

Final Report:

How sustainable will be NTFP based primary commodity cooperatives?

- ***An ecological assessment in three selected Gram Panchayats of Gurundia Block, Sundargarh District, Orissa.***

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**By
Pravat C. Sutar**

VASUNDHARA



**Pvt Plot No: 14/E, Gajapati Nagar, Near Press Chhak,
PO: Sainik School, Bhubaneswar – 751 005
e-mail: vasundharanr@satyam.net.in
Web site: vasundharaorissa.org**

Executive summary:

The use of Non Timber Forest Products (NTFPs) towards the livelihood improvement through collectivisation of trade attempts, no doubt, tends to improve the economic status of the agents involved. But the gauging at the sustainability of these attempts based on its resource availability in a sustained manner must be prioritised. This must be in consonance with the natural healthy growth of the resources in the natural ecosystems. The produces selected for the growth of commodity cooperatives in the selected areas include some major NTFP items viz Mahua flowers (flowers of *Madhuca indica*), Mahua fruits (fruits of *Madhuca indica*), Char seeds (seeds of *Buchanania lanzan*), Myrobalans (fruits of *Terminalia chebula*, *Terminalia bellerica* and *Emblica officinalis*) and Siali leaves (leaves of *Bauhinia vahlii*). The study emphasizes the participation of villagers in the process of ecological monitoring of the above concerned resources. Resources found and harvested in both forest and non-forestlands, were monitored. The findings share the common conservation concerns towards some of the selected resources to ensure continued supply of the commodity to the cooperatives in the surveyed areas. Mahua flower, char seeds and Siali leaves represent the promising NTFPs for collection and trade at the existing exploitation level. On the contrary, other selected produces need proper attention in order to provide the capital material for the cooperatives to trade and reap profits. There is a need for institutional set up promotion to look after the conservation strategies of vulnerable NTFPs in the selected sites.

Acknowledgements:

The author of this report is indebted to all the villagers of three sites namely Kainshibahal, Lachhada and Tamparkela studied for ecological monitoring of Selected NTFP resources for the proposed commodity cooperatives. The vibrant village volunteers who were committed and dedicated to the work with lots of enthusiasm have given the impetus for rapid and better information collection. The village youths who had participated during the ecological data analysis at Jarda also need special appreciation.

Sharing of the study findings with the commodity cooperative members of respective sites were encouraging and their interest towards putting some of viable and feasible suggestions into practice through incorporation into their cooperative bylaws demands for special appreciation.

My sincere thanks to all field staffs of Vasundhara at Gurundia and at the HQ who had provided all necessary and timely support for the study.

List of abbreviations:

NTFP: Non Timber Forest Produce
FMI: Forest Management Institution
GBH: Girth at Breast Height

	Page No
1.0 Introduction	06
<i>1.1 Study lay out</i>	<i>07</i>
<i>1.2 Objectives</i>	<i>08</i>
2.0 Methodology	09
3.0 Results	10
4.0 Data analysis, status of NTFP species and management recommendations	26
<i>4.1 Mahula</i>	<i>27</i>
<i>4.2 Char seeds</i>	<i>28</i>
<i>4.3 Harida</i>	<i>29</i>
<i>4.4 Anla</i>	<i>30</i>
<i>4.5 Bahada</i>	<i>31</i>
<i>4.6 Siali climbers</i>	<i>32</i>
5.0 List of Annexures	
<i>Annexure – I: Tree regeneration & growth in the Wild</i>	<i>33</i>
<i>Annexure – II: Population (Age) structure</i>	<i>35</i>
<i>Annexure – III: Canopy gaps</i>	<i>37</i>
<i>Annexure -IV: Profiles of selected NTFP species</i>	<i>38</i>
<i>Annexure - V: Formats for vegetation data collection</i>	<i>46</i>
<i>Annexure - VI: List of plants with scientific names</i>	<i>47</i>
6.0 Glossary	48
7.0 Bibliography	49

INTRODUCTION:

Exploitation of non-timber forest produces (NTFPs) for commercial purposes enhances / tends to enhance the livelihood opportunities of the communities / agents involved in this process. Commercial exploitations are considered from economic grounds that primarily focuses on profit maximization, with less approach towards ecological security of the resources the long run. In other words, the enterprises set up for economic upliftment of the primary stakeholders or other agents would not be sustainable if these are not mimic to natural healthy growth of these resources in the natural forest ecosystems. Any plant / animal resources if chosen as the resource base material for commercial enterprises must be ecologically sustainable for years to come. Prudential use of the resources safeguard sustainability of the micro-enterprise and on the contrary, profligacy leads to complete loss of the resource and hence the desired expected profits.

Thus, it is imperative to judge the sustainability of any enterprise from various fronts out of which ecological sustainability stands the foremost. Ecological sustainability assessment would therefore provide us the information on the status of these resources at its resource base, understanding ecological dynamics, biotic¹ and abiotic² pressure, production Vs harvest etc. Based on this information, type and extent of resources to be selected for the enterprise promotion activities can be determined.

Primary ecological information needed is the density and distribution of the species, age class structure, regenerating capabilities etc. (please refer to glossary of this report). If the species is rare and unevenly distributed, then the opportunity of commercial exploitation of the species is minimum. On the other hand, if the species forms the major crop (in density) along with its resources (such as fruits, leaves, flowers, seeds etc) and the species is more or less uniformly distributed in its natural habitat, this species may be judged for the micro-enterprise. The species yield of resources, are also equally important, as they are capital material for any enterprise. Complete picture of competitiveness of selected species with other plant forms at the forest ground and regeneration capabilities (Annexure-1) must be studied to gauge the “bouncing back effect” of the species to any other biotic and / or abiotic pressure exerted on it. Assessment of commercial exploitation limits also need to be made. Harvest adjustments need to be carried out with proper management practices to ensure long term availability of the resources for commodity cooperatives.

Thus, broadly to understand the ecological sustainability of any individual / community based enterprise(s) need to complete following steps.*

1. Species selection & its ecology
2. Forest inventory
3. Yield Studies
4. Regeneration Surveys
5. Harvest Assessment
6. Harvest Adjustments.

¹ Biotic pressure refers to the pressure due to animals and other life forms.

² Abiotic pressure refers to the pressure by wind, water etc.

(* Please refer fig – 1)

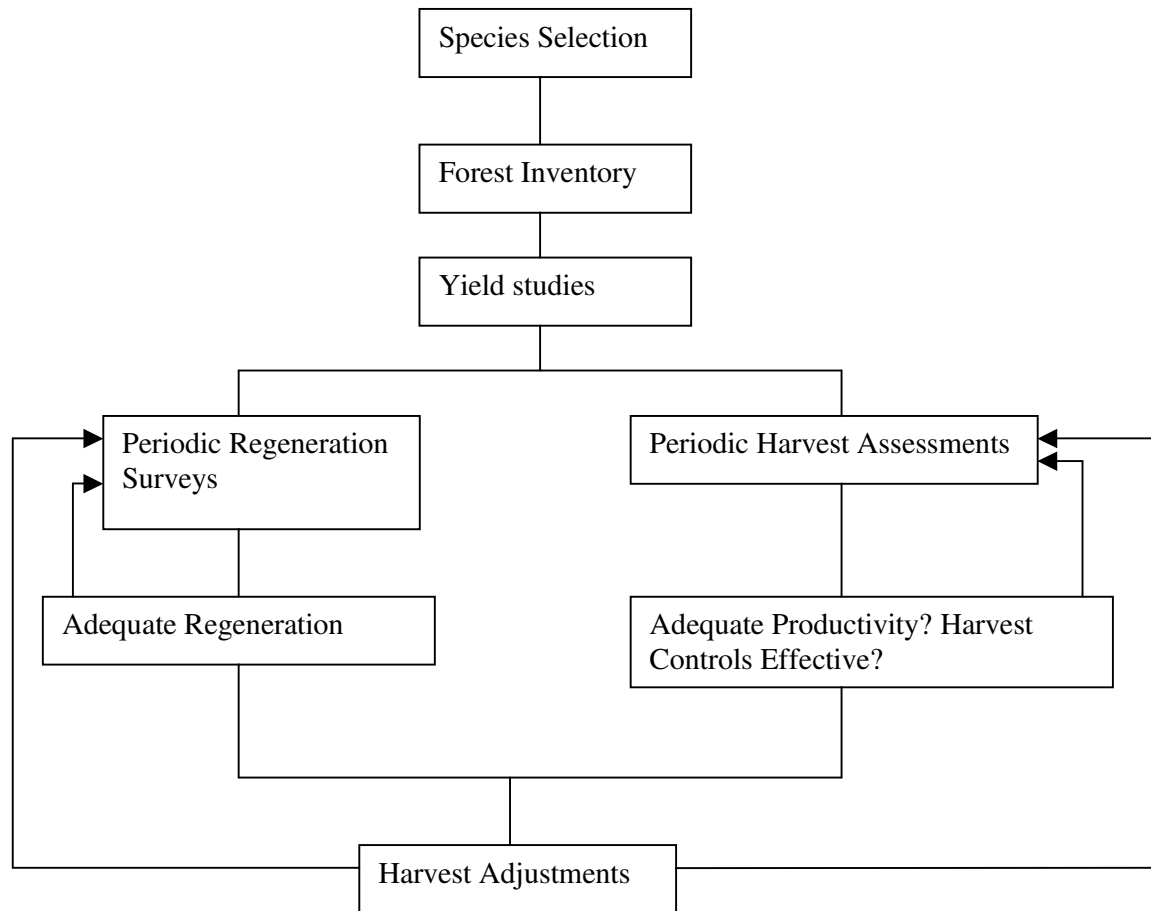


Fig – 1: Basic strategy for exploiting NTFPs (Peter Charles, M)

Fig – 1 refers to the general exploitation strategy of NTFPs that is subject to modification based on time, space and species concerned, if needed.

A careful ecological assessment promotes products that are sustainable for a sustainable enterprise promotion. Mismanagement of the resource and use of destructive harvesting practices occur if calendar of product cycles or necessary growth periods are not anticipated or the biological regeneration cycle is not understood. Provisions for pests and diseases or other calamities management are also needed.

Species selection & its ecology:

The spectrum and quantum of NTFPs available at the resource base and its ecology determines the exact role it can play in providing the raw materials. Greater availability of the individuals with greater production of the resource material proves promising for raw materials. Selection of the species for the enterprise needs prior understanding of the ecology of the species.

Layout of the study:

Area of study:

The ecological assessment of selected NTFP resources were carried out in selected resource patches of Gurundia Block of Sundargarh district, Orissa. As part of Vasundhara's NTFP based livelihood programme in the selected area through promotion of commodity cooperatives, it was decided to survey the few selected NTFP resources *viz* Mahua flowers and seeds, char seeds, Myrobalans (Anla, Harida, Bahada) and Siali climbers (please refer annexure IV for further details) that would be resource material for commodity cooperatives.

Why Gurundia:

Various NTFPs play significant roles from the perspective of rural livelihood in Gurundia. Timber is collected and used for self-use. More than eight different Non Timber Forest Products are important for them, *viz.*, Mohul, Tol, Sal seed, Sal leaf, Kendu leaf, Char seeds (decorticated), Myrobalans and Mushrooms, etc. Some of these (for *e.g.*, Kendu leaf) are collected exclusively for sale, some others(*e.g.*, Bendo) are collected exclusively for self-consumption and a number of NTFPs(*e.g.*, Mohul) are partly consumed & partly sold.

A few NTFPs like Siali leaf are concentrated in some parts of the block only and as such, are important for the people only in the areas of their potentiality. For *e.g.* among the six different sites selected for the study, Siali leaf was a major NTFP only at three sites with an average contribution of about 35% in the total average HH income from the NTFPs. Char is available almost every where and its decorticated seeds are the most valuable among the NTFPs collected locally; but the production (of decorticated seeds) is not high and thus, it fails to be the most significant NTFP in the area despite its highest procurement price. And Medha chhali, a glutinous bark which has high market demand, is collected in small quantities only by a few people simply because the resource have been reduced to the minimum through unsustainable practices of extraction.

