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# Assessment of Carbon Stocks and Biodiversity in Karore Forest, Rawalpindi-North, Pakistan

MAAZ MAQSOOD HASHMI[1]
International Centre for Integrated Mountain Development (ICIMOD)
Pakistan
MAZHAR HABIB
UMAR AFTAB ABBASI
RAJA SHAYAN TARIQ
Pir Mehr Ali Shah- University of Arid Agriculture, (PMAS-UAAR)
Rawalpindi, Pakistan

**Abstract:**

*Pakistan is near to face the threat of carbon emitting countries. Now a day, there is a need to conduct the research studies to dug out the major sources and sinks of this carbon and to conserve these sources to mitigate the constraints this, carbon dioxide, is creating to our environment. Study revolves around the assessment of the present carbon stocks of Subtropical Chir pine forest of Karore, a reserved forest, and a sub division of Rawalpindi- North Forests, under Punjab Forest Department in Pakistan. The study area is a hilly track with village and scattered pattern of land use. Its elevation is 1258 meters. It has a population of around 2000 individuals. The climax species of this area is Chir pine (Pinus roxburgii). The soils of the region are rich in sulfur, causing the forest fires every year during the months of April to June. Major study area contributes to the tree covered portion of forest. Fixed area plot method was defined for the sampling of the forest. At some places, random sampling was performed due to*

[1] Corresponding author: Maaz.Hashmi@icimod.org

*inaccessible portions of forest i.e. steeps, gullies etc. Performed forest inventory was used to draw the volume tables of the forest. The biomass of the sampled trees was estimated using the tree volume and specific gravity of the wood. Biomass estimation was performed and carbon index was calculated. Study also comprised the biodiversity survey of the region. Identification of under storey vegetation, herbarium sheets, biomass calculation and palatability of the species were observed. Carissa spinarum was evaluated in the palatable vegetation of the area. Moreover, study area depicted the on-timber forest product (NTFP) values with the wild presence of fruit trees in the locality. The output of the study showed that with the passage of time the carbon sink has now been shifting towards the carbon source and it is a dilemma for the coming decade.*

**Key words:** Field inventory, Carbon stock assessment, Biodiversity conservation, sub-tropical chir pine forest, Pakistan.

## Introduction

The growing threat of deforestation in Pakistan is driving the country towards the one with source carbon. Some studies show that the variation in global climate dynamics is more or less horribly drastic. The temperature and precipitation are going to extremities that some regions are receiving abnormally huge amount of rainfall that is leading towards the natural disasters or other issues like erosion and loss of our natural resources, contrary to this most of the places have become dry and desertification is creating a trouble for diminishing ground cover (Pregitzer and Euskirchen, 2004). These environmental fluctuations are degrading our atmosphere at a high rate and increasinggreen-house gases (GHG) is the issue which needs high attention to combat the climatic change (Carey *et al*, 2001). The major GHG is carbon dioxide which is formed by the combination of carbon with ozone, this carbon dioxide traps the infrared radiations and make a blanket around the globe which instead of allowing these infrared radiations, that are reflected

back by the earth's surface, to pass out through the atmosphere and are trapped inside making it warmer, this phenomenon is known as 'Global Warming'. Nowaday, there is a need to conduct the research studies to dug out the major sources and sinks of this carbon and to conserve these sources to mitigate the constraints this, carbon dioxide, is creating to our environment.

The study area was selected on the basis of insufficient research undergone in the region. Study was conducted on the basis of the assessment of the present carbon stocks of Subtropical Chir pine forest of Karore in Pakistan, a reserved forest and a sub division of Rawalpindi- North Forests, Punjab Forest Department. The study area is a hilly track with village and scattered pattern of land use. Altitude of the study area is 1258 masl. The population of the region is around 1200 individuals. As its name shows, the climax species of this area is Chir pine (*Pinus roxburgii*), other shrubs and some fruit species like apricot and peach were seen under agro forestry practices by the local community. Terracing is practiced extensively for land use and harvesting of agriculture crops and livestock practices. The common business in locality includes transportation and poultry farming. Water availability is a constraint in the area. It receives a rainfall about 70 inches per annum. Climate is mostly cold and moist winters and cooler summer with desiccating winds. Aspect of the forest is mostly northern. The wildlife of the area is comprises Porcupine which is also a pest for the trees as it feeds on the rootstock. Other wildlife is snakes, spiders, scorpions, birds. The environment of the region is very favorable and diverse for the avifauna. The limitation in conducting the study in the proposed study area was extreme slopes mostly.

