

# Financial valuation of non-timber forest product flows in Uttara Kannada district, Western Ghats, Karnataka

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**A study was undertaken to evaluate the flow of non-timber forest products (NTFPs) in Uttara Kannada district, Western Ghats. NTFPs are being collected in different forest zones of the district. The diversity, however, varies with availability and local knowledge, with communities gathering about 50% of the species available in the evergreen zone to about 40% in the semi evergreen and dry deciduous zones and only 13% in the moist deciduous zone. Significant quantities of NTFPs are gathered in all the four zones and the estimated value of NTFPs realized per household varies between Rs 3445/household in the evergreen zone and Rs 1233/household in the dry deciduous zone. Similarly, the financial value realized per hectare also varies across the four forest zones studied and it ranged from Rs 634 in the dry deciduous zone to Rs 1801 in the evergreen zone, with a mean of Rs 1159/ha/yr.**

Non-timber forest products (NTFPs) are an integral part of development and survival of people living in and around forests and depending on them. The potential economic value of NTFPs either in terms of utilization or their market value is often underestimated or unknown<sup>1</sup>. The challenge is therefore to assess and quantify the value of these products and to transform the use of many of them as are socially and ecologically viable for subsistence and development<sup>2</sup>.

In India, there are about 15,000 plant species out of which nearly 3000 species (20%) yield NTFPs. However, only about 126 species (0.8%) have been commercially developed<sup>3</sup>. NTFP activities hold prospects for integrated forms of development that yield higher rural incomes and conserve biodiversity while not competing with agriculture<sup>4</sup>.

The Western Ghats is one of the biodiversity-rich forest regions of India, and limited information is available on the NTFPs of this region. Therefore, this study was undertaken in Uttara Kannada district, Western Ghats with the following objectives.

- To prepare an inventory of the NTFPs extracted in the region,
- To estimate the quantity of NTFPs extracted by locals and the Forest Department, and
- To estimate the income derived from NTFP gathering.

## Materials and methods

The study was focused in Uttara Kannada district of the Western Ghats region, which lies in the northwestern part of Karnataka, India and spans approximately an area of 10291 km<sup>2</sup>. It extends between 13.55'–15.31'N lat. and 74.03'–75.05'E long. About 80% of the district is under the control of the Forest Department. The major forest types in the district are evergreen, semi evergreen, moist deciduous and dry deciduous/scrub forms. Among these, the moist deciduous forest covers about 34.53% of the forest area followed by the dry deciduous and semi evergreen forest types constituting 26.42 and 24.9% respectively, and the evergreen forests constitute about 14.4%. The district has 11 taluks and 1283 villages, with a total population of about 12.2 lakhs (1991 census). It receives an average annual rainfall of about 2742 mm.

### *Preliminary survey of villages*

The study was undertaken in four forest zones in the district, viz. evergreen, semi evergreen, moist deciduous and dry deciduous. The 21 villages included in the study had a large population dependent on the forests for NTFPs. Among these villages, 11 depended on evergreen forests, 4 on moist deciduous forests and 3 each on semi evergreen forests and dry deciduous forests. Maximum representative villages from the evergreen forest zone are due to the diversity of NTFPs. A preliminary survey was conducted to gather information on the geographic area of villages, occupation pattern, land and cattle holdings and other socio-economic aspects of the households.

### *Questionnaire survey*

A questionnaire survey was conducted to collect information on

- diversity of NTFPs extracted, the parts used, their end-use as well as the season of collection, and
- quantity of NTFPs gathered per typical trip and quantity collected in a season.

To conduct the study, the households were classified as those of large farmers, garden owners and landless labourers

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**Table 1.** Diversity of plant species used for different end-uses in the region

Forest type	Food	Household articles	Fencing	Commercial	Medicinal purpose		Total number of species <sup>18</sup>
					HH survey	Herbal shop survey	
Evergreen	17	7	5	4	26	80	116
Semi evergreen	19	5	3	2	11	No survey	98
Moist deciduous	11	1	Mixed spp.	2	4	42	95
Dry deciduous	5	3	Mixed spp.	2	2	No survey	36

based on their land holdings. If the number of households was less than 5 in a class, then 100% sampling was done; otherwise, 25% of the households were randomly selected for the survey.