The average HH income from NTFPs was around Rs. 3000/- per annum, which seems to be contributing approx. 30% of the total average HH income of the villagers. In fact, collection of NTFPs is so important for the local people that they spend approx. 50 % of their man-days for this purpose.

Objectives:

The study was taken up with following objectives:

- I. To study the ecological sustainability of selected NTFPs for proposed commodity cooperatives.

And

- II. To assess the productivity of NTFP species in the studied area.

Approach:

Participatory approaches involving village community mostly the volunteers, were taken up. The interested volunteers were trained to collect the vegetation data from the field and to record it. The primary data collected from the field were compiled and analysed to understand the results generated (please refer annexure - V for type of formats used).

The results thus obtained were shared with the leaders of cooperatives. The cooperative leaders in turn may form Forest Management Institutions (FMIs) to protect the existing forest and managing this resource for sustainable harvesting of the NTFPs for commodity cooperatives. The FMIs/Cooperatives would develop the rules and regulations for sustainable harvesting of NTFP resources.

2.0 Methodology:

Resource Mapping

Mapping of forest resources by the participation of volunteers from selected sites were carried out to draw the distribution of NTFP species in the wild, village commons and private lands (*i.e.* both forest and non forestlands). The maps were later used for vegetation surveys.

Data collection:

Primary data were collected for all trees (*Siali* fibres were exception) occurred in the sample plots (square quadrants of 50mX50m size). GBH (Girth at Breast Height), approximate height of trees, and anthropogenic disturbances on every tree species were also recorded. Tree regeneration stand (pre-reproductive individuals, also see annexures - 1, 2 & 3) were counted in smaller plots of 10mX10m size. *Siali* fibres were counted per sample plot. Yield analysis were also carried out. Data were then analysed to obtain the results. Linear belt transects were laid in non-forest lands to assess the primary data from these areas.

Data analysis:

Primary data were analysed to determine tree density, age-class (annexure-II) distribution, extent of anthropogenic (human induced) disturbances and productivity of NTFP resources.

Results...

Table 1: Density of trees, Kainshibahal, Gurundia, Sundargarh

Sl No	Tree Sps.	Avg density (Per ha)	% of Representation
1	Sal	181.33	30.98
2	Kendu	55.56	9.49
3	Bija	40.89	6.99
4	Chara	36.00	6.15
5	Mahula	32.33	5.09
6	Asana	24.89	4.25
7	Karama	13.33	2.28
8	Desana	12.89	2.20
9	Khaesh	11.56	1.97
10	Katai	10.67	1.82
11	Haladia	9.78	1.67
12	Bhrugi	8.89	1.52
13	Ruchmuchia	7.56	1.29
14	Sarala	7.11	1.21
15	Achhi	6.22	1.06
16	Bahada	6.22	1.06
17	Debdaru	5.78	0.99
18	Harida	5.78	0.99
19	Jamu	5.78	0.99
20	Bherun	4.89	0.84
21	Sishu	4.89	0.84
22	Anala	4.89	0.76
23	Bukasungha	4.44	0.76
24	Remel	4.44	0.76
25	Sunari	4.44	0.76
26	Tetalia	4.44	0.76
27	Bela	4.00	0.68
28	Dhaura	4.00	0.68
29	Gambhari	4.00	0.68
30	Muid	4.00	0.68
31	Gangasiuli	3.56	0.61
32	Ghunt	3.56	0.61
33	Chaili	3.11	0.53
34	Munagi	3.11	0.53
35	Tilei	3.11	0.53
36	Charaigudia	2.67	0.46
37	Damkhurulu	2.67	0.46
38	Kari	2.67	0.46
39	Kumbhi	2.67	0.46
40	Rethi	2.67	0.46
41	Bandena	2.22	0.38

42	Kekata	2.22	0.38
43	Bhelia	1.78	0.30
44	Karala	1.78	0.30
45	Papara	1.78	0.30
46	Chaulia	1.33	0.23
47	Karkat	1.33	0.23
48	Kasaili	1.33	0.23
49	Rai	1.33	0.23
50	Ratanagoura	1.33	0.23
51	Siali	1.33	0.23
52	Daka	0.89	0.15
53	Kurum	0.89	0.15
54	Paunsa	0.89	0.15
55	Sidha	0.89	0.15
56	Baranga	0.44	0.08
57	Bharanga	0.44	0.08
58	Chauda	0.44	0.08
59	Dantha	0.44	0.08
60	Gandargauda	0.44	0.08
61	Kasei	0.44	0.08
62	Kaya	0.44	0.08
63	Kurulu	0.44	0.08
64	Kusum	0.44	0.08
65	Retai	0.44	0.08
66	Samasihir	0.44	0.08
67	Saralguli	0.44	0.08
68	Semel	0.44	0.08
69	Senha	0.44	0.08

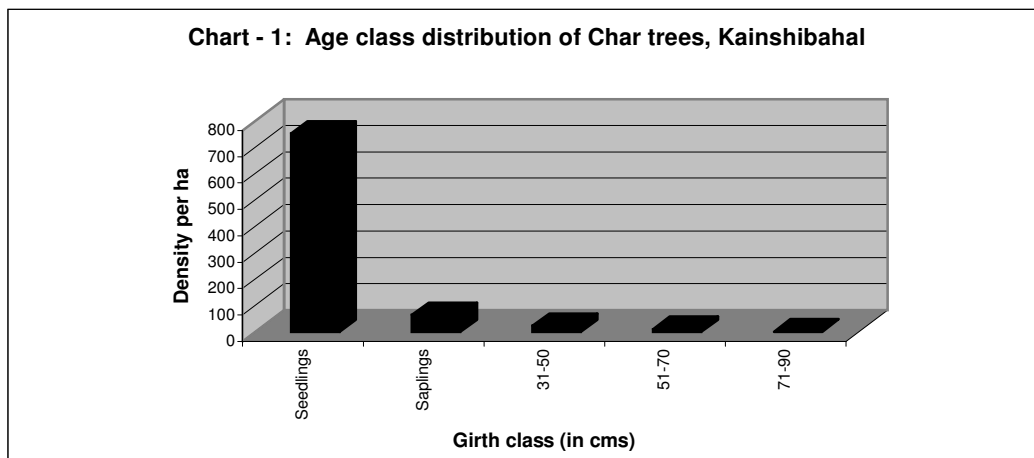


Chart - 2 : Age class distribution of Mahula trees, Kainshibahal

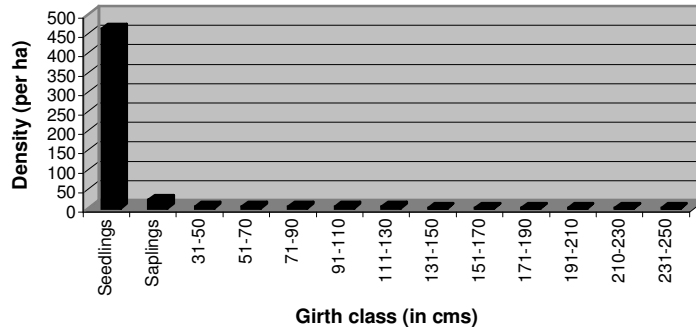


Chart - 3 : Age class distribution of Anla trees, Kainshibahal



Chart - 4 : Age class distribution of Bahada trees, Kainshibahal



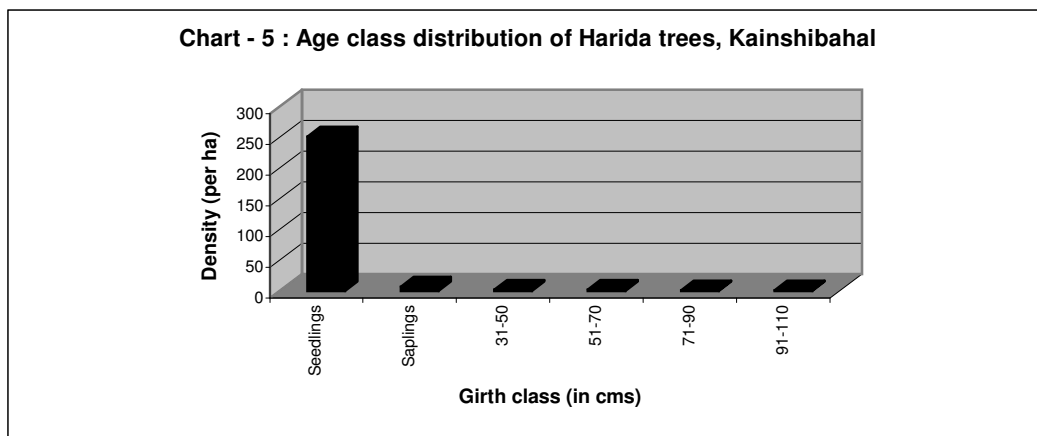


Table: 2 anthropogenic pressure on selected NTFPs, Kainshibahal.

	trees cut / ha	% of cut tree	total tree density
Anla	0	0	5
Bahada	0	0	6
Harida	0	0	6
char	0.88	2.44	36
Mahul	0.44	1.38	32

Table - 3 : Density of trees, Lachhada, Gurundia, Sundargarh

SI No	Tree Sps.	Avg no of trees/Ha	% of Represn
1	Sal	170	39.17
2	Chara	47	10.83
3	Asana	45	10.37
4	Kendu	32	7.37
5	Kalara	17	3.92
6	Dhuala	16	3.69
7	Mahula	16	3.69
8	Bija	13	3.00
9	Bhelia	12	2.76
10	Tilai	11	2.53
11	Jamu	9	2.07
12	Harida	8	1.84
13	Ruchmuchia	7	1.61
14	Munagi	6	1.38
15	Kathamahuli	4	0.92
16	Piasala	4	0.92
17	Anala	3	0.69
18	Ghuntakanta	3	0.69
19	Karada	2	0.46
20	Ladha	2	0.46
21	Ratanagoura	2	0.46
22	Amatha	1	0.23
23	Jugia	1	0.23
24	Karama	1	0.23
25	Kasai	1	0.23
26	Sunari	1	0.23

Chart - 6: Age class distribution of Bahada trees, Lachhada, Gurundia, Sundargarh

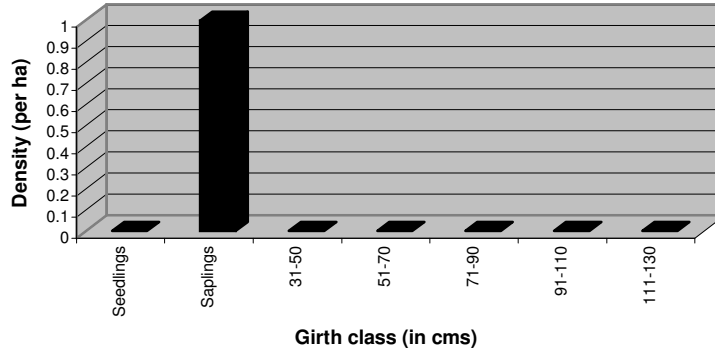


Chart - 7: Age class distribution of Char trees, Lachhada, Gurundia, Sundargarh

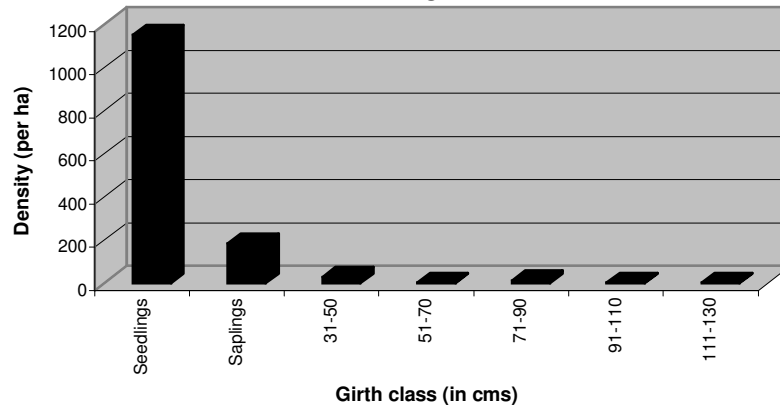


Chart - 8: Age class distribution of Mahula trees, Lachhada, Gurundia, Sundargarh

