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Assessment of Forest Biomass of Gorakhpur District of Uttar Pradesh

Atiqua Tajdar*, Mohammad Hashim, Anushree Nagpal, Suman Gaur
Research Scholar, Department of Geography, Jamia Millia Islamia University, Maulana Mohammad Ali Jauhar Marg, Jamia Nagar, New Delhi, Delhi

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***Corresponding author**
Atiqua Tajdar

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Abstract: Forest and its bi-product (often called as biomass) are the essential part of environment. Forest is directly or indirectly serving human being from the very beginning. Three forest ranges of Gorakhpur district of Uttar Pradesh namely Banki, Tilkonia and Pharenda are the reserved forest which have Sal *(Shorea Robusta*) and Sagaun *(Tectona Grandis)* as the dominant species. The biomasses generated from the three forest range are mainly dry leaves and twigs which are generally used as litter. The biomass production of three forest ranges are 2782.91 Kt. The trees are mostly mature in which the results state that the Sal plantation forest are with less Above Ground Biomass. It is revealed that plantation forest has large tree population with less DBH class. The plantation forest has greater carbon stock as well as great carbon sequestration potential than any other forest.

Keywords: forest, biomass, *(Shorea Robusta*), Sagaun *(Tectona Grandis)*, DBH.

INTRODUCTION

Forest is the essential land cover. It is a carbon sink and its very essential to hold the biodiversity. According to the India state of forest cover the total forest cover of India is 708273 sq. Km out of total 3287469 sq.km of geographic area. In India 70% of population is living in villages and is dependent on forest in one way or the other. The basic needs of the villagers are fulfilled by the agricultural residues or by products of forests. There are millions of people living around these protected areas and are dependent on the forest resources for their basic needs [1]. Presence of forest cover is the most rewarding land use for man and environment. It has both economical and ecological value.

Forest is the fast depleting renewable resource after soil because of the high demand of the increasing population. It's a carbon sink, air purifier most important renewable products are from forest. They have a capacity to regain the upper layer of the soil which is very essential for forest and agricultural purposes. The forest residue are major renewable energy sources and are sustainable for the local requirements of energy.These nearby residing villagers extract biomass in the form of livestock grazing, lopping, fuelwood, collection, extraction of NTFPs (non timber forest products). At large scale, the extraction of forest resources exerts impact on vegetation composition [2-5]. Because of the biomass extraction, this type of forest is being converted to dry deciduous scrub, dry savannah, and dry grasslands [6]. All India total biomass power is 17538 MW where as Uttar Pradesh is having 1617 MW of biomass power [7]. Biomass is the residue of forest, agricultural and other wastes. Biomass is used as energy generation component since ages. india is being a developing country needs alot of resources and energy to meet the industrial demands.

Study area

Gorakhpur district is located in the Eastern Uttar Pradesh and is a part of the *Terai* plain as well. It lies between 26^0 13' to 27^0 29'N latitude and 83^0 05'to 83^0 56' E longitude (Fig-1). The district covers an area of 332100 hectares. It has a population of 4,436,275 with an average density of 1,336 inhabitants per sq.km. Gorakhpur shares international border with Nepal in its North. This district is second largest after Varanasi in Uttar Pradesh. Ghaghara and Rohini are two main rivers that flow in this district along with numerous canals and nalas. Area under three forest range is 10047.8 hectare. Gorakhpur forest division was established in 1915 and from starting days the three ranges of forest division I.e. Banki, Tilkonia, Pharenda have plantation. Tilkonia and banki range have plantation in 1915 where as in Pharenda range the plantation was started in 1921. Gorakhpur falling in the foothills of himalayas have the characteristic of *Terai* region and have good forest cover in either protected forest or reserve forest and also there are some patches belong to the royalty. Sal *(Shorea Robusta*) and is the most spread tree along with the Sagaun *(Tectona Grandis)* and many other species.

The protected forests have large number of Sal trees as compare to the other species.

