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The impact of resource collection by local communities on the dry forests of the Kalakad–Mundanthurai Tiger Reserve

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Abstract: Rural communities often depend on forest resources for their livelihood, but non-sustainable extraction of these resources can result in the loss of biodiversity. To assess the impact of resource extraction on forest vegetation, we conducted a study in the dry deciduous forests adjoining the eastern boundary of the Kalakad-Mundanthurai Tiger Reserve in the southern western ghats, India. Using 8, 1–ha plots where all woody species ≥3.18 cm dbh (diameter at breast height) were permanently marked with tags, we estimated the number of fresh cuttings on branches and stems at 3–month intervals over a period of 2 years. We used these data to estimate the extraction pressure: [(total number of cuts*100/total number of plants in the plot)/ 3] to give monthly percentages for each village. We compared vegetation structure, diversity, basal area and regeneration in sites with heavy human pressure to control plots where there was no current extraction. On average, branches and stems from 10% of plants in a hectare of forest were pruned or cut every month. However, the mean % of branches and stems pruned or cut per month declined from 15% to 8% over the 2 year study period. There was lower species richness, species diversity, and mean height of trees in the disturbed site, when compared with the undisturbed sites. The basal area and regeneration of plants were also lower in the disturbed sites. Very few of the species extracted by villagers regenerated in the disturbed sites. This suggests that resource extraction is non-sustainable within the protected area and will eventually lead to loss of biodiversity and degradation of the forest.

Resumen: Con frecuencia las comunidades rurales dependen de recursos forestales para su subsistencia, pero la extracción no sostenible de estos recursos puede provocar la pérdida de biodiversidad. Para evaluar el impacto de la extracción de recursos sobre la vegetación forestal realizamos un estudio en los bosques tropicales caducifolios adyacentes al límite oriental de la Reserva del Tigre de Kalakad-Mundanthurai, en el sur de los Gates Occidentales, India. Usando ocho parcelas de 1 ha en las que todas las especies leñosas ≥ 3.18 cm dap (diámetro a la altura del pecho) fueron marcadas permanentemente con etiquetas, estimamos el número de cortes recientes sobre ramas y troncos a intervalos de tres meses durante un periodo de dos años. Usamos estos datos para estimar la presión de extracción: (número total de cortes* 100/número total de plantas en la parcela)/3) para obtener mensualmente porcentajes para cada poblado. Comparamos la estructura de la vegetación, la diversidad, el área basal y la regeneración en sitios con presión humana intensa con parcelas control sin extracción actual. En promedio, las ramas y los tallos de 10% de las plantas en una hectárea de bosque fueron podados o cortados cada mes. Sin embargo, las ramas y los tallos podados o cortados por mes declinaron de 15% a 8% durante los dos años de estudio. Hubo decrementos en la riqueza de especies, la diversidad de especies y la altura media de los árboles en el sitio perturbado en comparación con los sitios no perturbados, y el área basal y la regeneración de plantas también fueron menores. Muy pocas de las especies extraídas por los aldeanos mostraron regeneración en los sitios perturbados. Esto sugiere que la extracción de recursos no es sostenible en el interior del área protegida y a la larga conducirá a la pérdida de biodiversidad y la degradación del bosque.

Resumo: As comunidades rurais dependem muitas vezes dos recursos florestais para os seus meios de subsistência mas a extracção não sustentável destes recursos podem conduzir a uma perda de biodiversidade. Para avaliar o impacto da extracção destes recursos na vegetação florestal, conduzimos um estudo na floresta seca caducifólia adjacente à fronteira leste da Reserva de Kaçakad-Mundanthurai Tiger na zona meridional ocidental dos ghats, na Índia. Usando 8 parcelas de 1 ha todas as espécies lenhosas com DAP (diâmetro à