#### *Data from secondary sources*

Data regarding the extraction of several NTFPs from different forest divisions in the district were collected from the Forest Department records.

#### *Medicinal shop survey*

A sample survey of herbal shops marketing plant or plant parts was conducted in Sirsi and Kumta taluks, Uttara Kannada district. A list of NTFPs used for medicinal or pharmaceutical purposes was prepared. Effort was also made to obtain information regarding their medicinal importance.

## Results

#### *Diversity of NTFPs collected*

Several NTFPs were extracted in the evergreen, semi evergreen and moist deciduous zones, while in the dry deciduous zone few were extracted. Variation in availability and end-use of NTFPs available in the different forest types is given in Table 1.

In evergreen zone, NTFPs were extracted from 59 different plant species (among 116) and in the semi evergreen zone, 40 different plant species (among 98) were used. This includes species used as food, household article, for fencing and commercial purposes and for medicinal purposes, as revealed only from household surveys. The number of species used as food is 17 (28.8%) and 19 (32.2%) respectively, in the above-mentioned zones. In the moist deciduous and dry deciduous zones, the number of species extracted is 12 (among 95) and 15 (among 36) respectively, of which 11 (91.6%) and 5 (33.3%) species are used as food in the respective zones (Table 1). Plant species used as fuelwood, manure, fencing poles and for fodder are not included,

as they are not species-specific. These are collected in almost all sample villages from all the four forest zones. The fallen twigs of various species collected are used as fuelwood and the leaves collected, either fresh or dry are used as manure or mulching material, and grass is extracted exclusively for fodder. Thus, the per cent species used varies from greater than 50 in the evergreen zone to about 40 in semi evergreen and dry deciduous zones to as low as 13 in the moist deciduous zone.

Products of medicinal value were obtained from the bark of five different species, including *Cinnamomum zeylanicum*. Buds of 3 species and roots of about 23 species, including *Rauwolfia serpentina* and *Glycyrrhiza glabra* are used for medicinal purposes. The exudates of *Vateria indica* and *Anogeissus latifolia* and the seeds of various species such as *Abrus precatorius*, *Papaverum somnifera*, *Piper nigrum* and *Trigonella* are used for treatment of several ailments.

As seen from Table 1, 42–80 NTFP species of medicinal importance are marketed in herbal shops of Sirsi and Kumta, Uttara Kannada district. Appendix 1 lists major NTFPs, and the parts utilized for medicinal purposes. These NTFPs are used for treating ailments in both human as well as livestock. They are prescribed by medical practitioners for ailments such as cough (jeshta madhu, hipli, etc.), dysentery (sath isabgul and papauer), to increase lactation (in the case of alavi seeds), and for treatment of snake bites (*R. serpentina*). *Datura* seeds are used as an abortifacient, while seeds of *Strychnos nux vomica* are used to prepare rat poison. The number of species used for medicinal purposes, as seen from the household survey, ranges from 2 in the dry deciduous zone to as many as 26 in the evergreen zone. This variation in use of medicinal species may be attributed to differences in indigenous knowledge and also availability of the various species in different zones.

#### *Quantity of NTFPs extracted*

A survey of sample households in the selected villages indicates that fuelwood is the only source of cooking fuel in majority of the households, and it is extracted by all households in all the villages. On an average, each household collects about 1900–3300 kg of fuelwood per year in the form of fallen twigs or dry branches in all the forest zones.

