vulnerability of the forest eco system in context of the changing climate

a participatory assessment

in collaboration with

the communities from two Panchayats, Y. Ramavaram mandal, East Godavari district, Andhra Pradesh

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Bamboo mat making and array of other skills face multi vulnerability - decreasing raw material & persons with interest as well

Foreword

In India we have about 200 million forest dwellers that directly depend on different natural resources and nature services provided by the forest eco systems. The forests are the repository of biodiversity and fulcrum of array of cultural practices, belief systems, health care practices, and wisdom.

Over 70 per cent of India's population of one billion is rural and agriculturally oriented, for whom the rivers are the source of their livelihood and prosperity and forests play crucial role in sustaining the water flows in the rivers.

Because of the already changing climate and what may come in the near future forest ecosystems are one of the most vulnerable eco systems. Various studies and reports already indicate migration of species, slowing of the regeneration process, which may severely affect the biodiversity. Forests are also vulnerable to the impact of change in other livelihood sectors such as agriculture, livestock, fishing, and is most likely to bear the impact of quick fix alternative source of livelihood of the forest fringe communities.

In context of Climate Change – mitigation, adaptation, technology and financial transfers - from the ethical perspective are the development needs of the majority of the population, which have not been met through decades of planning, and are in great jeopardy, given the state of international negotiations and the pressure put by the rich, developed nations.

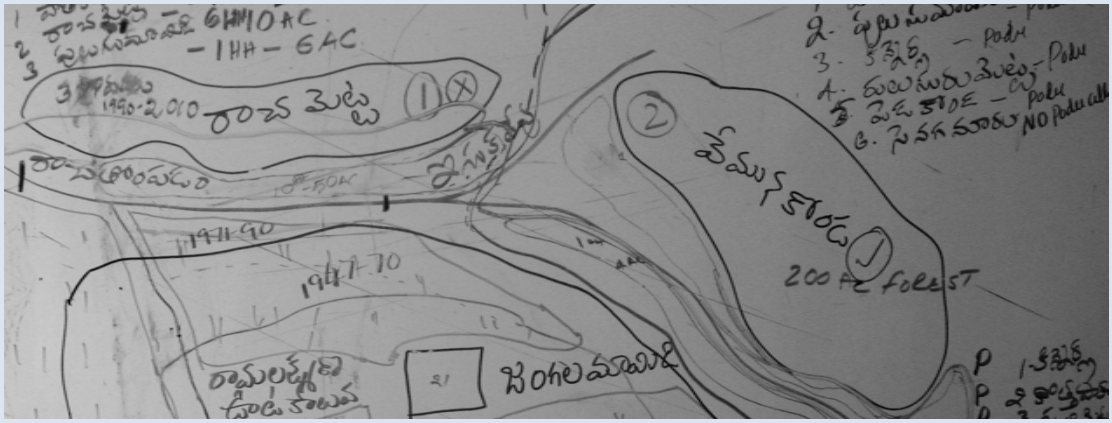
The vulnerability studies in different ecosystems are part of exploration to collate insights from different ecosystems from people's perspective. The participatory assessment of the forest ecosystem has gone one step forward to engage with communities and delve into their perception and experience of the changes and vulnerabilities in the forest ecosystem they live in and how the communities have been coping progressively with the changing climate as well the socio-cultural environment.

The insights from the assessment open many windows to the opportunities and challenges to deal with the complex development, adaptation-mitigation web in the climate changing times.

Nafisa Goga D'Souza

Convener, INECC

Change in the forest and livelihood systems - one of the timeline excercises by the community members of Darageddda



'Climate Change'

How do we assess the vulnerability of the forest ecosystem? We are not experts on plants and their symbiotic relationship with other elements in the ecosystem! - we did deal with these dilemmas while conceptualizing the process. We conjured up courage to do it when, during our recce, we found most of the people in the community living within the forest ecosystem were able to identify the changes, describe the changes and could even attribute the reasons and had their opinion on the trend.

They talked about not rain, but rains, varieties of rains, one subtly different from the other, and could relate which type was important for which crop and at what stage. The pattern of rainfall changed and they changed the pattern of crop growing; they did not bother to know the change in millimeters and all that. This indicates to another syndrome, when we as development facilitators, meet people in different ecosystems, people share their experience, observation, feelings about the changes in their ecosystems but they do not talk about the 'climate change' . But in serious forums when people talk about the 'climate change' with the attendant accessories of graphics and mind boggling statistics, we tend to complain about the lack of groundswell, 'unfortunate that people do not react adequately'.

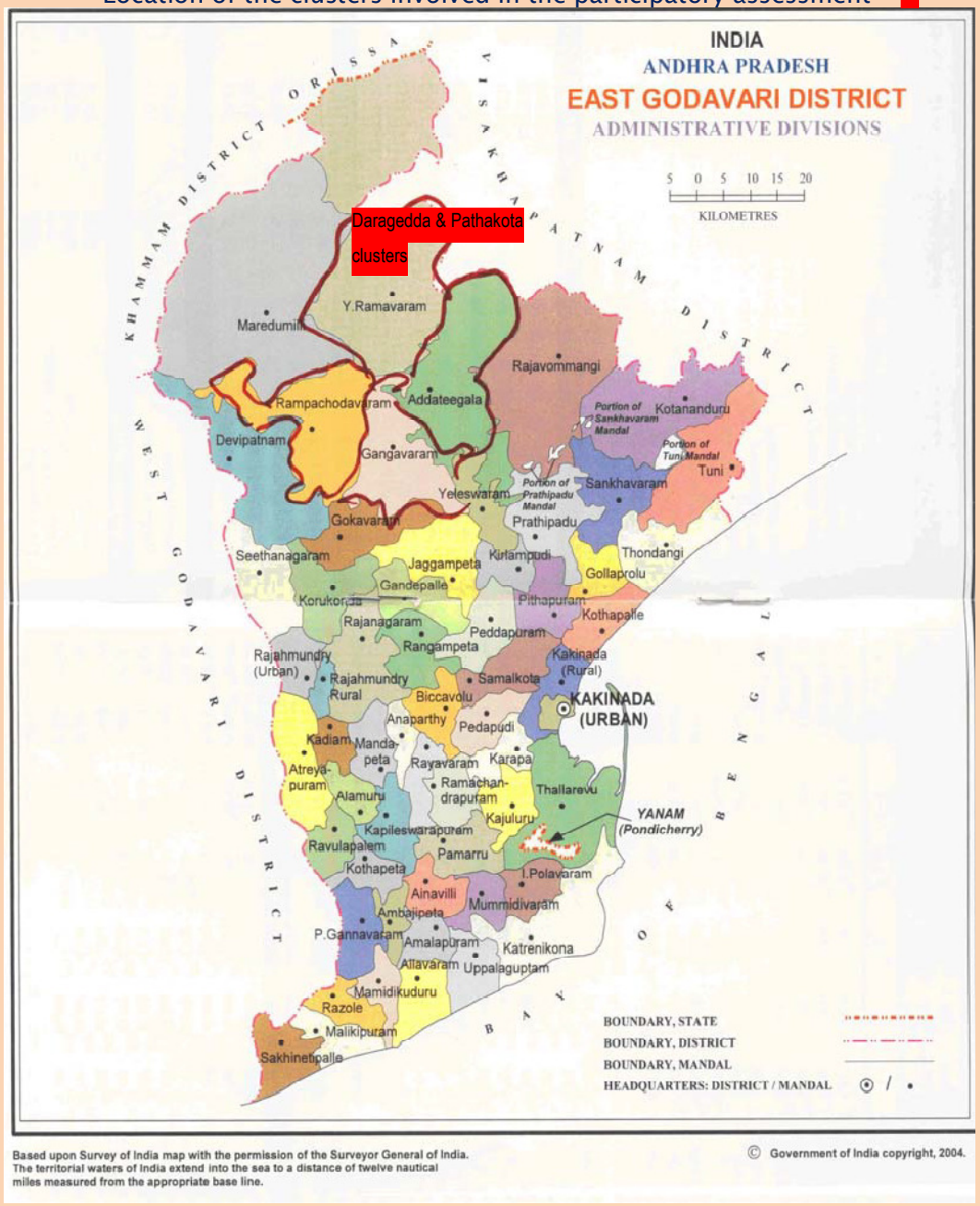
In the mainstream development paradigms the convergence of the people's wisdom and aspirations and scientific understanding, policies and programmes, have so far remained elusive. It is one of the important aspects in the climate changing world to change this 'climate'; as people, who were to a large extent not responsible for the emissions and wanton destruction of the resources are now expected to be disciplined enough to conserve the resources and be part of different mitigation and adaptation measures, while they are still struggling to meet their basic needs depending on the resources at varying degree of vulnerability.

The participatory assessment, from community perspective and beyond, show cases the experiences, the perceptions, the opportunities and the challenges to understand the changes triggered by a number of factors including the climate and has the potential to tickle the experts and the commoners to judge scientifically, rationally, experientially what is vulnerable, to what degree, the reasons and the domino effects, and ways to address them.

Sanjay Khatua,

Facilitator

Location of the clusters involved in the participatory assessment



vulnerability of the forest eco system in context of the changing climate

a participatory assessment

1. Background

In the present times of the climate changing world, the communities, who to a large extent continue to depend on the natural resources and various nature services, are in the process of adjusting to the emerging realities of the climate change. The adjustments especially relating to the practices of earning livelihood seem to be influenced by number of factors such as socio-cultural and economic realities; policies and programmes and the change in the pattern of the local climate as well.

The goal of this participatory assessment was to understand the people's perception of change in the climate, facets of vulnerabilities and the factors responsible.

The participatory assessment was carried out in two remote Panchayats, Pathakota and Daragedda (hereafter known as clusters) in Y. Ramavaram mandal, East Godavari district, Andhra Pradesh. The clusters are part of Laya's (Visakhapatnam based CSO having interventions over there) recent renewable energy intervention of micro hydro, solar and efficient woodstoves. While the Pathakota cluster already has a micro hydro operating, Daragedda cluster has good potential with presence of number of perennial streams.

2. Objectives

- To gain insight to people's perception on the nature of changes in forest and other natural resources and climate;
- To understand the dynamics of impact of these changes on the forest ecosystem and their livelihood and the interrelationship thereof, as well as the factors responsible;
- To map levels of vulnerability of the resource base as well as livelihood in the given forest ecosystem;
- To suggest potential initiatives necessary to decrease vulnerability and improve resilience;
- To develop inputs for the Green Mission of the National Action Plan on Climate Change (NAPCC).

2. Methodology

- The clusters were purposefully selected because the livelihood to a large extent has remained forest dependent and there was no major external intervention affecting the ecosystem;

- House census covering all the villages (29) in both the clusters; and collection of village level information and observation through FGD with help of pre-structured schedules in 15 sample villages representing the geo-physical and socio economic features – 5 and 10 villages from Pathakota and Daragedda clusters, respectively, was carried out by the Laya field staff under supervision of team leaders and accompanied by the Facilitator and the Observer;

- Review of the emerging trends and in-depth follow up in 6 villages, 3 villages from each cluster involving FGD and physical transect was done by key field staff of Laya, the Facilitator and the Observer. People's perception and understanding were given priority.

- To understand the dynamics, the study focused on the following:
  - Livelihood practices over the last six decades and the changes;- Community perception of change in the climate, impact and coping process;
  - Gain insights relating to the way forward and linkage to the larger picture arising out of the climate change concerns.

3. Profile of the community, resource base and the livelihood

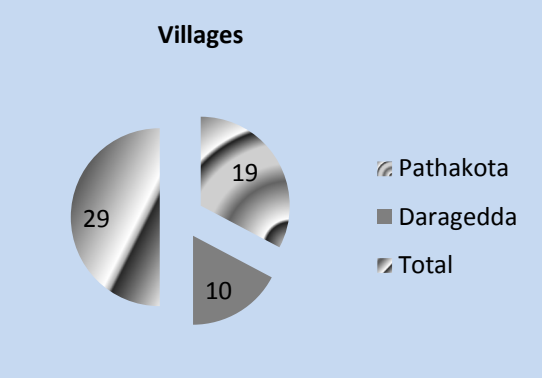
- So far as the day to day livelihood is concerned, the social groups, to a large extent have moved away from their distinctive social traits and are in various stages of settled agriculturalists (from being shifting cultivators on hills). However, the livelihood practices have to a large extent remained forest ecosystem based without migration and external services;
- Though there is no external pressure (mining, industry, organized logging, etc.) major livelihood resources show tell-tale signs of vulnerability, while considerable percentage of farmers have only 1-3 acres of land;
- Life style is fast changing and the next decade would see emergence of educated semi-educated young tribal generation, largely, detached from the traditional practices and values. Will the already degraded resources in a climate changing times meet their needs and aspirations?!

