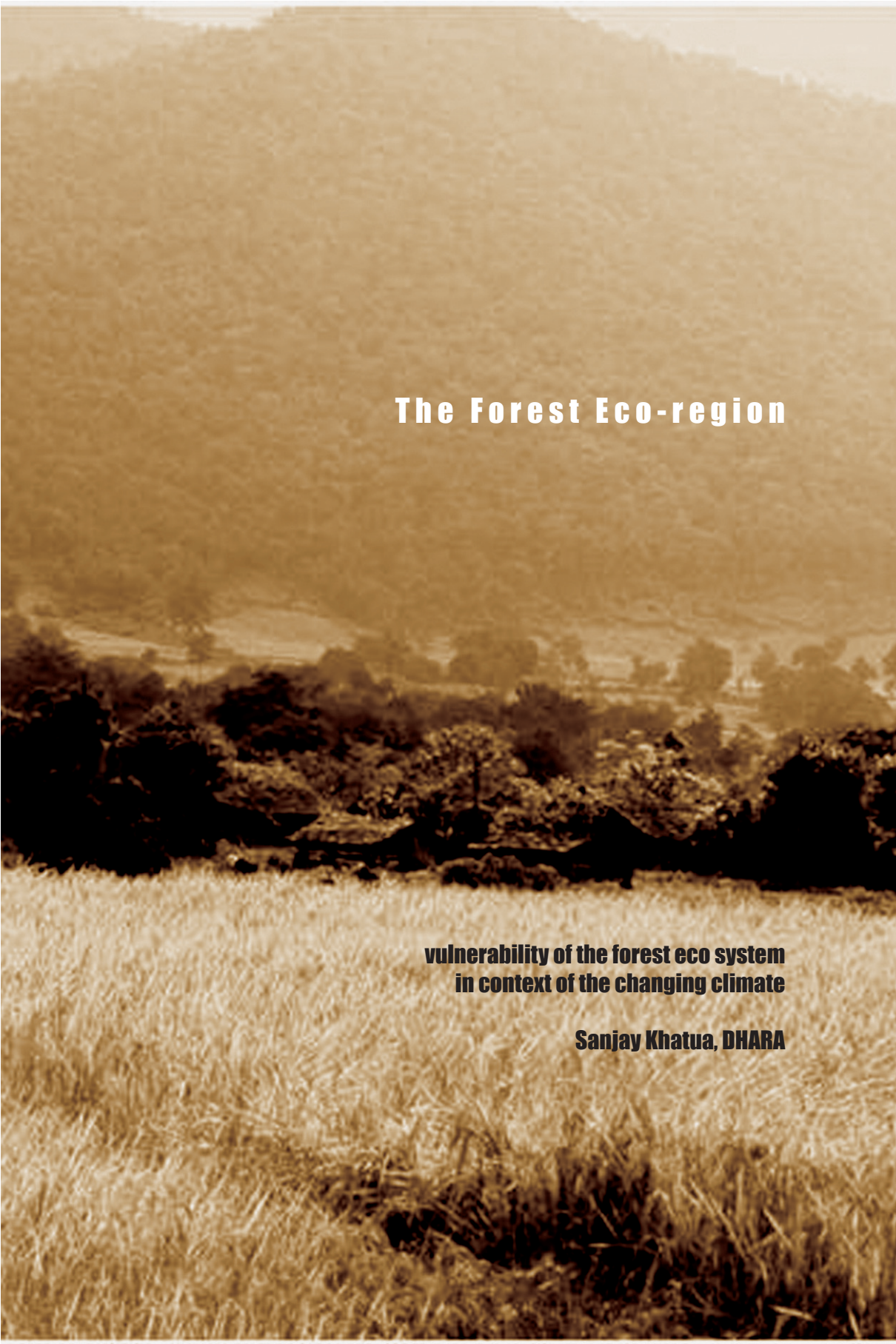


The Forest Eco-region

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

Sanjay Khatua, DHARA

Introduction: Of woods and trees

The forests are a key eco-region in India directly supporting the livelihoods about 200 million people and indirectly over 70% of India's rural population who depend on the rivers which originate in the forests. Forests also 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 cubic meter of timber and several Non-Timber Forest Products (NTFPs) are extracted from forests annually and the value of goods and services provided is estimated to be Rs. 25,984 crores.

Bio-diversity

Forests are the repository of bio-diversity supporting 16 major vegetation types - varying from alpine pastures in the Himalayas to temperate, sub-tropical and tropical forests, and mangroves in the coastal areas. 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.

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.

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

Forest dwellers: Nearly 3000 of the 15,000 plant species in India yield Non-timber Forest Produce (NTFP) - fruits, nuts, edible flowers, medicinal herbs, bamboo, honey and gum. NTFP activities also hold prospects for integrated development that yield higher rural incomes and conserve biodiversity, while not competing with agriculture. These activities are labour intensive and lead to rural employment generation.

More than half of India's 70 million tribal people, the most disadvantaged section of society, who subsist on forests are completely vulnerable to forest degradation. Thanks to rapid extraction of timber resources and minerals, 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 and lack of natural regeneration.

What makes the forest eco system more vulnerable is the rapid changes in the life and livelihood of the forest fringe communities. Traditionally, the social customs - religious performances, superstitious beliefs and rituals - governed the outlook of the Adivasis towards the forest and resulted in distinct forms of management. For example there was a belief that when the moon is on the rise, felled timber is eaten by termites and so

felling timber varieties during “pournami”-Suklapaksham was avoided. Plucking of fistula flowers (relia) was allowed only after the Gangalamma festival, and mangos were eaten mainly after they were ripe and fell on the ground, and their kernels were stored and sowed during the monsoons. Species of medicinal importance were not to be touched, except by medicine-men. Today due to pressure on land, tribal have moved to settled agriculture and under the influence of the market economy and modern governance, tribals have taken to commercial crops and horticulture, and individual ownership of land . Education, exposure to external world and improved communications has also lead to changing aspirations and taste transfers. Rather than go to the forests in times of distress, they have tended to go in for wage labour. Since Rice is now subsidized at Re. 1 per kilogram, subsistance based on a mutual relationship with the forest is completely disincentivised.

While market oriented cash economy has drawn tribals away from their traditional ways, polices and laws from pre-independence days have not recognized or built upon the tribal traditional rights and governance systems. The irregularities in the settlement process, immigration of tribal groups from other areas, and most dominantly alienation of forest for non-forest activities and displacement for projects, have skewed the relationship of the adivasis to the land and the forests. With traditional controls compromised, there is progressive encroachment of forests, and over-exploitation of forests as the diminishing forests are not able to cope with the demands. All these have lead to fragmentation and alienation of forest habitat. Thus forest events like forest fires, and uncontrolled grazing and cattle management have become the norm leading to further degradation of forests.

Degradation of the patches of forest due to non sustainable extraction of timber and NTFP, have also led to loss of biodiversity as migration of species, and regeneration from root stock and seed has been hampered. In addition dominance of monoculture plantation for commercial purposes and attendant vulnerability to forest fire involving certain varieties and increasing pests have had a cascading effect on degradation.

Climate Change impacts on Forests 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 the Doon valley, heavy deforestation between 1951 to 1960 induced significant rise in minimum and maximum temperature in the area. The percentage of evergreen species which was 69% in 1958, reduced to 24% by 1998, while the deciduous species increased from 31% in 1958 to 76% in 1998. The changing environment of Doon valley has ultimately altered the microclimate of sal forest from moist to dry, which has led to mass scale mortality in moist sal.