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altura do peito) ≥ a 3,18 cm foram permanentemente marcadas com tarjetas tendo-se estimado o número de rebentos novos nos ramos e troncos em intervalos de 3 meses durante um período de 2 anos. Estes dados foram utilizados para estimar a pressão de extracção: ((número total de cortes*100/número total de plantas na parcela)/3) para obtenção das percentagens mensais para cada aldeia. A estrutura da vegetação, a diversidade, a área basal e a regeneração nas estações com pressões humanas fortes foi comparada com parcelas controlo onde não se verificava extracção. Em média, os ramos e troncos de 10% das plantas num hectare de floresta foram podados ou cortados em cada mês. Contudo, os ramos e troncos podados ou cortados por mês declinou de 15% a 8% durante os dois anos do período de estudo. Verificou-se igualmente um decréscimo da riqueza específica, da diversidade e da altura média das árvores nas estações disturbadas em comparação com as estações não disturbadas. Verificou-se, também, que a área basal e a regeneração das plantas foi menor. Muito poucas espécies extraídas pelos camponeses regeneraram nas estações disturbadas. Isto parece sugerir que a extracção de recursos não é sustentável dentro das áreas protegidas e que eventualmente conduzirá a uma perda de biodiversidade e degradação das florestas.

Key words: Forest resources, India, Kalakad–Mundanthurai Tiger Reserve, protected areas, rural communities, sustainable extraction, Western ghats.

Introduction

Forests have provided a livelihood for rural populations in India over the ages and many plant species are used by local communities for their domestic needs. For example, about 124 plant species were used by the people living around the forest area of the Madhya Pradesh for fuel wood, fodder and for medicinal purpose (Purushothaman *et al.* 2000). However, due to the increase in population density, the harvesting of these products is no longer sustainable in many areas. Over-harvesting of forest products in a non-sustainable manner has had a drastic effect on the forest ecosystems in India (Anitha *et al.* 2003; Rai & Chakrabarti 2001). Species diversity and stem densities and the regeneration of target species were lower in heavily impacted forests (Murali & Hegde 1996; Murali *et al.* 1996; Sekar 1999; Shanker *et al.* 1998) and this has resulted in the degradation of the forest and loss of forest cover and biodiversity (Garrigues 1999; Pouchepadass & Puyravaud 2002; Silori & Mishra 2001).

Understanding the processes of forest degradation is very important for the conservation and management of biodiversity. In this paper, we undertook a study of the effect of resource extraction on the vegetation in the Kalakad-Mundanthurai Tiger Reserve (KMTR), the southernmost Project Tiger Reserve in India located in the western ghats. KMTR harbors high levels of plant and animal diversity, but is facing increasing anthropogenic pressure from the villages located along its eastern boundary in terms of cutting and removal of fuel wood, small and large timber, collection of fodder and leaves as organic fertilizers for fields and occasional poaching of animals. The foothills of KMTR neighboring the villages are covered with degraded thorn forest and dry deciduous forests up to an elevation of about 200 m. About 145 villages near the forest boundary are composed of a large number of low-income households. These villages maintain about 10,000 cattle that often graze in the forest and cause the degradation of foothill forests in the buffer zone of the KMTR (Dutt 2001).

A World Bank funded eco-development program was launched in December 1994 among the villages along the eastern boundary of KMTR. This five-year project (1994–1999) which was extended for two more years (1999–2001) had the objective of reducing forest dependency among the local communities and thereby providing them with alternative livelihoods. An added benefit of this would be the improvement of the habitat for wildlife.

This study investigated the disturbed and undisturbed dry forest near these villages to assess mean extraction pressure, the percentage of stems removed over a fixed period of time. We compared the effect of resource extraction on plant species richness, plant density, basal area and regeneration in disturbed and undisturbed dry forests.

Study area

Kalakad–Mundanthurai Tiger Reserve is situated in the southern western ghats region (8° 25′ to 8° 53′ N latitude and 77° 10′ to 77° 35′ E longitude) and is bounded on the eastern and southern sides by Tirunelveli and Kanyakumari districts of Tamil Nadu and on the western side by Kerala state. The Reserve covers a total area of 895 km^2, of which 537 km^2 is in the core zone (Fig. 1). It was created out of the Mundanthurai