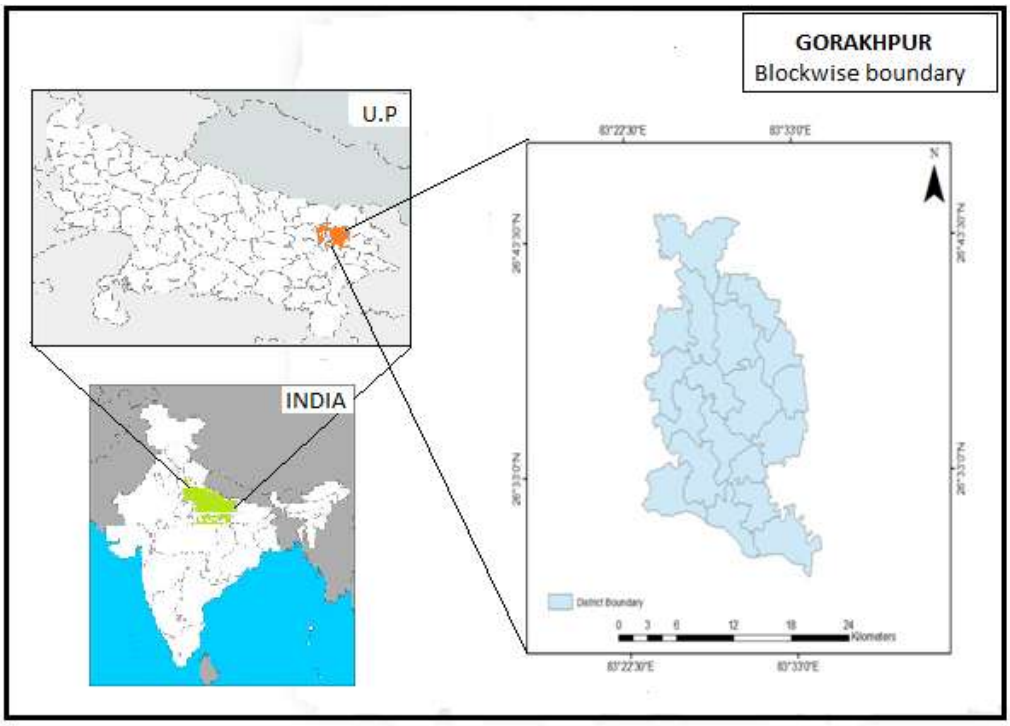


Fig-1: Gorakhpur: District wise administrative boundary

OBJECTIVES

- To assess the forest biomass and its potentials in the study area.
- To assess the dominant species
- To calculate the biomass production of three forest range

METHODOLOGY AND DATA COLLECTION

Data collection

For basic biomass evaluation, only Diameter at Breast's Height (DBH) of tree is included. This includes the assumption that the height is related to basal area of tree. Data on tree biomass was collected by plot method sampling. Sample plot of circular shape are the non destructive, easy to use, reduce edge effect and counting errors [8]. Therefore, circular plot of 20 meter radius was randomly placed in the forest patch. The distance between the two plot was 200 m so that the samples are statistically independent. Woody individual with>30cm girth at breast height and >3m height was considered as trees. In each plot, DBH is calculated and height was measured by occular estimation. In Gorakhpur Forest Division, a total of 50 plots were randomly laid for biomass estimation of tree layer.

Data analysis

For calculation of biomass, formula is given below following Ravindranath [9, 10]:

$$M= (8.32*BA)-1.69$$

Where,
M=biomass; BA= basal area (m^2/ha)

For calculating basal area of tree, following formula was used:

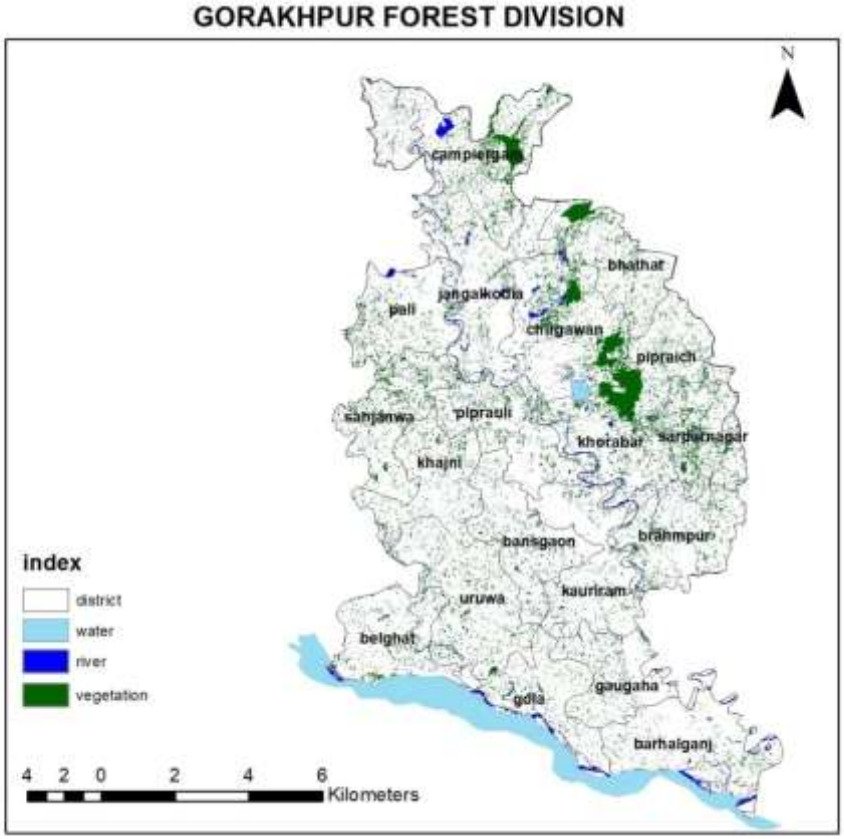
$$DBH=2\pi r$$
$$r= DBH/2\pi$$
$$BA= \pi r^2$$

