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Joint Forest Management in Forests of East Godavari and Enumeration of Species Diversity

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ABSTRACT

Biodiversity occurring at Pothavaram, Gedhada and Murari Reserve Forests (RFs) was studied along with impact of JFM works at Pothavaram RF. Out of 17 tree species observed, Terminalia tomentosa showed 100% frequency in Pothavaram RF, Wrightia tinctoria and Xylia xylocarpus in Gedhada RF, Polyalthia cerasodes and Stereospermum personatum in Murari RF. Eight species recorded higher IVI values. Higher species diversity observed in Murari RF and species dominance and richness at Gedhada RF. More number of tress observed in the height class of 2-4 m and girth class of 10-30 cm. Four species found to be endangered at Pothavaram RF and two each at Gedhada and Murari RF areas. Higher increment in basal area and growing stock observed at JFM implemented plots than control at Pothavaram RF indicating JFM works are effective in regenerating the degraded forests.

Introduction:

Over the years the forests have been destroyed and have been replaced by settlements, urban and rural, industries, farm and grazing lands and many other uses. Reduction in cover is adversely affecting the global climate and rainfall patterns. In view of this, afforestation of degraded forests is essential to maintain ecological equilibrium. Apart from these the monitoring the forest biodiversity and evaluating the performance of existing management regimes in the forest ecosystems are essential for sustainable forest development. This will help to identify the endangered species along with the opportunities for improved practices.

The distribution of forests in Andhra Pradesh are mainly in the form of wide strip in the North, starting from Adilabad District in the West to Srikakulam in the East and from the central to Southern part of the state in the Nallamalla hills. In Andhra Pradesh, Coppice with Reserve (CWR), Coppice with standards (CWS) and clear felling followed by artificial regeneration, are the Silviculture systems generally followed for working of forest coups. However, these systems lost relevance, as forest working for extraction of timber and fuel wood is no more in practice. Forests have been degraded and for improvement of degraded forests, a new system evolved i.e. participatory management system.

Consequent to a resolution issued by the Government of India, Ministry of Environment and Forests, on June 1, 1990, the Andhra Pradesh State Government has adopted the Joint Forest Management (JFM) program in 1993, as one of the three major components of the World Bank supported "Andhra Pradesh Forestry Project" (APFP). The JFM component under the APFP envisages developing degraded forests through Village Forest Societies, specially formed for the purpose. The scheme of the formation, management, functioning, duties and responsibilities of the Village forest societies, which are called "Vana Samrakshana Smithies (VSS). JFM basically introduced to focus on people rather than trees and established mechanisms through which local communities take part in decision making process and implementation of forest management work (Krahl & Henderson 1998).

Under this program, JFM works viz. Treatment Practice-I (TP-1) was taken up in the Pothavaram, Mallavaram, Gedhada and Murari Reserve Forests (RF) of East Godavari district, Andhra Pradesh. The

treatment practice number one (TP-1) works includes cleaning, coppicing, singling, pruning and thinning operations. In the present investigation an attempt has been made to study the tree diversity at Pothavaram, Mallavaram, Gedhada and Murari Reserve forest in East Godavari district, Andhra Pradesh along with the impact of JFM works (Treatment practices- I) at Pothavaram and Mallavaram forests.

Materials and Methods:

The present investigation was carried out by laying sample plots at different areas where treatment practices are carried out for the improvement of degraded forests under APFP (Andhra Pradesh Forestry Project). The details of the sample plots and methodology adopted are given below (Table-1).

Table: 1. Geo-Position Details of Study areas under Kakinada Division, East Godavari district

S. No	Reserve Forest	Section/ Range	Type of the Forest and area	Geopositing system readings or Compartment number (C.No)
1	Pothavaram	Gokavaram/ Gokavaram	Dry deciduous forest and mountainous area	1. 17^0 .18'. 12.11'' N 81^0. 44'. 47.32" E C. No : 688 A
2	Gedhada	Gedhada/ Rampacho-Davaram	Moist mixed deciduous forest and Mountaneous area	C. No : 420
3	Murari	Divanchervu/ Gokavaram	Dry deciduous forest and Plain area	C. No : 449

Details of Study Area:

Pothavaram RF:

One ha forest area selected at Pothavaram RF in East Godavari district. This is located in Kakinada division, Gokavaram Range, 688 A compartment number, 04117 Block code and Dandangi North Beat, Pothavaram village and the name of the VSS (Vana Samrakshna Samithi) is Girijana Samkshema. The area is hilly with 303 Mts elevation and forest type is dry deciduous forest. Soil texture is loamy and soil type is red soil.