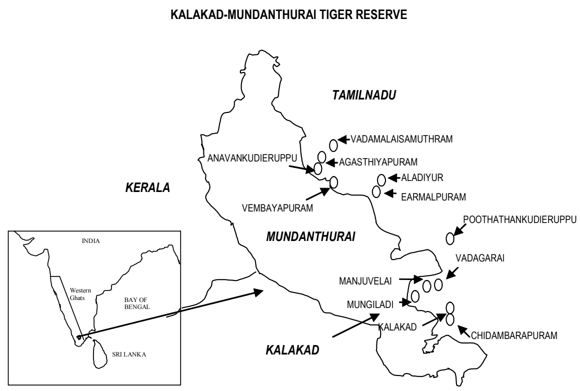

Fig. 1. Map of the study area showing the Kalakad–Mundanthurai Tiger Reserve and the study villages. Approximate scale 2 mm = 1 km.

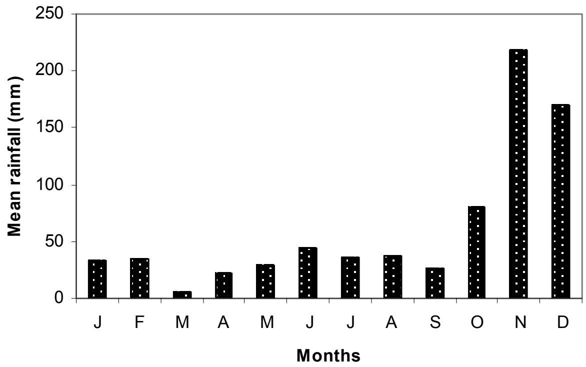

Fig. 2. Mean monthly rainfall recorded in Servalar, ≈10 km from the study region, for a period of 9 years from 1994 to 2002.

and Kalakad Wildlife Sanctuaries in the early 90's to provide protection to declining populations of the Tiger (*Panthera tigris*).

The eastern boundary of the reserve has 145 villages/hamlets comprising about 30,000 households located within 5 km of the boundary (Melkani 2001). Most villages have sandy loam red soils, which retain water for a long period and are suitable for the cultivation of rice, banana and vegetable crops.

Due to its topographical diversity and altitudinal range, KMTR has diverse forest types from thorny dense mixed scrub vegetation to rain forests. The foothills are clothed with dry thorny forest, dry deciduous forest and overgrown teak plantations. The local community has utilized this forest over the historical period for grazing, hunting and collection of forest products (Arjunan 2004), but human pressure on the forests has probably increased over the past 50 years due to increasing population densities.

Mean annual rainfall in Servalar, ≈10 km from the study site with similar climate, over a 9–year period, from 1994 to 2002, was 716 mm. The dry season extended from January to October (Fig. 2). Rainfall from the northeast monsoon fell mostly during November–December.

Materials and methods

Two different aspects of resource extraction were studied. The first was the quantification of extraction pressure by assessment of the number of new pruning or cuts on all plants ≥3.18 cm dbh (diameter at breast height), including lianas. These new cuts on plants were assessed at 3–month intervals over a period of 2 years using permanent plots. The second aspect was the effect of resource extraction on plant density, mean height, basal area and regeneration. For these two studies different sets of plots were used.

Estimates of extraction pressure

To assess the extraction pressure on the forest, eight square plots each measuring 1 ha were laid out in March 2000 in the forests frequented by villagers for collecting fuel wood and other forest products. Each of these plots was adjacent to a village and therefore the extraction pressure of 8 villages was estimated. All woody plant species ≥3.18 cm dbh and woody lianas were tagged in each 1–ha plot. The number of cut stems and branches on all standing stems ≥3.18 cm dbh was recorded every 3 months in each plot over a period of 2 years from May 2000 to February 2002. An index of extraction pressure was formulated based on the number of cut stems and branches on all the tagged plants in a plot. The removal of plants and plant parts was recorded. Extraction pressure was given as the [(total number of cuts*100/total number of plants in the plot)/ 3] to give monthly percentages for each village. The mean for each village over the 2–year period was used as the mean monthly extraction pressure per village, and the overall mean for all villages during a 3–month period was the mean extraction pressure given in months for that periodic interval. The extraction pressure at the beginning of the study and during the last sample period were compared using a non parametric Wilcoxon signed rank test.