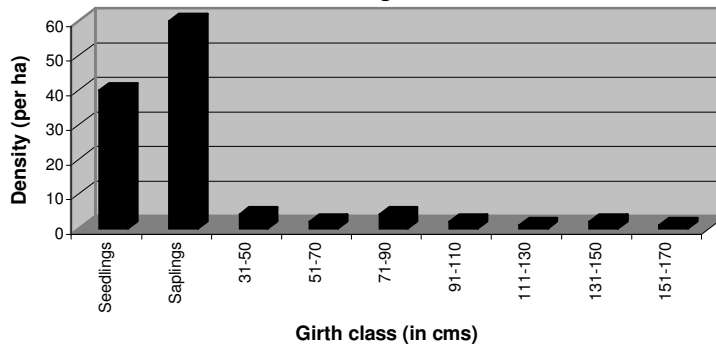


Chart - 9: Age class distribution of Anla trees, Lachhada, Gurundia, Sundargarh

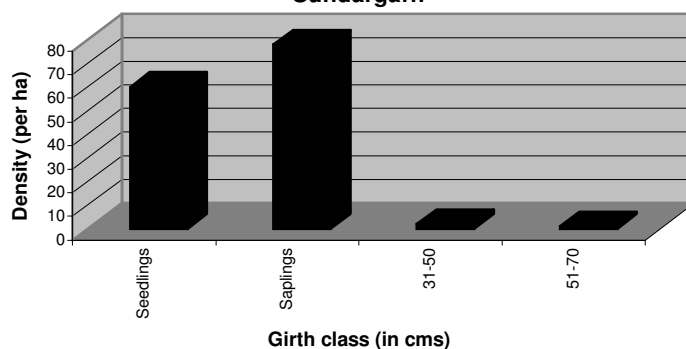


Chart - 10: Age class distribution of Harida trees, Lachhada, Gurundia, Sundargarh

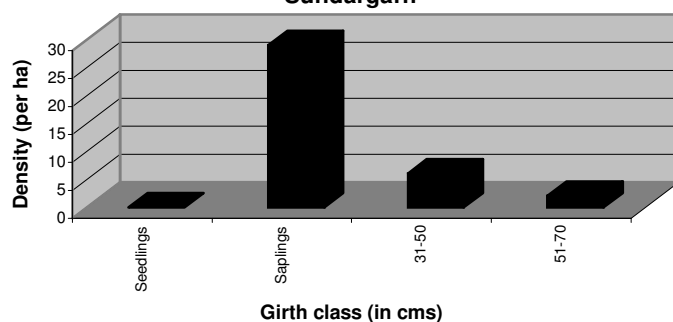


Table - 4: Density Of Trees, Tamparkela, Gurundia,

Sl No	Tree Sps.	Density/Ha	% of Reprsen
1	Sala	330.4	42.14
2	Kendu	72	9.18
3	Asana	68.4	8.72
4	Chara	58	7.40
5	Jamu	35.2	4.49
6	Mahula	27.6	3.52
7	Desana	20.8	2.65
8	Harida	18.8	2.40
9	Dhubena	15.2	1.94
10	Dhanala	11.2	1.43
11	Bija	9.2	1.17
12	Bhelia	8.4	1.07
13	Chauli	7.2	0.92
14	Lada	7.2	0.92
15	Tilo	6.4	0.82
16	Filei	6.0	0.77
17	Anla	5.2	0.66
18	Khakhada	5.2	0.66
19	Bukasungha	4.4	0.56
20	Rai	4.0	0.51
21	Baghakata	3.6	0.46

22	Kakada	3.6	0.46
23	Achhu	3.2	0.41
24	Damkurlu	3.2	0.41
25	Bahada	2.8	0.36
26	Baranga	2.8	0.36
27	Chikini	2.4	0.31
28	Debadaru	2.4	0.31
29	Kalamba	2.4	0.31
30	Kurudu	2.4	0.31
31	Dhubela	2.0	0.26
32	Kuruma	2.0	0.26
33	Sarla	2.0	0.26
34	Bandana	1.6	0.20
35	Daka	1.6	0.20
36	Gambhari	1.6	0.20
37	Kuileru	1.6	0.20
38	Rimbil	1.6	0.20
39	Sekre	1.6	0.20
40	Sunari	1.6	0.20
41	Chhotrai	1.2	0.15
42	Khainsa	1.2	0.15
43	Khumbhi	1.2	0.15
44	Patuli	1.2	0.15
45	Dhagala	0.8	0.10
46	Dhanatha	0.8	0.10
47	Ghanta	0.8	0.10
48	Kalama	0.8	0.10
49	Karama	0.8	0.10
50	Ludi	0.8	0.10
51	Papada	0.8	0.10
52	Badarai	0.4	0.05
53	Bammur	0.4	0.05
54	Chudeigudi	0.4	0.05
55	Gut Kharka	0.4	0.05
56	Kakita	0.4	0.05
57	Karua	0.4	0.05
58	Karuan	0.4	0.05
59	Kekat	0.4	0.05
60	Kindo	0.4	0.05
61	Kuimari	0.4	0.05
62	Kusum	0.4	0.05
63	Lakatei	0.4	0.05
64	Ludha	0.4	0.05
65	Mundi	0.4	0.05
66	Patwan	0.4	0.05
67	Phurphudia	0.4	0.05
68	Tetera	0.4	0.05

Chart - 11: Age class distribution of Char trees, Tamparkela, Gurundia, Sundargarh

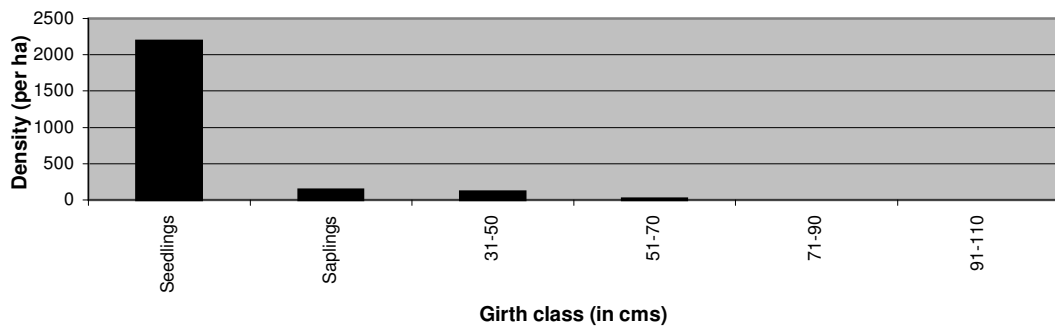


Chart - 12: Age class distribution of Mahula trees, Tamparkela, Gurundia, Sundargarh

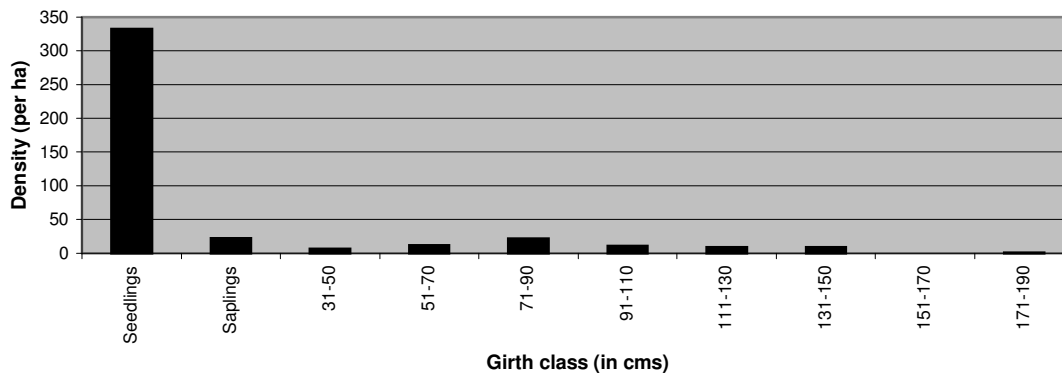
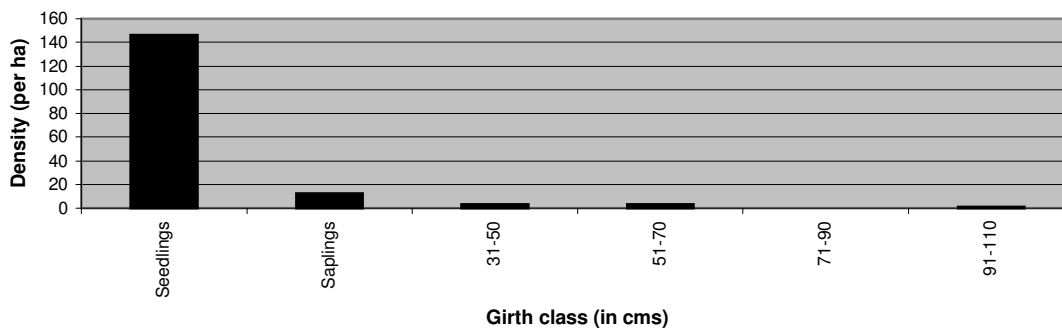


Chart - 13: Age class distribution of Bahada trees, Tamparkela, Gurundia, Sundargarh



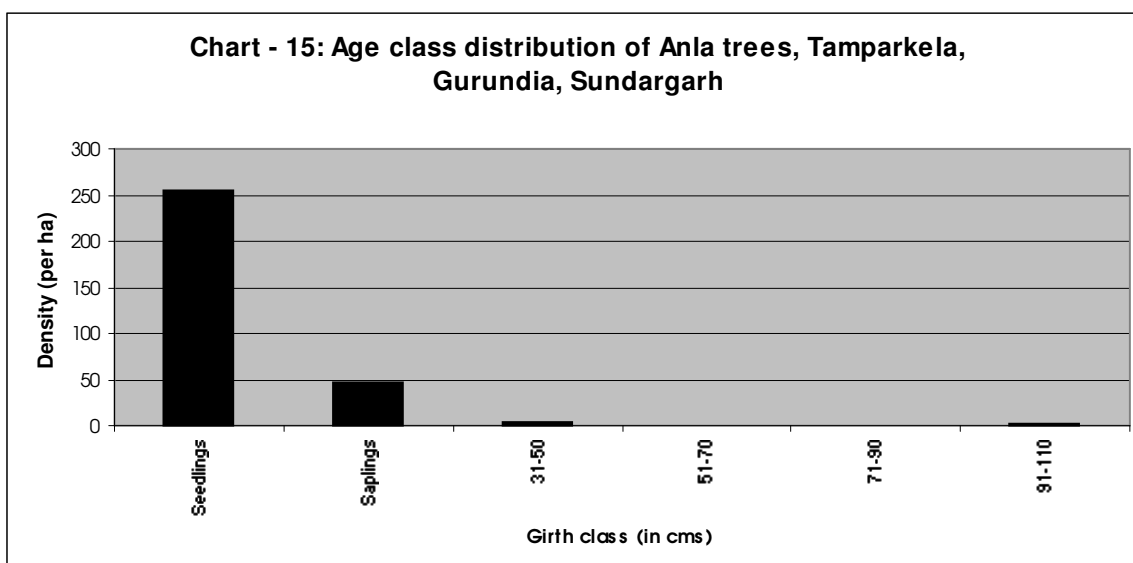
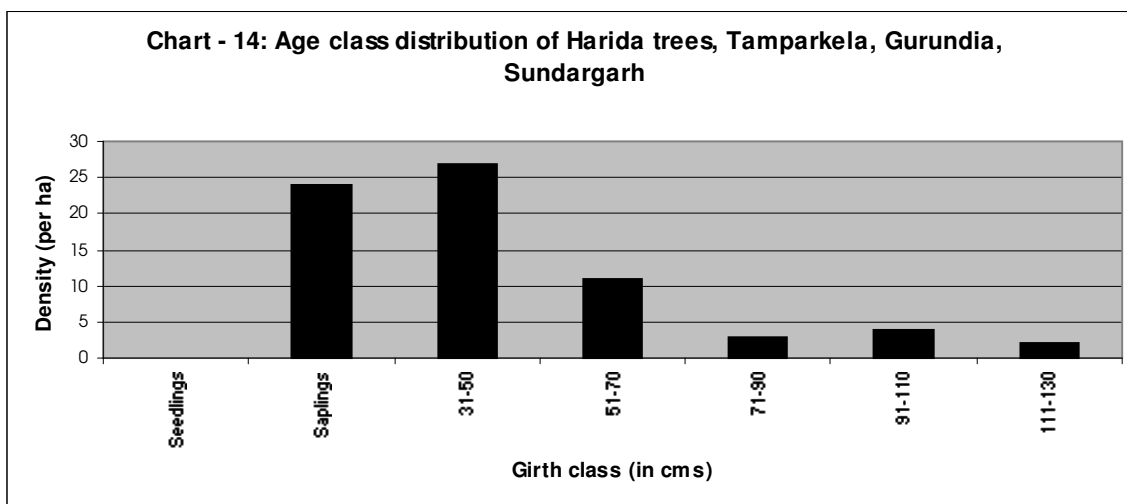


