J. Farm Sci., 31(2): (233-234) 2018

RESEARCH NOTE

Effect of watershed management practices on tree density and diversity in Kalve watershed

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(Received: August, 2017 ; Accepted: June, 2018)

This study was taken up in the Kalve watershed of Uttara Kannada district to assess the impact of watershed management on tree density and diversity in forest areas. Watershed management practices such as trenches, vented dams and ponds were compared with untreated forest area. The tree density and basal area showed a significant increase over the control plot. Trench- I and trench- II sites showed a maximum tree density (1500 and 1513 stems per hectare respectively) and basal area (34.13 and 36.75 m^2/ha respectively). The least density was found under the vented dam site followed by control site. The tree diversity under the various watershed treatments showed that the small pond site had the maximum diversity as expressed by Shannon-Weiner (H=2.88) and Simpson (D=0.079) index followed by the large pond site. The vented dam site showed a poor diversity than the control site.

Key words: Density, Diversity, Watershed

Watershed management can be used as an effective tool for managing tropical forests while maintaining their biodiversity. India ranks among the top ten species-rich nations and shows high endemism on both flora and fauna. It has four global biodiversity hot spots (Eastern Himalaya, Indo-Burma, Western Ghats - Sri Lanka, and Sunderland). The study area of Sirsi taluk bestowed with rich forests form a part of central Western Ghats. Moist deciduous forests cover much of the eastern slopes of Sirsi in Uttara Kannada. Watershed management through soil and moisture conservation practices can be effective in reducing the risk of forest degradation (Patil *et al.,* 2015) thereby improving the tree diversity in the area. Watershed management provides appropriate goods and services which in-turn conserve natural resources (Wang *et al.,* 2016). Watershed management programme is implemented as centrally sponsored programme under the Department of land resources, Ministry of rural development (Anonymous, 2008). The forest Department has taken up watershed development programme in Kalve watershed. The impact of watershed on tree species diversity needs to be studied; hence the study was taken up in Kalve watershed to assess tree species diversity.

The study was conducted in Kalve watershed in Sirsi taluk of Uttara Kannada district of Karnataka. The study was conducted in two micro watersheds. The micro watershed coded as 5B1A5g3 was treated with soil and water conservation practices laid out during the year 2008 and adjacent micro watershed coded 5B1A5g4 was untreated was selected to assess the species diversity. The experiment was laid out in randomized complete block design with four replications in both treated and untreated watershed during the year 2016. In treated watershed, Large pond (80 m L x 40 m W x 7 m D), Vented dam (3 m L x 1.5 m D), Small pond (10 m L × 6 m W × 2 m D), Trenches I (3 m L x 0.75 m W x 0 .5 m D) and Trenches II (18 m L × 1.5 m W × 0.75 m D) were considered and their impact on tree diversity was assessed in comparison with untreated plots.(Here, L = length, W = width and D = depth).

The study sites receive an average annual rainfall of 2500 mm from June to September. The mean maximum monthly temperature was ranges from 25 to 32°C. The mean minimum monthly temperature was from 13 to 21°C. In the field a quadrate with dimension 20 m x 20 m was laid out in each of the treatments and replicated four times. The quadrates were laid downstream side of the conservation structure. The data on girth of trees exceeding 10 cm diameter at breast height (1.37 m) were recorded. The tree species present in each treatments were analyzed for frequency, density, basal area and importance value index (IVI) of each species. The tree diversity were evaluated using different diversity indices such as, Shannon Weiner index (H), Simpson index (D), Pielou evenness index and Margalef richness index using the standard formulae.

The importance value index (IVI) is a synthetic index for denoting the status and function of a species in a community and it was calculated by using the formula.

IVI = R. D + R. Dom + R.F

Where, R.D is the relative density, R.Dom is the relative dominance and R.F is the relative frequency.

The density, basal area and volume of the trees and tree diversity indices were estimated using standard formulae and presented in Table 1. The density of trees ranged between 913 trees/haÉ¹ (control site) and 1513 trees/ haÉ¹ (trench-II). The vented dam site had the least number of trees/ haÉ¹ which was significantly lower than the control plot. Vented dam site was the only experimental site with a closer vicinity to human settlements (<0.25Km), which can affect the forest structure and diversity (Arjunan *et al.,* 2005). Trench-I and trench-II showed significantly higher tree densities and was followed by the large pond site (1419 trees/ haÉ¹). The basal area per hectare under large pond, vented dam and control sites were on par with each other. Though the tree density under large pond site was higher it did not contribute to a higher basal area or volume per hectare. Trench-II (312.44 m^3/ha), trench-I (305.69 m^3/ha), small pond (317.94 m^3/ha) and vented dam (238.25 m^3/ha) site exhibited a significantly higher volume per hectare compared to control site and large pond site. Soil conservation structures increases the growth and productivity of trees by reducing runoff and erosion (Anju and Koppad, 2013).