The reason to conduct the study was mainly to evaluate the present, above ground carbon of the forest. The need of this study is the assessment of the carbon pool of this forest that either this is a source or a sink, as this plays an important role

in continuous variability of global climate. After this research we could estimate the change in the carbon stocks with the previous calculated ones and this will help us to evaluate either our forest are carbon sources or sinks. This study will show the difference that is caused by the land use changes of the forest in past and present. A reference study for the future research plans to be made. The objectives of the research were to estimate the carbon stocks of the forest, to discover the biodiversity, finding of the palatable species of the forest and Non-Timber Forest Products (NTFPs) of the study area.

## Methodology:

The forest inventory was held in the forest to evaluate the present aboveground carbon stocks of the forest in subtropical chir pine zone. On field primary data was collected from the forest. For biomass calculation, there was not a liberty for felling of the tree as the forest is classified as Reserved Forest under the Pakistan Forest Act 1927, a different method was followed for calculating the biomass of the trees i.e. by using themeasurements of height and diameter of the sample trees we calculated the volume and density as well. Field inventory was performed using the fixed area plot method and to some extent random samples were taken to nullify the gaps caused due to limitation in conduct of survey. Plot size was taken one tenth (10%) of a hectare and sampling intensity we used was one percent (1%). Maps of the forests were provided by Punjab Forest Department. Instruments used were Magnetic compass (for directions), GPS device (recording of sampling coordinates), Rope (demarcation of the sample plots), Tree caliper (Measure tree diameter), Relascope (measure plot to plot distance), Abnies level (measuring tree height), Presstler borer (discovering tree age through annual rings), Measuring tape (measuring distance and other measurements), Map (layout of sampling).

The volume of the trees was extracted using the height and diameter ratio, chir pine has a taperness factor of 0.3 that was incorporated to pull out the exact volume of trees. For the calculation of present carbon stock, field inventory was performed that included; number of trees, diameter of trees at breast height, age of trees were collected (Zianis *et al,* 2005). Biomass of the Chir Pine (*Pinus roxburghii*) was calculated using a formula instead of the conventional method used today that is collecting a piece of wood of known volume and drying it in oven at seventy two degree Celsius for seven days, then weighing it to get the biomass value of that piece of wood; this value is used to extrapolate the biomass calculation for whole tree with the density of forest. The reason for this was that forest of Karore is classified as reserved forest according to Pakistan Forest Act 1927, tree felling was not appropriate. Therefore, biomass calculation was performed using the following formula (Brown, 1986); i.e.

**Specific gravity = density of wood/ density of water**

Density of wood was calculated by dividing specific gravity of Chir Pine, i.e. 0.7 (Trees of Pakistan, 1992), by density of water i.e. 1000 grams per cubic centimeter. Carbon stock was calculated by using the carbon factor that is 0.50 for Chir pine (Vyskot, 1983), i.e.

**Carbon stock = biomass x carbon factor**

Performing the second part of the study involved the collection of samples of the plants that were present dominant in the forest, drying and preparation of herbarium sheets for identification.

Third portion involved the rangeland phytosociology techniques using the number of species, density of the species

and total area. Palatability of the vegetation was estimated using the rangeland analyses techniques.

Final portion, NTFPs, comprised of Focused Group Discussions (FGDs) with the local community representatives and estimation was made using the information provided by the respondents.

## Results:

The study has not been undergone in the study area before focusing the carbon stocks. Study revealed that the estimated stored carbon contents stocks in the forest are in definite proportion to contribute to the CO2 emissions. This estimation is made as per the trees density in the forest and underground biomass (trees foliage, roots and organic matter) value is taken as 30% of the total biomass of trees (Kurz *et al,* 1996). This gives the probability of carbon estimation to be taken as 15% of the total stock in case of chir pine forest. The estimated values of the forest are shown in the Table-1, below.