The projected climate change is likely to further exacerbate the socioeconomic stresses, leading to adverse impacts on forest ecosystems and forest product

flows. A TERI Study of the Uttarkashi forest division has reported phonological changes namely earlier flowering and fruiting of various species and the implied lengthening of the growing season has been observed. This is likely to affect the distribution and availability of various non-timber forest products. In some locations like Saur village in Jalkurgad which used to have 90% oak and only 10% pine, now shows upto 50% 30 year old pine (chir - Pinus roxburghii). The change has been attributed to a gradual increase in temperature and the consequent drying out of the soil. Other climate trends are a decrease in precipitation especially over higher altitudes, change in precipitation pattern, warming leading to milder winters, warmer springs and the recession of glaciers.

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. The preliminary assessment of the impact of projected climate change, based on BIOME-32 outputs, indicates shifts in forest boundaries, replacement of current assemblage of species, leading to forest die-back. 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 poleward or upward from their current locations. Species that make up a community are unlikely to shift together. Some long-lived species will often be slow to change or recover from climate related stresses. Thus during the process of take-over of one biome type by another, large-scale mortality might be expected as constituents of interdependent plant-animal-microbe communities may not move together.

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. 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.

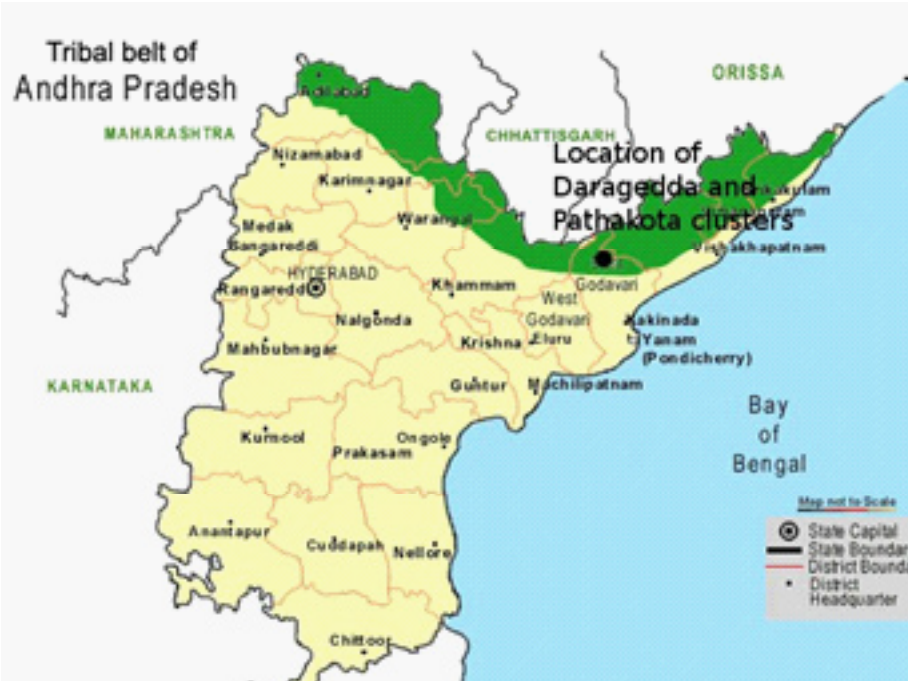
Forest communities living in these areas are in the process of adjusting to the emerging realities of climate change. This study seeks to understand the peoples' perception of climate change, the facets of vulnerabilities of marginalized forest dwellers and the factors responsible for the same.

The assessment was carried out in two clusters of 29 villages in two remote Panchayats, Pathakota (19 villages) and Daragedda(10 villages) in Y. Ramavaram mandal, East Godavari district, Andhra Pradesh.

The area was specifically chosen for study because there is little or no external intervention and the livelihoods of the people are cent per cent dependent on forest ecosystem and services. This would help us understand “development” in the context of forests and the relationship of the communities with the forests in terms of livelihood and in terms of changes, which are climate centric and otherwise. This assessment showcase the vulnerability as assessed by these communities, and relates these vulnerabilities to critical livelihood issues which need to be attended to while showing pathways for adaptation to climate change. Perhaps it is these areas which can show low carbon pathways such that the people in these areas can leapfrog into a sustainable development path which mitigates climate change, adapts to its ill effects while it addresses issues of poverty and inequity.

Laya, a Visakhapatnam based CSO has working in this area in the field of renewable energy intervention covering micro hydro, solar and efficient woodstoves. While the Pathakota cluster already has an operating micro hydro programme, Daragedda is a potential site as it has a number of perennial streams at suitable heights.

A house census covering all the 29 villages was used to collect information for the section of profile of the communities. This was followed up by collection of village level information and observation through Focus Group Discussion (FGD) with the help of pre-structured schedules in 15 sample villages covering land use and livelihood patterns. The schedules covered geo-physical and socio eco-



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!

nomic features. Finally there was indepth follow up in 6 villages, 3 in each cluster using FGD and participatory mapping. It involved detailed mapping of critical climate phenomena and their relationship with it. The techniques of participatory research was used in collecting the data for the assessment.

In this participatory assessment study, 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 -- 22 varieties of them, each subtly different from the other -- each having a specific impact. If the pattern of rainfall changed, they would change their cropping routine. They didn't need to know the change in millimeters, nor did they talk about 'climate change' -- at least not in the way we as development facilitators do, with the attendant accessories of graphics and mind boggling statistics, and complaints about the lack of groundswell - that communities do not adequately react to "climate change". The mainstream development paradigm is however not able to reconcile their "scientific" understanding, policies and programmes relating to climate with people's wisdom and aspirations. The people, who were to a large extent not responsible for the Green House Gas emissions are now expected to be disciplined enough to contribute to different mitigation and adaptation measures, even as they are still struggling to meet their basic needs from these resources which are vulnerable.

Profile of the community

		Both	PTK	DRG
No. villages		29	19	10
Population		4376	2821	1555
Male		49%	49%	50%
Female		51%	51%	50%
Age 0-5		13%	14%	10%
Age 6-14		23%	23%	25%
Family size	% hh	No of HHs		
1-2	14%	131	71	60
3-5	59%	563	369	164
6-10	27%	259	164	95
11-15	1%	5	4	1
16+	0%	2	2	0
Literacy (excluding toddlers)				
Illiterate	79	3010	1995	1015
Just literate	7	274	101	173
Primary	8	303	188	115
Secondary	4	149	91	58
Inter +	2	72	44	28
Technical	0	3	1	2
Vocational	0	8	4	4
		Both	PTK	DRG
Current Education				
Primary		821	486	335
Secondary		140	86	40
College		85	51	34
Other		2	2	
In School		961	572	375
Out of School (Age 6-14)		1571	1024	547
as %		61	56	69
Housing		All	PTK	DRG
Thatched roof		5%	4%	8%

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

Family size: While a majority have small families ie about 59% percent of families have 3 to 5 members and a significant number 14% has only 1 to 2 members. 27% families in both the clusters have 6 to 10 members. This as we shall see later has a bearing on increasing pressure on forests that are being cut to make way for loss of productivity, climate or otherwise.

