Plantae Scientia – An International Research Journal in Botany Publishing Bimonthly Open Access Journal

Plantae Scientia : Volume 04, Issue 03, May 2021

ISSN 2581-589X

RESEARCH ARTICLE

Carbon Sequestration by the Standing Mangrove Trees at the Achara Estuary along the Coast of Maharashtra State (India)

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Manuscript Details

Manuscript Submitted : 08/04/2021
Manuscript Revised : 13/05/2021
Manuscript Accepted : 25/05/2021
Manuscript Published : 12/06/2021

Available On

https://plantaescientia.com/ojs

Cite This Article As

Kulkarni N A, (2021). Carbon Sequestration by the Standing Mangrove Trees at the Achara Estuary along the Coast of Maharashtra State (India) Pla. *Sci.* 2021; Vol. 04 Iss. 03:143-147.

Indexed In

CrossRef, Scientific Indexing Services (SIS), Google Scholar, Index Copernicus International (ICI), Directory of Research Journal Indexing (DRJI), CiteFactor, Scientific Journal Impact Factor (SJIF), General Impact Factor, Journal Factor, Cosmos Impact Factor, PKP Index, AJIFACTOR Indexing, etc.

ABSTRACT

Mangroves or all the plants are known to absorb the atmospheric carbon by photosynthesis. This absorbed carbon is stored in various organic forms and helps to produce the biomass. Trees dominate this process. Greater and taller is the size of the tree more is the amount of carbon fixed. Hence trees are the major plant forms to absorb maximum atmospheric carbon and biomass production. Thus, the present investigation was carried out to calculate the carbon sequestration of 12 standing mangrove tree species in Achara estuary of Sindhudurg district of Maharashtra state. The biomass and total organic carbon of standing trees is estimated by the non-destructive method. The population of *Avicennia marina* var. *acutissima* Staf. & Mold. and *Rhizophora mucronata* Lamk. are more in the estuary and they sequestrate about 585.70×10^6 and 375.10×10^6 lbs carbon respectively. A total of 1892.96×10^6 lbs of the carbon is sequestering by all the mangrove trees present in the estuary.

Keywords: Mangroves, Achara, Maharashtra, Carbon Sequestration

INTRODUCTION

Mangroves are typical group of plants which are adopted for survival in sheltered brackish water habitats along coasts of tropical and sub-tropical regions. Mangroves play a key role in maintaining the quality and productivity of coastal waters. Mangroves are known as primary producers, shoreline protectors, nursery grounds and habitat for variety of animals, bridging components and unique biological resources. They provide erosion control and shoreline stabilization; they are also involved in complex detritus food webs. Maharashtra is one of the coastal states of India, with many rivers emerging from Sahyadri ranges and meeting the Arabian Sea. The coast line available for Maharashtra state is 720 km. Ratnagiri, Sindhudurg, Raigad, Thane and Mumbai are the five coastal districts of the state of Maharashtra. All the districts together have more than 55 small, medium and large estuaries. The estuaries in all the districts exhibit rich mangrove flora. However, in last few decades this fragile and sensitive ecosystem has been over exploited. All the mangroves in these districts are exposed to severe anthropogenic pressure.

Achara is one of the large estuaries situated in the Sindhudurg district of Maharashtra state. The estuary shows the greater mangrove diversity with the healthy performance. As the estuary show greater mangrove diversity with the healthy performance, the importance of the mangroves for carbon sequestration is still not highlighted or seems to be ignored.