Socio-economic correlates of extraction pressure

Mean extraction pressure for each village was correlated with the number of households in that village as an indicator of village size. The number of households increases with village size and households are the basic unit that is involved in resource extraction. The village statistics were obtained from the office of the Village Administration Officer. Comparison of extraction

Table 1. The number of households per village and mean monthly extraction pressure*.

Village name	Village size (total households)	Plant density ha^{-1} at beginning of study	Mean monthly extraction pressure* (%)
Agasthiyapuram	336	311	8.37
Anavankudieruppu	282	298	8.63
Chidambarapuram	1102	347	8.36
Earmalpuram	804	328	7.25
Manjuvelai	338	352	11.16
Mungiladi	414	346	12.97
Puthathankudieruppu	206	362	12.84
Thirupathiyapuram	110	277	12.80

* % of cuts every month on tagged plants.

pressure by villages with the highest and lowest mean extraction over the 3–month period was made using a non parametric Wilcoxon signed rank test.

Selection of plots for vegetation analysis

Another set of plots was used to assess the impact of human disturbance on plant species richness, plant density and basal area. Ten 30 x 30 m plots and one 20 x 50 m plot, totaling an area of one hectare, were randomly laid out in forest areas adjoining Mundanthurai, where the local people spent over 3 hours per day in collection of fuel wood and other forest products. A similar set of plots of the same dimensions, totaling to one hectare, were laid out in forested sites adjoining villages in Kalakad. All study villages were located adjacent to these two towns which are in different administrative ranges of the Forest Department. All stems over ≥3.18 cm dbh were inventoried, their dbh and height recorded. The number of saplings of each species

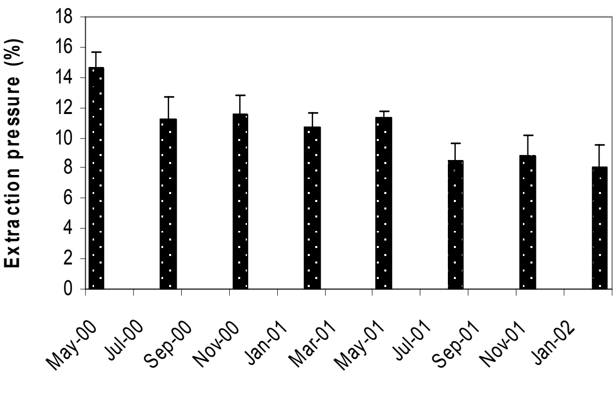

Fig. 3. The mean % of stems cut over 3–month intervals from May 2000 until January 2002.

was counted in 10 x 10 m sub-plots. Saplings were those plants that were >50 cm in height and <3.18 cm dbh.

Two control plots of 1 ha each, one in Kalakad and the other in Mundanthurai, were laid out in forested sites, about 2 km from the reserve boundary. These sites had no record of human extraction during the course of the study, although extraction prior to the creation of the protected area cannot be ruled out. Each plot was divided into 4 subplots of 50 x 50m. The distances between the disturbed and undisturbed plots were over 0.5 km.

Results

Extraction pressure

The mean monthly extraction pressure was 10% with a range of 7% in Earmalpuram to 13 % in Mungiladi. (Table 1). This shows that on average 10% of all standing stems had new cuttings every month. Only in some cases were whole plants removed, and in most instances only branches were removed leaving the plant intact. Certain villages such as Mungiladi, Puthathankudieruppu and Thirupathiyapuram had higher levels of extraction than others. There were significant differences between villages with the mean monthly extraction pressure ranging from 7–13% over the study period (Wilcoxon signed rank test: $p < 0.02$). The overall average % of branches and stems pruned or cut in all the sample plots at 3–month intervals declined from 43% in May 2000 to 23% in February 2002, a decline of 20% (Fig. 3). The mean values for all villages at the beginning of the study (16%) was significantly higher than for the last period of the study (9%) (Wilcoxon signed rank test: $p < 0.005$).

Table 2. Number of tree, shrub and liana species in the disturbed and undisturbed sites.