**Table 2.** Quantity of NTFPs gathered, their uses and financial value

NTFPs	Percentage of household gathering	Quantity/gathering household/yr (kg) with financial value (Rs) <sup>2</sup>	Main uses
Evergreen zone – sample size – 114 households			
<i>Bambusa arundinacea</i> <sup>3</sup>	71	62 (1550 ± 345)	Fencing, household article
<i>Artocarpus lakoocha</i> (kg)	54	129 (1935 ± 917)	Food, commercial
<i>Garcinia indica</i> (kg)	53	91 (637 ± 450)	Food, commercial
<i>Calamus rotundus</i> <sup>3</sup>	51	137 (1726 ± 439)	Household article, fencing
<i>Garcinia cambogea</i> (kg)	9	15 (150 ± 133)	Commercial, food
Others (5) <sup>1</sup>		{3445 ± 612}*	
Semi evergreen zone – sample size – 74 households			
<i>G. cambogea</i> (kg)	62	182 (1820 ± 1292)	Commercial, food
<i>A. lakoocha</i> (kg)	56	25 (375 ± 186)	Food, commercial
<i>Sapindus emarginatus</i> (kg)	50	17 (136 ± 60)	Commercial
<i>G. indica</i> (kg)	35	7 (49 ± 30)	Food, commercial
<i>Acacia sinuata</i> (kg)	13	3 (39 ± 19)	Commercial
Others (1) <sup>1</sup>		{1438 ± 938}*	
Moist deciduous zone – sample size – 75 households			
<i>A. sinuata</i> (kg)	85	111 (1443 ± 355)	Commercial
<i>A. lakoocha</i> (kg)	63	115 (1725 ± 415)	Food, commercial
Honey (kg)	37	5 (500 ± 329)	Medicinal
<i>B. arundinacea</i> (nos)	35	64 (1600 ± 958)	Fencing, household article
<i>Mangifera indica</i> (kg)	11	8 (24 ± 17)	Food
Others (4) <sup>1</sup>		{3080 ± 813}*	
Dry deciduous zone – sample size – 114 households			
Honey (kg)	73	16 (1600 ± 400)	Medicinal
<i>B. arundinacea</i> (nos)	15	17 (425 ± 175)	Fencing, household article
<i>Emblica officinalis</i> (kg)	11	5 (20 ± 11)	Food, medicinal
Others (2) <sup>1</sup>			Cannot monetize

\*Indicates the total financial value realized from all NTFPs/household in the zone and the standard deviation.

<sup>1</sup>Indicates the no. of species included in 'others' category.

<sup>2</sup>Value in brackets indicates financial value of quantities gathered/household and also the standard deviation excluding fuelwood, grass for fodder, green and dry leaves for manure and fencing poles.

<sup>3</sup>Units in numbers.

The garden owners and landed farmers, i.e. both large and small farmers with cattle holdings, collect grass for use as fodder. The quantity of fodder collected is highest in the semi evergreen zone with 2870 kg/household/yr, while in the dry deciduous and moist deciduous zones, the quantities gathered per household are as low as 350 and 40 kg respectively. The quantity collected per household in the evergreen zone is negligible compared to the other three zones.

The garden owners in evergreen, semi evergreen and moist deciduous zones extract green and dry leaves, which are chief sources of manure, in substantial quantities. Among the above-mentioned three zones, collection of green and dry leaves is highest in the evergreen zone at 5488 and 9920 kg/household/yr respectively. In the semi evergreen and moist deciduous zones, the quantity of green leaves gathered per household is approximately 2100–3170 kg, while the dry leaves extracted per household in these zones

are 1600–3350 kg. Fresh as well as dry leaves are not extracted in the dry deciduous zone, as the practice of spreading cattle-shed floors with leaves is not prevalent.

Table 2 gives the quantity of NTFPs extracted by gathering households in the four forest zones and their financial value. Mushrooms, honey and fruits of *Emblica officinalis* and *Carissa carandas* are collected in small quantities for use at the household level. About 1–5 kg of honey is extracted per household in all zones excepting the dry deciduous zone, where 16 kg honey is being extracted. A large amount of the honey extracted is sold either raw or after processing. Wild mangoes are collected by several households for pickling in all the zones excepting the dry deciduous zone and the quantity ranges from 62 kg in the evergreen zone to about 3 kg/household/year in the semi evergreen zone.

