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# CARBON SEQUESTRATION RATE, CARBON STORAGE RATE AND BIOMASS ESTIMATION IN MAJOR MULTIPURPOSE AGROFORESTRY TREE SPECIES IN DESTRUCTIVE METHOD.

Agriculture

KEYWORDS :

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## ABSTRACT

*Uptake of CO2 from atmosphere and utilization for production of photosynthates at mostly for production of biomass is key principle in CO2 sequestration by plants. The conversion of CO2 to plant carbon differs in plants species mainly due to its genetic nature, photosynthetic rate, energy conversion, age minorly its environment, edaphic factors. The CO2 sequestration rate with the tree differs in different plant parts (bole, stem, foliage) based on its activity. With dwindling forest area agroforesty become alternating source to compensate the forest losses, cultivable land to maintain carbon dioxide balance at optimum level in atmosphere. The present study is on some major six multipurpose trees which include legume and non-legume, timber species were selected within university campus. Among the tree species a comparison is done for estimation of total carbon biomass. Dalbergia sissoo indicated highest total biomass carbon (254.72 kg t-1) and Acacia nilotica (228.42 kg t-1), Albizia lebbeck (219.84 kg t-1) has the lowest values of biomass carbon. The CO2 sequestration rate of above ground parts highest value recorded in Dalbergia sissoo (916.98kg t-1) and lowest in Albizia lebbeck (791.43 kg t-1).Rate of Co2 sequestration is highest in 48% in Dalbergia sissoo and lowest in Albizia lebbeck 43%.*

In tropics major carbon sinks oceans, forests and soils contribute 1.6 gigatonnes of carbon (..).India has managed to conserve of more than 70 million hectares and the deforested areas are to a large extent replaced by agroforesty and horticulture crops. Increased population and their food ,fuel need increased pressure on forest areas this led to decreased the forest areas from 34% to 19.5% from past 60 years .Gradual decreasing area under forest cover ,converting the forest area into cultivable lands and human habitats emphasizing the importance of afforestation programmes by planting multipurpose trees mostly monoculture crops like eucalyptus , teak,sal.azadiracta and the like . As trees store carbon in their vegetation and soils and exchange large quantities of carbon with atmosphere through photosynthesis and respiration. Trees dominate the terrestrial biosphere carbon cycle due to their large pools and fluxes. The carbon sequestration way depends on human activity on forests, they emit carbon if disturbed and become carbon sinks if afforestated so they can be managed to alter the direction and magnitude of carbon fluxes (Brown *et al.*,1996).uptake of carbon is high young tree plantations of above 20 years after establishment and depends on tree species, soil conditions .The recent Assement of land

use, land use change and forestry mitigation options suggests that the global potential for biological feasible afforestation and reforestation activities between 1995 and 2050 could average 1.1-1.6 G t Cyear-1,of which 70% would be in the tropics(IPCC,2000).In Global carbon cycle tree cover become important store house and storing about 600Gt of $CO_2$ from atmosphere(schimel,1995). Ian Johnson and Rebecca Coburn (2010) study reported that well stocked trees in forests (including plantations), typically sequester carbon at a maximum rate between 10 years and 20–30 years age. As an indication, at age 30 years, about 200 to 520 tonnes $CO_2$ was sequestered per ha in forests with productivity ranging from low to high. Above 30 years, if the trees are not harvested, the sequestration rate slows gradually until maturity, At about 80 to 100+ years of age, $CO_2$ sequestration do not change as growth is balanced by decay Due to dwindling of forest cover afforestation like planting of plantation landscape become important source for carbon reductions and these plantations become alternate source for fuel, wood,non-timber forest product and the like. It also adds biomass storage ,reduction of human pressure on forests(vivek et al.,2003). A study reported that the minimum and maximum values of carbon contents of *Dalbergia sissoo* were 0.005 tonnes (with 4 cm DBH and 2 m Height) and 1.102 tonnes (with 50 cm DBH and 25 m Height) per tree respectively, Dalbergia *sissoo* has proved as more efficient with respect to carbon accumulation than *Cassia siamea, Acacia nilotica, Eucalyptus* and *Albizia lebbeck* Priyanka Bohre *et al.* (2012).

Total carbon storage capacity in total biomas varied from 91.00-88.45 t $ha^{-1}$ and also reported that tree plantations (6.7 t $ha^{-1}$) and coppiced system (9.05 $ha^{-1}$ $yr^{-1}$) appeared to be more efficient in carbon sequestration as compared to natural forest Negi and Chauhan (2002).

A study reported that minimum and maximum values of CO2 absorbed from the atmosphere were 0.019 tonnes (with 4 cm DBH and 2 m height) and 4.041 tonnes (with 50 cm dbh and 25 m height) per tree respectively *Dalbergia sissoo* has proved as more efficient with respect to more carbon sequestration than *Cassia siamea, Acacia nilotica, Eucalyptus* and *Albizia lebbeck* Priyanka Bohre *et al.* (2012).

*Dalbergia sissoo* $CO_2$ sequestration is maximum of 57t/ha at the age of three years as compared to other species Kimothi *et al.*, (1983).

The present study objective is to Study biomass production rate ,Caron sequestration of the major Multipurpose tree species in destructive method.