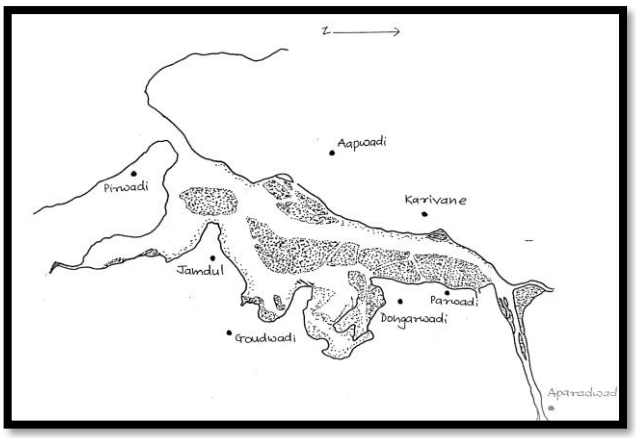
The current environmental disasters like global warming are creating havoc in the behavior of all the living organisms including man on the earth. Today's global warming is the outcome of lot of unnatural processes taking place since last many decades. Many manmade gases are responsible to disturb the natural form of air and atmosphere. Among all these gases, dominance of carbon dioxide is mainly responsible for global warming. Maintaining the optimum level of CO_2 in the atmosphere is the major challenge in today's modern world. Trees play an important role in lowering the atmospheric level of CO_2. They not only maintain the CO_2 level but also helps for ecosystem functioning. Trees absorb 50 % CO_2 in their standing biomass (Ravindranath *et.al.* 1997). Importance of forested areas in carbon sequestration is already accepted, and well documented (FSI 1988, Tiwari & Singh 1987). Patil and Co-workers (2013) have estimated the carbon sequestration of Shivaji University, Kolhapur campus. According to Myers and Goreau, (1991) tropical tree plantations of pine and eucalyptus can sequester an average of 10 tons of carbon per hectare per year. However, in the modern era due to industrial and technological advancement the vegetation has undergone destruction and degradation by human activities. This development has resulted in emissions of carbon in the atmosphere. Therefore, there is an urgent need to deal with environmental issues. Thus, the present investigation was carried out to calculate the carbon sequestration by 12 standing mangrove tree species in Achara estuary of Sindhudurg district of Maharashtra state.

MATERIALS AND METHODS

Study area

Achara (16°12'-16°14'N 73°25'-73°30'E) is one of the large estuaries situated in the Sindhudurg district of Maharashtra state. The river Achara runs to about 20 kms. From the mouth and is surrounded by tall hills towards the north and south sides. On the east it shows flat plains. The total area of the estuary is estimated to be 275 ha. The mangroves were spread in small and large islands continuously over a distance of three kilometers along the west and north side of the river. Twelve mangrove species were distributed along the stretch of the estuary.

Bird eye view of the Achara estuary



Site Map of Achara estuary (Scale – 1:25,000) SOI

Satelite Image of Threatened Lush green Mangrove stands at Achra estuary Dist : Sindhudurga (Courtesy – Google Earth)

The estuary shows the greater mangrove diversity with the healthy performance. As the estuary show greater mangrove diversity with the healthy performance the importance of the mangroves for carbon sequestration is still not highlighted or seems to be ignored. The total mangrove area of the estuary is more than 95 hectares. The species like *Avicennia marina* var. *acutissima*, *Avicennia officinalis*, *Rhizophora mucronata*, *Rhizophora apiculate*, *Sonneratia alba*, *Aegiceras corniculatum* and *Excoecaria agallocha* are dominant and species like *Xylocarpus granatum*, and *Cynometra iripa*, *Bruguiera gymnorrhiza* show a very limited occurrence.

The data has collected by frequent visits to the site. The trees or the population density has been sampled by putting quadrats of various sizes as 20m×20m or by putting variable transects depending upon the size of population at different sites. Carbon sequestration was calculated by using the formula given by Georgia Forestry Commission (1986). It is also referred by Chavan (2010).

Formula

$W = 0.15D^2H$ (For trees with D›=11 inches)
($W = 0.25D^2H$ for trees with D‹11 inches)
W× 120% = A
A × 72.5% = B
B × 50% = C
C × 3.6663 = D

Where, W= above ground height of tree
D = Diameter of tree trunks in inches
H = height of tree in feet

RESULTS AND DISCUSSION

Bhosale (2002) has categorized the mangroves of Maharashtra as per the IUCN guidelines. Kulkarni (2006) has studied the mangroves of Ratnagiri and Sindhudurg districts of Maharashtra state. He has collected the population densities of almost all the estuaries in these two districts. The data has been updated from time to time. The present study has calculated the standing biomass of the above ground woody parts of the mangroves in the Achara estuary along the coast of Maharashtra state. Table.1 depicts the species wise carbon sequestration by the mangroves of the study area. The table show that their 12 major mangrove tree species standing at Achara estuary.

The organic carbon sequestered by some the dominant mangrove species are *Avicennia marina* var. *acutissima* (585.70×10^6) *Avicennia officinalis* (754.06×10^6) *Rhizophora mucronata* (375.10×10^6) *Rhizophora apiculata* (861.0×10^1) *Sonneratia alba* (145.0×10^3) *Aegiceras corniculatum* (203.0×10^3) and *Excoecaria agallocha* (147.86×10^6) which are dominant and species like *Xylocarpus granatum* (170.9×10^3) and *Cynometra iripa* (730.8×10^1) *Bruguiera gymnorrhiza* (564.4×10^2) which are uncommon. All these species are very slow growing due to the constantly changing edaphic factors and they take lot of time to for regeneration and to gain a considerable woody size (Graph 1). Since last many years the felling of mangroves in this area is very fast and hence it is important for putting a strict ban on cutting the trees.