Cane, bamboo, *Phoenix sylvestris* and *Aranga pinnata* are the other important commercial NTFPs in addition to

Box 1. Access to forest products		
Products with free access	Forest Department controlled	
	Traders/contractors	Industry
Leaf manure	<i>Acacia sinuata</i> (soapnut)	<i>Bambusa arundinaceae</i> (bamboo)
<i>Phoenix sylvestris</i>	Honey	<i>Acacia</i> sp.
Grass	<i>Calamus rotundus</i> (cane)	<i>Calamus rotundus</i>
<i>Aranga pinnata</i>	Wax	
Fuelwood	<i>Diospyros melanoxylon</i> (Beedi leaves)	
	<i>Anacardium occidentale</i> (cashew)	
	<i>Terminalia chebula</i>	
	<i>Sapindus emarginatus</i>	
	<i>Garcinia cambogea</i>	
	<i>Myristica malabarica</i>	
	Surugi flowers	
	<i>Artocarpus lakoocha</i>	
	<i>Anogeissus latifolia</i> (gum)	
	Triphal	
	<i>Semecarpus</i> sp.	

*Garcinia cambogea*, *Acacia sinuata* and *Sapindus emarginatus*. These are extracted in significant quantities and processed to make baskets, brooms, etc. They are sold either in the local markets or to the Forest Department. *A. sinuata* is not extracted in the dry deciduous zone and among the other three zones, substantial quantity is being realized in the moist deciduous zone (111 kg/household/yr).

Among the NTFPs quantified in Table 2, *G. cambogea* is extracted in large quantities in the semi-evergreen zone; it is about 182 kg/household/yr compared to the evergreen zone where extraction level per household is about 15 kg/yr. The extraction of this NTFP has increased in the past decade and it is mainly used as fish-food preservative. This increased demand has led to indiscriminate felling of branches for collection, leading to decrease in yield over the years.

*Artocarpus lakoocha* is yet another NTFP collected in large quantities for use at household level as well as for marketing purposes. The quantity gathered per household over a year is more than 100 kg in the evergreen and moist deciduous zones, while in the semi evergreen zone a marginal quantity of 25 kg/household is being collected annually. Maximum quantities of *Garcinia indica* (91 kg/household) are being gathered in the evergreen villages annually by a single household in contrast to the other two zones (moist deciduous and semi evergreen), where only about 1–7 kg is gathered. These two products are used as substitute for tamarind.

**NTFP extraction by the Forest Department.** The access regime varies for different NTFPs gathered in Uttara Kannada district (Box 1). There is regulation on the collection of several NTFPs in the five forest divisions of Uttara Kannada, and the products are either auctioned or contracted by the Forest Department. The products that are under the control of the Forest Department are *A. sinuata*,

*S. emarginatus*, *G. indica*, *G. cambogea*, *Myristica malabarica*, *Terminalia chebula*, honey, wax, cane, *Diospyros melanoxylon* (Beedi leaves), *Artocarpus lakoocha*, *Semecarpus anacardium*, Triphal, Surugi flowers, and gum from *Anogeissus latifolia*.

In Honnavar division, 34% of the total area is moist deciduous. In the last ten years, highest quantity of *A. sinuata* extraction of 87 tons was recorded during 1985–86 and during the following years till 1989–90, very low quantities (less than a ton) were recorded. However, the quantity realized shot up again during 1990–91 and in 1994–95, 30 tons of *A. sinuata* was realized. Thus the quantity of *A. sinuata* realized over the years shows an irregular trend. Interestingly, in contrast to *A. sinuata*, the quantity of *G. cambogea* collected in the past ten years shows an increasing trend and the quantity realized in 1994–95 was as much as 30 tons compared to only 2 to 6 kg in the period between 1984 and 1992.

In Yellapur division, having an area of 1692 km<sup>2</sup> under its jurisdiction, 50% of the area is deciduous. Large quantities of *D. melanoxylon* leaves and *A. sinuata* are collected in this division. The quantities of the same had stabilized at 3 and 8 tons respectively, during 1993–94. In the Karwar division with 1712.95 km<sup>2</sup> under its jurisdiction, the key products gathered are *A. sinuata*, *G. indica*, *S. emarginatus*, cashew, *T. chebula*, honey and wax. The quantity of *A. sinuata* collected during 1990–91 was about 64 tons. The quantity of *G. indica* gathered the same year was about 2 tons. The trend in the collection of various NTFPs in the other two divisions of Haliyal and Sirsi is consistent over the years.