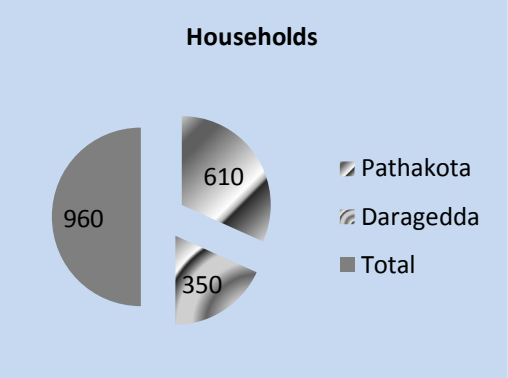
3.1. The social groups

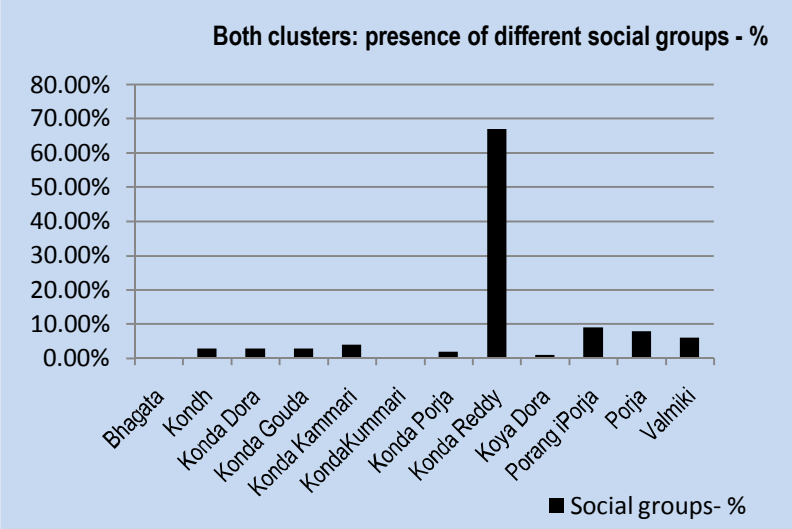
Pathakota cluster having comparatively wider valleys than Daragedda comprises 19 villages, and Daragedda cluster, located in remote narrow valleys has 10 villages. Altogether, the clusters have 960 households with a population of 4376. Women constitute 50.85 per cent of the population.

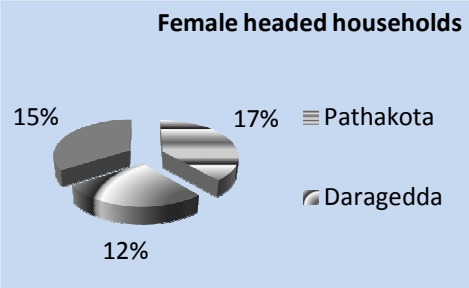
In all, 12 social groups live in the twin clusters: Bhagata, Kondh, Konda Dora, Konda Gouda, Konda Kammari, Konda Kummari, Konda Porja, Konda Reddy, Koya Dora, PorangiPorja, Porja, and Valmiki. Of the social groups, Konda Reddy households are numerically greater (67%) followed by Porangi Porja (9%), Porja (8%) and Valmiki (6%).

So far as the day to day livelihood is concerned, the social groups to a large extent have moved away from their distinctive social traits. Almost all of them have become or are at various stages of becoming agriculturalists. However, in respect of sanitation and hygiene, education, and acceptance of new ideas, traces of their core community traits are still evident in varying degrees. The Konda Reddys, who are designated by the government as primitive tribal group, live in closed valleys and depend comparatively more on hill cultivation. Valmikis are more open to education and new ideas and live in open valleys, and they have become advanced agriculturalists than the other groups. Kondh and Porja (and two other variations) are immigrants from Odisha and still in the process of acquiring land and securing their social space.









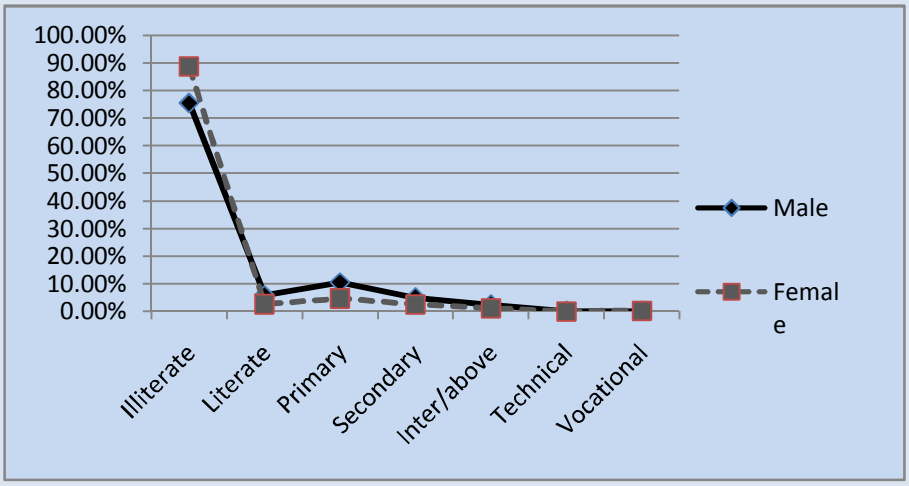
3.2. Family size

Family size range	Pathakota		Daragedda		Total of both clusters	
	No	%	No	%	No	%
1-2	71	11.64	60	17.14	131	13.65
3-5	369	60.49	194	55.43	563	58.65
6-10	164	26.89	95	27.14	259	26.98
11-15	4	0.66	1	0.29	5	0.52
16+	2	0.33	0	0.00	2	0.21
Total	**610**	**63.54**	**350**	**36.46**	**960**	**100.00**

In both the clusters, families with 3 to 5 members are the highest - 59%: 60% in Pathakota and 55% in Daragedda. 27% families in both the clusters have 6 to 10 members. It is significant to note that 14% families have only 1 to 2 members - in Daragedda it is 17%.

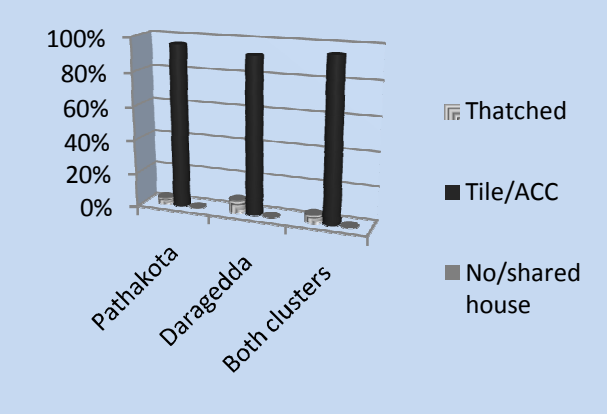
Abundant perennial streams: limited use in agriculture

3.3. Literacy (excluding 0-5 year's age group)



Most of the population is illiterate (excluding 0-5 years and school going)- 89% female and 76% male. Only 5% of the male and 2% of the female have studied up to secondary level. However, going by the trend the scenario is set to change soon. Of the children between 6 to 14 years, in both the clusters, 38 % is in primary schools (almost equal number of boys and girls) and 5% is in higher secondary level-3 % of girl children of the age group and 7 % of boys from the age group.

3.4. Housing

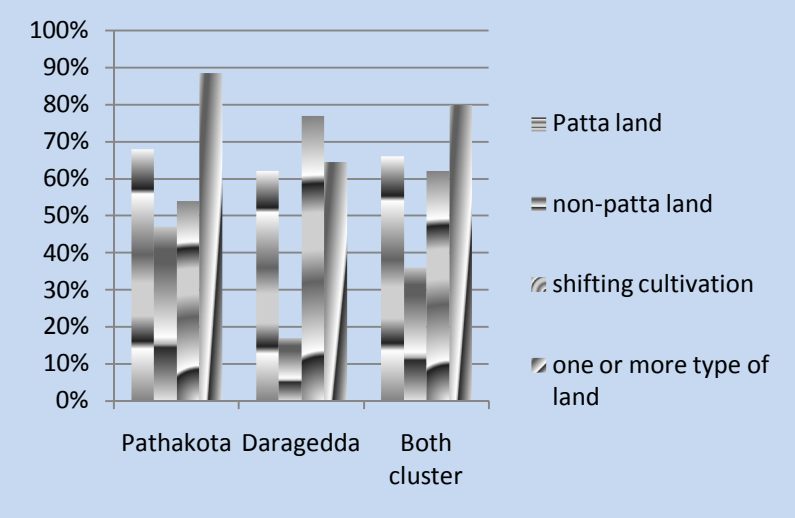


One of the major visible changes over the last two decades has been the shift from short term- housing (requiring frequent replacement of building materials) to long-term housing with brick/ stone walls, use of seasoned timber and tile/ACC roof. In both the clusters, 95% of the houses have been renovated /redesigned to long duration ones- 96% in Pathakota and 92% in Daragedda. In both the clusters, only 5% houses have thatched roof with short-term structures.

3.5. Access to land

- In both the clusters, the total land comprises of 5675 acres (patta, non-patta and shifting) - 4092.54 acres in Pathakota and 1582 acres in Daragedda.

- Of the total land, 45% is patta land, 24% non-patta land and 28% shifting cultivation land.
- While there is not much difference in the percentage of patta land 46% and 44% in Pathakota and Daragedda, respectively, the shifting cultivation land comprises of 25% of the total land in Pathakota and 45% of the total land in Daragedda.



- In both the clusters, 80% households have access to one or more type of land – 66% families have access to patta land, 36% families have access to non-patta land and 62% families have access to shifting cultivation.
- However, there is significant difference between the clusters. While in Pathakota 89 % families have access to one or more type of land, in Daragedda it is 65%. In case of patta land, while 68% of families in Pathakota has access to patta land , in Daragedda it is 62%. In case of non-patta land, in Pathakota and Daragedda it is 47% and 17% respectively. In case of shifting cultivation 54% families in Pathakota and 77% families in Daragedda have access to shifting cultivation land.

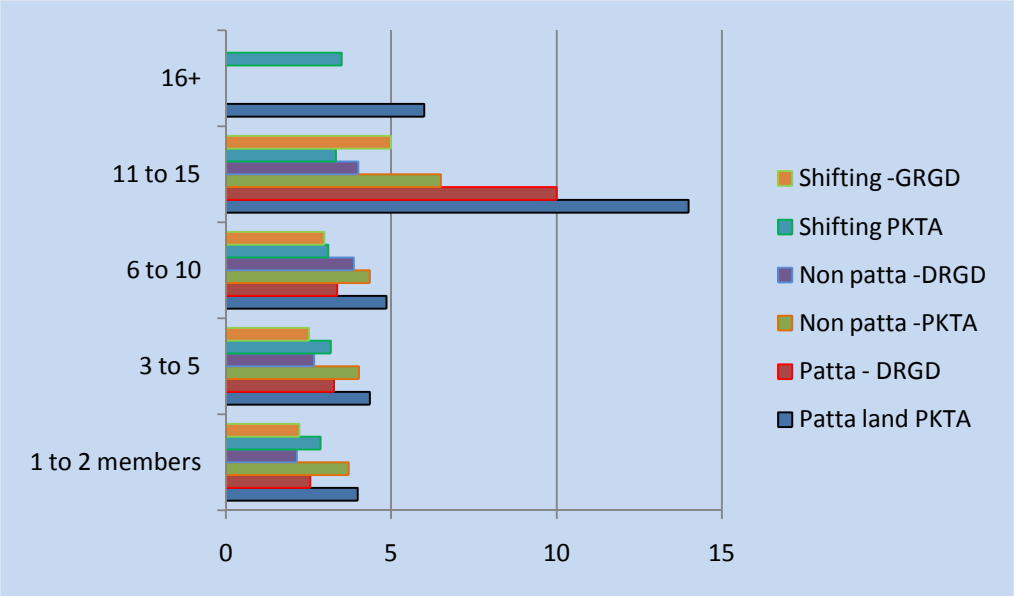
Average land per family

- In both the clusters, the average patta land per family is 4.9 acres (average 4.54 & 3.22 acres , respectively in Pathakota and Daragedda), non patta land 3.92 acres (average 4.11 acres & 2.98 acres, repectively in Pathakota and Daragedda) and shifting cultivation land 2.89 acres (averge 3.12 acres & 2.61 acres in Pathakota and Daragedda, respectively)- average land per family is 5.92 acres (average 6.7 acres & 4.5 acres, respectively in Pathakota and Daragedda).

- Extent of possession of different types of land varies - in combination of all types of land, about 8 % families have up to 1 acre of land; 34 % have 1 to 3 acres, 25% have 3to 5 acres, 27% 5 to 10 acres and 6% have more than 10 acres.

  In context of the patta lands, 8% families have up to 1 acre, 36% have 1 to 3 acres; 22% have 3 to 5 acres; 14 % have 5 to 10 acres and 2 % have more than 10 acres. And in case of non-patta lands 6% have up to 1 acres, 19% have 1 to 3 acres, 13% have 3 to 5 acres; 7% have 5 to 10 acres and less than 1 % have more than 10 acres. And in case of the shifting cultivation land, 17% families have up to 1 acre, 40% have 1 to 3 acres, 14% have 3 to 5 acres, 6% have 5 to 10 acres and less than 1 % have more than 10 acres.

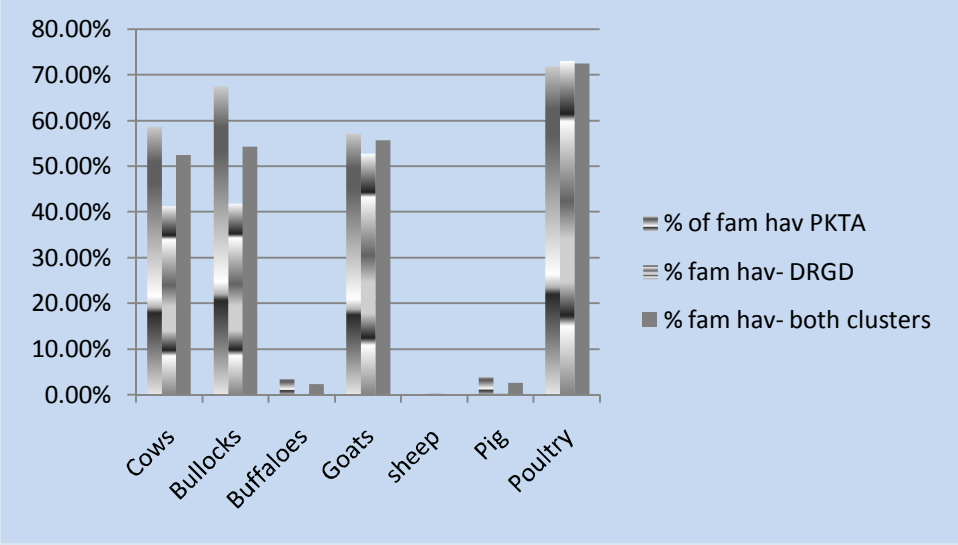
Land as per family size



Possession of land varies as per the family size. Families with 1 to 2 members have 4.88 acres and 2.95 acres, respectively in Pathakota and Daragedda; similarly, families with 3 to 5 members respectively have 5.54 and 3.66 acres, families with 6 to 10 members respectively have 6.03 and 4.17 acres, and families with 11 to 15 members have 13.75 and 14 acres, respectively in Pathakota and Daragedda clusters.