Literacy & Education: If we exclude the under five and school going population, most of the population is illiterate about 90%. However, the scenario is set to change, as more and more children between 6 to 14 years, are in school. The table shows that current enrollment in schools as well as higher education is markedly higher than the cumulative effect of the past.

Housing: Another major visible changes over the last two decades has been the shift from traditional short term thatch roofed housing, which requires frequent repair to long-term housing with tiled or asbestos roof. Only 5% houses now have thatched roof with short-term structures.

Though many more houses have traditional bamboo walls, a situation that, as we shall see later, does make them vulnerable to changes in the availability of bamboo.

Social Groups & Community traits

Socio-culturally, the people of this area have not changed much. They do live off the forests, there is no migration out of the forests and very few 6 to be precise have gone out of the area for work for about one or two months in a year.

Communities	Total		PTK	DRG
Total households		960	610	350
Konda Reddy	**67%**	642	328	314
Porja	9%	82	82	-
Valmiki	7%	64	30	34
Konda Kammari	4%	41	41	-
Kodhu	3%	30	30	-
Konda Dora	3%	30	28	2
Konda Gouda	3%	30	30	-
KondaPoraj a	2%	21	21	-
Koya Dora	1%	10	10	-
PorangiPorj a	1%	7	7	-
Konda-Kummari	0	1	1	-

All the 12 social groups essentially tribals living in the two clusters have by and large maintained their distinctive social traits, but to varying degrees. However as far as the day to day livelihood is concerned, the social groups have moved away from their distinctive tribal traits. Almost all of them have become or are at various stages of moving from purely podu cultivation to settled agriculture.

And these are, as we shall see, mainly due to degradation as well as increasing needs, with climate playing the tipping factor. Of the social groups, Konda Reddy households are dominant (67%) followed by Porangi Porja (9%), Porja (8%) and Valmiki (6%).
The Konda Reddys, who are designated by the government as a 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 more advanced agriculturalists than the other groups. The Kondh and Porja (and two other variations), who are immigrants from Odisha, are still in the process of acquiring land and securing their social space.

Lifestyle assets: There is not much variation in owning lifestyle assets in both the clusters 28% households do have a radio. 70% families have electricity connection under a recent scheme, but power supply is highly irregular. Since electricity has arrived, a few families have TV. 5% families have bicycles, 1% families have motor-bikes.
But what is important to note is that none

	total	PTK	DRG
Radio	265	188	77
TV	40	23	17
Bicycle	50	46	4
M. bike	9	6	3
Electricity	676	421	255
Solar light	173	170	3
Cell phone			
DVD			

of the families have fossil fuel related devices -- no pumps, no thresher, no weeder etc. There are three diesel operated rice mills. Only one village has one winnower that was supported by Laya.

Agricultural Equipment			
	total	PTK	DRG
Power tiller			
Thresher			
Winnower			
W. pump			
Sprayer	1	1	
Weeder	1	1	
Rice mill	3	3	
Other			

Cooking in Percentage

	total	PTK	DRG
Traditional chullah	99.79	99.84	958
Improved chullah	2.92	4.26	28
Electrical stove	0.21	0.16	2
Gas stove	0.73	0.33	7

Cooking. For cooking they depend on the traditional chullah. Though 3 % have improved chullah facilitated by Laya, they do not use it all the time. 0.21% have electric stoves/heater and 0.73% families have gas stoves.
Though there is no little contact with the outside mainstream social life, 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.

Access to Land

There are three type of land in this region -- patta land to which they have formal titles, non-patta land which they are cultivating and are in possession of but without any title, and then podu

	All	PTK	DRG
Total Land	5675	4093	1582
Patta Land	45%	46%	44%
Non patta	24%		
shifting cultivation	28%		
Access to Land (percentage of households)			
Patta land	66%	68%	62%
non-patta land	36%	47%	17%
shifting cultivation	62%	54%	77%
Average land per family			
Total	5.92	6.7	4.5
Patta Land	4.9	4.54	3.22
Non patta	3.92	4.11	2.98
shifting cultivation	2.89	3.12	2.61

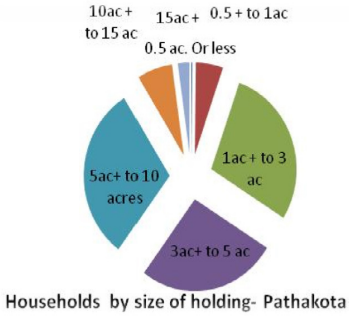
lands for shifting cultivation, The total amount of land in both the clusters is 5675 acres - 4092.54 acres in Pathakota and 1582 acres in Daragedda. Of the total land, 45% is patta land and 24% is non-patta land where settled agriculture is practiced. 28% of the land is under podu cultivation which goes upto 45% in some areas. In both the clusters, 80% households have more than one type of land. A few families take in land in share cropping. The increasing pressure for more land, and other factors, as we shall see later is why more and more forests are being felled for podu cultivation, and the same pressure in turn changes the cropping from podu to settled agriculture. While there is not much difference in the percentage of households having patta land (46% and 44%) between Pathakota and Daragedda, respectively, the larger proportion of households have podu lands in Daragedda at 77 % than in Pathakota which is 54% thereby indicating that the rates of conversion of podu land to settled agriculture is far less in the more remote Daragedda havin narrower valleys and steeper slopes.

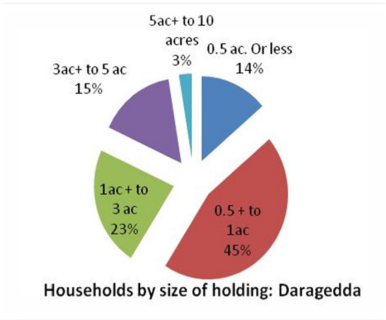
Average land per family

No of household as per land size & type								
Range of land	**Patta land**		**Non patta**		**Podu land**		**All lands**	
	PKT	**DRG**	**PKT**	**DRG**	**PKT**	**DRG**	**PKT**	**DRG**
0.5 ac. Or less	1	1	1	15	2	1	1	
0.5 + to 1ac	23	35	28	0	58	71	28	32
1ac + to 3 ac	175	104	119	24	168	141	154	105
3ac+ to 5 ac	116	54	87	15	69	39	142	53
5ac+ to 10 acres	82	22	49	5	28	19	167	36
10ac + to 15 ac	8		4		4		36	6
15ac +	8		1		0		12	
Cluster total	**413**	**216**	**289**	**59**	**329**	**271**	**540**	**232**

The average land per household is 5.9 acres, but is differentiated between the two clusters at 6.7 acres for Pathakota and 4.5 acres for Pathakota and Daragedda and this differentiation varies incrementally in favour of Daragedda as we go from Patta land, through non patta land and then on to shifting agriculture. (see table)

Land Distribution among households.





