"STUDY ON WATER RESOURCES OF SUPA DAM AND IT'S IMPACTS ON FOREST PRODUCTIVITY IN CATCHMENT AND COMMAND AREA USING GEOSPATIAL TECHNIQUES"

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Abstract:- The study was conducted in Joida taluka to assess the impact of water resources of supa dam on forest productivity and carbon sequestration. The watershed delineation and drainage map was done using CARTOSAT dem downloaded from the Bhuvan website and processed in ArcGIS software. The field data for assessing forest productivity was done through transact survey in catchment and command area of supa dam. There are 4 plots each in catchment and command area were laid out each plot with 20x20 m. The growth parameters such as tree height and diameter were recorded in all the 8 plots. The results indicated that the forest productivity in catchment area was 183.50m^3/ha whereas in command area the volume was 509.52m3/ha. The carbon sequestration was 91.75and 254.76t/ha in catchment and command area respectively. The water source influenced on forest productivity nearly 2.5 times more than normal forest. Soil organic Carbon was also estimated and the results indicated that the organic carbon of soil in catchment and command area was 1.77and 2.04% respectively. The LULC, watershed delineation mapping was done in ArcGIS software. Based on this study it is concluded that the water resource helps in command area to maintain the water table and provides the moisture to the tree growth as indicated by highest biomass in command area.

Key Words: catchment, command area, water resource, forest productivity, LULC and drainage map.

I. INTRODUCTION

Forest plays an important role in wide range provides an economic and social benefit, such as employment, forest products and protection of sites of cultural value (FAO, 2006). Forests provide a wide range of goods and services. Goods include timber, fuel-wood, as well as food products and fodder. With respect to services is concerned forests and trees play an important role in conservation of forest ecosystem, in maintaining water resources, and in preventing or reducing the severity soil erosion in forest areas, and drought assessments.

The Soil Organic Carbon (SOC) stock acts as a major part of the terrestrial carbon reservoir as soils contain more organic carbon than the atmosphere with a storage of about 1500 Pg to 2000 Pg C (1 Pg =1 billion tonnes) in the top 100 cm depth layer in the world soils (Batjes, 1996). The carbon pool in soils is twice the amount present in the atmosphere; any changes in soil carbon pool can affect the composition of the atmosphere significantly. The carbon sequestration in the soil is also depends on the forest tree growth and its productivity. Carbon sequestration in tree species is higher in high productivity lands. (Roger and Brent, 2012, Watson *et al*., 2000) Keeping these points in view the experiment was planned in catchment and command area of Tattihalla dam to assess the following objectives

1. To assess the impact of water resources on productivity of forest.

2. To study the impact of water resource on forest carbon sequestration.

II. MATERIALS AND METHOD.

Study area:

The study was conducted in joida taluk, one of the water resource dams called supa dam where in catchment and command area of the dam was considered for taking the observations on forest tree species. The map of Joida taluka is given in fig. 1.

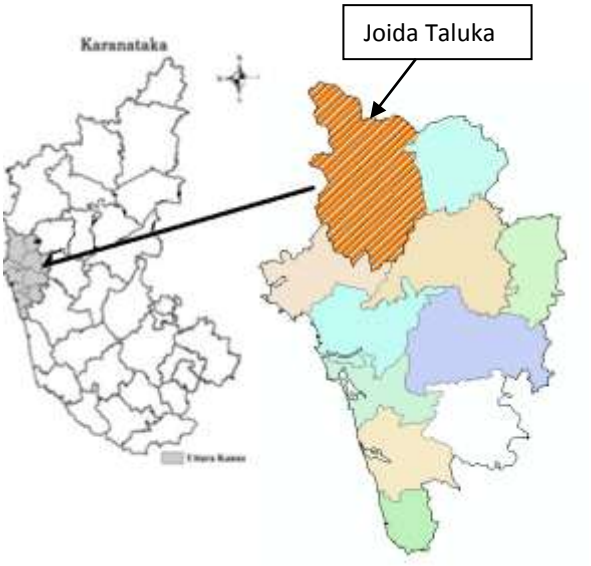

Fig.1: Study area of Joida Taluka

Collection of Data:

The watershed delineation and drainage assessment was done using Cartosat dem downloaded from the Bhuvan website; data was processed in ArcGIS software.