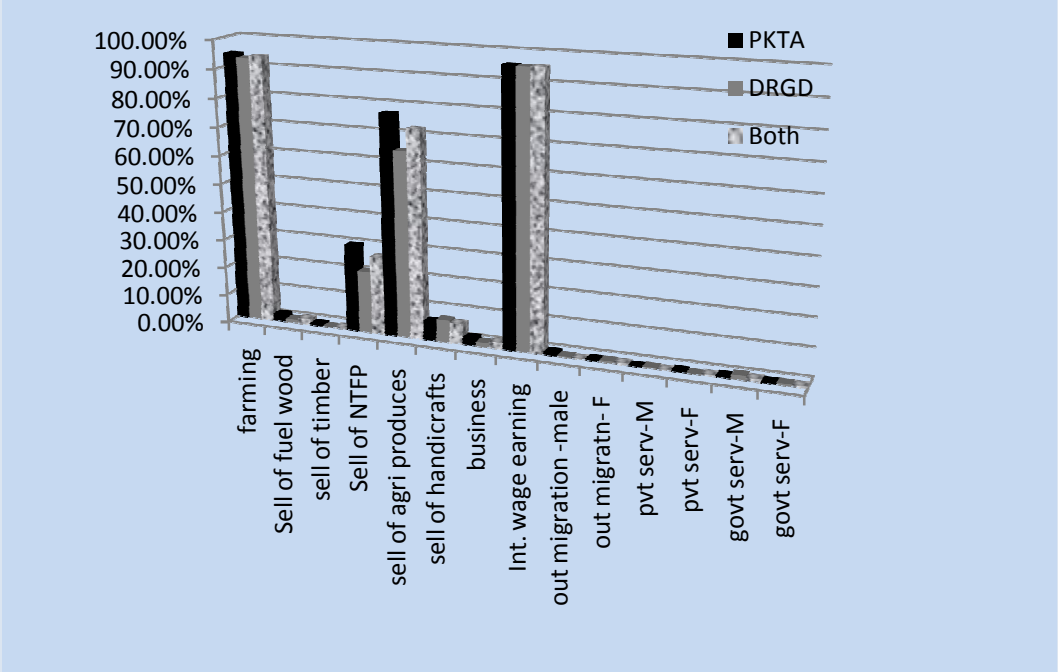
3.6. Livelihood sources: what they do for a living

3.6.1. Rearing of livestock



In both the clusters, 52% families have cows- average 2.21 (59% in Pathakota and 41% in Daragedda); 58% families have bullocks –average 2.48 (68% in Pathakota and 42% in Daragedda), 2.29% families have buffaloes- average 2.18 (only in Pathakota); 56% families have goats- average 3.39 (57% in Pathakota and 53% in Daragedda); 2.60 % families have pigs- average 2.44 (mostly in Pathakota) and 73% families have poultry - average 4 (72% in Pathakota and 73% in Daragedda)

3.6.2. Other livelihood earning activities



In both the clusters, 94% families are engaged in farming (95% in Pathakota and 93% in Daragedda), 27% families collect & sell NTFP (31% in Pathakota and 22% in Daragedda); 73% families sell some amount of agricultural produce(78% in Pathakota and 65% in Daragedda); 96 % families do internal wage earning (mostly working for each other, almost same in both the clusters), 7% families do some handicraft (mostly bamboo - almost same in both the clusters).

Other activities done by very small percentage of families include- fuel wood selling 2%, selling of timber 0.42%, business 2%, out migration- male 0.83% and female 0.52%; private service male 0.83%, female 0.52%, government service- male 94% and female 0.52%

Craft families usually have little land, now face difficulty in accessing raw material

3.6.3. Lifestyle assets

There is not much variation in owning lifestyle assets in both the clusters - 28% families have radio, 4% families have TV, 5% families have bicycle, 1% families have motor-bike, 70% families have electricity connection (under the recent schemes, highly irregular), none of the families have power tiller/thresher/winnower, except 0.16% families (Pathakota) having sprayer and weeder(supported by Laya) but there are 3 diesel operated rice mills.

Means of cooking have remained traditional - cent percent families using traditional chulla with firewood; while 3% have improved chulla (facilitated by Laya), 0.21% have electric stoves/heater and 0.73% families have gas stove.

Cluster	Life style assets (% of hh have)							Improved agri equipments/facilities (% hh have)							Means of cooking-% of hh reported			
	Radio	TV	Bicycle	M.bike	Electricity	Solar light	Other	Power tiller	Thresher	Winnower	Water pump	Sprayer	Weeder	Rice mill	Trad chullah	Improved chulla	Electric stove	Gas stove
PKTA	31	4	8	1	69	28	13	-	-	-	-	0.16	0.16	3Nos.	100	4	0.16	0.33
DRGD	22	5	1	1	73	1	23	-	-	-	-	-	-	-	100	0.57	0.29	1.43
Both clusters	28	4	5	1	70	18	17	-	-	-	-	0.10	0.10	3Nos	100	3	0.21	0.73

4. Forest resource and dependence

4.1. Presence of forest

- Total 5557 ha of forests in the 15 sample villages as per the community level estimate - these forest patches share space with shifting cultivation and agricultural land – covering total 106 patches including hills, slopes, plains; average 52 ha per patch and 370 ha per village.
- While Pathakota cluster has average 208 ha per village, in Daragedda it is 350 ha.
- While 85 patches are on hills, 25 are on plains.
- Location of 100 patches are perceived under the village boundary,29 shares boundary with the neighbouring villages.
- 38 of the forest patches are considered as reserve forests and the rest as village forests.
- There is no protection except in 2 cases, which are residing places of 2 deities.

Denuded hills due to repeated 'shifting cultivation' with heavy soil degradation; already scarcity of choice trees while considerable percentage of houses are yet to be long-term in all respect

4.2. Bio- diversity

Trees

- Going by the information and observation of the members of the community, the distribution of tree and other vegetation widely varies in forests across the clusters. For example, there are 71 types of trees identified, out of which 23% villages have only 10% of the total types, 34% villages report 10-25% of tree types, 22% villages report 25 to 50 % of the tree types; 10 % villages report 50 to 75% of the tree diversity and only 10% villages report more than 75% of the tree types.
- Of the tree types, 48% are used as timber, 28% trees yield edible fruits, fruits/pods of 10% trees are used as vegetable, different parts of 11% , 48% and 14% trees are respectively used as liquor, medicine and marketing. Leaves of 4% trees each are used as fodder and other economic purposes.
- Flower of 4%, 3% trees are respectively edible, used as medicines.
- 55 % percentage of trees are usually used for fuel, 42% trees each are used for fencing and crop support. Fibre, bark and resin from 3 to 6% trees are used for different socio-economic purposes; 7% trees have edible greens.
- Leaves of 44% trees are used for making plates for household use; 8% have medicinal use.

- 32 % trees are used for agricultural equipments.
- 21 tree types are used as timber by 50% villages and there are certain trees (bandaru, maddi, mamidi, neredu, panasu, pothadi, tangedu, vandanam, vegisa and konda veduru), which are used as timber by 80% of the villages.
- Other tree types which are in use by more than 50% villages include:

Use	Types	Name of the trees
Edible	6trees	Chintha, mamidi, neredu, panasa,tangedu, veduru
Vegetable	3 trees	Mamidi, pedabusi,thani, thellaguma
Liqour	2 trees	Mamidi, panasa
Medicine	1tree	Neredu
Marketed-fruits, pods	1tree	Chintha
Fodder	2 trees	Mamidi, panasa
Fuel	13 trees	Are nara,bandaru,maddi,mamidi,neredu,tangedu,thada,vegisa, velama
Fencing	9 trees	Busi, maddi, pothadi,sirimanu, tangedu, thada, veduru, vegisa, velama
Crop support	10 trees	Busi, dadduga, maddi, pothadi, sirimanu, tangedu, thada, veduru, vegisa, vellama
Fibre	2 trees	Arenara, gugillam nara
Edible green leaves	2 trees	Pavati akulu, munuga
Medicinal	1 tree	Vegisa
Agri equipment	12 trees	Bandaru, dadduga, maddi, mollika,neredu, vegisa, vellama, veduru, panasa, pothadi,thada, vandanam

- No doubt, the preference of most of the villages on certain trees for multiple purposes poses threat to those trees

Bushes

- Of the 62 types of bushes identified, 10% are used as small timber; fruits /pods of 23% bushes are edible. Parts of 53% bushes are used for medicine. 21%, 13% and 11% bushes are respectively used for fuel, fencing and crop support. Leaves of 29% creepers are used for plates for household use and leaves of 44% buses are used for medicinal purposes.

Creepers/ herbs/ grass/tuber/mushrooms

- Of the 51 creepers identified, fruits/pods of 25%, 71% and 31% are respectively edible, used for medicine and marketed. Similarly, flowers of 8% and 2% creepers are respectively used for medicine and marketed. 8%, 4% and 2 % of the creepers are used for fuel, fencing and crop support. Leaves of 78% creepers are used for health treatment.
- Of the 20 herbs/shrubs identified, 95% are edible. Of the fruits/pods 5 % each and 20% are respectively used for medicine, marketing and fodder.
- Of the 15 grass varieties identified 7% and 100% are respectively marketed and used as fodder. There are 20 and 28 varieties of tubers and mushrooms, which are edible.

Variation in the use of plant diversity between two clusters: sign of gradual departure from Adivasi ways!

If we make a cursory comparison between the two clusters, people in Daragedda use more varieties of trees (34 varieties) for timber than Pathakota (26 varieties); same trend in case of fruits/pods as edibles (19 and , 13 types of trees, respectively), liquor (respectively 11 and 4 types) and medicine (respectively 32 and 17 types).

Similarly, in case of the other major use of the different parts of the trees, Daragedda cluster uses greater number of tree types than Pathakota; for example, for fuel, fencing crop support and farm equipment Daragedda respectively uses 34, 28 25 and 19 types against 23, 15 , 17 and 14 types respectively in use in Pathakota. Reason: socially upwardly Pathakota people are becoming choosy and selective (long lasting, better finish, taste) and have started outsourcing while the majority in Daragedda in remote narrow valleys are less choosy and less concerned about the long-lasting aspect. This trend sticks to the most of the other uses of plant diversity.

Plant diversity and the extent of their presence in villages

Sl no	Type	Total species in the area of study	Extent of species distributed as per (%) of total types % of villages reported				
			Up to 10%	10 + to 25%	25+ to 50%	50+ to 75%	75% +
1	Tree	71	16 (23%)	24 (34%)	16 (22%)	7 (10%)	8 (11%)
2	Bush	62	25 (40%)	24 (39%)	16 (26%)	3 (5%)	2 (3%)
3	Creeper	51	14 (27%)	23 (45%)	9 (18%)	5 (10%)	-
4	Herb/shrub	20	05 (25%)	08 (40%)	05 (25%)	1 (5%)	1 (5%)
5	Grass	15	2 (13%)	6 (40%)	5 (33%)	1 (6%)	2 (13%)
6	Tuber	20	7 (35%)	3 (15%)	2 (10%)	4 (20%)	4 (20%)
7	Mushroom	28	10 (36%)	7 (25%)	6 (21%)	5 (18%	-

Pathakota cluster having comparatively wider valleys have good amount of leveled land but creation of more land out of forest continues – buffer against uncertainties including climate fluctuations!

5. Climate

The general understanding that emerges from the information, observation gathered and from the FGDs is the following:

- At present rain starts from the 2nd week of June and mostly stops by mid/end September; after that, no rain or very few showers are becoming frequent in recent years.
- Number of rain days/showers have become less and distribution uneven - about 20+ showers less.
- Continuous rains for couple of days are happening only in some years.
- Rain from October to March is becoming very unpredictable.
- Winter arrives about one month late (towards mid November) and leaves about one month early (by February).
- The period of dry months has increased – some years no rain or negligible rain for about 6 months.

  Over the last 17 years there were 7 years of major crop failure due to excess rainfall (3years) and deficit rainfall (4 years).

Pattern of rainfall over last 20 years	years	General impact
Rain starting 1st/2nd week of June and ending mid October	13 years	Suitable to all the crops, crops grown well, standard yield, NTFP available, water available in streams post rainy season
Rain starting mid June and ending 1st week of sept-2009,2002,2001,2000 (deficient rainfall and uneven distribution)	4 years	Production of all the food grains badly affected including pulses. Broom grass did not grow well. Post rainy season, there was little flow in the streams.
Rain starting 1st week of June and ending 1st week of November (excess rainfall-1993, 1995, 2005)	3 years	Substantial decrease in all crops except paddy. There was no impact on the availability of NTFP. Steady water flow in the streams post rainy season.