Gedhada RF:

The one hectare area trail plot was laid in the compartment of 420 and laid in the forest of East Godavari District at Gedhada RF located in Gedhada Section and Beat, Rampachodavaram Range, Kakinada division. The name of the VSS is Gandhi Nagar. Topography of the area is mountainous area. Soil type is red soil mixed with boulders and top soil erosion is medium.

Murari RF:

The one hectare trail plot laid in East Godavari District is Murari RF located in Divanchervu Section, Murari Beat, Gokavaram Range, Kakinada division. The name of the VSS is Murari. Topography of the area is plain area. Sand type is red soil with small boulders. The one hectare area trial plot laid in the compartment number 449.

Methodology:

To study the impact of TP-1, sample plots were laid out in selected reserve forests areas where TP-1 operations are being carried out. One of the methods followed in laying sample plots was the stratified random sampling. In stratified random sampling the forest will be divided in to a number of zones or strata that are as homogeneous as possible. Within these strata, plots are located at random. Permanent sample plots (PSPs) are permanently demarcated areas of forest, typically of one hectare, which are periodically remeasured. In the present study, all the locations of TP-1 areas, sample plots of one hectare area were permanently demarcated with stones. This one hectare plot was initially divided in to four quadrants. Randomly in each quadrant one 10 m x 10 m. sub plot and in the center of the four quadrants another 10 m x 10 m. sub plot were laid with permanent demarcation.

Data on the name and number of the species and their basal girth (cm), girth at breast height (cm) and height (m) of the trees was taken from each sub plot in the TP-1 areas. From the recorded data all the species are classified according to girth-height class wise. The species composition, density, abundance and frequency of various species were calculated. Menhinicks index of species richness, Shannon-Wiener index of species diversity and Simpson's index of dominance of the community were also calculated (Chandrashekera & Jayaraman 2002).

Impact of JFM works in the degraded forests:

One hectare sample plot laid in control and TP-1 area at Pothavaram RF area. After laying the sample plots, observations on basal area and growing stock were calculated. After two years again data recorded on basal area and the growing stock. Current annual increment calculated for basal area and growing stock in control and treated plots. Percent increments of the same parameters in treated over control were calculated.

Results:

Species diversity in different RF areas

Pothavaram RF:

16 different tree species were observed, among them Terminalia tomentosa found to be uniformly distributed over entire area with 100% frequency followed by Chloroxylon swietenia (75%) and Tectona grandis (75 %). Chloroxylon swietenia recorded higher density (3.75), abundance (5) and relative density (25.42) values and Terminalia tomentosa showed higher relative frequency (13.79) and high relative dominance value (27.91) (Table-2). Terminalia tomentosa (60.34) belongs to Combretaceae family recorded highest IVI value followed by Chloroxylon swietenia (51.52). Acacia leucophloea (6.15) and Bignonia chelonoides (5.83) recorded lower IVI values.

The species, Terminalia tomentosa and Terminalia bellirica and Xylia xylocarpus found to have highest height (above 8 m) (Table-5). More trees observed in 4-6 m height class (27) followed by 2-4 m (12) and 6-8 m (12) and only one tree observed in 10-12 m height class. More trees observed in 10-30 cm girth class (31), followed by 30-50 cm (18) and no trees are observed in the girth class of 90-110 cm. In this location the Shannon's index value of diversity is 3.458. The simpson's index value of species dominance is 0.133 and the Menhinick's index value of species richness is 2.1.

Gedhada RF:

16 different tree species were observed (Table 8). Wrightia tinctoria (100%) and Xylia xylocarpus (100%) are found to be uniformly distributed over entire area. The remaining 14 species showed 33% frequency. Wrightia tinctoria (2) and Xylia xylocarpus (6) recorded highest density value (Table – 3). Cleistanthus collinus (4), Cassia auriculata (4) and Xylia xylocarpus (6) recorded highest abundance value. Wrightia tinctoria (12.76, 15.10) and Xylia xylocarpus (38.29, 15.10) recorded highest relative density and relative frequency values, respectively. Ficus hispida (65.75) and Xylia xylocarpus (34.34) recorded highest relative dominance value. Xylia xylocarpus (87.73) and Cleistanthus collinus (74.98) recorded highest IVI value. Morinda citrifolia and Clerodendrum infortunatum are the species found in only one quadrate.

Clerodnedrum infortunatum found in highest height class (>10 m) (Table-5). More number of trees i.e. 22 out of 47 found in the height class of 4-6 m and all the trees are found above 2 m height only. More number of trees found in the girth class above 10 cm. In this location the Shannon's index value of diversity is 3.11. The Simpson's index value of species dominance is 0.18 and the Menhinick's index value of species richness is 2.33.