Table - 5: Densities of Siali climbers and harvestable leaf yield in the forest patches, Gurundia, Sundargarh

<i>Name of the forest patch</i>	<i>No of climbers/ha</i>	<i>Yield of harvestable leaves per climber season</i>	<i>Frequency of collection</i>	<i>Total annual collection (in No/ha)</i>	<i>Yield per year /ha (in Kgs)</i>
Kainshibahal	1259	128	2	322370.4	2930.64
Lachhada	2800	176	2	985600	8960
Tamparkela	2790	229	2	1277820	11616.55

Chart - 16: Age Class distribution of Mahula in Non forest plots, Kainshibahal, Gurundia, Sundargarh

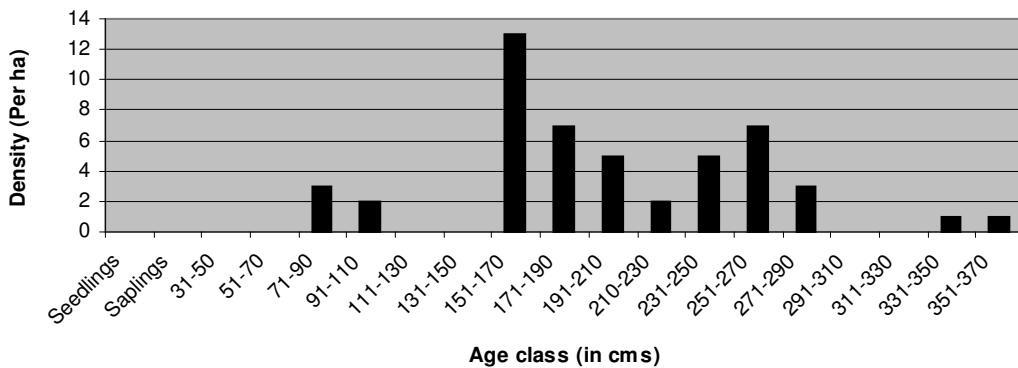


Chart - 17 : Age Class distribution of Mahula trees in Non forest lands, Lachhada, Gurundia, Sundargarh

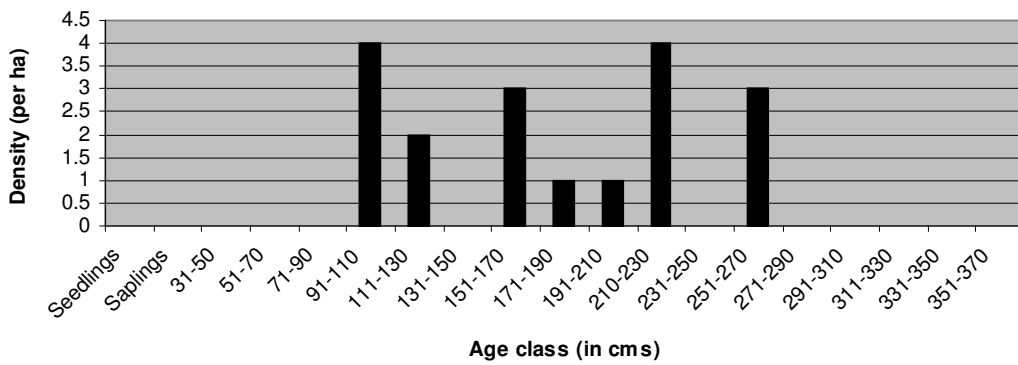


Chart - 18: Age Class distribution of Mahula trees in Non forest lands, Tamparkela, Sundargarh

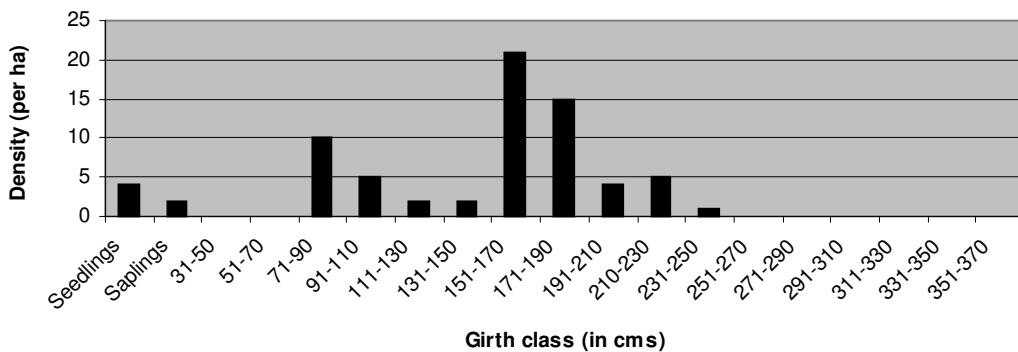


Chart - 19: Age class distribution of Char trees in Non forest lands, Kainshibahal, Gurundia, Sundargarh

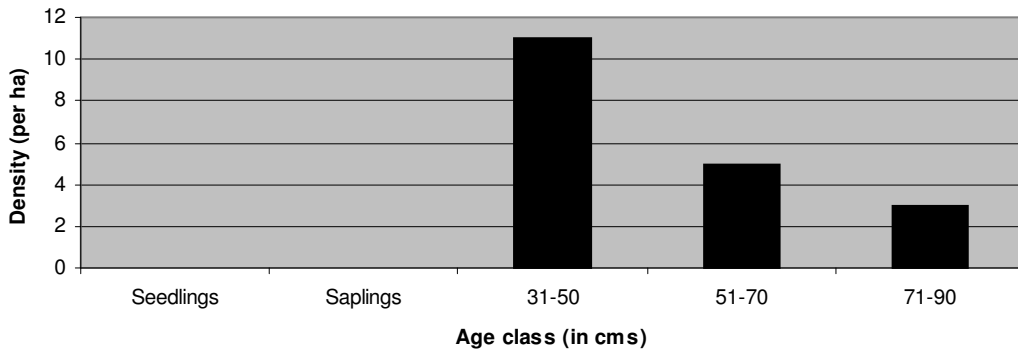


Chart - 20: Age Class distribution of Char trees in Non forest lands, Lachhada, Gurundia, Sundargarh

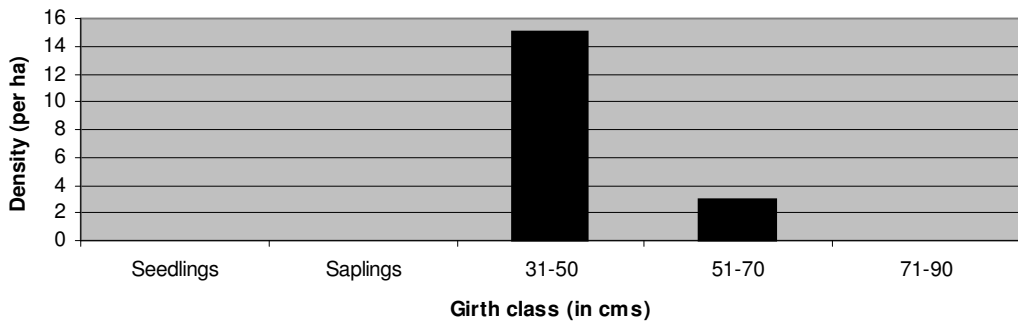


Chart - 21: Age class distribution of Char trees, Tamparkela, Gurundia, Sundargarh



Chart - 22: Age class distribution of Harida trees, Kainshibahal, Gurundia, Sundargarh



Chart - 23: Age class distribution of Harda trees, Lachhada, Gurundia, Sundargarh

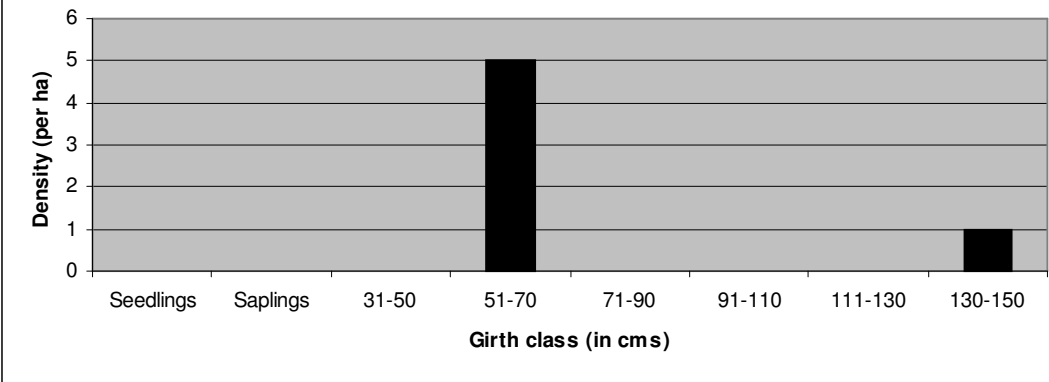


Chart - 24: Age Class distribution of Harida trees, Tamparkela, Gurundia, Sundargarh

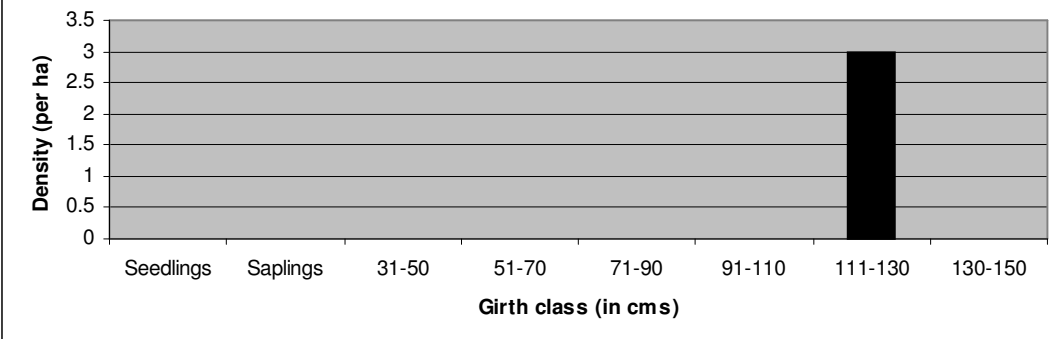


Table - 6: Yield estimation of Mahula in forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	43.81	32.33	1416.3773
Lachhada	34	16	544
Tamparkela	35	27.6	966

Table - 7: Yield estimation of Tola in forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	55.74	32.33	1802.0742
Lachhada	38.29	16	612.64
Tamparkela	42	27.6	1159.2

Table - 8: Yield estimation of Harida in forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	25.54	5.78	147.6212
Lachhada	32.56	8	260.48
Tamparkela	47.25	18.8	888.3

Table - 9: Yield estimation of Bahada in forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	38	6.22	236.36
Lachhada	0	0	0
Tamparkela	24	2.8	67.2