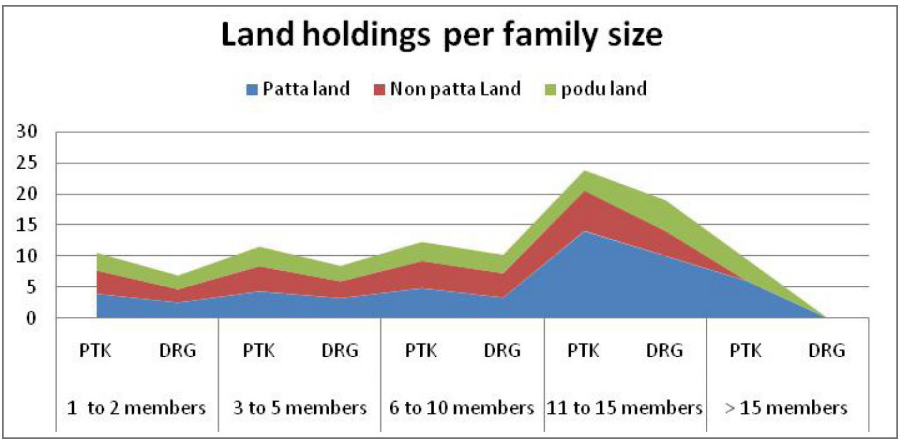
Differentiation in land distribution in these villages is not high as in other caste villages in India and most of the households lies around the averages. About 8 % families have up to 1 acre of land; 34 % have 1 to 3 acres, 25% have 3to 5 acres, 27% 5 to 10 acres and 6% have more than 10 acres. Since all families are totally dependent on the land and forest resources, there is no alternatives livelihood, any demand due to vulnerability or need would normally be met with persons being allowed to clear a part of the forest for podu cultivation. However the elasticity in supply is now restricted as the forests are in steep and higher places, making it that much more difficult to cultivate.

Those households having holdings between 1 to 3 acres are evenly distributed between the three types of land, as we go higher to the proportion of settled agriculture particularly patta lands increases, and goes down when the land holding is less than 1 acres barring the case of 15 families in Daragedda, who have shifted their very small holding of less than half an acre into settled agriculture.

Average Land Holdings as per family size

family size →	1 to 2		3 to 5		6 to 10		11 to 15		> 15	
	PTK	DRG	PTK	DRG	PTK	DRG	PTK	DRG	PTK	DRG
patta land	3.98	2.55	4.36	3.27	4.86	3.37	14	10	6	0
non-patta land	3.71	2.14	4.03	2.68	4.36	3.88	6.5	4	0	0
podu land	2.87	2.22	3.17	2.52	3.1	2.98	3.33	5	3.5	0

Land as per family size



Possession of land varies more or less according to family size, while maintaining the differentiation between Patakota and Daragedda clusters. Families with 1 to 2 members have 4.88 acres and 2.95 acres, respectively in Pathakota and Daragedda; and families with 3 to 5 members respectively have 5.54 and 3.66 acres. As seen from the chart the peak averages values of 14 acres and 10 acres are for the few large families, having 11 to 15 members in the family.

Livestock

Livestock	All	PKD	DGA
Cows	52.40%	58.69%	41.43%
Bullocks	54.23%	67.54%	42%
Buffaloes	2.29%	3.61%	
Goats	55.63%	57.21%	52.86%
sheep	0.10%		0.29%
Pig	2.60%	3.93%	0.29%
Poultry	72.40%	71.97%	73.14%

Over 50% househols support their land activity with bullocks --58% families have have an average 2.48 heads of bull, though Pathakota is much higher at 68% compared to 42% in Daragedda in line with proportion of settled agriculture.

Land activity is supported by livestock breeding, with over 72 percent having poultry, and over 50 percent each having cows and Goats.), 2.29% families have buffaloes- average 2.18 (only in Pathakota).

Income sources

The livelihood practices have to a large extent remained forest ecosystem based without migration and external services; Farming and wage earning are the main sources of livelihood -- over 95 % in the two clusters. And the bulk of their cash income comes from sale of agricultural produce that is 77 % in Pathakota and 65% which correlates with the settled agricultural land held in the village. What is noteworthy is that sale of fuel wood even though forest are relatively well endowed as compared to other areas, is very low at less than 2% with about a quarter of the households preferring the sale of NTFP as a source of secondary income. Other income sources are: handicraft mainly bamboo work - 7%selling of timber 0.42%, business 2%. Out migration is only one family. There is virtually no out bound migration as one family goes out for work for one or two months in the year. There are virtually no service holders either in private service or government service.

Income Sources of households			
Wage Earning	95.94%	96.07%	95.71%
Farming	94.06%	94.59%	93.14%
Sale of Agric. Produce	73.02%	77.54%	65.14%
Sale of NTFP	27.40%	30.66%	21.71%
Sale of handicraft	7.08%	6.72%	7.71%
Sale of fuel wood	1.98%	2.46%	1.14%
Sale of timber	0.42%	0.66%	0
Business	2.19%	2.62%	1.43%
Out migration - M	0.10%	1.15%	0.29%
Out migration- F	0.52%	0.49%	0.57%
Pvt service-M	0.10%	0.00%	0.29%
Pvt service-F	0.31%	0.49%	0.00%
Govt service-M	0.94%	0.66%	1.43%
Govt service-F	0.52%	0.49%	0.57%

The landscape now presents denuded hills due to repeated 'shifting cultivation' with heavy soil degradation and scarcity of the trees of choice for local needs. The photograph also shows that a considerable percentage of houses have bamboo walls, indicating the continuing needs to forest resources for repair

Forest resource and dependence

What exactly are the forest resources in the area and what is the nature and degree of forest dwellers dependence on it. Firstly, these forest share their space with shifting agriculture and now increasing patches of settled agriculture. This means that the same remote hill has large areas where shifting agriculture is practiced, where the lower foothills and flatter lands have given way to settled agriculture. The higher reaches and the steeper portions of the hills, generally on top of the hill are thickly wooded. There is no formal forest protection system except for traditional regulations based on mutual respect. There are two sacred groves on top of the hills where people do not cut trees the trees. There are also a few Vana Saurakshan Samitis set up under the JFM.

There are 106 patches of forests in the 15 sample villages selected for detailed study totaling 5557 ha of forests. Each patch has an average area of 52 hectares. 85 patches are on hills, 25 are on plains. 38 of the forest patches are considered as reserve forests and the rest as village forests. 100 patches are perceived to be within the village boundary while the 29 of them share boundaries with the neighbouring villages. The Pathakota cluster has average 208 ha per village while Daragedda has an average of 350 ha. per village.

Plant Diversity

Plant diversity and the presence in villages under study						
Type	species	Species presence in % of villages				
		<10%	10 to 25%	25 to 50%	50 to 75%	>75%
Tree	71	16 (23%)	24 (34%)	16 (22%)	7 (10%)	8 (11%)
Bush	62	25 (40%)	24 (39%)	16 (26%)	3 (5%)	2 (3%)
Creeper	51	14 (27%)	23 (45%)	9 (18%)	5 (10%)	-
Herb/shrub	20	05 (25%)	08 (40%)	05 (25%)	1 (5%)	1 (5%)
Grass	15	2 (13%)	6 40%)	5 (33%)	1 (6%)	2 (13%)
Tuber	20	7 (35%)	3 (15%)	2 (10%)	4 (20%)	4 (20%)
Mushroom	28	10 (36%)	7 (25%)	6 21%)	5 (18%	-

The people identified 71 types of trees but because of the degradation only 75% of the trees which have been identified are available in 10 per cent of the villages.

In the rest of the villages, though they know the tree and can identify it, they do not have the 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. 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.

Use of Forests: 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. 7% trees have edible greens.

Leaves of 44% trees are used for making plates for household use; 8% have medicinal use.