Since the unit was in square meter, therefore the basal area was multiplied to 10000 to get unit in hectare.

RESULTS AND DISCUSSION

Gorakhpur forest division is a part of the gangetic plain and have characteristics of tarai belt. It is a part of Indo Nepal borders and it is very rich in wildlife. Population dependencies on forest have increased day by day and the pressure on forest is quite high because of the limited resources. The growths of population through the decades have clearly shown the picture of increasing population in a district, especially in villages. And it is clearly visible that the forest patch of the district and surrounded by the villages. The increasing population of villages have continuously put the pressure on the forest patches and this pressure of population is increasing day by day. It is evident that after agriculture, forest is the natural resource that

district have for its development, village livelihood and and for the livelihood of wildlife.



Forest and human interventions

Gorakhpur is studded with the dense vegetation. Till the end of 19th C, the forest of Gorakhpur have been exploited very extensively, big patches of forest are cleared for agricultural practices. The development of district which includes construction of roads and nalas is the main reason for of the declining ratio of forest patches in the district. The wildlife act 1975 where the forest and the protection of wildlife is given importance, it gave some life to forest as well. The forests were labelled as reserve and protected forest. 90% of the population of the district is residing in villages. People are totally dependent on forest and agriculture for livelihood. The important vegetations and crops of the district consisting are Jamun, Mahuwa, Euclyotus, Neem, Babool, paddy, wheat, pulses, maize, mustard and sugarcane. The climate and soil of district is suitable for sugarcane cultivation. Being a cash crop, the cultivation of sugarcane is much encouraged in the district.

Essentials of forest used for villages

- Thatching of hut
- Wood for agriculture
- Fuelwood
- Fodder for livestock

The vegetation is spread all over the district in small patches and three large portion of forest is protected and reserve through the forest act. The human intervention is very much prevalent throughout the district putting pressure on patches. The settlement and agriculture land are surrounding such patches and the pressure on these patches is very much visible. The vegetation is getting extinguished because of the increasing population and main problem with these patches are the pressure of population. Two ranges mainly Banki and Pharenda which is situated along the village and spread in small patches have some demerit. The trees and bushes along the roads and rivers are often being cut off by the nearby villagers and there is nothing that forest division can do.

Forest Dependency

According to the household survey, it was observed that average consumption of fuelwood per household is 18-20 quintals per year. People living in urban areas are also dependent of forest fuelwood for some specific purposes like construction of houses, furniture etc. For cooking and heating purposes the villages are totally dependent on fuelwood on the other hand the urban area has gas connection which minimizes the dependency on fuelwood. Through the survey it was observed that the major source of cooking is fuelwood which is actually being accompanied by cow dung cake and agricultural residues. It was calculated through household survey that most of the

population are engage in agriculture and the 20% of the villages are having gas connection and the 80% of the population is dependent on the fuelwood from forest for their basic needs.

Forest act policy

In the 19th century because of abundance of forest cover and less population sizes the reservation or protection of forest was not much concern. In 1885 the state of Uttar Pradesh has decided to protect the forest, only to stop the merciless cutting of trees and encroachments of mafias. Forest was protected after wildlife protection act and from then the conservation and five year plan for the development of forest started. During World War II most of the forest was destroyed and after 1947-48, it was observe that the protection of forest was the need of the hour.