Trends in gathering of some of the major NTFPs among two divisions are given in Figure 1. It is seen that, by and large in both the divisions, there has been a decrease in the quantity of forest products extracted over the years. However, there has also been an increase in the quantity

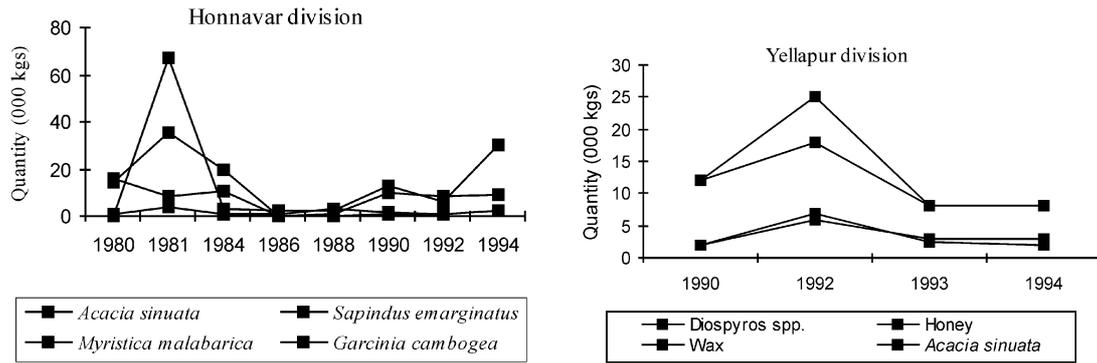


Figure 1. Quantity of NTFPs collected by the Forest Department in two divisions of Uttara Kannada district.

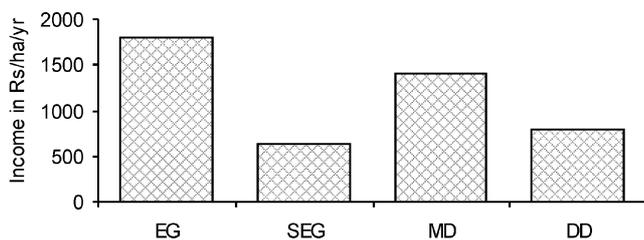


Figure 2. Income generated per hectare of forest in different forest zones.

of some of the products collected and this could be attributed to an increase in demand for the product or a better price for the same product in different years or may be greater productivity.

#### Valuation of NTFPs gathered per household

The contribution of NTFPs to household income is quite substantial in all zones. The contribution of different forest products to household income, however, varies. In the evergreen zone, bamboo, cane and *A. lakoocha* contribute more than Rs 1500 to the household income, while in the semi evergreen zone, maximum value is realized from *G. cambogea* (Rs 1820). In the moist deciduous zone, *A. lakoocha* and bamboo contribute Rs 1725 and Rs 1600 respectively, while in the dry deciduous zone, maximum income is realized from collection of honey. Latex of *A. latifolia* is yet another high-income yielding product of this zone, the collection being restricted to a class of people called the Lambanis.

Computation of financial value of NTFPs gathered in the different zones was also carried out, irrespective of the gathering household, i.e. by considering the total population in each of the forest zones. The estimated financial value realized per household was Rs 3445 in the evergreen zone and Rs 3080 in the moist deciduous zone, while in the semi-evergreen and dry deciduous zones, an income of Rs 1438 and Rs 1233 was realized respectively (Table 2).

The contribution of NTFPs is generally underestimated. However, a comparison of the annual value of timber with a ten-year mean (1985–94) of Rs 239 million and NTFP value of Rs 685 million for the year 1995–96 indicates that NTFPs contribute doubly to the economy. It is also important to note that benefits from NTFP flow directly to local communities.