The identified trees are sought after as they have multiple use, particularly those which are used as timber, as well as fuel and agricultural implements. 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. 5% 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

Bushes:

Of the 62 types of bushes identified, fruits /pods of 23% of the types are edible 10% are used as small timber and 21%, 13% and 11% bushes are used for fuel, fencing and crop support respectively.

Creepers:

Similarly out of the 51 creepers they have identified, different parts of 71%, including leaves of 44% of them are

Uses of different trees

Use	No.	Names of the trees
Edible	6 trees	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

used for medicine and 31% which are marketed. Further the flowers of 8% of creepers are used for medicine purposes, including 2% which are also marketed. These are not notional uses, but actual use. 25% of creepers are edible.

Tubers & Mushroom:

Similarly there are 20 varieties of tubers and 28 types of mushrooms which are edible.
Of the 20 herbs/shrubs identified, 95% are edible. Their fruit and pods are also used as medicine and fodder
Grass: All the the 15 grass varieties are used as fodder, with 7% of them marketed.

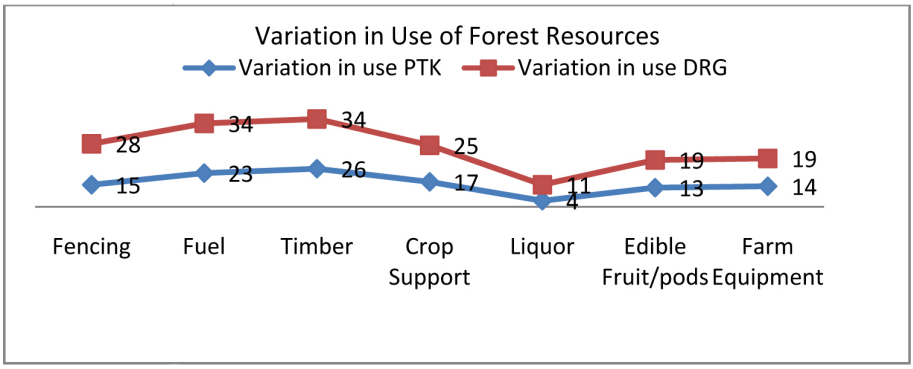
From the above it is evident that forest dwellers look to the forests to provide for their various needs, rather than other modern inventions which plains-people may take to. But the preference of most of the villages on certain trees for multiple purposes though plural may pose a threat to those trees as they are most sought after.

Variations:

Comparing the two clusters, Pathakota people use less varieties for different uses. If we make a cursory comparison between the two clusters, people in Daragedda use more varieties of trees for each of the uses whether it is for timber, or as food or fuel. The reason:seems to be that the people of Pathakota are relatively upward mobile, and are becoming more choosy and selective as they look for durability, better finish or taste. They have started out-sourcing their needs as their cash incomes have gone higher. They would also prefer to cut the trees for expanding their agricultural land.

However the majority in Daragedda who live in remote narrow valleys are less choosy and less concerned about durability. So they use more varieties and subsequently these species are also regenerated.

The variation between the two indicates that there is a gradual departure from the adivasi way of life.



Climate

While there is little doubt that there is climate change, how are these changes perceived by the local communities and how do they adapt to these changes. The study, through a number of Focus Group Discussions put together details of changes in rainfall and temperature in terms of the number of villages who have been experiencing changes which impact the livelihood of people.

Talking about the extreme vulnerability: In the last 17 years, four were the years of deficit or very low rains and three , years of excess rainfall. On both the counts, that is for seven years out of 17, the crop failure was almost 80%. Such failures were also found to have triggered a change in the cropping pattern.

The following is a month wise comparison between the perception of rainfall patterns 20 years ago and now, as conceptual categories, rather than as strict quantitative measurements. At present rain starts from the second week of June and mostly stops by mid or end September. And there is no rain except a few random showers, here and there upto March. Compared to 20 years ago, there appears to be about 20 heavy showers less than what used to be 20 yrs before. Further there is a marked decline of "continuous rains over two days", and we seem to be having one heavy precipitation after which the rain stops.

Rain from October to March is becoming very unpredictable. It is a common sharing among different regions across the country across the country that there is no rain after October till March or April. That means there is a prolonged dry period for about 6 to 7 months, It is very important to note that a number of livelihood activities either aggressively done or differently done turn, are totally stopped because of the prolonged dry period. And because of the prolonged dry period , there is a problem in fish regeneration.

Impact of rainfall pattern on Crops over last 17 years

Duration of main rains	Years	General impact
Rain starting 1st/2nd week of June and ending mid October	10 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- (deficient rainfall and uneven distribution)	4 years: 2009, 2002, 2001, 2000	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-)	3 years 1993, 1995, 2005	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.

Month	Rainfall Pattern **At present**	**Situation 20 years back**
June	Heavy rains for 6 to 10 days in **53%** villages & 11-15 days for 47% of the villages towards the middle of the month	Heavy rains for 6 to 10 days in **100%** of the villages towards the middle of the month
July	Rains for 11 -15 days in **100%** villages, with heavy showers in 67% villages. Rain spread over the month	Rain for more over 16days in 47% of villages, and 11 to 15 days in **40%** of villages, Continuous rain for couple of days in 47% villages This rain was spread through the month **in 33%** villages.
August	Rains 11-15 days in all villlages with heavy shower in 87% Rain spread over the month in 100% villages Continuous rain for couple of days in 13% villages	Rains for 11-15 days in 47%villages & over 16 days in 53%villages. Rain spread over the month in 100% villages continuous rains for couple of days in 67% villages
Sept	Light showers in 53% and heavy shower in 47% villages Rains 3 to 5 days in 47% villages & 6-10 days in 33% villages Rain spread over the month in 87% villages No rain after middle of the month have been frequent	Light showers for 6-10 days of light shower in 100% villages Rain spread over the month in 100% villages
Oct	Light showers for 1 to 2 days in 53% of villages and 3 to 5 days in 47% of villages. Years of no rain have become frequent	Heavy showers for 3 to 5 days toward latter half of month in 100 % villages
Nov	Rains towards end of the month in 13% villages. Years of no rain in this month have been frequent	Rains towards the middle of the month in 67% villages and end of the month in 33% villages. light showers of 3-5 days in 100% villages
Dec	Rain for 1-2days in 20% villages. Years of no rain in this month have been frequent	One or two light showers towards the end of the month in 20% of villages
January	Light shower towards the middle of the month in 27% villages and toward the end of the month in 40 to 67% villages Years of no rain in month of January have been frequent	2 - 3 light showers towards the middle of the month in 100% villages
February	1-2 light showers light showers towards the middle of the month in 27 to 67% villages- Years of no rain have been frequent	2 -3 light showers towards the middle of the month in 100% villages
March	1-2 light showers in67% villages In some years, does not rain	Rains for 1 - 2 days in 40% villages, and Light showers in 73% villages. Rains at the beginning of the month in 47% villages
April	Heavy showers for 3 - 5 days in 67% of villages and no rain to light showers in 33% of villages.	Rain for 3 to 5 days toward the end of the month in 100 % of villages with heavy showers in 40%, and lots of lightening in 60% villages
May	3-5 heavy showers towards end of the month in 67% villages	Rains for 3 - 5 days in 47 % villages & heavy showers in 53% villages. Lots of lightening in 47 % of villages. Rain toward middle of month in 47% villages & 40% towards the end