Site description	Number of species			Total
	Tree	Shrub	Liana	
Disturbed sites	20	9	0	29
Undisturbed sites	35	8	2	45

The mean monthly extraction pressure for each village was negatively correlated with village size (r= –63, p <0.05). This suggests that as the village grows in size alternative income generating opportunities might lower pressure on the forest. However, there was no correlation between initial stem densities in each plot at the initiation of the study in 2000 and village size (r=0.36, ns), suggesting that forests had similar stem densities across all village sizes at the beginning of the study.

Vegetation analysis

A total of 52 species of trees, shrubs and lianas belonging to 34 different families were recorded in the study sites (Appendix 1). Twenty-nine species were recorded in the disturbed sites and 45 in the undisturbed sites. The number of tree species was higher in the undisturbed sites (Table 2). A total of 22 species were common to both sites. Only 7 species recorded in the disturbed sites were not recorded in the undisturbed sites. These were generally species that were not cut by the local people. But 23 species recorded in the undisturbed sites were not found in the disturbed sites (Appendix 1). There were no lianas in the disturbed sites probably because the whole plant is removed to bind bundles of fuel-wood and fodder (Table 2).
Species richness was much lower in the disturbed sites (29) than in the undisturbed sites (45). Plant density ha^{-1} was similar in the disturbed (394) and the undisturbed sites (419). The undisturbed sites had a higher basal area and significantly higher mean height than the disturbed sites. Species diversity was lower in the disturbed sites as compared with the undisturbed sites (Table 3).

Regeneration

About 228 saplings of 19 species were recorded in both the disturbed and the undisturbed sites. All 19 species and 86% of the saplings were recorded in the undisturbed sites, whereas only 10 species and 14% of the saplings were recorded in the disturbed sites (Table 4). The regeneration of species extracted by the local communities was significantly different in the disturbed and undisturbed sites. (χ^2 = 4.11, df = 1, p = 0.01).

Table 3. Differences in vegetation parameters between disturbed and undisturbed sites for all plants ≥3.18cm dbh.

Parameters	Disturbed (2 ha)	Undisturbed (2 ha)	T test	p
Species richness	29	45		
Species diversity (Shannon-Wiener)	2.5	3.46		
Plant density (stems ha^{-1})	394	419		
Basal area (m^2 ha^{-1})	6	19		
Mean height (m)	5.7±1.4	7.5±6.2	7.18	0.0001
Number of sapling species (mean ha^{-1})	10	19		

Plant parts of *Bauhinia racemosa, Schleichera oleosa, Azadirachta indica* and *Syzygium cumini* were regularly collected by the local people for fuel wood, *Erythroxylon monogynum* and *Ventilago madraspatana* for fodder and rope, and *Helicteres isora* and *Combretum ovalifolium* for rope (Arjunan 2004). Among these eight, 5 species were absent and the remaining 3 were represented only by saplings. Adults and saplings of all 8 species were found in the control sites (Table 4).

Species extracted and their uses

The local people used 50 plant species growing in the study region for various purposes. Thirty five species were used for fuel wood and for making implements, the leaves of 14 species for fodder and green leaves as fertilizer for fields and bark from 6 species for tying fuel wood and fodder bundles (Table 5).

Discussion

The rural poor in developing countries often rely on natural resources from forests to support their livelihood. These resources tend to form an important component of the rural economy. However, in recent times, non-sustainable extraction of forest resources such as fuel wood has caused forest loss and degradation, loss of wildlife habitats (Jha 1999), and loss of species and diversity (Kakati 1999; Ramesh 2003; Verma *et al.* 1997). Forest degradation in protected areas caused by livestock grazing can reduce wild herbivore populations (Madhusuddan 2004; Silori & Mishra 2001), the prey base for endangered species such as the Tiger. Over-harvesting of

Table 4. Stem densities of adults ≥3.18 cm dbh and saplings <50cm in height recorded in the disturbed and undisturbed plots.