Kulkarni (2006) and till date is studying and updating the population densities of mangroves of Ratnagiri and Sindhudurg districts of Maharashtra state. On the basis of the observations, it can be predicted that the population densities of mangroves in these two districts will be 238×10^4 and these can sequester around 396.87×10^8 lbs carbon and can fix around 108.24×10^8 lbs of carbon. This proves the very importance of the mangroves of Ratnagiri and Sindhudurg districts of Maharashtra state in the present environmental crisis. After considering the carbon sequestration by the mangroves of Ratnagiri and Sindhudurg districts, one can predict the same for mangroves of Maharashtra state. Kulkarni (2018) has studied the carbon sequestration and standing biomass of the above ground woody parts of the trees in the Amrai Park of Sangli city.

CONCLUSION

As the mangroves are typical group of plants which are adopted for survival in sheltered brackish water habitats

along coasts of tropical and sub-tropical regions. They play a key role in maintaining the quality and productivity of coastal waters. As they are known as primary producers, shoreline protectors, nursery grounds and habitat for variety of animals, bridging components and unique biological resources. They also provide erosion control and shoreline stabilization; they are also involved in complex detritus food webs. The present piece of work emphasizes their role in carbon sequestration and standing biomass.

As Achara is one of the large estuaries situated in the Sindhudurg district of Maharashtra state. The mangroves were spread in small and large islands continuously over a distance of three kilometers along the west and north side of the river. Twelve mangrove species were distributed along the stretch of the estuary. The estuary shows the greater mangrove diversity with the healthy performance. As the estuary show greater mangrove diversity with the healthy performance the importance of the mangroves for carbon sequestration is still not highlighted or seems to be ignored. The total mangrove area of the estuary is more than 95 hectares. The species like *Avicennia marina* var. *acutissima*, *Avicennia officinalis*, *Rhizophora mucronata*, *Rhizophora apiculate*, *Sonneratia alba*, *Aegiceras corniculatum* and *Excoecaria agallocha* are dominant and species like *Xylocarpus granatum*, *Cynometra iripa* and *Cynometra iripa*, *Bruguiera gymnorrhiza* show a very limited occurrence. For their better use for environmental conservation the mangroves of Achara estuary of the Sindhudurg district of Maharashtra state should be well conserved as the national importance.

REFERENCES

Alexander Clark III, Joseph R. Saucier, and W. Henry McNab, (1986). Total-Tree Weight, Stem Weight, and Volume Tables for Hardwood Species in the Southeast, Research Division, Georgia Forestry Commission.

Bhosale, (2002). Final Report. Categorization of Mangroves of Maharashtra based on IUCN Red list Guidelines and Germplasm Preservation of Threatened Species. Submitted to MOEF, GOI, New Delhi.pp-155.

Chavan, B. L. and Rasal, G. B. (2010). Sequestered standing carbon stock in selective tree species grown in university campus in Aurangabad, Maharashtra, India. *International Journal of Engineering Science and Technology, 2(7): 3003-3007.*

FSI (2009). State of Forest Report 2009. Forest Survey of India, Ministry of Environment & Forests, New Delhi.

Kulkarni N. A., (2018). Carbon Sequestration by Standing trees at the Amrai Park of Sangli City (Maharastra) – India, Pla.Sci.2018; Vol.01 Iss.04; 60-63.