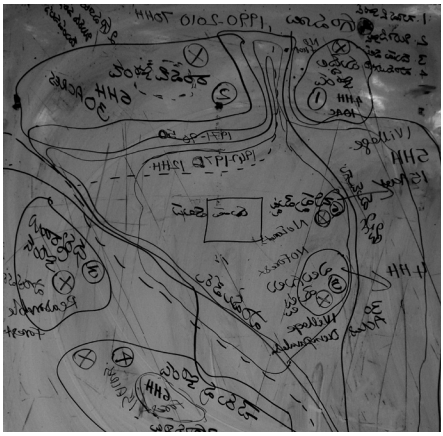
Vulnerability

The vulnerability of the communities are completely tied up to the vulnerability of the forest eco-system itself. Therefore the forest need to be regenerated, at least at the same pace as it is exploited. In this regard, the FGD identified two important vulnerability variables --climate and reproduction. The discussion also traced the evolution of livelihood practices and other socio-economic practices, which has made the forests vulnerable to degeneration.

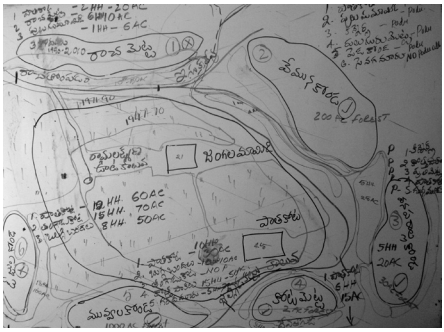
Even though the area is still bountiful, and the livelihood practices fairly uniform and eco-sensitive, the little variations point to the beginning of stress on the system. The stress revolves around agricultural production and extraction of forest produce. They involve some of the practices like shifting cultivation and dry land rice cultivation as well as the resource base itself like the hill lands, specific tree species.

Livelihood practices

In the participatory mapping exercise, the participants traced the trend in land development. 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 the podu lands on moderate slope were leveled and bunded for settled cultivation, even as podu expanded to steeper slopes. Out of the 102 hill forests in 15 sample villages studied, 30% were entirely converted to agriculture.



Livelihood time- line Dumpavalsa in Daregedda with narrower valleys



Livelihood time-line Pathakota with open valleys

State of 102 hill-forests	%
Entire hill has already been converted to agriculture. land	30%
No forest at the bottom of the hills - converted to agricultural land	19%
No podu/shifting cultivation but forest highly degraded due to over exploitation	3 %
Forest in varying degree of degradation from middle to top, rest is used for podu/shifting cultivation	25%
Small portion of the forest exist as it is considered sacred	2 %
Relatively good forest growth, not yet used for shifting or settled cultivation but villagers do collect timber and other materials	23%

The trend continues, but it is getting increasingly difficult to level land further up. 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.

Timber Needs: Besides the pressure on forest for agriculture, there is a large amount of extraction of forest produce by the local people for their minimum needs. In the area under study, the frequency of collection for major purposes like house building, agricultural equipment, homestead fencing and other kinds of fencing, varies from once in every year to once in five to ten years. The amount of material that is being extracted is also increasing. Every family extracts 60+ logs once in five years. Regular, extraction includes firewood collection of anything from two tones to five tons per family. Logging for agriculture fencing is another routine regular extraction which claims upto 5 tonnes per year per family. Thus every year the communities have to go to the same forest and extract this amount of material both unmatured and matured. If this continues, climate change or not the forests will disappear, leaving both the forest as well as the communities vulnerable.

Purpose	Frequency	Per family	Villages
House- Wall	5-10 years	60+logs	60%
		1 tons	40%
House- Roof	5-10 years	60+ logs	60%
		2 tons	40%
House- Door	5-10 years	5 logs	100%
Furniture	5-10 years	60+ logs	40%
		30 logs	13%
		2 tons	47%
Homestead fencing	1-2 years	2 tons	60%
		1 ton	40%
Agri. Equipment	2-5 years	20 logs	60%
		2 tons	40%
Agri. Fencing	every year	5 tons	60%
		1 ton	40%
Crop support	every year	40 logs	40%
		20 logs	47%
		5 logs	13%
Fire wood	yearly	5 tons	27%
	weekly	2 tons	33%
	winter	2 tons	46%

Livelihood resources

Forest communities are dependent on the forest for a range of resources, which are in stress. Broom Grass is decreasing due to forest fires and over-exploitation. Bamboo is in short supply in the nearby hills affected bamboo based craft and artisans. Mulch for their agriculture at the rate of 10 to 10 kgs per family, and a daily requirement for fodder of 5 to 20 kgs per family is also in stress. The availability of fruit, fibre, mushroom is also decreasing.

All these needs are exacerbated as the pressure for agricultural land increases. There is a gradual increase of tree felling for shifting cultivation and podu lands to settled agricultural lands. By 2010 36% of the hill forests had been cleared partially or fully and changed from podu to settled agriculture. Meanwhile increasing soil erosion and crop failure due to rainfall fluctuation has reduced the cultivation of foodgrain in podu lands. The pressure on the forests specific trees of multipurpose have almost disappeared from the forest. They 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 The trees that have retreated to the upper reaches are tangedu, maddi, sinnem, sinduga, vandanam, panasa, mamidi, etc.

Forest Regeneration

We have seen that the normal socio-economic and livelihood needs have put a major strain on the forest eco-system. Forest regeneration systems have been badly hit. Of the 148 species that the local people had knowledge of, 76% percent were said to be reproduced through seed, while 32 percent by rhizome and 5% by both processes. The seeding process is done by itself, or with the help of wind and birds and animals.

Birds & Animals: The people identified 6 animals who help regeneration by consuming the seed and excreting it, encased in manure. 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.

	Species	Status	Reason
Wild animals	18	72% reduction	hunting , forest cutting and weather change. 12 wild animals hunted by bow and arrow or trap. Higher in Daragedda
Bees	4 out of 20 known	almost 50% reduction	longer dry period, temperature rise and change in the crop pattern and forest cutting
Birds	64	40-75% decrease in 94% species	hunting and weather change. 8 varieties of birds hunted by nets, gum and stick

Varieties	Conditions for Regeneration
Tangedu, nallajeedi	High temperature, summer rains, humus and moisture
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	Low rainfall affects germination. Rain is crucial in June-July, spring/summer rain helps
Mamidi, neredu, mollika, thummi, panasa, bodda, tumika, nepalam, guggilamnara, arenara chintha, naramamidi, tharipi, raavi, etc	Humus and reasonable rain required for germi-nation .
Bushes like pathal-garadi	good humus and low temperatures and shady area required. Germination affected by low rainfall.
Broom Grass	Drastically reduced in Low rainfall years

Similarly, the people have identified 12 birds (including peacock and mynah), which help in the similar fashion. 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.

Climate Fluctuation: Temperature, timing of rains, moisture in the soil and humus are other factors which affect the forests ability to regenerate itself. While the rains in September and October plays a major factor in re-generative growth, particularly of newly regenerated plants, the critical timing and conditions for different stages of reproductive functions are essential (see chart).