Scientific Name	Adults		Saplings	
	Disturbed (plants ha^{-1})	Undisturbed (plants ha^{-1})	Disturbed N	Undisturbed N
Albizia amara	2	8.5	0	0
Albizia lebbeck	0.5	6.5	0	0
Azadirachta indica	1.5	5	0	2
Bauhinia racemosa	0	11	0	11
Borassus flabellifer	0.5	0	0	0
Cadaba trifoliata	15	13	0	5
Canthium dicoccum	0	3	0	0
Capparis brevispina	15.5	9.5	3	5
Carmona retusa	1.5	0	0	0
Catunaregam dumetorum	12	0	0	0
Celtis philippensis	0	2	0	0
Chionanthus malabarica	4.5	2.5	1	4
Chloroxylon swietenia	0.5	7.5	0	0
Combretum ovalifolium	0	8	0	8
Commiphora caudata	45.5	24.5	6	13
Cordia wallichii Don.	0	4.5	0	0
Dalbergia paniculata	12	15	1	3
Dichrostachys cinerea	6.5	4.5	0	0
Diospyros paniculata	0	22	0	0
Dodonaea viscosa	0	0	0	0
Dolichandrone atrovirens	0	0	0	0
Drypetes wightii	0.5	0	0	0
Ehretia ovalifolia	0	1	0	0
Erythroxylon monogynun	0	4	0	10
Ficus amplissima	2	3	0	0
Ficus retusa	8	5.5	0	0
Givotia rottleriformis	13.5	10	0	0
Grewia sp	1	0	0	0
Helicteres isora	0	16	0	13
Holoptelea integrifolia	0	0.5	0	0
Hopea parviflora	0	3	0	0
Ixora brachiata	17	11	0	0
Lannea coromandelica	0	3.5	0	0
Miliusa eriocarpa	0	3	1	8
Mitragyna parvifolia	0	6	0	0
Morinda tinctoria	6.5	9.5	0	0
Mundulea suberosa	0	4.5	0	0
Phyllanthus emblica	0	8	0	0
Rhus mysorensis	0	11.5	1	2
Schleichera oleosa	0	7.5	0	21
Securinega leucopyrus	1.5	0	0	0
Streblus asper	14.5	10	0	0
Strychnos nux-vomica	15	18	6	11
Syzygium cumini	6.5	10.5	0	4
Tamarindus indicus	0.5	0	0	0
Tectona grandis	129	65	11	47
Trema orientalis	0	1	0	0
Trewia nudiflora	13.5	10	0	0
Ventilago maderaspatana	0	7	0	7
Wendlandia tinctoria	0	12	0	0
Ziziphus oenoplia	2.5	17	2	8
Ziziphus rugosa	45	13.5	9	5

forest products can have a drastic effect on vegetation structure and diversity as shown by Murali *et al.* (1996) for the forests in the Biligiri Rangaswamy Temple Wildlife Sanctuary. Non-sustainable extraction resulted in a deficit of smaller size classes and poor regeneration of the target species (Murali *et al.* 1996) and the vegetation in highly disturbed sites had lower stem densities, species diversity and basal area than in moderately disturbed sites in the same area (Murali & Hegde 1996; Shanker *et al.* 1998).

Our study supports these findings and we show that unregulated resource extraction has an adverse impact on the forest structure, diversity and regeneration. Species such as *Commiphora caudata* that were not used by the local people occurred at high densities and regenerated well. Rarely are whole plants cut. Branches of all sizes are removed first and after all the branches have been removed the standing stem is cut thereby destroying the plant. Therefore, the number of plants decreases more slowly than the number of branches. Forest degradation is an ongoing process and the World Bank funded eco-development project in the Kalakad-Mundanthurai Tiger Reserve seems not to have effectively addressed this problem.

Although levels of extraction decreased by 20% from 2000 to 2002, an average of 66 stems per plot over the 2 year study period, the current levels of resource extraction are clearly non-sustainable (Arjunan 2004). Larger villages, counter-intuitively have a lower impact on the forest than smaller villages. This might be because larger villages could have a more diversified economy that is less dependent on forest resources than smaller villages.