Weather pattern- now and then

Month	At present	Situation 20 years back
January	-Extreme cold -Light shower towards the middle of the month-27% villages reported -Light showers towards end of the month - 40 to 67% village reported -Years of no rain in month of January have been frequent	-Extreme cold - Rains towards the middle of the month, 2-3 light showers- 100% villages
February	-Rain towards the middle of the month- 1-2 light showers-27- 67%villages -Years of no rain have been frequent -Winter ends by last of the moth and day temperature increases- 60% villages	-Cold remains - Rains towards the middle of the month, 2-3 light showers- 100% villages
March	- 1-2 light showers-67% villages -In some years does not rain - Temperature increases	-Rains at the beginning of the month-47%, rains for 1-2 days40%, light shower-73% villages -Just cold, ends by 2nd week- 100% villages
April	-Rains 3-5 days, heavy showers-67% villages -No rain or 2-3 light showers-33% villages -Temperature steadily increases	-Rains towards end of the month for about 3-5 days-100%, heavy shower-40%, lots of lightning-60%villages -Temperature begins to increase- 100% villages
May	-Rains towards end of the month, 3-5 heavy showers-67% villages -Temperature at its peak	-Rains towards the middle of the month-47%, towards end of the month-40% villages -Rains for 3-5 days47%, heavy shower-53%, lots of lightning-47% villages
June	-Rains towards the middle of the month-100% villages -Rains 6-10 days-53%, 11 -15 days-47%, heavy shower-100% villages	-Rains towards the middle of the month for 6 to 10 days, heavy shower-100% villages - Temperature comes down by 2nd week- 100% villages
July	-Rain spread over the month-100% villages -Rains 11 -15 days-100%, heavy shower 67% villages	-Spread over the month-33% villages -Rains 11-15 days-40%, rains16days+-47%, continuous rain for couple of days-47% villages
August	-Rain spread over the month-100% villages -Rains 11-15 days-100%, heavy shower-87% and continuous rain for couple of days-13% villages	-Rain spread over the month-100% villages -Rains 11-15 days-47%, 16days+-53% and rains continuously for couple of days-67% villages
Sept	-Rain spread over the month-87% villages -Rains 3 to 5 days-47% 6-10 days-33% villages -Light shower-53% and heavy shower 47% villages -No rain after middle of the month have been frequent	-Rain spread over the month, rains for 6-10 days of light shower- 100% villages

Oct	-Rains 1-2 days-53%, 3-5 days-47% villages -Light shower-100% villages -Years of no rain in this month have been frequent	-Rains towards middle or end of the month for 3-5 days, heavy shower-100% villages -Just cold by middle of the month
Nov	-Rains towards end of the month-13% villages - Just cold towards the middle of the month -Years of no rain in this month have been frequent	-Rains towards the middle of the month-67% and end of the month-33%; light shower of 3-5 days-100% villages - Extreme cold by middle of the month
Dec	-Rains 1-2days-20% villages - Extreme cold by middle of month -Years of no rain in this month have been frequent	-Rains towards the end of the month 1-2 light showers-20% villages -No rain, Extreme cold- 100% villages

Pattern of rainfall at present

Example of houses being transformed from short term to long term including stock for the future – certain varieties threatened due to selective felling

Irregular *Aparalu*

In East Godavari, farmers usually have 2 cycles of sowing crops:

June – Sept called *Tholakari*, when they sow millets and dry-land rice

Oct – Jan called *Aparalu*, when they sow pulses

In past few years the North-East monsoons, which bring sufficient rains for *Aparalu* crops are highly irregular, farmers losing their crop has become a regular feature in absence of last crucial rain. Some medicinal plants usually found in lower reaches (altitude), have now been found in higher reaches, indicating some change (increase) in temperature.

www.ipcca.net/module_02_06.php?lg=fr

6. Vulnerability

The general understanding that emerges from the assessment is that livelihood practices till the present have been almost fully dependent on the different components of forest ecosystem. However, already, the seasonal agricultural productions, forest collections and some of the practices themselves (e.g., Shifting cultivation, dry land rice) as well as the resource base (e.g., Hill land, specific forest species) lay vulnerable to complex combination of climatic and socio economic factors .

It also shows that the 'vulnerability' is beyond poverty, marginalization, the present state of livelihood or the status of resource base; it involves a predictive aspect what may happen under progressive changing conditions or the chain impacts.

The insight from the assessment indicates that the communities still living in the midst of relative bounties of nature with their indigenous wisdom neither adequately prepared nor have capacity to hold to their resources and utilize them to earn livelihood matching with the present realities without facilitation. Though they live in seemingly uniform eco-system, there are numerous micro variations in relation to resources and socio cultural practices and accordingly their vulnerability, resilience varies.

Going by the trend with the coming generation and the change in the level of aspiration and other complex socio cultural factors, it entails to recognize social vulnerability that could potentially provide additional trigger to climate related vulnerabilities.

6.1. Aspects of vulnerability (harvested from community level FDGs)

6.1.1. Vulnerability of forest (regeneration)

Climate fluctuation

- High temperature, summer rains, humus and moisture in the soil is required (e.g., tangedu, nallajeedi).
- Low rainfall affects germination (trees include : vegisa, maddi, bandaru, dadduga, vandanam, thada, venki, burugu, anem, thurayipoolu, thani, thadi, karaka, sirimanu, velama veduru, busi, korikibusi, gumpena, garuvu, edakulapala, edakulapala, usiri, sommitha, peddabusi nallamaddi, mussidichekka, etc): rain is crucial in June-July, spring/summer rain helps
- Humus and reasonable rain required for germination (mamidi, neredu, mollika, thummi, panasa, bodda, tumika, nepalam, guggilamnara, arenara chintha, naramamidi, tharipi, raavi, etc).
- For bushes like pathalgaradi - good humus and low temperature is required, as well as shady area, germination affected in case of low rainfall.
- Rain required in September and October for survival growth of regenerated plants.
- Decreasing of broom-grass in low rainfall years.

Decrease of birds and animals, which help in regeneration

While 8% seeds are spread and germinated by self, 14%, 5% spread and regenerate with help of wind and bird, respectively. Similarly, 27%, 10% and 9% plants spread and regenerate by self and with help of wind, bird and animals, respectively. Some plants spread and regenerate through combination of 3 factors- self, bird and animal (7%), self, wind and animal (5%), self, wind and animal 3%, self, wind, bird and animals 5% and wind and animals (4%).

Of the 148 plants, on which people could share their observation, 76% are spread/regenerated by seeds, 32% by rhizome and 5 % by both.

- People identified 6 animals that help in regeneration by eating and shitting. The wild animals include - wild sheep, bisons, sambar, spotted deer, bear and kurudupillulu. The trees they help in regeneration include- busi, korkibusi, neredu, parimi, panasa, mammidi, garrikigaddi, kopurigaddi, vempalli, nallajeedi, etc.

- Similarly, they have identified 12 birds (including peacock and mynah), which help in the similar fashion- eat and shit. The trees, which they help in regeneration, include busi, parimi, kota parimi, neredu, and other edible fruit plants.

- Animal and bird population are decreasing due to a combination of factors - hunting and change in the weather

Particulars	Numbers identified	Status	Remark
Wild animal sighted in forest	18	Decrease in 72% the animals due to hunting ,forest cutting and weather change (e.g., squirrel)	People hunt 12 wild animals during winter and summer, mostly by bow and arrow or trap Hunting is relatively higher in Daragedda cluster - more of tribal culture
Bees	4 major types of the 20 varieties people describe	There is almost 50% reduction due to longer dry period, temperature rise and change in the crop pattern and forest cutting	
Birds	64	People observe decrease of 40 to 75% in case of 94 % of birds. Decrease in their number is attributed to hunting and weather change	Similarly, people hunt 8 varieties of birds especially during summer season by nets, gum and stick

6.1.2. Vulnerability of Livelihood/ livelihood resources

Over exploitation of forest resources (to some extent triggered by climate fluctuation)

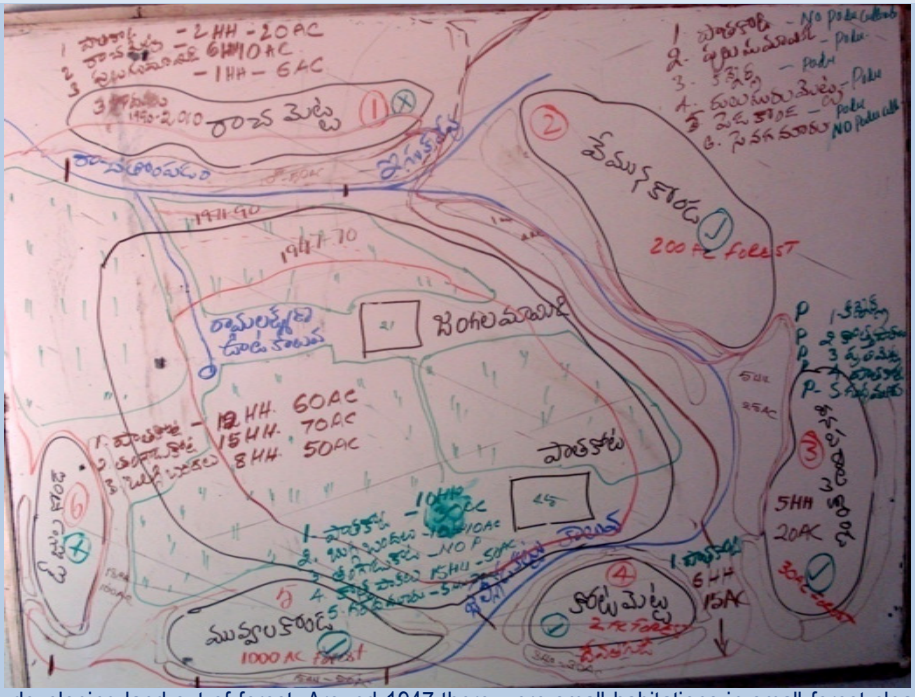
- Broom grass is decreasing due to forest fire and over exploitation
- Cultivation of food grains decreased in podu lands- because of soil erosion and repeated crop failure due to rainfall fluctuation
- Bamboo in nearby hills decreasing affecting bamboo based craft. Fencing in farm land is also affected
- Difficulty in getting seasoned wood for doors, furniture; also difficult in getting choice trees for farm tools
- Felling of forest by the immigrants for agriculture lands
- Decrease in fruit, fibre, mushroom, fuel and fencing material in nearby hills (felling of trees nearby for agriculture lands)
- Gradual increase in conversion of forest to agricultural land , selected felling of trees, mass felling for shifting cultivation since long
- Specific trees used for multiple purposes

- Species almost disappeared from forest / substantially decreased include- neredu, panasa, daduga, veduru, vegisa, vasaka, kinnerea, velamma, gummadi, karaka, thani, busi, gumpena, usiri, pothadi,bandaru, zelugu, sinduga, tadisa, erugudu, kondachippuru, chinnem, anem, etc.
- Some trees are found only at the upper reach- tangedu, maddi, sinnem, sinduga, vandanam, panasa, mamidi, etc., in some of the hill forests
- Amount of land occupied for agriculture have been constantly increasing; by 2010 36 % of hill forests are cleared partially or fully and changed from podu to settled agriculture.

Case of 102 hill-forests identified in 15 sample villages which are in different degree of cultivation, observation

Status of degradation	% of hill forests
Entire hill has already converted to agriculture. land	30% of fill-forests
Small portion of the forest exist as it is considered sacred	2%
Forest in varying degree of degradation from middle to top, rest is used for podu/shifting cultivation	25%
Relatively good forest growth, not yet used for shifting or settled cultivation but villagers do collect timber and other materials	23%
No podu/shifting cultivation but forest highly degraded due to over exploitation	3%
No forest at the bottom of the hills- converted to agricultural land	19%

Soil erosion decrease production and need to acquire more forest land



General trend in developing land out of forest: Around 1947 there were small habitations in small forest clearings; livelihood depended on gathering from forest and shifting cultivation. Gradually, the population and number of families increased, some of t shifting cultivation lands on hills with moderate slope were developed– leveled and bunded for settled cultivation - in all directions, while further expanding the shifting cultivation. While they continued making leveled lands out of moderate slopes shifting cultivation moved further to steeper hills, in all directions .The trend continues, while it is getting increasingly difficult to level land, about 8% families still have only about 1 acre of land; 34 % have 1 to 3 acres - they are only eager to acquire more land along with other families (who have enough!) to have a buffer against vulnerabilities including change in climate..(time line exercise –Pathakota (see up) located in comparatively wider valleys and Dumpavalsa in Daragedda having narrower valleys(see below)

Routine extraction from forest

- Huge amount of materials extracted from forests at regular intervals:

Purpose	Frequency of extraction	Quantity extracted per family / % village reported
House building	Once in 5-10 years	-Wall- 60+logs per fam-60% , 1ton + 40% - Super structure/roof-60 logs above- 60%, 2 tons + 40% - Door- 5 logs-100% -Furniture - 60 logs+ 40% , 30 logs +-13%, 2 tons above - 47%
Agri. Equipment	Once in 2 to 5 years	20 logs +-60%, 2 tons + -40%
Homestead fencing	Once in 1 to 2 years	2 tons + 60% village,-1ton + 40%
Agri. Fencing	Once in every year	5 tons+-60% village,1ton + -40%
Crop support	Once in every year	40 logs + -40% village , -20 logs +47% village, -5 logs-13%
Fire wood	Once in a year- 20% village -Every week-33% village -In winter/summer-46% village	5 tons + -27%, 2 tons +-73%
Mulching	Once in every year	10 to 20 kg/family (most)
Fodder	Almost every day	5 to 20 kg/family (most)

Huge fence for the summer paddy cultivation (Pathakota) will be replaced in next season