Streams: In the ten villages in the Daragedda cluster, there are 27 streams, 26 of which are perennial and have about 7 check dams. There is no other water management system. The streams are located at a distance between 1 and 15 kilometers from habitation and are used for agriculture, washing and drinking. The situation is similar in Pathakota where 5 of its villages have 14 streams with 11 of them perennial.

The degradation of forests near the sources of streams have led to the streams being vulnerable. The flow, people observed was substantially reduced during years of low rainfall in 2006 and 2009. This lead to conflict over sharing of water for khariff crops between two villages, Gurraputhompadam and Jalimadugula in Pathakota

Crop Selection: Rainfall fluctuation has also impacted crop choice in these villages. Except for little millet and finger millet which is cultivated in all the villages, other millets are cultivated in 7 to 40% of the villages due to crop failure on account of late rain or excess rain.

Sorghum is cultivated in only 47% of the villages. Wet paddy after having peaked following change over to settled agriculture, has reduced to 66% villages and Budama rice, a dry land paddy variety, is cultivated in 80% of the villages.

Forms of agriculture: The traditional forms of agriculture are vulnerable due to a combination of factors including climate. There has also been a change in patterns of needs due to taste transfer and increasing aspirations coupled with the fact that traditional livelihood resources are in varying degrees of degradation. The adivasi way of shifting cultivation is no longer tenable as there are little forest land that they can convert. Further, those who have less land may need more, and when they see a shortage they tend to acquire more. Those who have been cultivating podu lands have been doing so for 30 odd years on the same plot, which means that trees are cannot regenerate. This leads to increasing soil erosion and reducing productivity. This again leads to more aggressive extraction of forest resources either for mulch or for food, and saleable forest produce.

Thus even without climate change the forest way of life was getting very vulnerable. Since the bulk of the vulnerability are due to basic needs, there is little sense in trying to counter direct climate change induced effects by itself. The people are trying to expand their activity by increasing acreage or foraging, or moving more intensive agriculture. Some are trying to occupy more land as they feel that the under the new forest rights act, they may get ownership. In fact in the surrounding areas they have heard about how non-traditional communities have staked claim to forests under the Act. Most families particularly those of small size, and those with school going children, find it difficult to spare time on rejuvenation work. They also do not have the manpower for taking up grazing, animal keeping, hunting-gathering etc. Thus the adivasis way of living is changing. They are into settled agriculture, moving away from traditional crops to 'marketable crops', using of high yielding seed and other external inputs. There is also a substantial increase in boys and girls attending school at the higher secondary level, quality of housing, lifestyle assets, cash needs, etc.

Conclusions

"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'.

Forest communities are vulnerable even without climate change. Their main problems are increasing degradation of the land, depleting forest resources including water, food and timber and a changing profile of needs and habits. The livelihood of the communities in the micro forest eco system under study has undergone complex changes over 5 to 6 decades. Livelihood was primarily based on gathering materials from the forest and on shifting cultivation. Climate fluctuation did not matter much as food and other needs were at basic level and the forests provided adequate survival backup in extreme situations. Over the years, population increased and there was a significant shift in livelihood practices to intensive agriculture. These systems are as sensitive to changes and timings in weather as they respond positively to well timed and appropriate rain-moisture, temperature, water etc. Thus changes in climate now affects these systems more than earlier.

.

Coping Mechanisms: In order to cope with these changes and uncertainty, people have resorted to gradual expansion of the area under shifting cultivation by clearing of more forest and increased settled cultivation and adapting cropping to the changed situations. When there have been delayed rain and low rainfall, they have tried to cope by growing pulses in podu plots and on slope lands at the foothills using the residual moisture in the soil. Black gram, red gram, kidney beans (red) are cultivated in 80 to 100% villages. People have also started to go in for plantations. Cashew is grown on the foothills and slope lands. The Integrated Tribal Development Agency has also promoted rubber plantation and citrus orchards. In another development, people have started using the System of Rice Intensification (SRI).

In order to reduce their requirement of timber, people have started using fly ash brick under the BPL (Below Poverty Line) housing scheme. The thatched roofs are being replaced by Mangalore tiles and asbestos roofs. Some people have also shifted to live fencing for their agricultural plots.

Climate Change as trigger: In the region under study, most of the effects of climate change do not create vulnerability by itself. It exacerbates existing vulnerability and perhaps provides the tipping conditions. Many of

the direct effects of climate change will trigger bigger changes which will effect larger natural cycles. Climate change will have major subsidiary impacts on forest regeneration cycles. And given the dependence on the forests and the evidence of increasing extraction of the forest for basic needs it will lead to vulnerability of the forest communities. For example, a delay in the rains, may affect "sprouting", which by itself could be overcome. But there is also a whole host of man-determined activity like settled agriculture, which is also affected by the same phenomena, which forces people to look to the forests for sustenance. At that time it is also likely that tubers growth is also affected and to meet their need, forest dwellers will have to dig up more areas, resulting perhaps in the destruction of the rhizome.

Loss of Predictivty: The main problem of climate change, according to the local communities is that climate change has affected their predictive capacity. Their traditional knowledge of nature which helped them understand and work with the forces of nature stands challenged, and they are no longer able to "read the sky". They are therefore not able to fall back on their normal adaptation methods. So in addition to poverty and marginalization, and a diminishing resource base, vulnerability is caused by progressively changing 'predictivity'. Further, the range of responses that they knew about also seems limited, and they do not have the experience to predict the impact of the choices they make given the newer circumstances, as their knowledge base has evolved from long experience of relatively stable factors. In the meantime, life style has changed, traditional values and practices are fast degrading. Thus adaptation to climate change as also existing vulnerabilities would have to go beyond the "back-to-tradition" line. Tribal societies have become more complex, as their their resource base is becoming in-elastic and their children educated, and their aspirations, modern.

Policy & programmes: There are several laws and policies which are aimed at protecting the forests. However the implementation of these laws and policies have either resulted in alienation of the forest dwellers or in conservation programmes failing to adequately address forest degradation. There is also official inaction if not complicity on illegal felling and large scale smuggling aided by the forest department as well as insurgent groups controlling forests, acting in concert.

Another important problem with the policy and programmes has been its tendency to favour monoculture at various levels. The current afforestation and silvicultural practices are dominated by exotics and monocultures, which will only enhance the vulnerability of forests in the long run. Besides affecting bio-diversity and a variety of uses and needs of the local people, monoculture in afforestation leads to vulnerability to fire and pestilence. Despite the rhetoric in Joint Forest Management (JFM), the laws and policies generally favour bureaucracy and government machinery rather than forest dwellers to control forest activities. Since the loss of bio-diversity is long-term and irreversible, it is essential to

adopt appropriate and diversity enabling silvicultural practices which can only be done by the communities, rather than bureaucratic writ.

Another glaring shortcoming of the forest conservation programmes is that it does not adequately address the energy needs. Thus the policies need to be researched in terms of its implications on basic needs. It is also important to taking care of the current needs of the community either directly or by finding substitutes. The research should also identify the silvicultural practices which reduce vulnerability of forest ecosystems to changing climate parameters and build institution and capacity building to address climate change in the forest sector.

There is also need to link the Wildlife and Reserved forest activities to the needs of the community. Some of these are The Forest Conservation Act, 1980; Wildlife Protection Act, 1972 and 2002 and protected area act and wildlife conservation programmes such as Project Tiger and Project Elephant.

What is to be done!

