in the agroforestry at district level
			Bilaspur (3.0 trees/ha)
Tree Biomass (above and below ground) Mg DM ha^{-1}	Baseline	Biomass	1.76
	Simulated		4.87
Total Biomass (tree+ crop) Mg DM ha^{-1}	Baseline		13.39
	Simulated		16.82
Soil carbon (Mg C ha^{-1})	Baseline	Carbon	12.32
	Simulated		13.11
Biomass carbon (Mg C ha^{-1})	Baseline		5.85
	Simulated		7.48
Total carbon (biomass + soil) (Mg C ha^{-1})	Baseline		18.17
	Simulated		20.59
Net carbon sequestered in agroforestry systems over the simulated period of thirty years (Mg C ha^{-1})		Carbon sequestered	2.42
Estimated annual carbon sequestration potential of agroforestry system in different districts of India (Mg C $ha^{-1}yr^{-1}$)			0.08

The tree biomass (above and below ground) increased from 1.76 to 4.87 Mg DM ha^{-1}. The soil carbon for Bilaspur district is expected to increase from 18.17 to 20.59 Mg C ha^{-1} for thirty year simulation. Biomass carbon and total carbon has been estimated to be 5.85 and 18.17 Mg C ha-1 for baseline. This has become 7.48 and 20.59 Mg C ha^{-1} for simulated period of 30 years. Net carbon sequestered was estimated to be 2.42 Mg C ha-1 in 30 years period. And total net carbon sequestered by district per year 0.08 Mg C $ha^{-1}yr^{-1}$. The CSP increased with increasing tree density (number of tree per hectare). The CSP was influenced by the site's climate factors viz monthly average temperature, total precipitation along with its distribution over different months, evapotranspiration etc.

CONCLUSION

Trees played the major role in carbon sequestration potential. They play a vital role in mitigating the effects of climate change through sequestration of atmospheric CO2. CO2FIX model in conjunction with geospatial technology can be successfully applied for accurate estimation of area and carbon sequestration under agroforestry at district or region level. As in the Bilaspur district the total carbon sequestration by the district was 2.42(Mg C ha^{-1})and 0.08 (Mg C $ha^{-1}yr^{-1}$) per year over the period of 30 years.

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