Table - 10: Yield estimation of Anla in forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	5.6	4.89	27.384
Lachhada	4.25	3	12.75
Tamparkela	7	5.2	36.4

Table - 11: Yield estimation of Char in forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	0.83	36	29.88
Lachhada	0.55	47	25.85
Tamparkela	0.56	58	32.48

Table - 12: Yield estimation of Mahula in Non forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	65.5	49	3209.5
Lachhada	42.5	18	765
Tamparkela	57.2	65	3718

Table - 13: Yield estimation of Tola in Non forest lands

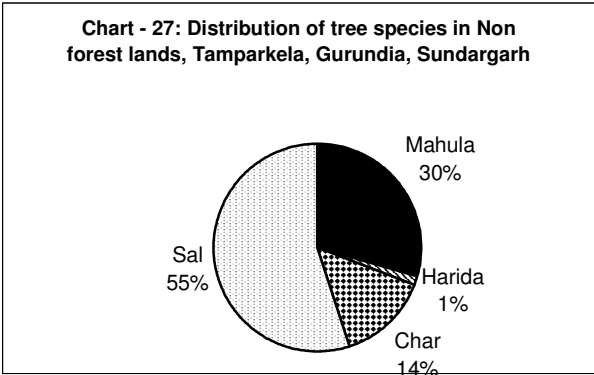
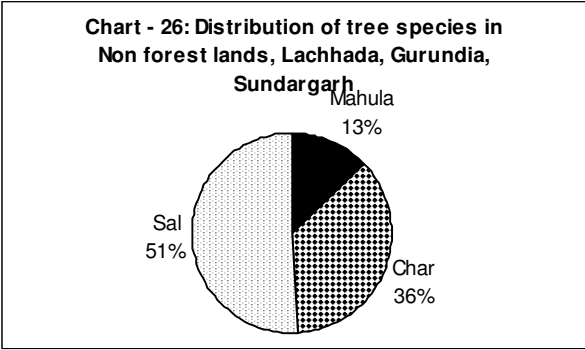
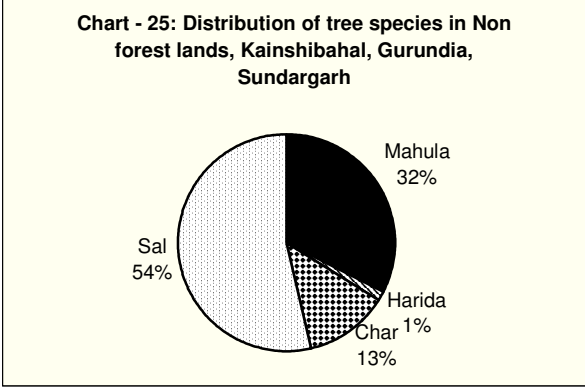
Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	71.65	49	3510.85
Lachhada	54.66	18	983.88
Tamparkela	62.5	65	4062.5

Table - 14: Yield estimation of Harida in Non forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	14.5	2	29
Lachhada	0	0	0
Tamparkela	25.6	3	76.8

Table - 15: Yield estimation of Char in Non forest lands

Sites	Avg. yield/ tree	Avg. density/ha	Yield (in Kgs) / ha
Kainshibahal	0.8	19	15.2
Lachhada	0.75	51	38.25
Tamparkela	0.7	31	21.7



*Data analysis, status of NTFP
resources and management
recommendations...*

The results show interesting phenomenon of the NTFP resources both in the forest and non forestlands. The detailed nature and behaviour of the NTFP species may be analysed as under.

4.1 Mahula:

Mahula represents fairly well in forests next to Char trees in the wild among selected NTFP resources. Representation of Mahula trees is upto 5% total plant population in the wild (tab - 1,3 & 4) and 32% in the non-forest lands (charts - 25, 26 & 27, Annexure - V). This seems fair (in numbers) for the proposed commodity cooperatives in the concerned area at present context to provide the raw materials for trade.

The population structure (charts - 2 & 12) in the wild although broadly represents that there is enough of seedling establishment (annexure - II) in Kainshibahal and Tamparkela, it is not similar in Lachhada (chart - 8). The ratio between numbers of individuals of different age class is not fairly noticed. There is inadequate Mahula seed establishment in the wild at Lachhada. In other two sites the number of seedlings getting established to saplings and other matured individuals have been drastically reduced (reduction is upto 94 -95%). Total number of matured individuals yielding Mahula/Tola is restricted to only 6% in Kainshibahal. However, this is higher in Lachhada (upto 22.5%) and Tamparkela (18%). The age class distribution indicates that the species has previously experienced some sort of disturbance in the wild in all sites. The disturbance originated due to:

- I. Failure of seedlings establishment because of dense canopy.
- II. Extensive forest fire during the summer³.
- III. Grazing pressure by cattle and fungus attack
- IV. Increased anthropogenic pressure Vs slow growth and establishment of seedlings in both type (forest and non forest) sites.
- V. Lopping pressure on the species (table - 2).

The distribution of Mahula individuals in non-forestlands reflects a picture of destructive harvesting. In all sites Mahula lacks adequate regeneration (charts - 16,17 and 18). Although in Tamparkela some regeneration stands exist, the regeneration is inadequate. Flower / fruit yielding individuals noticed in the non forest lands show a skewed distribution along with complete loss of individuals of certain age class. This is due to loss of seed establishment in the non-forestlands due to complete removal of Tola seeds (Mahua seeds).

Absence of standard age class distribution and loss of few individuals of specific age class reveals its history of disturbance it had experienced. It thus necessitates taking care towards its back recurrence in its natural ecosystem.

³ Forest fire occur in the wild due to various reasons. Lighting fire to get clean forest floor for easy collection of Mahula flowers, to augment the Kendu leaf (beedi leaves) production, hunting wild animals etc.

Production of Mahula flowers is ample in both forest and non-forestlands (refer tables - 6 & 12). Thus, Mahula flowers may suitably be collected and employed for primary commodity cooperatives which seems promising for these without any adverse effect on the species. Adequate attention must be paid towards protection of Mahula seedlings, its successful establishments and recruitment both in the forest and non-forestlands.

Management recommendations:

- I. Collection of Tola (Mahula seeds) to be restricted in the wild completely.
- II. Mahua seeds may be sown and seedlings should be transplanted both in the wild and private / common lands with adequate canopy gap or sunny places (Annexure - III).
- III. The young seedlings must be protected from forest fires, grazing pressure, cattle trampling etc.
- IV. Complete restriction of tree lopping (tab - II) in both type of ecosystems.
- V. Existing population to be saved immediately by strengthening of local community based Forest Management Institutions in the area.

4.2 Char

Char species is one of the dominating species among our all selected NTFP resources for the primary commodity cooperatives (Tab - 1,3 & 4) in the forest patches. Average fruit yielding Char individuals ranges from 36 - 58 per ha in the wild (tab - 1,3 & 4) and non-forest lands similar number of individuals are noticed (charts-25, 26 & 27) which hints that Char species also been well preserved in the non-forestlands. The range of Char density is from 19-51 per ha in the non forest lands.

Char species is the most ecologically balanced species among the selected NTFPs. There exists a fairer ratio among number of individuals of different age class of this species (charts - 1, 7 and 11) in the forests. However, this distribution is not equally noticed in the non-forest areas. Char seedlings are completely lacking (Charts - 19 & 20) or inadequately distributed (chart - 21) in the non-forest areas. The survey reveals that during growth of seedlings to saplings and other higher matured individuals only 6.5 - 16% of total seedlings grow upto sapling stage and form the major seed yielding individuals in various studied sites (please refer charts - 1, 7 and 11) in the wild. In non-forest areas, such as in Tamparkela, there is reduction of saplings establishment upto 50%. In all sites the percentage of matured individuals comprising seed yielding individuals range from 60-100% of entire Char tree population. In the forested areas the species behaves normally (annexure - II & IV). Complete or greater removal of seeds to gain greater economic returns had threatened this species in the non-forestlands.

Char seeds collection from the forests can provide substantial amount (tab - 11) for the proposed commodity cooperatives. Although significant number of matured individuals exist in the non-forest lands (tab - 15), loss of seedlings and saplings would not make the seed collection in the long run.

Management recommendations:

- I. Formulation of conventional thumb rules for careful Char seed collection by the Forest Management Institution members in this area.
- II. Restriction on entire seed crop harvest in the non-forest lands.
- III. Restriction on increased Char seed collection than existing limit in the wild.
- IV. Sowing matured seeds in the non-forest and forest lands in moderately sunny areas.
- V. Reduction in lopping pressure (tab - 2) on this species in the wild.
- VI. Conservation of existing Char tree resource in both ecosystems.

4.3 Harida:

Scarce distribution of Harida in both forest and non-forest areas doesn't provide much opportunity for encouraging the trade through commodity cooperatives. The density of Harida trees found in sampled area ranges from 6-19 trees/ha in the forestlands, which comprises 1-2.4% of entire tree populations. In non-forest areas Harida tree represents 2-6 trees/ha.

Disturbed population structure (please refer charts – 10,14,22,23 & 24)) further strengthens the limiting possibilities of employing Harida fruits in trade. Severity of the disturbance in non forest-lands is greater exclusively restricting to very few individuals of specific age class. In the forest and non-forest lands Harida regeneration is severely lacking (please refer charts 5, 10, 14, 22, 23, & 24 for Harida age class distribution) except in Kainshibahal where though the species is represented by good number of seedlings, most of seedlings are lost while attending sapling stage. Wherever saplings are present, it is dominantly restricted to sapling stage with very low matured individuals. Fruit yielding trees are restricted to only very few matured individuals (charts – 10,14,22,23 and 24). The reasons attributed for low regeneration of Harida on both forest and non forest ecosystem include:

- I. Very hard seed coat that hinders seed germination to greater extent (Annexure – IV).
- II. The species is a strong light demander. The “shade effect” of other species creates cramped situation that suppresses the Harida regeneration.
- III. Complete burning of Harida seedlings due to forest fires during summer. However, the matured individuals withstand the fire very well.
- IV. Intensive removal of Harida fruits for sale in the local markets does not return the seeds back to the ecosystem of future generation.

- V. Intolerance to shade and slow growth rate of seedlings.
- VI. Absence of wild mammals such as *Cheetal* (Barking deer) in the forest ecosystem renders the digestion and dispersion of the seeds in the wild. Digestion by mammals and dispersion allows greater probability of seed germination.

In this present context, yield per ha (tab - 8 & 14) does not provide a reasonable and promising collection quantity for trading of Harida seeds from its ecosystems. Population structure does not reveal a healthy population dynamics of this species both type of ecosystems. The regenerating and recruiting individuals to successive age classes are low and unpredictable.

Management recommendations:

- I. Complete restriction of Harida fruits collection from its sources and due attention to be given towards regeneration through artificial techniques (please refer annexure - IV). Community based nursery raising and plantation in the canopy gaps in both type of ecosystems should be encouraged. Transplantation of seedlings, root and shoot cutting (the species coppices very well) may also be carried out.
- II. Application of controlled forest fire under the canopy of matured Harida trees. Forest fires help in burning the seed hard coat of Harida and its early regeneration.
- III. Reduction of destructive harvesting methods such as hacking tree branches and lopping pressure.
- IV. Transplanting fast growing and with better pulp / seed ratio Harida variety looking from commercial point by the cooperatives. Sustainability from trade economics point of view would not allow the cooperatives to wait for 15-20 years for a natural growth of Harida tree.
- V. Establishment of community based pulp extraction enterprises near the forest ecosystem help in "returning back" the seeds to the ecosystem enabling greater chances of regeneration by extracting the pulp and reusing the seeds for Harida regeneration.
- VI. Set up of conventional thumb rules by FMIs / Cooperatives towards conservation and harvesting of fruits.

4.4 Anla

This species represents poor in the wild. The tree density varies from average of 3 - 5 trees/ha (tab- 1,3 & 4) in the wild and it is altogether absent in the non-forest areas. Anla represents less than 1% of total tree population in the studied sites.