List of Red listed species in Andhra Pradesh

S.No	Red Listed Species	Trade / Popular Name	Vernacular Name
1	*Aegle marmelos*	**Bael Tree**	Maredu, Bilvamu
2	*Amorphophallus paeniifolius*	-	Advai kanda, Advai dumpa
3	*Aphanamixis Polystachya*	**Sohaga**	Chawarmau, Rohitaka
4	*Aristolochia tagala Cham (VU)*	**Heart leaved Indian Birth wort**	Nallayi swari
5	*Baliospermum montanum*	**Wild Cstor, wild croton**	Nela jidi, adavi aamudamu
6	*Celastrus paniculatus*	**Black oil tree, staff oil plant**	Malkavni, Bavanji, Kasara
7	*Curcuma pseudomontana*	-	Adavi pasupu
8	*Dealgis hamiltonii*	-	Madina Kommu
9	*Dispyros candolleana*	-	Tamil – Karikkattai
10	*Drosera indica*	**Sundew or Dew Plant**	-
11	*Embelia ribes*	**Common Wind Berry, Cabool rice**	Potosul, Vilangamu, Vellal
12	*Embelia tsjeriam-cottam*	**Worm killer**	Vindangamu
13	*Gardenia gummifera*	**Gummy Capa Jasmine, Cambi resin**	Bikki, Chit-mit, Manchi
14	*Gloriosa superba*	**Tiger's claws, Superblily, Malbar Glory lily**	Ganjeri, Agni sikha
15	*Hedychium coronarium Koenig*	**Common Ginger lily, Garland Flower**	Kichiligadda
16	*Holostemma annulare*	**Ring-coronet, swallow wort**	Bandi, Guruvinda teega
17	*Madhuca longifolia*	**South Indian Mahua, Mowha fat**	Ippa, Uriyippa
18	*Michelia champaca L. (VU)*	**Golden-yellow champa**	Champa, Champakamu
19	*Moringa Concanensis*	-	Advai munaga, karumunga
20	*Nervilia aragoana Gaud. (EN)*	-	-
21	*Operculina turpethum*	**Indian Jalap**	Nalla tegada, Errategada
22	*Oroxylum indicum*	**Indian trumpet flower**	Mokkavepa, Dundilamu
23	*Persea macrantha*	**Machilus, ladder wood**	Nara
24	*Piper longum L. (LR / NT)*	**Long pepper**	Modi, Pippalu
25	*Piper nigrum L. (VU)*	**Black & white pepper**	Mirchamu, Miremu
26	*Pseudarthria viscida*	-	Muyyakuponna
27	*Pterocarpus santalinus L.f (EN)*	**Red Sandal wood**	Erra Chandanamu
28	*Pueraria tuberosa*	**Indian kudzu**	Niala-gumodi, Darigundai
29	*Rauvolfia serpentina*	**Serpentina root**	Piatalangani, Sarpa gandhi
30	*Phaphidophora pertusa*	**Indian ivy**	Enugu nalleru
31	*Salacia oblonga Wall*	-	Tamil – Ponkoranti
32	*Santalum album L. (EN)*	**Sandal wood tree**	Chandanamu, srigandham
33	*Saraca asoca (Roxb.) Wilde (EN)*	**Ashoka**	Ashoka, Asokamu
34	*Schrebera swietenoides Roxb. (VU)*	**Weaver's Beam tree**	Bullakaya, Nagalinaga
35	*Shorea tumbuggaia Roxb (CR)*	**Green Dammer**	Guggilamu, Tamba
36	*Smilax zeylanica L. (VU)*	**Rough Bind Weed**	Kondadantena
37	*Symplocos cochinchinensis*	-	Assam - Motabhomlati
38	*Terminalia arjuna*	**White Murdah**	Kakubhamu, Eurmaddimaddi
39	*Tinospora sinensis (Lour) Merr (VU)*	-	Tippateega
40	*Trichosanthes animalaiensis Bedd (CR)*	-	-

Source: State of Forest Report 2001, Forest Survey of India

Reduction in food-grain crops

- Wet paddy cultivation is decreasing because of rainfall fluctuation (after the peak following settled cultivation), at present cultivated in 66% villages so also the Budama rice (dry land paddy is cultivated in 80% villages). Except little millet and finger millet (cultivated in all villages) other millets are cultivated in 7 to 40% villages due crop failure (late rain, excess rain, also change in choice). Sorghum is cultivated only in 47% villages.

Streams

- Flow substantially reduced during the year of low rainfall, for example, during 2006 and 2009 and there was conflict in two villages (Gurraputhompadam and Jalimadugula in Pathakota Panchayat) over sharing of water for kharif paddy.
- Streams lie vulnerable to over exploitation of forest at stream sources and increased incidence of low rainfall.

Streams: perennial flow, no management				
Cluster	**No. of villages**	**Seasonality**	**Distant travel**	**Management**
Pathakota	5 villages	14 (11 perennial)	Travel between 0.5 km to 11 km There are 8 check dams on the streams Water used for agriculture, washing, drinking	No management
Daragedda	10 villages	27 steams (26 perennial)	Travel between 1 to 15 km. There are 7 check dams Mostly used for agriculture, washing, drinking	No management

Socio cultural

- The traditional form of agriculture (seed, practices, etc.) is vulnerable because of combination of factors - change in the climate, livelihood resources in varying degree of degradation, as well as change in the needs, choices and aspirations
- Rearing of small animals decreasing due to lack of manpower (including increasing number of children attending schools) and frequent epidemics (e.g.,. dysentery)
- The Adivasi way of living is changing; indicators include - settled agriculture, moving away from traditional crops to 'marketable crops', use of high yielding seed and other external input,

substantial increase in both boys and girls at higher secondary level, quality of housing, lifestyle assets, cash needs, etc.

- Desire to have more land - 8% and 34% families have 1-3 acres of land, with other families who have enough (!) they continue to acquire more land out of forest before it is too late
- Considerable percentage of families have only 1-2 members (14%) , thus their capacity is limited in context of rejuvenating the degraded resources.

community mapping the streams in Daragedda cluster

Education & tradtional knowledge

"Now there is a single teacher school in almost all habitations, besides more than 1000 hostels and residential schools. The literacy rate has also increased substantially. However, this has resulted in substantial decrease in the number of persons with traditional knowledge, especially in tribal medicine, flora and fauna, customs and practices…"

State of Environment, Andhra Pradesh , Chapter 5 EPTRI, Hyderabad

6.2. Coping

- Due to repeated crop failure, to a large extent caused by rainfall fluctuation, the trend now is to keep buffer as far as possible by acquiring more land out of forest
- Growing pulses in shifting cultivation land and slope lands at the foothills - making use of the residual moisture post monsoon – also as buffer to crop failure because of late rain, low rainfall (Nelachikkudu and Sriramchikudu, etc.). Black gram, red gram, kidney beans (red) are cultivated in 80 to 100% villages
- Cashew plantation at the foot hills/slope lands
- Rubber plantation (ITDA)
- Citrus orchard (ITDA support, failed due to pest attack, e.g., Daragedda village)
- Fly ash brick used for BPL housing, thatched roofs are replaced by Mangalore tiles and ACC roofs (scarcity of forest based thatching material)
- Exploitation of distant forest for matured / choice trees for door, furniture and agriculture tools
- Live fencing/bio-fencing
- Following System of Rice Intensification (SRI) method.

Summary of vulnerability

"Human progress is neither automatic nor inevitable. We are faced now with the fact that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history there is such a thing as being too late…We may cry out desperately for time to pause in her passage, but time is deaf to every plea and rushes on. Over the bleached bones and jumbled residues of numerous civilizations are written the pathetic words: Too late."

Martin Luther King Jr. *'Where do we go from here: chaos or community'*

- Livelihood resources:

Hill lands: soil degradation triggered by over exploitation, absence of land development and exposure to excess rainfall and prolonged dry conditions

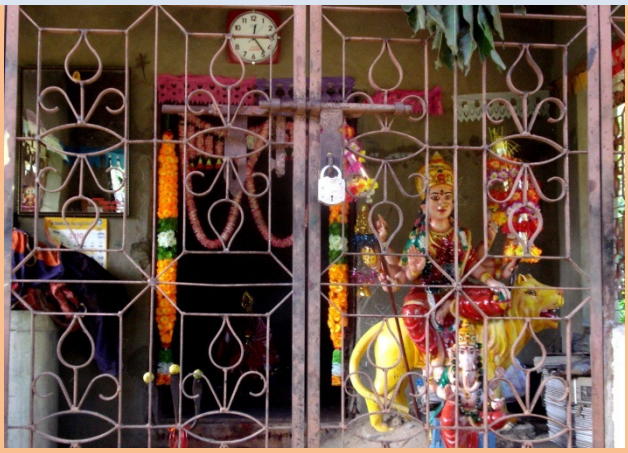
Forest: over exploration; regeneration affected due to climatic fluctuation, decrease of elements that help in regeneration, non-forest activities due to insecurities in conventional livelihood activities, selective extraction, unsustainable practices of extraction, lack of management, unregulated conversion of forest into agricultural land

Cropping pattern: climatic fluctuation, loss of fertility, change in need, change in socio-cultural aspects

Streams: over exploitation of forest at source, climatic fluctuation

Livelihood practices: change in need, change in socio- cultural aspects

- Socio cultural: overall change in the society, change in the values and ethics, exposure, govt. policies and programmes, education, change in aspiration
- Change in the climate appear to have been working as overarching trigger to take decisions in favour of change or coping by acquiring and over exploiting 'unregulated forest resources' (partly contributed by the problem of extremism).

One belief, different facets : sanskritization of 'forest deity' (Daragedda-R)

7. Macro Linkage

The Macro-perspective

On the sideline of the participatory assessment we tried to understand the climate change and the forest eco system from a macro perspective, mainly through the materials available on the net. We realize that the community experience and perceptions are not isolated cases. The insights from the vulnerability assessment in a micro region are reflected in the findings of other studies, macro-assessments. The common thread is that the forest eco system lies vulnerable to the changing climate and the corresponding changes in the socio- economic fabric, partly contributed by the changing climate. What triggers the changes remains a complex issue. A short profile is presented below.

Climate and its variability in India

In India, the climate and weather are dominated by the largest seasonal mode of precipitation due to the summer monsoon circulation. Over and above this seasonal mode, the precipitation variability has predominant inter-annual and intra-seasonal components, giving rise to extremes in seasonal anomalies resulting in large-scale droughts and floods, and also short-period precipitation extremes in the form of heavy rainstorms or prolonged breaks on asynoptic scale.

The most important feature in the meteorology of the Indian subcontinent and, hence, its economy, is the Indian summer monsoon. Almost all regions of the country receive their entire annual rainfall

during the summer monsoon (South-West monsoon), while some parts of the south-eastern states also receive rainfall during early winter from the north-east monsoon.

Rainfall increases by almost three orders of magnitude from west to east across the country.

All India and regional mean seasonal and annual surface air temperature for the period 1901-2000 indicate a significant warming of 0.4°C per hundred years. On a seasonal scale, the warming in the annual mean temperatures is mainly contributed by the post-monsoon and winter seasons. Also, data analyzed in terms of daytime and night-time temperatures indicate that the warming was predominantly due to an increase in the maximum temperatures, while the minimum temperatures remained practically constant during the past century.

The mean annual number of rainy days (with rainfall of 2.5 mm and above) over India varies from less than 20 days over the northwestern parts (west Rajasthan and Kutch region of Gujarat) to more than 180 days in the north-east (Meghalaya).

Indeed, rainfall during a typical monsoon season is by no means uniformly distributed in time on a regional/local scale, but is marked by a few active spells separated by weak monsoon or break periods of little or no rain. Thus, the daily distribution of rainfall at the local level has important consequences in terms of the occurrence of extremes.

Climate change - water resources and forest eco-system

India's geographical area of 328.726 Mha is covered by a large number of small and big rivers. Over 70 per cent of India's population of one billion is rural and agriculturally oriented, for whom these rivers are the source of their livelihood and prosperity. Climate plays a very decisive factor in water resource availability of a country.

There are 12 major rivers in India (with individual catchment areas of more than 10 Mha), with a cumulative catchment area of 252.8 Mha. The annual precipitation, including snowfall, which is the main source of the water in the country, is estimated to be of the order of 4'000 km3. The water resources potential of the country (occurring as natural run-off in the rivers) is about 1,869 km3, as per the latest basin-wise estimates made by the Central Water Commission. No doubt the forest eco systems in the huge catchments area play crucial role in sustaining the water flow in the rivers.

Climate projections

Taking 1961-1990 as the baseline period, the GHG simulations with IS92a scenarios [1] show marked increase in both rainfall and temperature by the end of the 21st century relative to the baseline. The different models/experiments generally indicate the increase of temperature to be of the order of

2-5°C across the country. The warming is more pronounced during winter and post monsoon months, compared to the rest of the year.

In the IS92a scenario, the model showed an overall decrease in the number of rainy days over a major part of the country. This decrease is more in western and central parts of the country (by more than 15 days) while along the foothills of Himalayas (Uttaranchal) and in north-east India the number of rainy days is found to increase by 5-10 days.

The projections of climate variables for the 2050s, under the IS92a scenario of GHG emissions include:

- An all-round increase in temperatures and a general increase in monsoon precipitation in the monsoon season
- A large spatial variation in the relative increase in monsoon precipitation
- An overall decrease in the number of rainy days over a major part of the country
- An overall increase in the rainy day intensity by 1-4 mm/day
- An increase in the temperature (maximum and minimum) of the order of 2-4°C over the southern region which may exceed 4°C over the northern region

The conservation process and the traditional collectors: largely isolated from each other

Status of India's forest

India is one of the 12 mega-diversity nations with a rich variety of flora and fauna. It is home to seven per cent of the world's biodiversity and supports 16 major vegetation types - varying from alpine pastures in the Himalayas to temperate, sub-tropical and tropical forests, and mangroves in the coastal areas.

The State of Forest Report, 2001, estimates the forest cover in India as 67 Mha, constituting 20.5 per cent of the geographical area. This is composed of 41.7Mha (12.7 per cent) of dense forest, 25.9 Mha (7.9 per cent) of open forest and 0.4 Mha (0.14 per cent) of mangroves. There is also 4.73 Mha of scrub in addition to the reported forest cover of 67 Mha.

In India, about 200 million people depend on forests directly or indirectly for their livelihoods. Forests play an important role in environmental and economic sustainability.