**Table-1: Estimated Carbon Stocks in Karore Forest**

| Mean Diameter (cm) | Average Plant Density | Total Average Volume (ft3) | Biomass (Kg) | Carbon Contents (tons ppm) |
|---|---|---|---|---|
| 8 | 439 | 678.02 | 474610.87 | 237.31 |
| 13 | 209 | 862.57 | 603798.14 | 301.90 |
| 18 | 128 | 1068.52 | 747964.54 | 373.98 |
| 23 | 89 | 1522.29 | 1065600.15 | 532.80 |
| 28 | 62 | 1718.12 | 1202683.11 | 601.34 |
| 33 | 44 | 2018.45 | 1412917.98 | 706.46 |
| 38 | 36 | 2342.19 | 1639536.33 | 819.77 |
| 43 | 26 | 2485.34 | 1739736.75 | 869.87 |
| 48 | 19 | 2611.95 | 1828365.76 | 914.18 |

| | | | | |
|---|---|---|---|---|
| 53 | 15 | 3027.73 | 2119407.52 | 1059.70 |
| 58 | 13 | 3421.83 | 2395278.84 | 1197.64 |
| 63 | 10 | 3327.30 | 2329108.34 | 1164.55 |
| 68 | 8 | 3359.34 | 2351536.54 | 1175.77 |
| 73 | 7 | 3401.01 | 2380705.11 | 1190.35 |
| 78 | 6 | 3674.32 | 2572022.73 | 1286.01 |
| 83 | 5 | 3134.29 | 2193999.98 | 1097.00 |
| 88 | 4 | 3548.18 | 2483729.45 | 1241.86 |
| 93 | 1 | 522.11 | 365475.22 | 182.74 |
| 98 | 1 | 553.02 | 387111.41 | 193.56 |
| Total | | 43276.56 | 30293588.76 | 15146.79 |

Second portion of the study involves the biodiversity survey of the area including the most palatable species present in the region. Species present the forest area and nearby wild locality includes sanatha (*Dedonea vescosa*), garanda (*Carissa spinarum*), anaar (*Punica granatum*), lantana (*lantana kamara*), narr (*Narium species*), Khajur (*Phoenix dactylifera*), kahu (*Olea ferruginea*), Tecolemlla (*Tecolmella undulata*), Coniza (*Coniza species*), Mazri leaves (*Nannorhops ritchieana*), Fruit tree (*Prunus species*) mainly.

Third part of the study revolves around the discovery of the palatable species of the forest area. As per the survey and analyses *Carissa spinarum* commonly known as Garanda is the palatable species in that area but the upcoming threat to the forest and rangeland of the region is the succession of the species which is estimated to be recede the present biodiversity by the coming decade.

Final part of the study is the evaluation of the Non Timber Forest Products (NTFPs) values for improvement of livelihoods in the forest area. It was estimated the wild production of fruits and other value added products in the locality, as per by the community representatives through focused group discussions, is as below in table-2, below:

**Table-2: Non-Timber Forest Products (NTFPs) in Karore Forest**

| Name | Yield (kg) | Utilization |
|---|---|---|
| Apple | 200-250 | Edible fruit, value additions |
| Apricot | 300 | Do |
| Garanda | 50-70 | Do |
| Falsa | 80-100 | Do |
| Pear | 25-50 | Do |
| Mazri | - | Mazri leaves products |
| Coniza | - | Beautification, floriculture |
| Apiculture (Honey production) | 6-12 (per hive) | Raw honey, wax |
| Pine cones | - | Decoration, wax extraction |

## Conclusion:

The study is the estimation of the carbon stocks and biodiversity assets in the Forest of Karore and there is the need to conduct more studies in the region regarding biodiversity and latest techniques like Remote sensing etc. to estimate and analyze the resources in the areas. In addition, the forest area is highly susceptible to forest fires that are mostly observed during the months of April to June, annually. Study needs to be conducted on carbon stocks with agroforestry practices impact in community forests (Smith, 2004). The reason behind that was found the sulfur rich soils of the forest. Another reason behind the fires is the defoliated spur of the Chir pine that acts as a biomass fuel and catalyzes the pyric reactions in the forest (Siddique, 1997). Community participation in the utilization of NTFPS is negligible in the region due to social reasons.

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