#### Value of NTFPs extracted per hectare in different forest types

It is generally believed that the value of NTFPs gathered from the forests is high. But, little information is available on the financial value of NTFPs extracted on per hectare basis for the different forest types. The quantity of NTFPs gathered in the four forest zones and also the financial value realized per hectare of forest (using current market values) were calculated by combining NTFP extraction data derived from both Forest Department records as well as household surveys, excluding firewood, fodder and manure. From field observations, it can be concluded that NTFPs gathered by individual households are not accounted in the Forest Department records. This is because, during the peak season authorized contractors hire their own labour and further, the households do not sell the product they gather to these contractors due to the lower price paid.

It was found that highest income of Rs 1801 accrued from a hectare of evergreen forest followed by the moist deciduous zone and the dry deciduous zone, yielding Rs 1404/ha and Rs 797/ha respectively. Least income was from the semi evergreen zone (Rs 634/ha; Figure 2).

#### Discussion

Diverse NTFPs are gathered and utilized by communities in four forest zones of the study. The per cent species gathered of the total number of species in the four forest zones is as high as 50 in the evergreen zone to as low as 13 in the moist deciduous zone. Significant quantities of NTFPs are gathered in all the four zones and the financial value

realized per hectare ranged from Rs 634 to Rs 1801 with a mean of Rs 1159/ha/yr. This is comparable to the mean value realized from NTFPs (Rs 1211/ha/year) in the Nilgiri Biosphere Reserve<sup>5</sup>. A similar study in Kadavakurichi reserve forest has shown that the income<sup>6</sup> per hectare per year from the NTFPs alone is Rs 2090. Another study of Forest Protection Committees in West Bengal, under Joint Forest Management, showed that the income from NTFPs ranged from Rs 234 to Rs 5569 per hectare with a mean of Rs 2299 per hectare<sup>7</sup>.

In Uttara Kannada district, revenue from timber is only Rs 372 million compared to an income of Rs 685 million realized from NTFPs. The income derived from timber is only Rs 535/ha compared to an income of Rs 634 to Rs 1801/ha/yr with a mean of Rs 1159/ha/year from NTFPs. Thus, in absolute and relative terms, NTFPs offer more financial value. However, it remains to be seen as to how much they contribute to the foreign currency earnings of the state.

Cash income from the sale of NTFPs can vary even for the same resource category. Earnings vary from a few dollars for ad hoc sales to several thousand rupees per year. In rural Madhya Pradesh, for example, NTFPs provide 40–63% of total annual income<sup>8</sup>. In general, returns to labour from NTFP sales are usually higher than the average local agricultural wage, with income usually higher for externally marketed products. Subsistence values are often also high, particularly for poorer rural households. In Zimbabwe, for example, Cavendish<sup>9</sup> calculated that these subsistence ('non-market') values contributed 35% of total household incomes.

Medicinal plants are being gathered at the household level as well as marketed in all the forest zones, depending on the local knowledge and demand. Peters *et al.*<sup>10</sup> have showed that an hectare of Amazonian forest managed for NTFP can perennially yield better economic returns per hectare than a comparable area from which only timber is extracted. Several other studies have confirmed the large-scale income and employment generation potential of NTFPs across different regions<sup>11–13</sup>.

### Conclusions

It is clear that NTFPs as a group, contribute more than timber to domestic and international economies on a per hectare basis<sup>14</sup>. There is potential to further increase income from NTFPs in the four forest zones studied, especially the moist deciduous forest zone, given that there are more species that could yield NTFPs and contribute to household income. However, restraint needs to be exercised in the harvest of NTFPs, as unsustainable extraction practices may develop due to increasing demand, causing communities to disregard traditional harvest techniques as in the case of chironji (*Buchnanania lanzan*) seeds in Madhya Pradesh, where natural regeneration of the species was hampered.