Field data collection:

In the catchment area of sanavalli dam of Mundgod taluka, transact was laid out, there were four plots with size 20 X 20m was laid out randomly over the catchment area and observation on growth parameters i.e., girth at breast height (GBH) at 1.37m above the ground level and tree height was recorded with diameter tape and Ravi altimeter respectively in all the plots. The plot latitude and longitude and elevation were recorded with GPS. Similarly four plots were selected in command area from just below the dam and away from the dam at downstream side and recorded all the parameters as did in catchment area.

The basal area was determined by the formuia (Chaturvedi and Khanna,1984).

Basal area= $\pi d^2/4$ or $g2/4\pi$.

The total wood volume was determined by using formula

Volume = Total height x Basal area x Form factor. (Chaturvedi and Khanna, 1984)

Biomass:

Above and below ground biomass was calculated separately by using standard formulae's and expressed in tonnes per hectare.

Above ground biomass (tonnes /ha) = Volume of tree X Density of wood (Mac dicken ,1997)

Below ground biomass (tonnes/ha)=Above ground biomass X0.26 (Ravindranath *et al* ,2008)

Density of wood:

Wood sample of square shaped was cut from each species and weighed in weighing balance and also volume of that square shaped wood sample was calculated by using formulae volume of cube

$$\text{Density of wood (g/cc)} = \frac{\text{Mass of wood sample}}{\text{Volume of that wood sample}}$$

Carbon Sequestration (tonnes/ha)

The above ground biomass of standing trees was estimated to work out the amount of carbon sequestration by reducing the total biomass yield to its 50% or converting biomass by multiplying 0.5 (Mac Dicken., 1997).

Carbon sequestration=Total biomass(AGB+BGB) x0.5

Soil parameters`

Soil samples was collected from representative sample plots from 0-30 cm depth after scraping away the litter.The soil samples were air dried, powdered and allowed to pass through 2mm sieve and analyzed for chemical properties. The soil properties such as Electrical Conductivity which was analysed by Conducto metric method.

Bulk-density by Core Sampler method, pH by using Potentiometric method (Jakson,1973) and soil Organic carbon (%) was estimated by Wet oxidation method (Walkely and Black, 1934)

III. RESULT AND DISCUSSION:

The field data recorded on tree species both at catchment (Upstream) and command (Down stream) area is given in table 1 and 2.

Table 1. Tree species volume (m^3) on upstream side of the water source

		Volume of tree species m^3			
SL.NO	TREE SPECIES	N14°58'664'', E75°03'611''	N14°17'248'', E74°30'769''	N15°17'488'' E74°30'554''	N15°17'517'' E 74°30'568''
	Elevation(M)	563	586	605	615
1.	*Alsodeftia*	0.039			0.087
2.	*Aprosa*			0.080	
3.	*Aprosalyndliyana*		1.059		0.419
4.	*Caria arboria*	4.730	0.841	1.985	0.502
5.	*Diosporousmelanoxylon*				0.114
6.	*Flucortiamontana*	0.085	0.033		0.028
7.	*Flucurtia*			0.099	
8.	*Flucurtia monatana*		0.048		
9.	*Glycosmis pentaphylla*	0.004			
10.	*Holegarna*	0.052			0.210
11.	*Lea indica*				0.108
12.	*Lopopetalum*	0.014			
13.	*Macarangapeltata*	0.692	1.008	0.886	0.047
14.	*Orosixarboria*				0.668
15.	*Syzygiumcumini*	0.063	0.659	0.704	1.165
16.	*Terminalia arjuna*				0.343
17.	*Terminalia penniculata*	1.129	1.274	7.122	0.814
18.	*Tubernamontana hyneyana*	0.397	0.194	0.560	0.348
19.	*Unknown*				1.137
20.	Total m^3/plot	7.206	4.719	11.435	5.989
21.	Average m^3/plot	7.34			
22.	Total m^3/ha	183.50			