Murari RF:

A total of 16 different tree species were observed (Table – 4). Polyalthia cerasodes (100%) and Stereospermum personatum (100%) are found to be uniformly distributed over entire area. Diospyros sylvatica (10) found to be present in three quadrates but more in number almost equal to the high frequency value species. Stereospermum personatum (3.00; 3.0) and Diospyros sylvatica (2.50; 3.3) are found to be having more density and abundance values respectively. Stereospermum personatum (16.66), Diospyros sylvatica (13.88) and Polyalthia cerasodes (12.50) are found to be having more relative density value. Stereospermum personatum (10.81) and Polyalthia cerasodes (10.81) are found to be having more relative frequency value. Lannea caromandelica (16.52) and Diospyros sylvatica (17.38) are having high relative dominance value. Stereospermum personatum (42.26), Diospyros sylvatica (39.36) and Lannea caromandelica (30.17) are having high IVI value among the other species.

Carissa spinarum and Capsicum annum are present in only one quadrate and only single individual present. Both are traditionally useful plants. Acacia suma, Memecylon edule, Capsicum annum, Carissa spinarum and Stereospermum personatum are the species present only in this area among all.

More number of species found in the height class of 2-4 m and none of the species found above 6-8 m. More number of species found in girth class of 10-30 cm and none above 50-70 cm (Table-5). In this location the Shannon's index value of diversity is 3.5. The simpson's index value of species dominance is 0.095 and the Menhinick's index value of species richness is 1.88 (Table-6).

Impact of JFM works in Pothavaram Reserve forest area:

Initially, at Pothavaram RF, the basal area/ha found to be more in treated area (10.14 m2 ha) compared to control area (9.94 m2 ha). In the initial data the growing stock found to be more in treated plot (35.32 m3 /ha) compared to control plot (35.31 m3/ha). After two years the basal area/ha in treated plot (12.30 m2 ha) is more than in control plot (11.652 m2 ha), an increment of 4.5 percent over control plot. After two years, the growing stock/hectare in treated plot (35.36 m3 /ha) is 0.02 m3 /ha more than in control plot i.e., 0.18 percent of increment. All the above results indicate that JFM works are effective in increasing the forest cover (Table – 7).

Table: 2. Species frequency, density, abundance, relative density, relative frequency, relative dominance and importance value index (IVI) at Pothavaram RF

Sl. No	Botanical name	Frequency %	Density	Abundance	Relative density	Relative Frequency	Relative Domi-nance	Important Value Index
1	*Terminalia bellirica*	50	0.5	1	3.38	6.89	4.66	14.93
2	*Tectona grandis*	75	0.75	1	5.08	10.34	3.17	18.59
3	*Chloroxylon swietenia*	75	3.75	5	25.42	10.34	15.76	51.52
4	*Terminalia tomentosa*	100	2.75	2.75	18.64	13.79	27.91	60.34
5	*Lannea caromadelica*	50	1	2	6.77	6.89	5.86	19.52
6	*Emblica officianalis*	50	1.25	2.05	8.47	6.89	14	29.36
7	*Semecarpus acacardium*	25	0.25	1	1.69	3.44	0.76	5.89
8	*Sapindus emarginatus*	25	0.25	1	1.69	3.44	1.4	6.53
9	*Holarrhena pubescens*	50	0.75	1.5	5.08	6.89	2.63	14.6
10	*Acacia leucophloea*	25	0.25	1	1.69	3.44	1.02	6.15
11	*Pterocarpus morsupium*	25	0.25	1	1.69	3.44	6.83	11.96
12	*Atylosia limeata*	50	1	2	6.77	6.89	4.86	18.52
13	*Xylia xylocarpus*	50	0.75	1.5	5.08	6.89	3.89	15.86
14	*Helecteress isora*	25	0.25	1	1.69	3.44	2.53	7.66
15	*Cassia fistula*	25	0.75	3	5.08	3.44	3.93	12.45
16	*Bignonia chelonoides*	25	0.25	1	1.69	3.44	0.7	5.83

Table: 3. Species frequency, density, abundance, relative density, relative frequency, relative dominance and importance value index (IVI) at Gedhadda RF