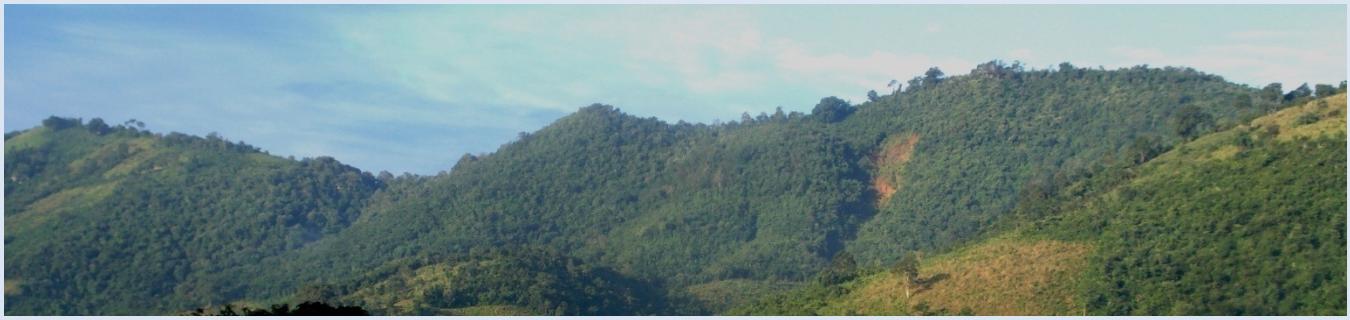
The forests support a wide variety of flora and fauna. More than 5,150 species of plants, 16,214 species of insects, 44 mammals, 42 birds, 164 reptiles, 121 amphibians and 435 fish, are endemic to the country.

Forests meet nearly 40 per cent of the country's energy needs and 30 per cent of the fodder needs. It is estimated that approximately 270 Mt of fuel wood, 280 Mt of fodder, and over 12 million m3 of timber and several Non-Timber Forest Products (NTFPs) are removed from forests, annually.

In India there are about 15,000 plant species out of which nearly 3,000 species (20 per cent) yield NTFPs. NTFP activities hold prospects for integrated development that yield higher rural incomes and conserve biodiversity, while not competing with agriculture. Millions of forest dwellers and agricultural communities depend on forests for a range of non timber forest products, such as fruits, nuts, edible flowers, medicinal herbs, rattan and bamboo, honey and gum. Further, all forest sector activities are labour intensive and lead to rural employment generation.

The value of goods and services provided by the forest sector is estimated to be Rs. 25,984 crores. Forest types in India

The dominant forest types are the tropical dry deciduous forest (38%) and tropical moist deciduous forest (32%). The other important forest types are tropical evergreen, tropical thorn, sub-tropical pine and alpine forest. The dominant forest stratum is the 'miscellaneous' category, accounting for 66 per cent of total forest area, where no dominant species could be identified.



Climate change impacts on the forest sector in India

In recent times, heavy biotic pressures have begun to exert tremendous stress on natural resources and, many of the plant and animal species are under threat in varying degrees. The projected climate change is likely to further exacerbate the socioeconomic stresses, leading to adverse impacts on forest ecosystems and forest product flows.

The preliminary assessment of the impact of projected climate change, based on BIOME-3[2] outputs, indicates shifts in forest boundaries, replacement of current assemblage of species, leading to forest die-back.

In the relatively short span of about 50 years, most of the forest biomes in India seem to be vulnerable to the change in climate. About 70 per cent of the locations are expected to experience a change in the prevailing biome type. In other words, about 70 per cent of the vegetation is likely to find itself less optimally adapted to its existing location, making it more vulnerable to the adverse climatic conditions as well as to the biotic stresses, which it is subjected to from time to time.

Habitats of many species will move pole ward or upward from their current locations. Species that make up a community are unlikely to shift together. Ecosystems dominated by long-lived species (for example, long-lived trees) will often be slow to show evidence of change and slow to recover from climate related stresses.

During the process of take-over of one biome type by another, large-scale mortality might be expected. The actual negative impact may be more than what is initially expected -as different species respond differently to the changes in climate where there is no shift in the biome type, changes in the composition of the assemblages are certainly very likely. Thus, a few species may show a steep decline in population and perhaps result in local extinctions affecting other taxa dependent on the different species; the interdependent nature of the many plant-animal-microbe communities that are known to exist in forest ecosystems.

The north-western region of the country seems to be more vulnerable to climate change, since it is likely to experience the effect of two negative influences: a large temperature increase together with a decrease in precipitation. Any large-scale change in vegetation to drier types over central and north-western India would also have consequences for the fauna of these regions.

The vulnerability of the north-eastern region stems from a very different cause. The major increase in precipitation expected in this region is likely to shift the vegetation towards the wetter, more evergreen vegetation. Since these are rather slow growing, the replacement will take much longer, and increased mortality in the existing vegetation may lead to a decrease in the standing stock.

The moist sal of Dehradoon

A smaller study focusing on the Doon Valley in northern India shows that a sudden rise in both maximum and minimum temperatures has been recorded during 1951-60, owing to increased deforestation around Doon valley during the decade. The percentage of evergreen species was 69% in 1958, which has reduced to 24% by 1998. While on the other hand, the deciduous species increased from 31% in 1958 to 76% by the year 1998. This is again attributed to increase temperatures followed by reduction in total rainfall, which causes moisture limitations in the region, a situation favourable for deciduous species. The study reflects a 19% reduction in forest corridor in the region from 1960 onwards. The changing environment of Doon valley has ultimately altered the microclimate of sal forest from moist to dry in the Dehradoon Forest division which has led to mass scale mortality in moist sal.

Shifts in forest patterns in Uttarkashi Forest Division

Indian Mountain ecosystems have been shown to be some of the most vulnerable to climate change both from an ecological and a socio-economic perspective. People who reside in these areas tend to be more dependent on their forest resources for a livelihood as it is harder to cultivate the land..

The Uttarkashi Forest Division lies between the latitudes 30025'N and 310 27'N and longitudes 780 9' E and 79025'E. The dependence of the people on forests is very high: they depend on the forests for fodder, grazing of animals, fuel wood and small timber.

The study shows that there has been a discernable change in the climate of the study area in recent decades. The main trends indicate a decrease in precipitation especially over higher altitudes, change in precipitation pattern, warming leading to milder winters, warmer springs and the recession of glaciers. The observed changes in climate correspond with observed changes in the phonology of some species in the study area.

The phonological changes taking place in this region, namely the earlier flowering and fruiting of various species and the implied lengthening of the growing season is likely to affect the distribution and availability of various non-timber forest products.

In some locations (Saur village, Jalkurgad Block – compartment - 29), which used to have 90% oak (Quercus leucotricophora) and mixed species with only 10% pine cover about 50 years before now have about 50% pine (Pinus roxburghii)cover replacing other species. Chir (Pinus roxburghii) had begun to grow. The pine at this site appeared to be about 30 years of age. The respondents attributed this change mainly to a gradual increase in temperature and the consequent drying out of the soil. . The replacement of mixed species forests and oak forests by Chir pine leads to a significant decrease in the quality and availability of fodder for livestock, clean water and good fuel wood. The large root systems of Chir pines also draw down the water tables.

Source: TERI (2007) Suruchi Bhadwal *hdr.undp.org/en/.../Kelkar_Ulka%20and%20Bhadwal_Suruchi.pdf*

Socio-economic factors contributing to vulnerability of the forest eco system:

Independent of climate change, biodiversity is forecast to decrease in the future due to multiple pressures, in particular, increased land-use intensity and the associated destruction of natural or semi-natural habitats.

Forest sector is the second largest land use after agriculture .Nearly 200,000 villages in India are situated in or on the fringe of forests. Further, about 200 million people depend on forests for their livelihood, directly or indirectly. For about 100 million of them, forests are main source for livelihood and cash income from fuel wood, non-timber forest products (NTFP) or construction materials. More than half of India's 70 million tribal people, the most disadvantaged section of society, subsist from forests.

Forest ecosystems in India are already subjected to socio-economic pressures leading to forest degradation and loss, with adverse impacts on the livelihoods of forest dependent communities. Having about 2.5% of world's geographic area, India at present is supporting 16% of planet's human population and 18% of cattle population. The forest cover has been reducing both in quality and extent. The degradation is not only indicated by crown density decline but also soil erosion, lack of natural regeneration.

What makes the forest eco system further vulnerable is the rapid changes in the life and livelihood of the forest fringe communities.

- The social customs, religious performances, superstitious beliefs and rituals used to influence the outlook of the Adivasis towards the forest and resulted in distinct forms of management; which under rapid transformation due to multiple factors such as
    - Exposure, education, improvement in communication and changes needs etc
    - Settlement of land leading to individual ownership
    - Influence of market economy leading to commercial crops under irrigated agriculture and horticulture (relatively less dependent on NTFP).
    - Change in practice, values and belief relating to festivals, extraction of certain plants, fruits, timber, grass, and animals to particular seasons alone. For example, not felling timber varieties during 'Pournami' – Suklapaksham, when the moon is on the rise with belief that they would get eaten by termites, plucking Relia (Fistula flowers) only after Gangalamma festival. Restricted eating of mango until it ripens and falls down; the kernels are stored and sowed during the monsoons. Same with palm. Exploitation of species of medicinal importance only by the medicine-men and so on.

- Degradation and vulnerability are attributed to the pre and post Independence policies of little respect and pace to distinct livelihood of the Adivasis and forest fringe communities , such as

- Non recognition of tribal rights in 'normal' forest settlement
- Irregularities in the settlement process
- Huge land alienation for no-forestry activities and displacement
- In-migration of tribal groups from other states

Other factors include:

- Free grazing and unscientific management of cattle population leading to overgrazing of forests
- Fragmentation of forest habitat leading to isolation
- Annual ground fires affecting the bio-diversity and regeneration of the forests
- Progressive encroachment to forest and over exploitation as the pressure on agriculture increases
- Organized smuggling.

Vulnerability due to policy and programmes

The vulnerability of forest ecosystems to climate change depends on the status of forests, biodiversity, fragmentation, afforestation practices, rates of extraction of timber, etc.

Some of the policies programmes and practices that potentially contribute to enhancing the vulnerability of forest ecosystems to climate change include:

- Forest fragmentation leading to loss of biodiversity by hampering migration of species
- Dominance of monoculture species under afforestation increase vulnerability to fire, pests, etc.
- Absence of fire protection and management practices enhance vulnerability to fire
- Non-sustainable extraction of timber, fuel wood and NTFPs leading to degradation of forests, fragmentation of forests and affecting shift of forest boundaries and regeneration of plant species
- Inadequate fuel wood conservation programmes increases pressure on forests, leading to degradation
- Inadequate and less-effective implementation of the different conservation programmes leading to forest degradation. There is a need for research studies to identify and assess the implications of policies and programmes to vulnerability of forest ecosystems.

Potential factors in context of the 'adaptation' in the forest sector

- Impacts such as loss of biodiversity are long term and irreversible
- Incorporation of climate concern in a long-term forest policy-making process
- Incorporate climate concern in the forest 'working plan' process to enable incorporation of silvicultural practices to promote adaptation

- Improve and ensure the effective implementation of existing policies/Acts/guidelines such as: Forest Conservation Act, 1980; Wildlife Protection Act, 1972 and 2002; enhance coverage and effectiveness of protected area; wildlife conservation programmes such as Project Tiger and Project Elephant.
- Link Protected Areas, Wildlife Reserves and Reserve Forests
- Enhance support to afforestation and reforestation programmes and increase area covered to increase the production of timber and fuel wood to reduce pressure on primary forests.
- Forestry and silvicultural practices: Current afforestation and silvicultural practices dominated by exotics and monocultures are enhancing the vulnerability of forests. Some of the potential silvicultural practices that could reduce vulnerability and enhance resilience are:
    - The promotion of natural regeneration in degraded forest lands and mixed species forestry on degraded non-forest lands.
    - The anticipatory planting of species along the latitudinal and altitudinal gradient.
    - The in-situ and ex-situ conservation of plant and animal species.
    - The implementation of fire prevention and management practices.
    - The adoption of short rotation species and practices.
    - The adoption of sustainable harvest practices for timber and non-timber products.
- Need for research to identify the silvicultural practices which reduce vulnerability of forest ecosystems to changing climate parameters. Institution and capacity building to address climate change in forest sector
- Forest dependent communities have poor financial, technical and institutional capacity to adapt to adverse impacts of climate change. It is necessary to enhance the capacity of those forest-dependent who are likely to be vulnerable to climate impacts.
- Effective and innovative implementation of the Command Area Development Programme (CAD) to generate positive impact on irrigation water utilization, irrigation intensity, agricultural productivity, and soil and water environment. It has been felt that the main emphasis of CAD has so far been on physical works, such as construction of field channels and on-farm development work.

[1]Six alternative IPCC scenarios (IS92a to f) were published in the 1992 Supplementary Report to the IPCC Assessment. These scenarios embodied a wide array of assumptions affecting how future greenhouse gas emissions might evolve in the absence of climate policies beyond those already adopted. IS92a has been widely adopted as a standard scenario for use in impact assessments- population rises to 11.3 billion by 2100, economic growth averages 2.3% year $^{-1}$ between 1990 and 2100 and a mix of conventional and renewable energy sources are used. Only those emissions controls internationally agreed upon and national policies enacted into law, e.g., London Amendments to the Montreal Protocol, are included.

[2]An equilibrium terrestrial biosphere model based on eco physiological constraints, resource availability, and competition among plant functional types. The model is envisaged as a tool for integrated analysis of the impacts of changes in climate and CO_2 on ecosystem structure and function)

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Interdependence in dilemma: amateur hunters of Busikota, Daragedda

8.1. Rationale

The potential initiatives delineated below have the following rationale:

- The livelihood of the communities living in the micro forest eco system under the study has undergone a number of complex changes in relation to the benchmark from 5 to 6 decades before. The dependence then was primarily of gathering materials from the forest and one of the typical tribal practice of crop growing- podu cultivation. The fluctuation in the weather did not matter much – since the food habits and other needs were at basic level and largely integrated to forest; the forest was used as the backup in extreme situations.