Table 2. Tree species volume (m^3) on downstream side of the water source

SL. NO	TREE SPECIES	Volume of tree species m^3			
	Elevation	[illegible] 824m	[illegible] 806m	[illegible] 770m	[illegible] 803m
1.	*Alseodaphne semecarpifolia*				0.297
2.	*[illegible]*	1.234	0.447	1.596	1.065
3.	*[illegible]*		0.229		
4.	*Careya arborea*			0.732	3.265
5.	*Cassia fistula*				0.427
6.	*Cinnamomum*	0.098	0.026	0.100	0.045
7.	*Ficus species*			25.602	
8.	*Ficus spp*				2.481
9.	*Flacourtia montana*		0.840	0.024	
10.	*Holigarna arnottiana*		0.033		0.078
11.	*Holigarna arnottiana*	0.035			
12.	*[illegible]*	0.211	0.593		
13.	*Ixora brachiata*	0.358			
14.	*Macaranga peltata*		0.085		0.120
15.	*Macaranga peltata*		0.318		0.080
16.	*Macaranga peltata*		0.077		0.056
17.	*Macaranga peltata*		0.018		0.040
18.	*Mallotus philippensis*				0.115
19.	*[illegible]*				0.021
20.	*Olea dioica*	0.086		0.082	0.067
21.	*Olea dioica*			0.055	0.024
22.	*Sapindus laurifolia*				0.071
23.	*Syzygium cumini*	2.164		0.149	
24.	*Terminalia arjuna*	0.166			
25.	*Terminalia bellirica*	8.452			
26.	*Terminalia paniculata*	5.487	0.330	3.821	0.491
27.	*Terminalia paniculata*	1.722	0.313	0.815	0.451
28.	*Terminalia paniculata*	2.833			0.731
29.	*Terminalia paniculata*	7.802			
30.	*Tabernaemontana [illegible]*		0.004	0.106	
31.	Total m^3/plot	[illegible]	4.698	[illegible]	9.311
	Average m^3/plot	10.30			
	Total m^3/ha	[illegible]			

On upstream area i.e., in the catchment area of supa dam there are different types of tree species among them Caria arboria is highest in number. The total volume in transact plot was varied from 4.719 to 11.435 m3/plot. On downstream side i.e., in command area of supa dam there is more number of species present as compared to catchment area. The total volume in transact plot was varied from 4.698 to 32.99 m3/plot. The average wood volume in catchment area was m^3/ha. The results indicated that more than double volume of wood was recorded in command area as compared to catchment area; this variation in wood volume was due to the influence of water source stored in the dam. The study clearly indicated that water source is essential for the forest growth and for tree higher wood volume.

The soil samples collected from catchment and command area from all the transact plots were analysed. The results are given in table 3. The results indicated that PH is varies from 5.70 to 6.43. The electric conductivity was increased from to 95.55 to 136.10 µŚ/dm. The bulk density was increased slightly and organic carbon in soil was also increased from 1.87 to 2.22 %. The higher organic carbon returned to the soil via litter fall is an important source of nutrients for vegetation. Organic carbon content in surface soil is higher command area due to higher leaf litter and less soil erosion (Dutta and Singh, 2007).

Table. 3 Soil properties in catchment and command area of Supa Dam

Places	PH	EC (µŚ/dm)	Bulk density (g/cc)	Organic carbon %
Catchment area	**5.70**	**95.55**	**1.13**	**1.87**
Command area	**6.43**	**136.10**	**1.33**	**2.22**

Based on the volume of the wood, the carbon sequestration was estimated as shown in table 4. It was found that the carbon sequestration was 91.75 tonnes/ha in catchment area where as it was 254.76 tonnes/ha in command area. There was a significant increase in the carbon sequestration in tree species present in command area. This was due to the influence of supa dam water.