Sl. No	Name of the Species	Frequency	Density	Abundance	Relative density	Relative Frequency	Relative Dominance	Important Value Index
1	*Cassia fistula*	33	0	1	2.1	4.98	1	8.08
2	*Chloroxylon swietenia*	33	0	1	2.1	4.98	0.4	7.54
3	*Ficus hispida*	33	1	2	4.3	4.98	66	75
4	*Cleistanthus collinus*	33	1	4	8.5	4.98	9.3	22.8
5	*Cassia auriculata*	33	1	4	8.5	4.98	4.9	18.4
6	*Bridella cinerascens*	33	0	1	2.1	4.98	2.9	10
7	*Wrightia tinctoria*	100	2	2	13	15	4.9	32.8
8	*Azardirecta indica*	33	0	1	2.1	4.98	1	8.08
9	*Morinda citrifolia*	33	0	1	2.1	4.98	0.5	7.59
10	*Casearia elliptica*	33	0	1	2.1	4.98	0.5	7.59
11	*Xylia xylocarpus*	100	6	6	38	15	34	87.7
12	*Dalbergia latifolia*	33	1	2	4.3	4.98	3.9	13.2
13	*Bridella retusa*	33	0	1	2.1	4.98	1.5	8.57
14	*Lumnitzera recemasa*	33	0	1	2.1	4.98	2.9	10
15	*Adina cardifolia*	33	1	2	4.3	4.98	4.9	14.1
16	*Clerodendrum infortunatum*	33	0	1	2.1	4.98	16	23.3

Table: 4. Species frequency, density, abundance, relative density, relative frequency, relative dominance and importance value index (IVI) at Murari RF

S. No	Name of the Species	Frequency	Frequency class *	Density	Abundance	Relative density	Relative Frequency	Relative Dominance	Important Value Index (IVI)
1	*Atylosia limeata*	50	C	1.25	2.5	6.94	5.4	8.654	21
2	*Polyalthia cerasodes*	100	E	2.25	2.25	12.5	10.81	5.9	29.2
3	*Lannea caromandelica*	75	D	1	1.33	5.55	8.1	16.52	30.2
4	*Vitex pinnata*	50	C	0.75	1.5	4.16	5.4	6.13	15.7
5	*Loranthus phillipensis*	25	B	0.26	1	1.38	2.7	0.05	4.13
6	*Albizia odarotissima*	50	C	0.5	1	2.77	5.4	3.03	11.2
7	*Holarrhena pubescens*	75	D	1.5	2	8.33	8.1	1.15	17.6
8	*Stereospermum personatum*	100	E	3	3	16.66	10.81	14.79	42.3
9	*Zizyphus xylopyrus*	75	D	1.25	1.6	6.94	8.1	5.06	20.1
10	*Milletia auriculata*	25	B	0.25	1	1.38	2.7	0.75	4.83
11	*Carissa spinarum*	25	B	0.25	1	1.38	2.7	14.39	18.5
12	*Diospyros sylvatica*	75	D	2.5	3.3	13.88	8.1	17.38	39.4
13	*Acacia suma*	50	C	1.25	2.5	6.94	5.4	2.43	14.8
14	*Capsicum annum*	25	B	0.25	1.1	1.38	2.7	0.75	4.83
15	*Memecylon edule*	50	C	0.75	1.5	4.16	5.4	1.73	11.3
16	*Sapindus emarginatus*	75	D	1.33	1.3	5.55	8.1	2.51	16.2

Table: 5. Height and girth wise distribution of various species at different RF areas

S. No.	Class	Range	Pothavaram RF	Gedhada RF	Murari RF	Total
1.	Height (m)	0-2	0	0	15	35
		2-4	12	8	44	90
		4-6	27	22	13	82
		6-8	12	16	0	29
		8-10	3	0	0	8
		10-12	1	1	0	2
		12-14	0	0	0	0
		14-16	0	0	0	0
		16-18	0	0	0	0
		Total	**55**	**47**	**72**	**246**
2.	Girth (cm)	1-10	0	19	25	44
		10-30	31	25	44	162
		30-50	18	2	3	32
		50-70	5	1	0	7
		70-90	1	0	0	1
		90-110	0	0	0	0
		Total	**55**	**47**	**72**	**246**

Table: 6. Indices of species diversity, richness and dominance at different RF areas

S. No	Location	Total number of species	Shannon's index (H)	Simpson's index (C)	Menhinick's index of Species richness (R)
1	Pothavaram RF	16	3.458	0.133	2.1
2	Gedhada RF	16	3.11	0.18	2.33
3	Murari RF	16	3.5	0.095	1.88

Table: 7. Effect of JFM works on the Growing stock and Basal area of different species in Pothavaram RF

S. No	Name of the location	No of individual species	*Initial data*		*Increment data*	
			Basal area m^2 h (BA)	**Growing stock m^3 h (GS)**	**Basal area m^2 h (BA)**	**Growing stock m^3 h (GS)**
1	Control Plot	16	9.942	35.31	11.652	35.33
2	TP – 1 Plot	16	10.14	35.32	12.30	35.36

Discussion:

In the present study, an attempt was made to study the biodiversity in four reserve forests of Andhra Pradesh. Each of the area is differing from each other both climatically and topographically. The soil characteristics are also differing from each other. The topography of the locations ranges from mountainous to plain areas. The type of forests includes dry deciduous forest, moist mixed forest and moist mixed forest types. We recorded the flora of these locations.