The species represents with disturbed population structure (Lachhada and Tamparkela) or is restricted to low fruit yield or regeneration stands in Kainshibahal (charts - 3,9 and 15).

Very low yield of Anla per tree indicates scarce possibilities for trade of this commodity by primary commodity cooperatives in this area (tab-10). Yield of Anla fruits vary from 12.75 kgs / ha to 27.38 kgs/ ha in the wild. This yield is expected to rise in future in Kainshibahal and Tamparkela whereas in Lachhada, the yield expected to face a disturbance. Minimisation of the disturbance can be followed with following proposed activities:

- I. Safeguarding existing seedlings and allowing the seeds to germinate in the wild.
- II. Prevention of forest fires and prohibition of tree hacking.
- III. Domesticating the better variety of the species and its cultivation with value addition. Agro forestry practices to be carried out in the agricultural fields. The wild species may be suitably raised in the private plots.
- IV. Restriction on fruits collection for commercial purpose besides for storing annual medicinal uses.
- V. Sowing seeds in selected places of the wild enables increasing its density.
- VI. Selective pollarding of oldest branches in the wild and in the agricultural / non-forest lands must be carried out for suitable and considerable growing of young shoots for better yield.

4.5 Bahada

Distribution of Bahada is restricted only to the wild. Insignificant distribution of Bahada in the wild (3-6 trees/ha) restricts the possibility of collective trading by the commodity cooperatives. In some areas it represents 0.36-1.06% of total tree population (Kainshibahal and Tamparkela) whereas it is completely absent in Lachhada. Thus this species is sporadically and unevenly distributed. Sporadic and uneven distribution does not guarantee the continuous and sufficient fruit yield and ensuring the sustenance the commodity cooperatives.

Population structure of Bahada species again depicts a disturbed structure (charts - 4, 6 and 13). Analysing the population structure indicates complete absence of few age classes in all sites otherwise imply that the species is under various pressures that lead to inability to establish on the forest floor. As per the nature and behaviour (ability) of the species to yield a good fruit / seed per tree although contradicts the existing situation, the existing situations are not favourable for seed establishment in the wild. Few reasons may be sited as under:

- I. Insufficient productivity of Bahada fruits in the wild (tab-9).
- II. Inadequate representation and complete absence of Bahada trees in the wild (tab-1, 3 & 4).
- III. Destruction of seed by insects and animals. Trampling of seedlings and grazing pressure by the grazing animals.

- IV. Its inability to withstand the drought situations. Since, the studied sites are under dry deciduous forest ecosystem, hence, absence of enough moisture to stimulate the germination often hinders the establishment.
- V. Although the vitality of seed remains for one year, its failure in establishment in the first year reduces the germinative capacity to 40-50% of total vitality in the 2nd year.

The ecological situation of Bahada species again does not permit for immediate steps for procurement of Bahada fruits for Commodity Cooperatives. It may take more 10-15 years for enterprise set up for a suitable trade.

Management Recommendations:

- I. Collection of 50% of fallen fruits and sowing in the moderate shade and moist conditions.
- II. Restriction on complete removal of all seed crops besides for absolute essential conditions.
- III. Complete inhibition of forest fire.
- IV. Transplanting of Bahada seedlings of 2-4 months old in the selected place as mentioned above (it gives 96% with proper care)
- V. No timber extraction should be allowed by the FMIs.

4.6 Siali Climber

The availability and distribution of Siali climbers in the wild is gregarious. The number number of climbers in the patches ranged from 1259 - 2800 climbers / ha. This sound establishment in the wild promises a feasible NTFP resource potential for primary commodity cooperatives. Its strong ability to produce more than 50m long young shoot with adequate young tender leaves in one season does not allow to eradicate this climber from the wild. That's why this climber is most distinctively noticed in the forest patches. Forest fires does not affect the Siali seeds significantly as their pods are mostly in the above the forest fire height. More interestingly forest fire helps in releasing the seeds and widely disseminating in (Annexure – IV). Local inhabitants of this area often cut the trees (where the climber is much bigger and climbed high of the free) without affecting the climber. Further more the yield of harvestable leaves/climber/season and total annual yield/year in the present context ensures establishment of either raw or processed leaf / leaf plates substantially.

However, following management recommendations are suggested for better raw capital material improvement.

Management Recommendations:

- 1. Suitable seeds may be collected and either sowed or put in loose soils with adequate sunlight for climbers establishment.
- 2. Over extraction of Siali climbers per season than usual threshold limit to be restricted. Single climber although regenerates the side branches, maturing of this new branches would further yield side branches that would be the sources of new leaves.

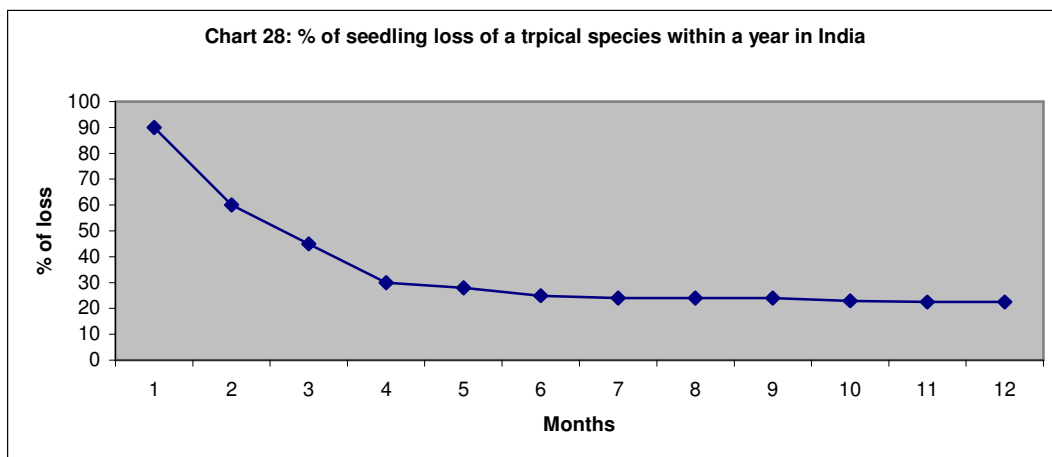
Annexure – 1

Tree regeneration & growth in the Wild

The trees in the wild are subjected to several pressures both anthropogenic and natural. The regenerating individuals and agents more specifically, are more susceptible to different threats. Safe seed arrival from the parent tree to the forest floor does not by any means, guarantee that a seed will germinate and become established in the under storey of the forest. The seed must avoid being eaten, it must encounter the appropriate light, moisture and nutrient conditions for germination and it must be able to germinate and grow faster than the seeds of all the other species that one trying to establish themselves on the same spot.

There is a high probability that a seed will come in contact with an animal during the lapse between dispersal and germination. In most cases, this encounter possess fatal for the seed. In term of total numbers, seed predation⁴ is unquestionably one of the most severe sources of mortality during the life of a plant. Over 98% of the seeds of some forest species is lost to predation, rodents, beetles and ants are most frequently cited seed destroyers.

Even assuming that a seed has successfully germinated and new seedling has established its roots and shoots unfurled its first new leaves, there is still very little chance that the plant will become established on that site. The first year of life for a seedling is plagued with problems. To begin with, light levels in the forest under-storey are usually so low (1-2% of full sun) that it is difficult to grow. Added to this is a very high probability that it will be browsed by an animal, out competed by its neighbours, smashed by a falling branches, attacked by fungal pathogens, ripped out of the soil by a rolling rock or wilted by wildy fluctuating moisture lends.



The graphical examples (chart - 28) shows that seedling survivorship by a dipterocarp (family member of *Dipterocarpaceae*) shows that the seedling survival gets reduced to 90% in the first month immediately after germination to 22.5% of survival after 12 months. Studies also indicate survival rate of seedlings get declined to 3% after 12months in some species. The graph above shows five months after germination over 50% of the seedlings have already

⁴ Seed predation refers to destruction of seeds by animals that attack, eat, lay eggs on or otherwise damage them.

been died. Char seeds (seeds of *Buchanania lanzan*) under direct sunlight also have very low survival rate. Similarly natural survival of Mahua seedlings is also low. Mahua seeds germinate during rainy season after falling. Exposure of Mahua seeds renders them liable to fungus attack and eaten by insects. Germination takes place only covered by soil but subsequent growth is slow and favoured by abundant light. Similarly natural regeneration of Harida (*Terminalia chebula*) is scarce in tropical dry deciduous forests of Orissa which is attributable to poor germinative capacity of seed, destruction of seed by insects, rats, squirrels and other rodents. Further, the Harida species is strong light demander and requires direct overhead light and cannot tolerate shade or cramped situation. Despite the fact that Bahada species usually have good seed crops, wide dissemination of seeds, their quick and easy germination and ability of seedlings to tolerate under shade for first two initial years, it is less gregarious in the forest than ideally it should be this is due to destruction of seed by insects, animals, birds and insects. Drought conditions in the forest floor restrict germination of seeds⁵. Similar situation may be cited for Sal (which constitutes the major crop of Orissa tropical dry deciduous forest) regeneration. Information such as these, which are typical of tropical trees growing in primary forests provide a convincing demonstration of how difficult it is for a tree population to maintain itself in the forest – even in the absence of any type of resource harvesting.

⁵ Survival data of Mahula, Harida, Bahada, Sal species etc are inadequate.

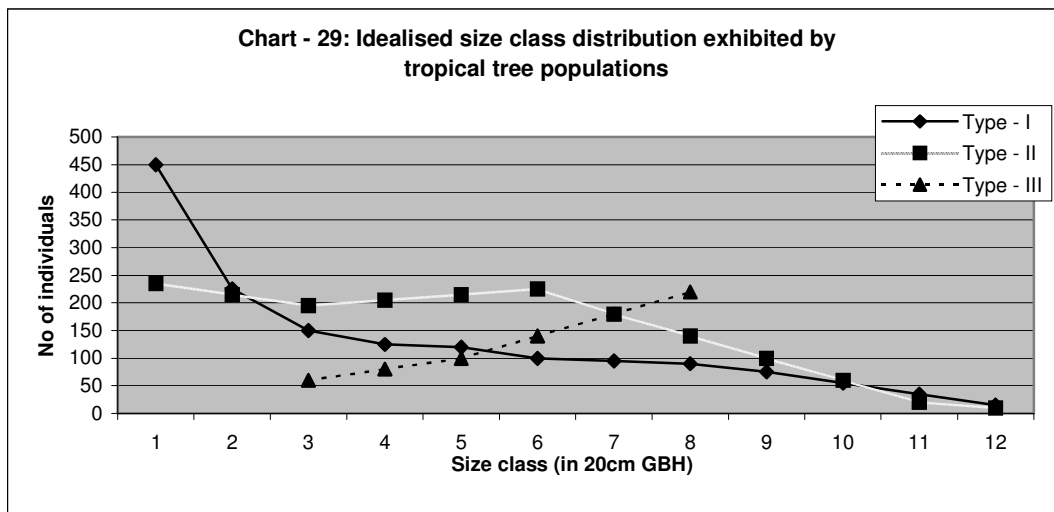
Annexure – II

Population (Age) structure

The life criteria of a species must be measured by its effectiveness of in "recruiting" new individuals into the population of concerned species. The more effective this strategy, the longer the population will be able to maintain itself in the forest. One method of measuring this success is to monitor the frequency and abundance of seedling establishment over a period of several decades, and to record the resultant increase or decrease in population size over time. Fortunately it is not always necessary to conduct this laborious and time-consuming procedure. In many cases the recruitment history of a particular species is reflected by the size distribution of individuals within its population. A rapid appraisal of population structure can frequently provide information about whether or not a species is regenerating itself in the forest.

Population structure data have long been used to study the regeneration dynamics of forest species. The results from these studies have shown that the structure of most tree populations can be described by a limited number of size class or diameter distributions. Three of the most common types of population structure are given in chart-29.

The type - I size class structure displays a greater number of small trees than large trees and an almost constant reduction in the number of trees from one size-class to the next. This type of population structure is characteristic of shade - tolerant, primary species which maintain a more or less constant rate of seedling establishment.