Table.4: Wood Volume and carbon sequestration as influenced by water resource

Sl. No	Place	Volume m^3/ha	Carbon sequestration t/ha
1	Catchment area	183.50	91.75
2	Command area	509.52	254.76

Based on the supervised classification the different LULC classes and their area details are shown the Table.5 and Fig.2. The results indicated that the forest covers an area of about (88.10%) forest and followed by Agriculture (3.93%) and other classes are shown in the Table.5.

Table.5. Land use and Land cover different classification area details in Ha

Land cover features	Area in Ha	% Area
Water bodies	9793.87	5.18
Stony	1503.26	0.79
Agriculture	7433.4	3.93
open land	3728.94	1.97
Forest	166293	88.10
Total	**188752.5**	**100**

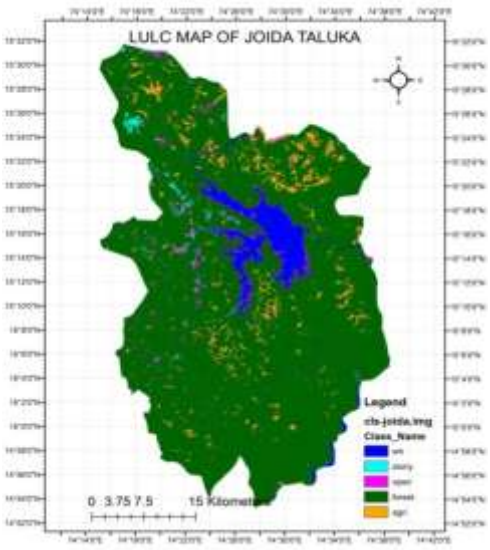

Fig.2 Land use and Land cover map of Joida Taluka

The watershed elevation and drainage map is shown in **Fig.3 and 4.** The elevation in the Joida taluka varies from -70 to 928 Km. The data regarding the forest production was estimated on upstream and downstream side of the dam as indicated in table 1 and 2. The stream flow is very important for the collection of water in the dam. The storage water in the dam is throughout the year hence there is always provision to maintain the water table in the downstream side of the dam which has helped for the tree growth much better in command area as compared to the catchment area.

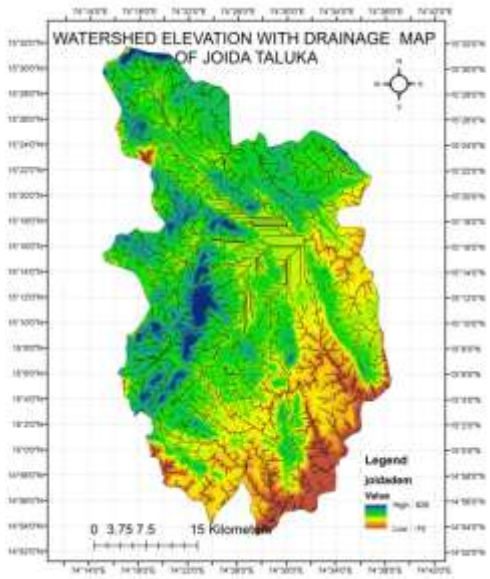

Fig.3 Watershed elevation map with drainage lines of Haliyal Taluka

Fig.4 Watershed delineation along with drainage lines map of Joida Taluka

CONCLUSION

Water source helped in increasing in forest productivity and their by higher carbon sequestration. The water source though not directly applied to the trees but from the ground water table stability, the moisture availability is continues as indicated by higher biomass of trees in command area compared to catchment area. The remote sensing technology would help to plan properly for preparing drainage assessment and its management. The mapping of watershed delineation would provide the idea to store the water resources at suitable places which in turn helps in increasing the forest productivity.

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