Kacholi (2014) documented 93 species/ha within 26 families from 0.72 ha in a section of the Kilengwe Forest in Tanzania. Dar et al. (2013) recorded a total of five tree species belonging to four families in the periodic study conducted during 2010 to 2011 in four selected sites of Branwar forest areas of Kashmir Himalaya for assessing ecological distribution and diversity of trees and shrubs. Chandrashedara et al. (2002) studied the stand structure diversity and dynamics in natural forests of Kerala and recorded 740 indigenous tree species and in our study in East Godavari district recorded 65 tree species.

Kameswara Rao (1998) conducted experiments in four villages of Visakhapatnam circle. His study region mainly included tropical dry and moist deciduous types with few patches of semi-evergreens existing in association with high lands. All the four villages he selected are being guided and motivated by NGO's and forest department. Kushwah and Kumar (2002) estimated the status of flora in protected areas of eight protected areas (PA's) of Madhya Pradesh (India). The PA's were selected randomly representing one National Park and one sanctuary. In our study at East Godavari district four areas of different topographical and climatic selected.

Munesh Kumar et al. (2004) studied the structure and diversity of forest of Pauri district at Garhwal Himalayas. He selected two study sites on the basis of the disturbance gradient at an elevation of 900 to 1,300 m ASL and calculated the IVI and dominance and diversity values. In our study also we calculated the above values. Sahoo et al., (2004) in Abhoya of Midnapore District of West Bengal (India), Ranjana Gupta (2004) in Dodsi and Talaichittor villages of Dahra Dun district and all these studies indicated positive effect of JFM and other such management works in improving the forest cover as well as increasing the income of the forest communities.

Joint Forest Management (JFM) is Participatory action involving the Government and a local community for regeneration of degraded forests through effective protection, sharing of produce and improving the socio economic conditions of these forests communities. Girijana Samkshema Vana Samrakshna Samithi (VSS) at Pothavaram and Kali Jolla VSS at Mallavaram RF were involved in the management of these forest areas from the year 1999 to till date. These VSS taken up TP-1 works in both the forests for their regeneration. An attempt made to study the impact of TP-1 works in maintaining these forests. In the present study, basal area and growing stock found to increase in the TP-1 areas than control, in both Pothavaram and Mallavaram RF areas.

This indicated that JFM works are effective in improving the growth and regeneration of the degraded forests. Different workers studied the impact of such management systems on conservation of forests biodiversity. Kameswara Rao (1998) studied the impact of JFM activities on the vegetation and development of Eastern Ghats region of A.P., Varma et al., (2005) in the plantation forest and degraded forest of Surajpur block (Barotiwala) of Kuthar Forest Range in Kunihar Forest Division of Himachal Pradesh, Sahoo et al., (2004) in Abhoya of Midnapore District of West Bengal (India), Ranjana Gupta et al. (2004) in Dodsi and Talaichittor villages of Dahra Dun District and Chandrashekara and Jayaraman (2002) in natural forests of Kerala. Pratima and Jattan (2002) studied JFM at village level and Ajaz Ahmed (2002) studied object oriented forest management system.

All these studies indicated positive effect of JFM and other such management works in improving the forest cover as well as increasing the income of the forest communities. The study results of Ravi Prasad Rao et al. (2011) supported the view that local communities afford better protection and management to sacred groves. They also suggested that the long-term sustenance of biodiversity in sacred forest sites require an integrated approach involving local communities as well the government sector.

Conclusion:

Present study helped to understand the plant biodiversity growth variation of different forest species in the East Godavari district of Andhra Pradesh. Forest growth difference between the managed forests and non managed forest areas were also estimated and in the managed forest areas it is found vigorous growth of

species and increase of growing stock was observed. Our study also provided the information of the economically useful plant species present in different areas, such information is useful to the local communities and government in planning generation activities. Our study also provided information on the rare and threatened species and also the intensity of biotic pressure on different species and social conditions of different areas and why the deforestation is more in some areas and very less in some areas. According to our study, deforestation can be stopped, if continuous work is provided to the local communities for their survival. Encouragement of JFM works not only improving the degraded forests but also reducing the biotic pressure in the forest areas. JFM works found to be effective in improving the growth and regeneration of the forests.

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