- Over the years, the population has increased and there has been significant shift in the practice of livelihood –more inclined to land based production, buying from the market, use of cash and the social security systems, etc. In the changed situation the fluctuation in production matters significantly, and as delineated earlier, has wide spread impact. The major coping up mechanism so far have been gradual expansion of the area shifting cultivation, clearing of more forest and increased land based cultivation, change in crop growing practice. In the meantime, life style has

changed; considerable percentage of children at present purse education at different boarding schools outside the region; traditional values and practices are fast degrading.

- The region present wide range of opportunities: bountiful resources are not used or grossly underutilized; farming to a large extent has remained organic; almost zero outmigration and engagement in service sector. At the same time, for the community in transition, number of practices show tell tale signs of being unsustainable: shifting cultivation , routine extraction of huge amount of materials from forest for fuel, fencing and crop support, selective felling of trees for timber for construction of long duration houses and furniture and so on. Another emerging challenge is the semi educated youth with different aspiration and orientation to livelihood.

- Going by the benchmark of the weather shared by the senior farmers there have been significant change and the relatively new cultivators are yet to fine tune their practices to the changing climate.

- This region under the study could be developed as pilot to gain insight and develop different models involving adaptation strategies in context of sustainable development and concerns of changing climate – taking advantage of the hitherto zero carbon livelihood, repository of traditional practices and wisdom, large network of perennial streams, low dependence on cash economy, not so degraded forests, different tribal communities, etc., to contribute to wider replication and dissemination of models of eco system based sustainable development matching to the present realities, while indirectly contributing to the mitigation process as well as capacity building of the generation next.

8.2. Potential initiatives

8.2.1. Developing the livelihood resources and improve the livelihood practices

- Terracing of the hill land, leveling and bunding of the slopes on the foothills
- Gravity irrigation of the terraced lands using water from the streams/runoffs
- Sustainable use of the hills- from top to bottom (combination of crops/tree growing ,etc.)
- Identification of best practices (seed, crop rotation, cultural) and developing models to address the present needs
- Development of land use models for different 'micro' regions with distinct features.

8.2.2. Protection and scaling up of the zero carbon practices

- Identification and popularization of 'best seeds'
- Initiate and popularize effective organic nutrients, soil enrichment, pest control, improved crop growing methods, such as SRI
- Stream and run-off based irrigation

People got land entitlement right up to the top of the hills; will there be soil to make any use of them!

8.2.3. Reduction of the unsustainable practices

- Develop and popularize live fencing with suitable plants
- Need based plantation to prevent/reduce felling for routine needs (fuel, fencing, building)
- Terraced cultivation in 'shifting cultivation' lands
- Awareness on sustainable methods of NTFP extraction
- Popularize fuel saving improved cooking systems.

8.2.4. Making the forests productive to address the diverse needs of the communities sustainably

- Strategic stocking of the trees, plants, tubers, herbs, etc., in the forest to meet the diverse needs
- Conservation and selective regeneration of trees which have been extensively degraded
- Conservation and selective regeneration of trees and plants of economic and cultural importance to the local community.

8.2.5. Management of the resources

- Identification of the resources (forest, streams, hills) that belong to the village, panchayat and the region
- Development of different management models- including inter-panchayat- and facilitating management

- Development of strategic plans for different hills and facilitating community regulation
- Protection and management of stream sources and sacred forests, community forests
- Community regulation of forest clearance for new lands.

The region has the contrasting profile of un-irrigated lands and large number of grossly underutilized seasonal and perennial streams

8.2.6. Coping with the changing climate

- Identification of appropriate seeds and practices and development of different crop rotation for different type of land to address potential vulnerability
- Improve in seeds storage practice to address vulnerability
- Improve in the response mechanism to maximize from the present pattern of rains, moisture and other weather elements
- Improve soil moisture retention capacity
- Improve stream and run-off based irrigation potential

March for more land continues - buffer for future!: where to draw the line ?!

8.2.7. Eco-system based education and the capacity building

- Making the community aware of the micro and macro concerns relating the changing climate
- Making the community aware regarding the opportunities to address the changing climate
- Building the capacity to develop, utilize and manage the low carbon farming method, alternative zero carbon technology, water management, forest management, etc.
- Identification of the ecosystem based resources, skills relevant to the educated and semi educated youth and their capacity building
- Educating the future generation of the resources and the dynamics of the forest eco systems and the sustainable opportunities for improved livelihood.

8.2.8. Macro linkage

- The insights in a way mirror the dynamics in the livelihood of 300 million tribal and other people in India that depend on forest for their subsistence and livelihood. Potential use include influencing policies/

programmes like Green India Mission, which envisages taking up afforestation /eco-restoration in India to 20 million ha over 10 years leading to additional carbon sequestration of 43 million tons CO2-e annually by the year 2020. Similarly, Reducing Emissions from Deforestation and Forest Degradation (REDD+) aims at carbon sequestration. These entail the tress to stay longer in the forest. Considering the routine livelihood needs and amount of extraction the insight could be used to help redesign the programmes from community point of view.

- Potential models for wider replication and dissemination
  - Regulated forest for harvesting ensures that rest of the forests are not felled, only usufruct products are extracted (carbon sink!)
  - Low carbon farming
  - Inter-panchayat water, forest and hill management
  - Stocking and regeneration of trees, plants, tubers, herbs, etc as per the need of the people (Green India Mission)
  - Up scaling community based alternative zero carbon technology (cooking, lighting, processing, irrigating, soil enriching, etc.)
  - Marketing of organic products, processing and end use of forest resources, alternative technology, etc., - appraisal of policies, programmes, technologies and feeding system to the community level.

Future generation, time to ensure that they do not become 'guest' inhabitants in their own society

List of Participants in VA

Sl no	Name of the persons	Identification	Remark
1	Mr. K. Koteswara Rao	Coordinator, Natural Resource Management	Survey Facilitator, Mapping, Data collection
2	Dr. R. Venugopal Rao	Forestry Specialist, Science and Technology	Technical aspects in puts
3	Mr. L. Mallikharjuna Rao	Coordinator, Documentation	Documentation and Data collection
4	Mr. M. Satyanarayana	Coordinator, Information Technology	Photo documentation and HH census Data Processing
5	Mrs. B. Sindu	Data entry operator, Addateegala	Village schedules and HH sample schedules Data entry
6	Mr. Siddharth D'Souza	Coordinator, Climate Change - DEO	Pilot survey
7	Mr. V. Ravindra	Area Coordinator, Paderu	Data collection and interviews
8	Mr. M. Veeru Naidu	Field Coordinator, Natural Resource Management, Paderu	Data collection of Village schedules and HH sample survey
9	Mr. Saramkota Balaraju	Community member(Elder group), Patahakota	Sharing of cultural aspects
10	Mr. B. Chellayya	Field Coordinator, DEO Addateegala	Logistics, Data collection and data entry
11	Mr Sadala Baburao	Field assistant DEO, Pathakota Cluster	Logistics and Data collection
12	Ms Saramkota Lingamma	Field assistant DEO,Pathakota Cluster	Women leader
13	Mr. Kadabala Kameswara reddy	Field assistant NRM, Daragedda	Mapping and Data collection
14	Mr. Kadabala.Chiranjeevi	Community member	HH census data collection
15	Mr S. Sathish Reddy	Community member	HH census data collection
16	Mr S. Dalapathi Reddy	Community member	HH census data collection
17	Mrs. Kakuri Rajyalakshmi	Women field assistant NRM unit, Tungamadugula	HH census Data collection
18	Mrs. Kunjam Veeralakshmi	Women field assistant NRM unit, Tunikelapadu	HH census Data collection
19	Ms P. Prasanthi	Women field assistant NRM unit, Aradikota	HH census Data collection
20	Ms K. Narayanamma	Women field assistant NRM unit, Bandamamidi	HH census Data collection
21	Ms K. Varahalamma	Women field assistant NRM unit, Peddakodapalli	HH census Data collection
22	Ms P. Varalakshmi	Women field assistant NRM unit, Puruguduputtu	HH census Data collection
23	Mr Murla Sureshreddy	Field assistant NRM, Ravulapadu	HH census Data collection
24	Mr Murla Lakshmanareddy	Field assistant NRM, Pulusumamidi	HH census Data collection
25	Mr Kunjam Ramarao	Field assistant NRM, Peddaulempadu	HH census Data collection
26	Ms P. Lakshmi	Women field assistant NRM unit, Utlapalem	HH census Data collection
27	Mr Pallala Neelamreddy	Field assistant NRM, Pasaruginni	HH census Data collection
28	Mr Ulli Simhachalam	Field assistant NRM, Durupalli	HH census Data collection
29	Mr Vanthala Anandh	Field assistant NRM, Sariyapalli	HH census Data collection
30	Mr Vanthala Kamalakar	Field assistant NRM, Kullubha	HH census Data collection
31	Mr P. Sathibabu	Field assistant NRM, Kandamamidi	HH census Data collection
32	Mr. Dominic D'Souza	Laya resource person	Observer
33	Mr. Sanjay Khatua	Freelnacer- developmental research & communication	Facilitator

Annex tables

Annex table. 1 **Demography**

Name of the cluster (Panchayat)	No. of villages	Total household	Total population	% of male	% of female	0-5			6-14		
						Male	female	Total	Male	female	Total
Pathakota	19	610	2821	48.88	51.12	198	195	393	319	312	631
Daragedda	10	350	1555	49.65	50.35	80	80	160	210	177	387
Both clusters	29	960	4376	49.15	50.85	278	275	553	529	489	1018

Annex table 2 Status of communities in the clusters of assessment

Sl no	Name of the community	Pathakota (no. of hh)	Dragedda (no. of hh)	Total hh in both the clusters
1	Bhagatalu	2	-	2(0.2%)
2	Kodhu	30	-	30 (3%)
3	Konda Dora	28	2	30(3%)
4	Konda Gouda	30	-	30(3%)
5	KondaKammari	41	-	41(4%)
6	KondaKummari	1	-	1(0.1%)
7	KondaPoraja	21	-	21(2%)
8	Konda Reddy	328	314	642 (67%)
9	Koya Dora	10	-	10(1%)
10	PorangiPorja	7	-	7(9%)
11	Porja	82	-	82 (8%)
12	Valmiki	30	34	64 (6%)
	Total	610	350	960 (100%)

Annex table 3. Use of the forest resources

Type of species	Timber	Fruits/pods							Flower							Usually used for						Leaves				Usually used for			
		Edible	Vegetable	Oil yielding	Liquor	Medicinal	Marketed	Fodder	Edible	Vegetable	Oil yielding	Liquor	Medicinal	Marketed	Fodder	Fuel	Fencing	Crop support	Fiber extract	Bark collected	Resin collected	Edible Green	Plate &	Medicinal	fodder	Broom	Poison	Agri equip.	Other
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Tree (71)	48 %	28 %	10 %	-	11 %	48 %	14 %	4 %	4 %	3 %	-	-	1 %	-	-	55 %	42 %	42 %	6 %	3 %	4 %	7 %	44 %	8 %	4 %	1 %	1 %	32 %	6 %
Bush (62)	10 %	23 %	6 %	-	3 %	53 %	2 %	8 %	3 %	-	-	-	5 %	-	-	21 %	13 %	11 %	-	2 %	2 %	6 %	29 %	44 %	-	2 %	2 %	-	-
Creeper (51)	-	25 %	24 %	2 %	2 %	71 %	31 %	6 %	-	-	-	-	8 %	2 %	-	8 %	4 %	2 %	4 %	-	-	6 %	4 %	78 %	6 %	-	2 %	-	2 %
Herb\shrub (20)	-	95 %	90 %	-	-	5 %	5 %	20 %	5 %	5 %	-	-	-	-	-	-	-	-	-	-	-	100 %	-	10 %	-	5 %	-	-	-
Grass (15)	-	-	-	-	-	-	7 %	100 %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tuber (20)	-	100 %	55 %	-	-	5 %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Mushroom (28)	-	**100 %**	**50 %**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sl No	**Name**	**Classification**	**Botanical name**	**Popular trade name**

Annex table-4 Master chart- Flora

1	Adavichemakura	Shrub	*Arum esculentum*	
2	Adavikakara	creeper	*Momordica tuberosa*	
3	Adavi kondlemkura	bush		
4	Adavimalli	creeper	*Jasminum angustifolium*	Wild Jasmine
5	Adavinabhi(Aggikona)	creeper	*Gloriosa superba*	Superb Lily, Flame Flower
6	Addateega	creeper	*Bauhinia vahlii*	Platter leaves
7	Anapa	creeper	*Luffa aegyptica*	Dish-Cloth Gourd
8	Anem	Tree	*Bridella retusa*	Spinous Kino Tree
9	Aratiakulu	bush	*Musa paradisiaca*	Banana
10	Are nara	Tree	*Bauchinia racemosa*	
11	Badidam	Tree	*Erythrina variegata*	Indian Coral Tree
12	Battapallu	bush	*Mitragyna parvifolia*	Water Cadamba
13	Bandaru	Tree	*Adina cordifolia, Nauclea cordifolia*	Saffron Teak , Turmeric Wood
14	Belangidumpa	Tuber plant (TP)		
15	Bhuradhapattiri	bush		
16	Boddipala teega	creeper	*Rivea hypocrateriformis*	Clove-scented Creeper
17	Bodda	Tree	*Ficus hispida*	Wild Fig
18	Boduga	Tree		
19	Boragakura	Shrub	*Combretum roxbughii*	
20	Bottimanu	Tree		
21	Budaritdumpa	Tuber plant (TP)	*Capparis divaricata*	
22	Budaritheega	creeper		
23	Burugu	Tree	*Bombax malabaricum*	Red Silk-Cotton Tree
24	Busi/Korikibusi	Tree	*Vitex altissima*	Tail Peacock's foot tree
25	Charukura	Shrub	*Colocasia esculenta*	Taro
26	Chavidi dumpa	Tuber plant (TP)		
27	Cheekatikura	Shrub		
28	Chedavemu	bush		