Forest tree diversity was found highest in the treated micro watershed compared to untreated micro watershed. Within the treated micro watershed the small pond, large pond and

Table 1. Tree stems, basal area (m²/ha) volume (m³/ha) and different biodiversity indices of trees under different watershed management treatments

Treatment	Density (Stems per ha)	Basal area m^2/ ha	Volume m^3/ ha	Shannon weiner index (H)	Simpsons index(D)	Evenness index	Margalef richness index
T_1: Large pond	1419	23.95	216	2.87	0.09	0.82	5.89
T_2: Vented dam	781	24.38	238.25	2.34	0.13	0.81	3.31
T_3: Small pond	938	28.63	317.94	2.88	0.08	0.87	5.19
T_4: Trenches I	1500	34.13	305.69	2.48	0.12	0.78	4.2
T_5: Trenches II	1513	36.75	312.44	2.79	0.08	0.84	4.92
T_6: Untreated	913	25.63	193.63	2.44	0.12	0.79	4.32
C.D.(0.05)	78.89	1.78	24.67				
S.Em ±	26.17	0.59	8.18				

Table 2. Important Value Index of tree species under different watershed management practices

Treatments	Terminalia tomentosa	Terminalia paniculata	Aporosa lindliyana	Xylia xylocarpa	Acacia auriculiformis	Careya arborea	Buchanania lanzan
T_1: Large pond	5.65	37.91	26.08	-	30.23	18.73	-
T_2: Vented dam	65.29	59.17	12.03	-	10.15	37.24	32.71
T_3: Small pond	38.27	9.17	33.67	-	-	22.78	11
T_4: Trenches I	39.00	33.25	16.41	-	7.54	20.80	30.98
T_5: Trenches II	49.21	29.96	17.35	-	-	24.09	17.54
T_6: Untreated	10.93	30.13	4.37	31.95	-	2.67	3.40

staggered trench-II showed maximum diversity with a Shannon weiner index of 2.88, 2.87 and 2.79 respectively. Margalef richness index ranged from 3.31 to 5.89 with highest value recorded in the large pond site. The evenness index was highest in the small pond and trench-II site. The tree diversity was lowest under the vented dam site which may be due to anthropogenic pressure observed in the site. The in-situ moisture conservation structures helps to conserve moisture in-turn increase the moisture availability over extended periods which could have improved the tree diversity (Shanwad *et al.,* 2008).

Terminalia tomentosa, Careya arborea and *Terminalia paniculata* was present in all the six sites with IVI ranging from 5.65 to 65.29, 2.67 to 37.24 and 9.17 to 59.17 respectively. In the small and large pond site *Aporosa lindleyana* rendered to be a dominant species. *Xylia xylocarpa* was dominant under the control plot although it was absent in all other sites (Table 2). *Acacia auriculiformis* was one of the most important co-dominants in the large pond, vented dam, small pond and trench-I site. This can be attributed to the large scale afforestation programs undertaken under JFM in Uttara Kannada district were dominated by exotic tree species such as Acacia which have got naturalized in forests by natural regeneration.

The findings of this study clearly reveal that the use of watershed management practices is an effective tool to improve diversity of natural forest vegetation and its density. The effect of individual practices and suitability also vary according to the regions. In this study trenches were most effective in improving the density and volume of the forests while the ponds were most effective in improving the tree diversity.

Acknowledgement

Authors are thankful to the University of Agricultural Sciences, Dharwad for providing the financial assistance to carry out this research work under staff research project.

References

Anju, S. V. and Koppad, A. G., 2013, Influence of in situ soil moisture conservation measures ongrowth and productivity of *Acacia auriculiformis. Karnataka J. Agric. Sci.,* 26(1): 170-171.

Anonymous, 2006. Global Forest Resource Assessment 2005 – Progress towards sustainable forest management. FAO Forestry Paper 147.

Anonymous, 2008, Common guidelines for watershed development projects. National rain-fed area authority, Ministry of Land Resources, India. pp. 1-3.

Arjunan, M., Puyravaud, J. P. and Davidar, P., 2005, The impact of resource collection by local communities on the dry forests of the Kalakad–Mundanthurai Tiger Reserve. *Tropical Ecol.,* 46(2): 135–143.

Patil, C., Basavaraja, D. and Desai, N., 2015, Impact assessment study of a watershed development programme in terms of irrigation sources, groundwater recharge and crop productivity in a micro-watershed, Karnataka. *Karnataka J. Agric. Sci.,* 28(1): 75-78.

Shanwad, U. K., Patil, V. C., Gowda, H. H. and Dasog, G.S., 2008, Application of remote sensing technology for impact assessment of watershed development programme. *J. Indian Soc. Remote Sens.,* 36:375-386.

Wang, G., Mang, S., Liu, S. and Innes, J. L., 2016, Integrated watershed management: evolution, development and emerging trends. *J. For. Res.,* DOI 10.1007/s11676-016-0293-3.