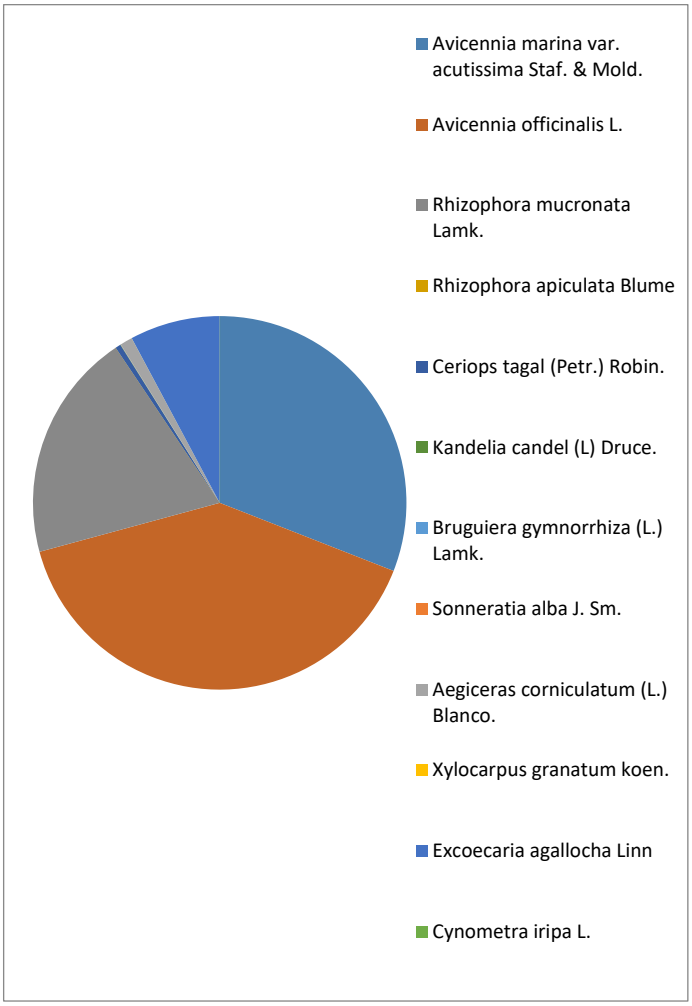
Kulkarni N.A., (2006). Ph. D. thesis submitted to Shivaji University, Kolhapur.

Norman Myers and Thomas J. Goreau, (1991). Tropical Forests and the Greenhouse Effect: A Management Response, Discovery Bay Marine Laboratory, University of the West Indies, Discovery Bay, Jamaica,

Ravindranath, N. H., Somasekhar, B. S. and Gadgil, M. (1997). Carbon flows in Indian forests. *Climatic Change, 35(3): 297-320.*

Sachin Patil, Dubal, K., P. Ghorpade and M. Dongare. (2013). Carbon Sequestration in the Standing Trees at the Shivaji University, Kolhapur campus. *Nature Environment and Pollution Technology. Vol.12.No.4, pp 725-726,* ISSN:0972-6268.

Tiwari, A.K. and Singh, J. S. (1987). Analysis of forest land use and vegetation in a part of Central Himalaya using aerial photographs. *Enviro Conserv., 14: 233-244.*



Graph 1: Carbon Sequestration by the Major Standing Mangrove Trees at the Achra Estuary

Table 1: Field Data and Carbon Sequestration by the Standing Mangrove Trees at the Achara Estuary.

Sr. No.	Name of plant species	Average Height (Feet)	Average Sequestration (lbs)	Average carbon (lbs)	Population Density/ Number of Individuals	Total Carbon (lbs)	Total Carbon Sequestration (lbs)
1.	*Avicennia marina* var. *acutissima* Staf. & Mold.	57.49	12750.75	3477.83	45935	159.75×10^{6}	585.70×10^{6}
2.	*Avicennia officinalis* L.	29.77	16655.59	4542.89	45274	205.67×10^{6}	754.06×10^{6}
3.	*Rhizophora mucronata* Lamk.	25.18	1321.81	360.85	283780	102.40×10^{6}	375.10×10^{6}
4.	*Rhizophora apiculata* Blume	23.78	0.105	0.029	82009	23.78×10^{2}	861.0×10^{1}
5.	*Ceriops tagal* (Petr.) Robin.	12.26	455.34	124.21	19698	244.66×10^{4}	896.92×10^{4}
6.	*Kandelia candel* (L) Druce.	10.76	1504.99	410.49	372	152.70×10^{3}	559.85×10^{3}
7.	*Bruguiera gymnorrhiza* (L.) Lamk.	22.82	137.67	37.55	410	153.95×10^{2}	564.4×10^{2}
8.	*Sonneratia alba* J. Sm.	23.53	1986.31	541.78	73	395.49×10^{2}	145.0×10^{3}
9.	*Aegiceras corniculatum* (L.) Blanco.	5.64	150.84	41.14	134644	553.92×10^{4}	203.0×10^{5}
10	*Xylocarpus granatum* koen.	20.92	4070.7	1110.31	42	466.33×10^{2}	170.9×10^{3}
11	*Excoecaria agallocha* Linn	17.28	2495.53	680.67	59252	403.31×10^{5}	147.86×10^{6}
12	*Cynometra iripa* L.	15.28	730.85	199.34	10	199.3×10^{1}	730.8×10^{1}
					Grand Total	**516.40×10^{6}**	**1892.96×10^{6}**