In India after Independence those forest that were protected and reserve, got attention of the government and further development and reforms were done to protect the area of forest. Afforestation was done on a large scale throughout India. In 1952 to protect the wildlife protection act was formed. The pressure which is being developed on the forest because of the increasing population, in 1988 the forest act was formed to protect the forest and to define area of them so that forest couldn't be shrink more. In forest act it was clearly defined that at least 1/3rd of the states of India should have forest cover. It has also public support to be encouraged to protect the forest. According to the forest report of India, 2001, total geographical area of forest is 20.55% whereas now it has covered as 21.54 during 2011. Uttar Pradesh has only 5.71% of forest cover.

Five year plan policy

The five year plan of the forest division was started in 1956 and after that various programs and schemes were introduced by the forest division for the expansion and the protection of forest cover in the district. It was in 6th and 8th five year plan that the forest area was restricted by the forest division.

The forest range in whole district is easy accessible through road. All the three ranges i.e. Tilkonia, Banki, Pharenda are well connected to the railways or national highways. The forest is reserve and the access is restricted for the common people. The villagers are allowed to collect the twigs, fallen leaves, and the branches of the trees. The area which is being reserve for the forest in the district is only to save the area of the forest was conserve and the extension of the area in the form of plantation of trees along the rivers, roads and railways are done in the 6th and 8th five year plan of the forest department.

India has forest cover of 701673 sq.km (21.54%), where as the per capita availability is 0.63 hectares. The forests are generally found in the northern portion of the district though in the past they extended as far as to the south of Gorakhpur and along the Rapti in south-eastern part of the district. The Sal is the principal tree of the forests found in the district. The undergrowth in Sal areas is very dense in the strips along the banks of *nalas* and streams, and is a evergreen shrubs and small trees. The proximity of Nepal and the wide extent of forests is responsible for the presence of large number of wild animals in the districts. The peculiar situation of the forests where they are nowhere more than 10 km. away from the village habitation makes the wild life prone to destruction.

Estimation of Forest biomass residue

The agriculture and forest residue are the main source of household energy requirements. The best suited method of biomass estimation is to calculate the diameter of trees and their breadth and height. It is non destructive method.

The total above ground biomass was calculated of three forest ranges is 2782.91 Kt. The calculated biomass is less then estimated because the forest was dominated by the Sal trees which don't have canopy cover. The main species of Gorakhpur forest division is Sal *(Shorea Robusta)*-(81percent), Sagaun *(Tectona Grandis)*-(4percent), Jamun *(Syzygium Cumini*) -(11percent), Other-(4percent).The main biomass from these trees derived was leaves, twigs and barks which don't have that much heating value compare to branches and woods. The leaves are broad and were concentrated on the top of the trees spread in their leaves and branches. Trees shed their trees in autumn and these leaves don't have heating value of the woods. The villages usually don't collect them for heating purposes. They are actually called as litter.

Range name	Area of the range	Biomass production (KT)
Tilkonia	3207.10	1191.10
Banki	3161.10	653.38
Pharenda	3679.60	938.42
total	10047.8	2782.91

There is a strong relation between the basal area and the biomass. Biomass strongly associated with the tree structure i.e. tree height, its DBH, and its canopy cover. Out of three ranges banki share the large portion of area almost 3679.60hectare and its calculated biomass is 938.42 Kt. The overall biomass is calculated as 2782.91 Kt of the total 10047.8 hectare of three ranges. The main biomass of these forest ranges are

mainly leaves and twigs. The trees are mostly mature in which the results state that the Sal plantation forest are with less Above Ground Biomass. it is revealed that plantation forest has large tree population with less DBH class. The plantation forest has greater carbon stock as well as great carbon sequestration potential than any other forest**.**

CONCLUSION

In the present study the biomass calculation was done through basic calculation method. The presents results are almost similar to the biomass atlas of India, calculated the biomass of different states and district of India. Being around the populated blocks these forest range have continuous human intervention and this results in the illegal cutting of trees. The principle trees have dominancy over the range and there are negligible amount of shrubs and scrubs. A total number of 50 plots have been laid. In which sal and sagaun were the dominant trees in the forest followed by mahua, jamun, mango, neem, ashok and many more. The total area of the three forest range and the biomass from them are calculated. The sampling plots have observed the cutting of trees. This clearly shows the human intervention and the pressure of population on the trees. Illegal tree cutting for fuelwood collection done by nearby villages are the main cause of thinning of forest range. The illegal cutting of trees should be checked. Land must be given to villagers for agro forestry. Forest department and local NGO's should start and promote the awareness programme related to biodiversity conservation, forest conservation and protection.

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