Type II size-class distribution is characteristic of populations which experience sporadic or irregular seedling establishment. The actual level of regeneration may be sufficient to maintain the population, but its infrequency of occurrence causes notable "peaks" and valleys in the size class distribution as the new seedlings grow into larger size classes. This type of distribution is common among late secondary species that depend on canopy gaps for regeneration. It may also reflect a population whose regeneration has been temporarily

interrupted through excessive harvesting of fruits or seeds, direct physical damage to seedlings (e.g. trampling by collectors) or lack of pollinators or dispersal agents.

The final size-class distribution, type - III reflects a species whose regeneration is severely limited for some reason. Most of individuals in these populations are more or less the same size and although many of them may be producing flowers and fruits, no seedlings have been successfully established. Type - III population structures are frequently encountered among light demanding, early pioneer species which require large canopy gaps for regeneration. In absence of such a disturbance, these species may temporarily disappear from the forest - the former population represented only by the seeds lying dormant in the soil. A type-III distribution is not restricted to early pioneer species. Populations of late secondary or primary species can also exhibit this pattern if seedling establishment is interrupted for a long enough period of time. Unless conditions change, these populations will permanently disappear from the forest.

Although the three size-class distributions correlate well with the three different regeneration types, it is important to remember that the population structure of a species is extremely dynamic and sensitive to changes in the level of regeneration. A type I distribution can easily change into a type-II if existing rates of seedling recruitment are reduced. Further constraints on regeneration may drive the population to a type-III distribution. Given this behaviour, it is most useful to view the three structural types as a single sequence through which a population passes on its way to extinction. The occurrence of a type - III structure in a population of shade - tolerant, primary trees, for example, is a sure sign that something is wrong.

Although necessarily brief, the preceding discussion has attempted to show that a tropical forest species display a variety of different ecological characteristics that can make sustainable harvesting very difficult objective to achieve. The major problems areas are:

- The high diversity and low population density of plant species.
- The irregularity of flowering and fruiting.
- The importance of animals for pollination and seed dispersal.
- The high mortality and low success rate during seedling establishment.
- The sensitivity of population structure to change in the level of natural regeneration.

These five characteristics are immutable facts of plant life in the tropics. Ignoring them can cause serious, in some cases irreparable damage to the populations being exploited.

Annexure – III

Canopy gaps

This is a well known fact that very few seedlings in the forest floor survive for future establishment for matured individuals (annexure - I). It is interesting to know that the location of these establishing seedlings is found in a specified area of the forest floor. This study of parameters may provide us vital information for ecological management of forest resources towards sustainability. The specific combinations of location of establishing seedlings, type of conditions favouring seedlings establishment, other parameters needed for optimal rate of growth relative to its neighbours are thought as the regeneration niche of a species. To large extent the area and distribution of these niches regulate the number of seedlings that become established in the forest.

Extensive research on seedling establishment has shown that the regeneration niches of a large percentage of tropical trees have one feature in common - they are all in some way related to the sporadic occurrence of tree falls. Tropical trees may blow down, get struck by lightening, or simply die from old age and fall down. Each of these events produces an opening of "gap" in the forest canopy that allows direct sunlight to enter the understorey. In addition to the increased sunlight, canopy gaps also exhibit lower humidity, higher temperatures and higher soil moisture levels than those found under a closed canopy.

These abrupt changes in the understorey environment have a notable effect on most of the seedlings in the vicinity of a canopy gap. In smaller gaps, many of the more shade-tolerant seedlings which have managed to survive under a closed canopy will display a significant increase in growth in response to the higher light levels. Numerous canopy species exhibit this behaviour. Their seeds germinate in the shade and the young seedlings grow until they have produced about two to three leaves. The seedlings then appear to enter a state of suppression in which they exhibit little or no height growth. There are only two possible outcomes to this physiological condition. The seedlings slowly die over time, or they are "released" by the occurrence of a canopy gap overhead.

In larger gaps, the drastic increase in light level and soil temperature may trigger the germination and growth of light demanding species. The seedlings of these species grow extremely fast under sunny conditions and large gaps are soon swamped with these aggressive, "weedy" plants. Any shade tolerant species, which may occupy the site, are soon out competed.

Canopy gaps play a critical role in the establishment and growth of tropical trees; upto 75% of the canopy trees on some areas require the occurrence of a tree fall for seedling establishment. The problem is that there is absolutely no way to predict exactly when and where a canopy gap will be created. There is also no guarantee that the desired species will actually colonize a gap should it occur.

Annexure -IV

Profiles of selected NTFP species

MAHUA

Vernacular name: Mahula, Mahua

Trade name: Butter tree

Scientific name: *Madhuca indica*

Family: *Sapotaceae*

Habit:

A medium sized tree to large deciduous tree with short bole and large rounded crown found in most places of Orissa. Bark dark coloured and cracked, leaves clustered near ends of branches. Leaves elliptic in shape. Flowers are cream coloured and fleshy, tubular and in clumps near the ends of branches.

It is a strong light demander and ordinarily drought and frost hardy. When young, it is browsed by cattle and deer.

Habitat:

Mahua plants are found mostly in deciduous forests mostly in dry deciduous type. It is noticed both in the wild and in agricultural and private lands and village commons as well. Availability of Mahua trees in agricultural and / or private lands are due to selective preservation of trees while clearing forest lands for agricultural purposes. It is oftenly noticed growing in rocky and sandy soils.

Regeneration of species:

Natural regeneration: Mahua trees regenerates naturally and artificial propagation techniques must be followed otherwise. Natural regeneration takes place by seeds which germinate early in the rainy season, soon after falling. Exposure renders seeds liable to fungus attack and often eaten by insects. Germination is successful only when covered by soil or debris. Seedlings grow slowly but gets fasten up with the availability of abundant light.

Artificial regeneration: Artificial propagation is usually done by sowing or by transplanting nursery-raised seedlings. Fresh seeds are usually sown during July - August and covered with earth. Direct sowing in prepared lines or patches is preferred to transplanting which is troublesome. For transplanting seeds should be sown direct in deep pots or baskets. Seedlings transplanted into them from nursery during the first season a few weeks after germination. They are planted in the forewst early in the second rainy season.

Threats :

Mahua trees are affected by fungi. Leaves are eaten up by caterpillars. The trees and green log are attacked by pin-hole borers. The bark is destroyed by white ants and bark borers.

Uses:

Mahua flowers are of commercial interest. The flowers are eaten raw or cooked. It is largely used in the preparation of distilled liquors. Mahua flowers are also used as feed for livestock.

Mahua seeds are used for Mahua oil extraction. Mahua fruits ripen during May - June when they fall from the tree or dropped by vigorous shaking of the branches. The season for collecting the seeds is short and absence of organised harvesting, a significant portion of the crop is lost during monsoon. Mahua oil is used mainly manufacture of laundry soaps. In rural areas, the oil is used for cooking purposes. It is also used as the adulterant for ghee. Refined mahua oil is used for lubricating greases and fatty alcohols. The oil is used for candles and batching oil in jute industries. Mahua oil is also used for its medicinal properties against skin diseases, rheumatism and the headache. It has laxative properties and is reported to be beneficial for piles and haemorrhoids.

Similarly Mahua cake, formed from the residue of Mahua oil extraction is used for manure with other cakes or ammonium sulphate. It has also insecticidal and piscicidal properties and is applied to lawns and golf greens.

Mahua berries are eaten raw or cooked. They are also eaten by cattle, sheep, goats, monkeys and parrots. Mahua leaves are astringent and used for embrocations. Leaves are eaten by cattle.

Mahua wood is a constitutional timber. It is used for building purposes as beams, door and window frames. It is used for carriages, furniture, turnery, sports goods, musical instruments, oil and sugar presses, shipbuilding, boats, bridges etc. Well-seasoned wood is suitable for agricultural implements, drums and carving. Use of timber for fuel wood in Orissa is rare although it is a good fuel wood.

CHAR

Vernacular Name: Char

Trade Name: Almondette tree

Scientific Name: *Buchanania lanzan*

Family: *Anacardiaceae*

Habit:

Evergreen tree with a straight, cylindrical trunk upto 15m height. It is commonly found in dry deciduous forests of Orissa. Branches tomentous when young. Barks rough, leaves thick, oblong in shape. Flowers small and greenish white in colour. Fruits in drupe, black, 8-12 mm in diam.

Habitat:

It is a common associate in Sal forests and occupies lower canopy. It occupies the lower canopy of the dry deciduous forest. Moderately light demander, somewhat sensitive to drought. It is noticed to be severely sensitive to frost. It is often found in clayey and lateritic soils but noticed to be less growth on waterlogged soils. The tree also server as a host tree for *Kusumi* lac.

Regeneration of species:

Natural regeneration occurs through seed disposal after the fruits get ripen during April-June. The seeds lying on the ground exposed to the sun have very low germination potential. Fresh seeds are noticed to have 70% fertility rate. Artificial tree raising by direct sowing of seeds.

Threats:

The species is attacked by various woodborers. Borers also bore the flower buds. Being highly recommended for common substitute for almonds in flavouring sweetmeats confectioneries and betel nut powder, it has greater market demand and hence almost the entire crop is harvested in a season.

Uses:

As mentioned before, it's a very common substitute for almonds in flavouring sweetmeats and confectioneries. Ointment made out of kernels to cure itch of skin and to remove blemishes from the face. Oil having mild but pleasant aroma is used as a substitute for olive and almond oils in indigenous medicine. The wood is utilized as small beams for various constructional purposes and in make cheap furniture.

HARIDA

Local name: Harida

Scientific name: *Terminalia chebula*

Trade name: Chebolic myrobalan

Family: *Combretaceae*

Habit:

A tree 15 -24m in height and 1.5 - 2.4 m girth with a cylindrical bole of 4-9m, a rounded crown and spreading branches found in most of the tropical forests of Orissa. Bark dark brown, often longitudinally cracked, exfoliating in woody scales. Leaves ovate to elliptic with a pair of glands at the top of the petiole. Flowers are yellowish white. Fruits are ellipsoidal or ovoid, yellow to orange brown sometimes tinged with red or black, 3.5 cm long, become 5-ribbed on drying, seeds hard, pale yellow.

Habitat:

In Orissa it is found in tropical deciduous forests. In most places and favourable localities it attains a girth of 2.4m and bole height upto 9m. It is noticed to be small in rocky places. The species is a strong light demander and hence requires direct overhead light and cannot tolerate shade or cramped situation. Younger plants require certain amount of shade. The species withstands fire very well. It coppices very well, the coppice shoots being afterwards very vigorous.

Regeneration of species:

Natural regeneration: in some localities where the germinating factors are favourable, it is found in good conditions but on the other areas the trees are absent. Intensive removal of harida seeds often reduces the regeneration of this species. Under dense canopy the natural regeneration of shade bearing species is prolific, Harida species is noticed to be lacking its chance to survive. It is observed that the natural germinative capacity of the

Harida is low and this is also attributable for its low natural regeneration. Harida seeds are often predated by and destroyed by insects, rats, squirrels and other rodents. Heavy and continuous rain kills the Harida seedlings.

Artificial regeneration: Low germinative capacity of Harida is due to hard seed coat and hence needs pre-treatment. Fermentation of seeds and soaking the seeds in cold water for 36 hours without damaging the embryo and sowing in the nursery beds give better results. Germination commences in 15 days and completes in 3-4 weeks giving around 80% germination. Untreated seeds are noticed to provide better results in boiling water. Direct sowing of seeds in the fields have also shown successful results. Transplanting the seedlings, root and shoot cuttings in the field had also been successful in the field. Fruit stones after removing the pulpy portion are dried and shown wither in wooden box or nursery beds covered with soil and regularly watered. Ordinary clayey loam or sandy loam suffices germination and no manuring is required. Young plants may require watering during first hot weather. Plants suitable for transplanting are obtained in second rains. Shelter is desirable in early stages in the nursery and also after transplanting. The plant grows slowly.