This region does not present a doomsday scenario as yet, but tell-tale signs are there. Unless corrective measures are taken, this region too will see disaster and extreme vulnerability to climate events. Luckily, the region presents a wide range of opportunities for adaptation through sustainable development.

Resource, Practices and Knowledge: A large number of sustainable zero-carbon practices are still strongly rooted in the culture and the economy of the communities. Organic and low external inputs farming is still pre-dominant, almost zero outmigration and engagement in service sector There is also a growing disenchantment with some of the unsustainable practices like shifting cultivation. While the elders who practiced podu, have perceived climate change, the younger lot is still not set in their ways and have not fine tuned their practice to changing climate. They are willing to accept changed behavior. As in the housing example, people have shown the willingness to change to more sustainable options. In terms of extraction of forest resources, the reducing elasticity of supply as well as the increasing efforts needed for such extraction, provides incentives for alternatives if they are can be made available.

There is a dynamic and mutually impacting relationship between livelihood resources and livelihood practices. In a climate changing world, knowledge, institutions and capacities will have the address the issues of sustainability as well as development -- or rather defining development within the context of sustainability and resilience to the effects of climate change. In this context a basic premises on which new knowledge is to be based is **that every need should be serviced by multiple sources, and every resource should serve multiple needs.**

Livelihood Resources

On the supply side, resources can be rejuvenated very fast. , the region still

has bountiful resources that are unused or grossly underutilized. This would need an integrated approach to the entire hill slopes and the valleys combining principles of watershed management, silviculture, multi-crop organic agriculture. The emphasis would be on multi and mixed cropping and land, water and forest development. Rather than have a master design for all areas, the micro-features of each hill slope should be taken into account while designing intervention. A mix of the best practices from various places need to be identified and a selection of these appropriate to each micro-situation need to be worked into a local model which will take care of all the needs, including those of cash.

The broad principles however would be that on the higher hills, silviculture should be developed such that the trees, plants, tubers, herbs, etc., are able to meet the diverse needs of forest communities. This would require conservation and selective regeneration of trees which have been extensively degraded, particularly those which are of economic and cultural importance to the local community.

In the middle less-sloppy areas, the degraded forest lands would need support for natural regeneration. If any planting or seeding is done it should be an appropriate mix of different species which can take care of timber, food, mulch and fuel needs. A fair proportion should be kept for short duration, quick growing varieties, which enable appropriate harvesting for these needs without degrading the forests. In the lower hills and on the steps, there is a major potential for increasing agricultural efficiency through terracing, leveling and bunding of suitable lands already being used for agriculture.

The region has a fair springling of springs and water bodies. There are about 50 perenial streams , but there is no programmes to harvest the perennial waters for irrigation. The waters need to be micro managed, rather than diverted. The run-offs and withdrawal from these sources are at different altitudes and they can be managed better through gravity based channeling through fields for irrigation.

Livelihood practices

In view of the changing conditions, the gene pool of crops need to be diversified. They are best enhanced by in-situ propagation of multiple varieties in addition to ex-situ conservations. Preference should be given to those strains which respond better to organic soil nutrients, and local soil types. These need to be supplemented by advanced technological development of natural pest management, intensification techniques based on higher response respond to local rather than exotic or artificial conditions of water soil types, nutrients and also work around likely climate constraints. For example different SRI (System of Rice Intensification) work according to restraints of water and nature of likely weeds based on soil conditions. As more land is terraced and moved away from podu, intensification techniques need to be carefully chosen based on the above principles of appropriate seed and crop choice. This can be based on a menu of crop rotation and mutli crop options

technologies, which are adaptable to different emergent climate conditions. For this a wide range of seeds need to be preserved in situ as well as ex-situ, perhaps in projected climate conditions where they are available as in higher sloped or higher latitudes.

Options for different scenarios needs to be worked out and the technologies shared with the communities through appropriate local institutions and capacity building mechanisms.
Given the general trend towards higher temperatures and longer dry spell, soil moisture retention techniques like mulching, humous development can be used as the base for fertilization and soil nutrition instead of concentrate powders and liquids. While traditional technologies of harness stream and run-off for gravity based irrigation need investments, emergency drip like systems need to be provided for. The Command Area Development Programme has so far revolved around physical works such as construction of dams, field channels, and farm leveling and bunding. It needs to integrate development of water sources and the entire water cycle, including soil and sub-surface water environment, as well as end use such as appropriate agriculture, and appropriate water utilization.

Similarly those techniques in the traditional systems which have been a drain on the system need to be identified and appropriate substitutes need to be found. For example the need for fencing of agricultural plots, must be fulfilled by other means like live fencing techniques, which besides providing quick growing stumps, provide fuel on coppicing, where creepers and intertwining bushes provide medicine and mulch.

Cooking: The woodstove is the most popular, and improvements for fuel saving in the cookstoves need to be popularized and adapted for local situations.

Management of the resources

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. Management of resources: Forest protection as well as management of the balance between habitat, livelihood and lifestyle play a major role in successful adaptation to changes. However most efforts are alien to the cultural ethos and social systems of the people. Under the Forest Rights Act, a majority of claims by groups who are not the rightful users of forests, but groups who could take advantage of modern law. At the same time, among genuine cooperative cultures, it has created a culture of individual land grab, and also pre-emptive occupation.

The community based models of management need to strengthened by increasing re-vitalising communal methods of resource conservation and management. The forest, streams and hills belonging to the villages, panchayat and the region need to be identified as such and concrete goals, methods and

tasks need to be re-iterated in modern terms and a system of implementation and review initiated. Many of these are traditional systems which have fallen into disuse and needs to be re-vitalised.

Inter panchayat and larger level support and management however cannot be ignored and these will need to be inter-faced with formal law in order to protect sacred groves, community forests, water sources, as well as find creative ways of aligning local goals with national and international conservation priorities.

References

NATCOM 2004. India's Initial National Communication to the UNFCCC, Ministry of Environment and Forests, Government of India www.natcomindia.org/chapter3.pdf

Forests & Biodiversity - envis-soe.ap.nic.in/images/CHAPTER5.PDF

Forest management issues in East Godavari- a case study of Pedda Mallapuram - Ravi R Pragada www.samataindia.org/.../forestmanagementinpaddemallapuram.PDF

Forest, People and Livelihoods: The Need for Participatory Management P.K. Biswas, Faculty of sociology and Social Anthropology, IIFM, Bhopal, India. www.fao.org/DOCREP/ARTICLE/WFC/XII/0586-C1.HTM

The Making of Andhra's Forest Underclass: An Historical Institutional Analysis of Forest Rights Deprivations- M Gopinath Reddy, K Anil Kumar, P Trinadha Rao and Oliver Springate-Baginski[1],Discussion Paper Series, Number Forty Two, June 2010. www.ippg.org.uk

State of Environment, Andhra Pradesh- Chapter5 EPTRI, Hyderabad TERI, Paper prepared by TERI for Human Development Report 2007- Suruchi Bhadwal hdr.undp.org/en/.../Kelkar_Ulka%20and%20Bhadwal_Suruchi.pdf

Climate change and India: Impacts, policy responses and a frame work for EU-India cooperation

www.pedz.uni-mannheim.de/daten/edz-ma/ep/08/EST19208.pdf

Forest conservation is too complex an issue to be resolved by executive fiat Madhu Sarin, July 15 , Down to Earth, 2003