29	Cheda dumpa	Tuber plant (TP)		
30	Cheducheda	Tuber plant (TP)		
31	Chetakattuteega	creeper	*Desmodium triangulare*	
32	Chevadidumpatheegala	creeper		
33	Chidigari dumpa	Tuber plant (TP)		
34	Chillipoolu	bush	*Ehretia Leavis*	
35	Chinnagandugu	Tree		
36	Chinnaputtakokkulu	Mushroom		
37	Chintha	Tree	*Tamarindus indica*	Chintha
38	Chitti Pala	Tree		
39	Dadduga	Tree	*Adina cordifolia, Nauclea cordifolia*	Saffreon Teak , Turmeric Wood
40	Dosa	creeper	*Cucumus sativus*	Cucumber
41	Dulikura	bush		
42	Edakulapala	Tree	*Alstonia scholaris*	Shaitan Wood
43	Ethapallu	bush	*Phoenix loureirii*	Dwarf Date Palm
44	Gajukura	Shrub	*Passiflora foetida*	Stinking Passion-flower
45	Galidumpalu	bush	*Hedychium coronarium*	Ginger Lily
46	Gandukura	Shrub	*Melochia corchrifolia*	
47	Ganneru	Tree	*Nerium indicum*	Oleander
48	Garijelu/Galijeru	bush	*Trianthema portulacastrum*	Horse-purslane
49	Garsakura	Shrub		
50	Garuvu	Tree	*Bischofia javanica*	Bishop Wood
51	Gecha /Pedda Gecha	creeper	*Caesalpinia crista*	Fever Nut
52	Gesari	Tree		
53	Gillateega	creeper	*Entada rheedii*	St.Thomas bean
54	Gitum dumpa	Tuber plant(TP)		
55	Gobbipoolu	bush	*Barleria cristata*	Crested Purple
56	Godugukokkulu	Mushroom		

57	Goddukura	Shrub	*Portulaca quadrifida*	
58	Guggilamnara	Tree	*Shorea robusta*	Sal
59	Gulugukura	Shrub	*Celosia argentea*	
60	Gummadi	Tree	*Gmelina arborea*	White Teak
61	Gummadikura	creeper	*Cucurbita maxima*	Red Gourd
62	Gumpena	Tree	*Lannea coromandelica*	Thingam
63	Gundumura	Tree		
64	Guntukadumpatheegalu	creeper		
65	Isukakokkulu	Mushroom		
66	Jagaram	bush		
67	Jare	bush	*Woodfordia fruticosa*	Fire-Flame Bush
68	Jilledu	bush	*Calotropis gigantea*	Madar
69	Kagitha	Tree		
70	Kamala	bush	*Citrus aurantium*	Orange
71	Kappakura teega	creeper	*Tiliacora acuminata*	
72	Karaka	Tree	*Terminalia chebula*	Yellow Myrobalan
73	Karuchikkudu teega	creeper		
74	Kanchedupoolu	Tree		
75	Kodikoppukura	Shrub		
76	Kodipuri teega	creeper	*Anamirta cocculus*	Fish Berry
77	Kollempoolu	creeper	*Butea monosperma*	Flame of the Forest
78	Kondaveduru	Bamboo (B)	*Dendrocalamus strictus*	Hard Bamboo
79	Kondakasimi	bush		
80	Kondamallipoolu	creeper	*Jasminum angustifolium*	Wild Jasmine
81	Konkodikura	Shrub	*Pisonia aculeata*	Prickly Climbing Cock's Spur
82	korrapindikura	Shrub		
83	Kotaparimi/Parimi	bush	*Zizyphus oenoplia*	Jackal Jujube
84	Kulakari akulu	creeper		
85	Kusumanti	creeper		
86	Lollodi	creeper		

87	Maddi	Tree	*Terminalia alata*	
88	Mamidi	Tree	*Mangifera indica*	
89	Mamidi kokkulu	Mushroom		
90	Manudekudupoolu	creeper		
91	Manupippali	creeper	*Piper longum*	Long Pepper
92	Maredu	Tree	*Aegle marmelos*	Bael Tree
93	Modugateega	creeper	*Butea monosperma*	Flame of the Forest
94	Moddukokkulu/Manukokkulu	Mushroom		
95	Mollika	Tree	*Celastrus paniculata*	Staff Oil Plant
96	Mullerutheega	creeper		
97	Munaga	Tree	*Moringa oleifera*	Drumstick
98	Munnurukaraka	Tree	*Melia composita*	Malabar Neem Wood
99	Musidichekka	Tree	*Strychnos nux-vomica*	Nux-vomica
100	Najeyyidumpa	Tuber plant (TP)		
101	Nallachitramulam	bush	*Plumbago auriculata*	Leadwort-Blue-Flowered
102	Nallagandugu	Tree		
103	Nalla Gumma	Tree		
104	Nalla Jeedi	Tree	*semecarpus anacardium*	Marking nut
105	Nallagumma	Tree	*Gardenia montana*	
106	Nallagurivinda	creeper	*Abrus precatorius*	Jequirily seeds
107	Nallapasupu	bush	*Curcuma pseudomontana*	Black Turmeric
108	Nallamaddi	Tree	*Terminalia crenulata*	
109	Nallateega	creeper	*Ichnocarpus frutescens*	Black Creeper
110	Naara dumpa	Tuber plant (TP)		Naara dumpa
111	Naradumpa theega	creeper	*Aponogeton natans*	
112	Naramamidi	Tree	*Polyalthia longifolia*	Indian Fir
113	Naramamidikura	Tree	*Litsea decanensis*	Ganapaty Tree
114	Naratheega	creeper		
115	Nelaravalla	creeper		

116	Nelavemu	herb	*Andrographis panculata*	King of Bitters
117	Nelausiri	bush	*Phyllanthus fraternus*	
118	Neelimogamalle	bush		
119	Nemaliadugu chettu	Tree	*Vitex pinnata*	Downy Peacock's Foot Tree
120	Nepalam	bush	*Jatropha curcas*	False Croton Oil Plant
121	Neredu	Tree	*Syzygium cumini, Myrtus cumini*	Indian Cherry
122	Nuledumpa	Tuber plant (TP)		
123	NuneGecha	creeper	*Caesalpinia crista*	NuneGecha
124	Osakommalu	bush	*Acorus calamus*	Sweet Flag
125	Pachamoga malle	bush		
126	Palakura	Shrub	*Spinacea oleracea*	Spinach
127	Palapoolu	bush	*Wrightia tinctora*	Ivory Wood
128	Palateega	creeper	*Leptadenia reticulata*	Cork Swallow-wort
129	Panasa	Tree	*Artocarpus heterophyllus*	Jack Tree
130	Paratiakulu	Tree	*Phanera vahlii*	Camel's foot climber
131	Pantamanu/Chettu	Tree		
132	Pasupu	bush	*Curcuma domestica*	Turmeric
133	Pathalagaridi	bush	*Rauvolfia serpentina*	Rauvolfia root
134	Peddabusi	Tree	*Schleichera oleosa*	Ceylon oak
135	Peddachedadumpa	Peddachedadumpa	*Peddachedadumpa*	Peddachedadumpa
136	Peddagandugu	Tree	*Salvodora persica*	Tooth Brush Tree
137	Pedda Pala	Tree	*Palaquium ellipticum*	Indian Gutta Percha tree
138	Peddaputtakokkulu	Mushroom		
139	Peddarachachettu	Tree		
140	Pendligummadi	bush	*Benincasa hispida*	Ash Gourd
141	Pididiga	bush		
142	Pidi dumpa	Tuber plant (TP)		
143	Pilliadugu	Tree	*Macuna pruriens*	Cowhage

144	Pillitegalu	creeper	*Asparagus racemosus*	Wild Carrot
145	Pindidumpa	Tuber plant (TP)		
146	Pindidumpa theega	creeper		
147	Pippali(Saruku)	creeper	*Piper longum*	Long Pepper
148	Pippidi	creeper	*Calycopteris floribunda*	
149	Ponnagantikura	Shrub	*Alternanthera sessilis*	
150	Pothadi	Tree		
151	Pullori	bush	*Holoptelea integrifolia*	Jungle Cork Tree
152	Putangpoolu	bush	*Combretum ovalifolium*	
153	Raavi	Tree	*Ficus religiosa*	Sacred Peepul
154	Redekkakura	Shrub		
155	Rella	bush	*Cassia fistula*	Golden-shower
156	Sanpangipoolu	Tree	*Michella champaca*	Champak
157	Sappikura	Shrub		
158	Sikakai teega	creeper	*Acacia sinuata*	Soap pod
159	Sinnela	Tree		
160	Sirimanu	Tree	*Anogeissus latifolia , Conocarpus latifolia*	Axle wood, Gum Ghatti
161	Sithammamusugu	creeper	*Cassytha filiformis*	Green Thread Creeper,Sita's Yarn
162	Somitha	Tree	*Cowhage*	Indian Red Wood
163	Sugandhipalateega	creeper	*Hemidesmus indicus*	
164	Tangedu	Tree	*Cassia auriculata*	Tanner's cassia
165	Teak	Tree	*Tectona grandis*	Indian Oak Teak
166	Thada	Tree	*Pterospermum xylocarpum*	
167	Thadi	Tree	*Terminalia bellerica*	Belleric Myrobalan
168	Thani	Tree	*Terminalia bellerica*	Belleric Myrobalan
169	Tharipi(Kanchi Chettu)	Tree	*Gardenia latifolia*	Indian Box Wood
170	Thattacheekum	creeper		
171	Thega dumpa	Tuber plant (TP)		
172	Theegagummudu	creeper		

173	Theegaanem	creeper		
174	Theegaracha	creeper		
175	Theegaravadi	creeper		
176	Theegavepachettu	creeper	*Cipadessa baccifera*	
177	Thellachidigaridumpa	Tuber plant (TP)		
178	Thellachitramulam	bush	*Plumbago zeylanica*	Leadwort-White-Flowered
179	Thellagumma	Tree	*Gardenia turgida*	
180	Thellagurivinda	creeper	*Abrus precatorius*	Jequirily seeds
181	Thellamoga malle	bush		
182	Thotakura	Shrub	*Amaranthus gracilis*	Amarunthus
183	Thulasi	bush	*Ocimum sanctum*	Holy Basil
184	Thummi	Tree	*Diospyros melanoxylon*	Ebony/Tendu
185	Thurayipoolu	Tree	*Delonix regla*	Gulmohar
186	Tumika	Tree	*Diospyros melanoxylon*	Ebony/Tendu
187	Usiri	Tree	*Emblica officinalis*	Goose-Berry
188	Vaimu dumpatheega	creeper		
189	Vaimu dumpa	Tuber plant (TP)		
190	Vandanam	Tree	*Ougenia oojeinensis*	Sandan
191	Vanjari	Shrub	*Erythrina suberosa*	
192	Vasakura	Shrub	*Acorus calamus*	Sweet Flag
193	Veduru	Bamboo (B)	*Dendrocalamus strictus, Bambusa stricta*	Bamboo
194	Vegisa	Tree	*Pterocarpus marsupium*	Kino Tree
195	Velaga	Tree	*Limonia elaphantum*	Elephant-Apple, Wood Apple
196	Verricheda	Tuber plant (TP)		Can't find
197	Venki	Tree	*Putranjiva roxburghii*	Child-Life Tree
198	Vennuvedurukura	Shrub		
199	Velama	Tree	*Anogeissus latifolia , Conocarpus latifolia*	Axle wood, Gum Ghatti
200	Voobhakura	Shrub		
201	Yerramoga malle	bush		

202	Yerragrivinda	creeper	*Abrus precatorius*	Jequirily seeds
203	Yerrachidigari	Tuber plant(TP)		

Misc

Sl.no	Local Name	Botanical Name	Trade/popular name
	Mushrooms		
1	Bandari kokkulu		
2	Bidadarikokkulu		
3	Bonthukokkulu		
4	Cheedikokkulu		
5	Chinnapillangulu		
6	Chinnaputtakokkulu		
7	Dokkikokkulu		
8	Gaddikokkulu		
9	Godugukokkulu		
10	Gundem kokkulu		
11	Isukakokkulu		
12	Keruvukokkulu		
13	Mamidi kokkulu		
14	Moddu/Manukokkulu		
15	Nelavelugulu		
17	Padimatara Kokkulu		
18	Pasupukokkulu		
19	Peddapillangulu		
20	Peddaputtakokkulu		
21	Pothadi kokkulu		
22	Rachelukakokkulu		
23	Sandikokkulu		
24	Sogakukokkulu		
25	Somikokkulu		
26	Tadisakokkulu		
27	Tankakokkulu		
28	Vedurukokkulu		
29	Vepichevulakokkulu		
	Fodder		
1	Bonthugaddi		
2	Cheepurugaddi		Hill broom grass
3	Chippagaddi		
4	Dabbagaddi		
5	Garikagaddi		
6	Katarikura		

7	Kinneragaddi		
8	Kopurugaddi	*Echinochloa colona*	
9	Narachedagaddi		
10	Naradumpa tuttlu		
11	Nelatunga		
12	Pooredugaddi		
13	Poothikagaddi		Wild broom grass
14	Sengalagaddi	*Cicer arietinum*	
15	Tungagaddi		
16	Veduru chedagaddi	*Bambusa stricta*	Bamboo