Threats:

Usually Harida plants don't suffer from any serious pests. Although few pests are recognised, they do not cause any appreciable damage. Pests mainly are the defoliators. Intolerance to shade, slow growth rate are also reasons attributed for natural inhibitors of its population in natural habitats. Collection of entire crop for commercial use and removal of tender Harida for medicinal purposes are the reasons attributed for drastic regeneration loss. Grazing, trampling of grazers often suppresses its successful establishment in natural habitats. Hard seed coat lessens the germination that hinders natural growth from the first step.

Uses:

Harida yields one of the principal bloom yielding tannins and is useful especially in the production of sole leather. Myrobalan is widely used tanning for weight and to fix fine colour, resistant to light and ageing. Myrobalans are commonly used in combination with Babul (*Acacia nilotica*), *Cassia auriculata*, and *Cassia fistula* in sole leather tanning. Myrobalans are also used in ink-making; fruits in which the fleshy part has not dried hard but become black and powdery on drying are preferred for ink making. Because of its colouring agent the tribals also use the extract for painting doors and windows in few areas of Madhya Pradesh. It is believed that windows and doors are not affected by other insects and remains durable.

Harida fruits have laxative, stomachic tonic and alterative properties. In combination with emblic myrobalan (Amla) and belleric myrobalan (Bahada) under the name *triphala* Harida is extensively used as adjuncts to other medicines in almost all diseases. *Triphala* has antihelmintic activities due to "synergistic effects" of all three components. Harida fruit pulp is used to cure bleeding and ulceration of gums. Coarsely powdered and smoking of this coarsely powdered Harida relieves from asthma.

BAHADA

Name:

Local name: Bahada

Trade name: Belliric myrobalan

Scientific name: *Terminalia bellirica*

Family: *Combretaceae*

Habit:

A handsome tree, with characteristic bark, attaining a height upto 40m and a girth of 1.8-3.0 m found in deciduous forests of Orissa. Stems straight, frequently buttressed when large, leaves broadly elliptic, clustered towards the ends of branches. Flowers single and simple. Fruits are globular, 1.3 -2.0cm in diam, obscurely 5 angled.

Habitat:

In Orissa, it is found in both types of deciduous forests. This species is a common associate of Sal, teak and other important trees occurring more or less scattered. However, gregarious distribution is not found. It is more frequently noticed in moist valleys. In its natural habitat the absolute maximum shade temperature is 36⁰ C - 46⁰ C and absolute minimum temperature is 0-15⁰ C. It sustains itself from 100 to 305 cm of rainfall.

Regeneration of species:

Natural regeneration: this species yields good seed crop and it disseminates seeds widely. It has also high germinative capacity of healthy seeds and their ability of the seedlings to thrive under shade for the first one or two years are favourable for the natural regeneration and the tree should be more abundant and gregarious on the forest that it is actually noticed. Sporadic occurrence of the species is actually due to destruction of seeds by insects and animals and also the destruction of the embryos germinated seeds by birds and insects. Sometimes they also succumb to drought to which the embryo is very sensitive during its germination. A considerable amount of moisture appears to be necessary to stimulate germination and the subsequent establishment of the seedlings. Natural regeneration is usually adequate in moist deciduous forests.

Artificial regeneration: The fruits ripen during November - February. Freshly fallen fruits are collected from the ground swept clean in advance. The pulp is immediately removed and the seed dried in the sun before storing. The seeds retain viability for about a year. For such stored seed the germinative capacity is reduced from 40 to 05 percent.

The plant can be raised in the field by direct sowing or by transplanting the nursery raised entire seedlings of one-year growth. The seed is sown in the nursery from March to May and watered. Germination commences approximately within 14 days and is complete within 30 days. The seedlings are ready for transplanting in July when they are two to four months old. The small plants give 96% survivals if properly weeded and tended. The height growth is 15 cms after first season, 30 cms after second season, 90cm after third season and 150 - 180cm after the 04th season. The tree is not subject to fungal attack of any consequence and also not subject to any serious pests.

The rate of growth of this species is slow in the early stages, but moderate to rapid later on which varies from region to region.

Threats:

Overexploitation of fruits from economic considerations leave less fruits in the wild. In Orissa due to very low price of Bahada in the local markets, amount of Bahada is collected and sold to fetch some price for livelihood purposes. As mentioned before, although Bahada fruits have greatest germinative capacity in *Terminalia* genus, due to above mentioned factors of embryo predation by pests and insects, irrisistant to drought situations lead to loss of Bahada tree establishment. This leads to scarce distribution in the wild.

Uses:

The timber is not of commercial demand. It is in demand where more durable and large timber is not available.

The fruit is also a well-known commercial myrobalan. It can be substituted for myrobalans in tanning purposes. A non-edible oil is extracted from the Bahada kernels can be used in the manufacture of toilet soaps of attractive appearance.

The fruit pulp is used in medicines for dropsy, piles, diarrhoea and leprosy and also occasionally in fever. It is also used as purgatives when half ripe.

Bahada leaves are fed to *Tassar* silkworm. The fruits are also used for ink making.

ANLA

Name: local name : Anla

Scientific name: *Embllica officinalis*

Trade Name: Emblic myrobalan, Indian Gooseberry.

Family: *Euphorbiaceae*

Habit & habitat: A small or medium sized tree with smooth, greenish grey, exfoliating bark. Leaves feathery with small narrowly oblong, pinnately arranged leaflets. Fruits depressed globose, 0.5 - 1 inch in diam., fleshy, obscurely 6-lobed, containing 6 trigonous seeds. The tree is common in mixed deciduous forests of Orissa ascending upto 4,500 ft on the hills. It is often cultivated in gardens and homeyards. However, cultivation in homelands and gardens are very limited in Orissa. A type bearing comparatively larger fruits than wild plant is known in cultivation.

Regeneration:

Embllica officinalis is usually propagated by seeds. It may also be propagated by budding, cutting and inarching. The plant is sensitive to frost and drought. The tree coppices well and pollards moderately well. Coppice shoots in particular, grow vigorously. Flowers usually appear in the hot season and fruits ripen during the following winter.

Threats:

The plant is affected by a leaf rust caused by *Phakopsora phyllanthi* and ring dust caused by *Ravenelia emblicae*.

Uses:

The fruit is green when tender changing to light yellow or brick red coloured when mature. It is sour and astringent and is occasionally eaten raw. It is much esteemed for making pickles, preserves, jellies etc.

The fruits are probably the richest known natural source of vitamin C. The fruit juice contains nearly 20 times as much as vitamin C. as orange juice and single fruit is equal in antiscorvic value to one two oranges. Feeding trials on healthy human beings subjects show that the vitamin present in the fruit is utilised as well as pure ascorbic acid. When administered to patients suffering from pulmonary tuberculosis, vitamin C saturation is more quickly reached with anla powder than synthetic vitamin C, thereby showing that the former is more readily assimilated, probably due to the presence of accessory factors.

Anla fruits have been held in high esteem in indigenous medicine. It is acrid, cooling, refrigerant, diuretic and laxative. The raw fruit is eaten as an aperient. Dried fruits are useful in haemorrhage, diarrhoea dysentery. In combination with iron, it is used as a remedy for anaemia, jaundice, and dyspepsia. Triphala, consisting of equal parts of powdered emblic, chebulic and belleric myrobalans used as a laxative and in headache.

The fruits are used in the preparation of writing inks and hair dyes. The dried fruit is detergent and is used as shampoo for the head.

The fruits, bark and leaves are rich in tannin. The distribution of tannins in the plant is as follows:

Fruit: 28%, twig bark: 21%, stem bark: 8-9%, leaves: 22%

Immature fruits are employed for tanning in combination with other tan stuffs such as myrobalans.

The leaves and fruits are used as fodder for cattle. The leaves contain a brownish yellow colouring matter used in dyeing tussar and mulberry silks and wool. The leaves are used as manure in areca and cardamom plantations in south India.

The wood is used for agricultural implements, poles and inferior building and furniture work. It is durable under water and is suited for well work.

SIALI LEAVES:

Local names: Siali

Scientific Name: *Bauhinia vahlii*

Family: *Leguminosae*

Habit and habitat: A gigantic climber, with densely pubescent branches and abundant circinate tendrils, mostly leaf-opposed. Leaves compound, alternate, with leaf petiole and 11-

15 nerved at the base, almost orbicular in shape and upto 18 inch long, petiole 3 inch long. Flowers numerous, 1-2.5 inch long. Flowering during April - June and fruits appear during cold season. In Orissa it is basically distributed in mostly in the Sal forests. It is one of the most distinctive climbers in Indian forests. It is otherwise known as camel' s foot climber as the leaves are very much the size and shape of a camel' s foot print.

Regeneration: this gigantic woody climber needs plenty of space for its growth. It can be easily raised from the seeds. When cut down, shoots more than 50 feet long may be produced in one season and for this reason it is difficult to eradicate this plant.

Uses:

The large leaves are used as plates by the local inhabitants. Now a days these plates are also commercialised due to its tenderness and capacity not to break easily. The seeds are also used as food. To extract the seeds, the pods are kept in the fire. The bark yields a strong fibre which is used for making ropes. The stem produces a valuable tanning material. The seeds are said to possess tonic qualities.

Annexure - V:

Formats for vegetation data collection

Format - 1: vegetation data collection for trees

Plot No: Village: Name of the forest:
Plot size: GP: Forest Range:
Date of survey: Block: Forest Division:
Name of the village/organisation involved in data collection Distt:

SI No	Tree species	GBH (in cms)	Height (in m)	Anthropogenic signs

Format - 2: vegetation data collection for tree regeneration (seedlings and saplings)

Size of the plots: seedlings: 10 X 10 sq m, Saplings : 25 X 50 sq m

SI No	Name of the species	Number of individuals

Annexure - VI:

List of plants with scientific names

SI No	Vernacular Names	Scientific Names
1	Achhi/ Achhu	<i>Morinda coreia</i>
3	Amatha	<i>Piliostigma recemosa</i>
4	Anla	<i>Emblica officinalis</i>
5	Asana	<i>Terminalia tomentosa</i>
6	Bahada	<i>Terminalia belerica</i>
7	Bandana	<i>Ougenia oojeinensis</i>
8	Bela	<i>Aegle marmelos</i>
9	Bhelia	<i>Semecarpus anacardium</i>
10	Bherun	<i>Chloroxylon swietenia</i>
12	Bija/Piasal	<i>Pterocarpus marsupium</i>
13	Bukasungha	<i>Robinia grandiflora</i>
14	Char	<i>Buchanania lanzan</i>
15	Charaigudia/ Chudeigudi	<i>Vitex leucoxylon</i>
16	Chauli	<i>Chionanthus malbaricus</i>
17	Damkhurulu/ Damkurulu	<i>Gardenia latifolia</i>
18	Debdaru	<i>Guazoma tomentosa</i>
19	Desana	<i>Croton oblongifolius</i>
20	Dhaura/Dhaunla/Dhaura	<i>Anogeissus latifolia</i>
21	Harida	<i>Terminalia chebula</i>
22	Jamu	<i>Syzigium cuminii</i>
23	Jugia	<i>Hemigymnia macleodii</i>
24	Kakada/Khakda	<i>Cesearia tomentosa</i>

GLOSSARY:

Abiotic pressure: Abiotic pressure relates to the pressure due to non-biotic factors such as wind, water etc.

Age class structure: it refers to the distribution of individuals of different age group in a population.

Biotic pressure: Biotic pressure refers to pressure due to animals and other life forms. It includes harvesting by human, predation by other animals, fungi etc.

Density: it refers to the number of individuals of a particular species occurring per unit area at any given time.

Distribution: distribution of species is the spatial arrangements and distance of individuals occurring in that place.

FMI: It refers to Forest Management Institutions which are informal institutions formed by the forest protecting villagers in and around forest patch (-es).

NTFPs: It refers to non-timber forest products, which comprises of non wood parts of trees in the forests.

Population: It is the aggregation of individuals of same type having genetic transfers among themselves.

Rare: species having very low / scanty density.

Regenerating capabilities: regeneration is the ability of reproducing of its own kind to continue its race in the long run.

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