**Table 1:Total biomas content (kg $t^{-1}$) in different tree species and different locations in ANGRAU campus**

| Plant species | Student farm (kg $t^{-1}$) | College farm (kg $t^{-1}$) | Agriculture research Inistute (kg $t^{-1}$) | Horti college (kg $t^{-1}$) | Veterinary college (kg $t^{-1}$) | Mean |
|---|---|---|---|---|---|---|
| Acacia nilotica | 392.70 | 498.36 | 543.34 | 575.10 | 587.56 | 519.41 |
| Azadiracta indica | 464.56 | 488.40 | 559.58 | 575.58 | 581.42 | 533.91 |
| Dalbergia sisso | 486.46 | 495.30 | 507.86 | 505.14 | 569.3 | 512.81 |
| Eucalyptus tetranicus | 405.00 | 444.68 | 479.22 | 516.08 | 538.52 | 476.70 |
| Albergia lebbeck | 392.44 | 482.02 | 454.02 | 475.80 | 527.44 | 466.34 |
| Pongamia pinnata | 391.06 | 490.34 | 503.36 | 509.88 | 530.82 | 485.09 |
| Tectona grandis | 393.20 | 484.92 | 510.78 | 532.88 | 528.14 | 489.98 |

**Materials and methods**

The study was conducted in Acharya N G Ranga Agriculture University Campus which has an area of 1500 Acars situated in Hyderabad in Andhraprdesh in India. The average rainfall is 890 mm .the campus consists of red and black ,red sandy soils with deciduas vegetation and cultivable lands. The study was done by destructive method for trees. The measurement of six different major multipurpose tree species were taken for study the above ground biomass was estimated by destructive sampling method. The tree is felled to ground level using mechanical chain saw, weight is recorded by mechanical weigher after above portion of tree is separated into bole, branch and leaves samples(each of 500g) are collected from individually from each separate tree parts.

Tree samples (leaf, twig and wood along with bark) collected from tree species under seven land use systems(except Fallow ) selected for the study were dried in an electric oven at 60ºC, powdered and used for estimation of carbon. Carbon status was determined in different parts such as leaf, twig and wood along with bark. The carbon content was determined by Perkin Elmer 2400 CHN Elemental Analyzer. To determine the weight of carbon in the tree, multiply the dry weight of the tree by carbon content from individual sample and pool together to calculate total carbon content in tree. $CO_2$ is composed of one molecule of Carbon and 2 molecules of Oxygen.

The atomic weight of Carbon is 12.0

The atomic weight of Oxygen is 15.9

The weight of $CO_2$ is C+2=43.9

The ratio of $CO_2$ to C is 43.9/12.0 =3.6

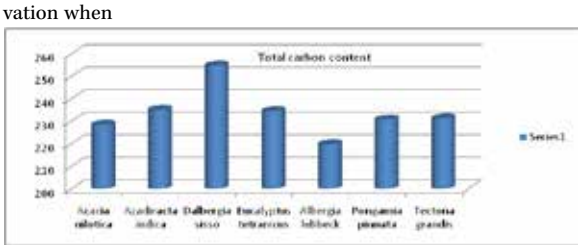
Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.6.

**Table 2: Total carbon content (kg $t^{-1}$) in different plant species and different locations in ANGRAU campus.**

| Tree species | Student farm | College farm | Agriculture Research Inistute | Horti-cultural college | Veterinary college | Mean |
|---|---|---|---|---|---|---|
| Acacia nilotica | 166.31 | 229.52 | 240.04 | 246.21 | 260.02 | 228.42 |
| Azadiracta indica | 205.22 | 225.36 | 246.9 | 252.28 | 245.80 | 235.11 |
| Dalbergia sisso | 246.19 | 252.99 | 252.41 | 249.59 | 272.40 | 254.72 |
| Eucalyptus tetranicus | 210.81 | 233.06 | 235.01 | 248 | 245.56 | 234.49 |
| Albergia lebbeck | 196.6 | 225.94 | 217.26 | 222.36 | 237.05 | 219.84 |
| Pongamia pinnata | 209.47 | 223.52 | 238.13 | 238.58 | 244.27 | 230.79 |
| Tectona grandis | 196.9 | 231.88 | 242.7 | 243.21 | 241.93 | 231.32 |

**Result and discussion**

In the analysis criteria average biomass was used to study tree biomass in the study area and presented in table 1. In above ground biomass of different tree species at different locations the study showed that the biomass accumulation of *Dalbergia sisso* (533.91 kg) was significantly higher over other tree species (Srivastava and Ram, 2009) and lowest was recorded in *Pongamia pinnata*(466.34 kg). Among the multipurpose trees studied with respect to bole(with bark),branchs , leaves and for total biomass *Dalbergia sisso*(533.91 kg $tree^{-1}$) maximum followed by *Acacia nilotica* (519.41kg $tree^{-1}$), *Eucalyptus tereticornis* (512.81kg), *Azadiracta indica* (489.98kg), *Tectona grandis* (485.09 kg), *Albergia lebbeck*(476.70kg) ( Vishal Singh *et al* ., 2011 , Negi and Chauhan .,2002).From table 2 for total carbon content *Dalbergia sissoo* (254.72kg $tree^{-1}$),showed higest carbon content in total biomass it was followed by *Azadiracta indica* (235.11 kg $tree^{-1}$), *Eucalyptus tereticornis*(234.49 kg $tree^{-1}$), *Tectona grandis* (231.32 kg $tree^{-1}$), *Pongamia pinnata* (230.79 kg $tree^{-1}$) lowest total carbon content recorded with *Acacia nilotica* (228.42kg $tree^{-1}$) and *Albizia lebbeck* (219.84 kg $tree^{-1}$).the average carbon content of these tree species is 221kg $tree^{-1}$.in this study total biomass contributes to the maximum carbon storage it was coincided with the work of Negi *et al.*(2003). among the multipurpose trees studied carbon sequestration capacity is highest reordered with *Dalbergia sissoo* (916.98kg $tree^{-1}$) over other tree species and lowest in *Albizia lebbeck* (791kg $tree^{-1}$) similar results were observed by Kimothi (1984). This is significant observation when




compared to fast-growing tree species slow growing, high wood density tree species produce more biomass and contribute significantly in terms of decrease in global warming and there by-climate change.

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