Appendix 1. Species gathered, parts used and end-use

Species	Part used	End-use
<i>Anogeissus latifolia</i>	Bark	Medicinal and food
Arjun chakke	Bark	Medicinal
Ashoka chakke	Bark	Medicinal
Cinnamomum	Bark	Medicinal
Dikke mali	Bark	Medicinal
Gali chakke	Bark	Medicinal
Jeshta madhu	Bark	Medicinal
Nerlu chakke	Bark	Medicinal
Chakra moggu	Buds	Medicinal
Maratha moggu	Buds	Medicinal
<i>Syzigium cuminii</i>	Buds	Spice, medicinal
Bare balli	Entire climber	Making ropes
Kavari naru	Entire climber	Making ropes
<i>Anogeissus latifolia</i>	Exudate	Medicinal
Halmaddi	Exudate	Medicinal
Rakathchuda	Exudate	Medicinal
<i>Vateria indica</i>	Exudate	Medicinal
<i>Artocarpus lakoocha</i>	Fruit	Food (as tamarind substitute)
<i>Carissa carandas</i>	Fruit	Food (pickled)
<i>Cinamomum zeylancium</i>	Fruit	Spice, medicinal
<i>Emblica officinalis</i>	Fruit	Food (pickled)
<i>Garcinia indica</i>	Fruit	Food
<i>Mangifera indica</i>	Fruit	Food (pickled)
<i>Strychnos nux vomica</i>	Fruit	Medicinal
Datura	Fruit	Medicinal
Dry gooseberry	Fruit	Medicinal
Gajagan kai	Fruit	Medicinal
Hipli	Fruit	Medicinal
Ingalki	Fruit	Medicinal
Jaikai	Fruit	Medicinal
Jeerge	Fruit	Medicinal
Marata moggu	Fruit	Medicinal
Maypal	Fruit	Medicinal
Mull badne	Fruit	Medicinal
Nusgunnikai	Fruit	Medicinal
Rudrakshi	Fruit	Medicinal
Samudra kai	Fruit	Medicinal
<i>S. n. vomica</i>	Fruit	Medicinal
<i>Terminalia chebula</i>	Fruit	Medicinal
<i>Garcinia indica</i>	Fruit rind	Medicinal
Amruthaballi	Leaves	Medicinal
Bade soppu	Leaves	Medicinal
Boochpatri	Leaves	Medicinal
Moorele honne	Leaves	Medicinal
Ondele honne	Leaves	Medicinal
Sonamakki	Leaves	Medicinal
Vayuvilanga	Leaves	Medicinal
Kahi bevu	Leaves and roots	Medicinal
<i>Diospyros melanoxylon</i>	Fruit, leaf	Food, making leaf plates
Mushroom	Fruiting body	Food
<i>Aranga pinnata</i>	Leaf	As roofing
<i>Calamus rotundus</i>	Leaf	Making house hold articles like baskets
<i>Ochlandra indica</i>	Leaf	Household and structural articles
<i>Phoenix sylvestris</i>	Leaf	Household articles
<i>Acacia sinuata</i>	Pod	In shampoos

Conversely, faulty techniques of harvest may result in loss of natural stock and affect regeneration as in the case of Mahua in West Bengal and Central India<sup>15</sup>. The extensive loss of gulmavu (*Persea macarantha*) in Malnad and Coorg districts<sup>16</sup> due to debarking of trees and *Ailanthus malabarica* and *G. cambogea* due to indiscriminate felling in Uttara Kannada district should serve as warning to policy makers as well as local collectors. While faulty harvest techniques result in loss of species on the one hand, market forces on the other hand, drive communities to resort to unsustainable harvest mechanisms as in the case of *G. cambogea* in Uttara Kannada district.

In order to avoid the drastic consequences mentioned above, information about NTFP yields as well as extraction rates needs to be generated for taking decisions on whether a given practice is sustainable or not in the long run. Research is also required on the ecological aspects of NTFPs such as distribution, regeneration pattern, growth rates, yield in different forest types and silvicultural techniques for managing multiple products. The extraction and utilization rates over time and different seasons need to be assessed over a period to identify trends or patterns in yield and use of NTFPs. Research is also required on various harvest mechanisms as such knowledge will ensure sustainable harvest of resources, which in turn can contribute to the economic well-being of the people and involve them in the conservation of biodiversity<sup>17</sup>. However, NTFP activities should be based on participatory planning and management, as socio-cultural issues play an important role in the sustainability of the NTFP resource base.

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