Of the 52 species used by the local population for different purposes, the majority (35: 67%) were for fuel wood and 14 species for fodder. About 75% of households in developing countries use fuel-wood for domestic purposes (Desai 1991). Rural areas in India account for about 85% of the total fuel wood consumption and a large portion of the rural energy demand is met from the locally available fuel wood, cow dung and agricultural residues (Natarajan 1997). About 62% is from forest sources (Leach 1987).

Fuel-wood extraction was the biggest cause of forest degradation in the buffer zone of the park. All segments of the local villages, both the poor daily wage earners and the wealthy landowners depend on fuel-wood collected from the forest (Arjunan 2004). With the current levels of extraction, the forest areas will become increasingly degraded.

Fast growing trees can be planted to provide a regular source of fuel-wood and thereby reduce pressure on natural forests (Patel 1985). A restoration program can be initiated in the degraded dry forests adjoining KMTR. Some kind of a rotational restoration using fast growing species as well as species used by the local communities can be carried out and sites targeted for restoration should be protected from human impact and livestock grazing until they are self-sustaining. Unless there is managed extraction regulated at the village level, the extent of degraded forest and wasteland will encroach into KMTR and the environmental services that healthy ecosystems provide will be negatively impacted.

Table 5. Number of species used for different purposes by the local communities.

Plant parts used	Number of species in use	*Uses*
Wood	35	Fuel wood and implements
Leaf	18	Livestock fodder, green leaves as fertilizer
Bark	6	Rope and medicine
Fruit	1	Food
Stem	1	Rope

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Appendix 1. List of species recorded in the disturbed and undisturbed plots (0=absent, x=present).

Scientific name	Family	Habit	Disturbed	Undisturbed
Rhus mysorensis	Anacardiaceae	Shrub	0	x
Miliusa eriocarpa	Annonaceae	Tree	0	x
Borassus flabellifer	Arecaceae	Tree	x	0
Dolichandrone atrovirens	Bignoniaceae	Tree	0	x
Carmona retusa	Boraginaceae	Shrub	x	0
Cordia wallichii	Boraginaceae	Tree	0	x
Ehretia ovalifolia	Boraginaceae	Tree	0	x
Commiphora caudate	Burseraceae	Tree	x	x
Cadaba trifoliate	Capparidaceae	Shrub	x	x
Capparis brevispina	Capparidaceae	Shrub	x	x
Combretum ovalifolium	Combretaceae	Liana	0	x
Hopea parviflora	Dipterocarpaceae	Tree	0	x
Diospyros paniculata	Ebenaceae	Tree	x	x
Drypetes wightii	Euphorbiaceae	Tree	x	0
Givotia rottleriformis	Euphorbiaceae	Tree	x	x
Lannea coromandelica	Euphorbiaceae	Tree	0	x
Phyllanthus emblica	Euphorbiaceae	Tree	0	x
Securinega leucopyrus	Euphorbiaceae	Shrub	x	0
Dalbergia paniculata	Leguminosae	Tree	x	x
Bauhinia racemosa	Leguminosae	Tree	0	x
Dichrostachys cinerea	Leguminosae	Shrub	x	x
Mundulea suberosa	Leguminosae	Tree	0	x
Tamarindus indica	Leguminosae	Tree	x	0
Erythroxylon monogynum	Malpighiaceae	Tree	0	x
Azadirachta indica	Meliaceae	Tree	x	x
Albizia amara	Mimosoidae	Tree	x	x
Albizia lebbeck	Mimosoidae	Tree	x	x
Ficus amplissima	Moraceae	Tree	0	x
Ficus retusa	Moraceae	Tree	0	x
Streblus asper	Moraceae	Tree	x	x
Syzygium cumini	Myrtaceae	Tree	0	x
Chionanthus malabarica	Oleaceae	Tree	x	x
Ventilago maderaspatana	Rhamnaceae	Liana	0	x
Ziziphus oenoplia	Rhamnaceae	Liana	x	x
Ziziphus rugosa	Rhamnaceae	Shrub	x	x
Canthium dicoccum	Rubiaceae	Tree	0	x
Ixora brachiata	Rubiaceae	Tree	x	x
Catunaregam dumetorum	Rubiaceae	Shrub	x	0
Mitragyna parvifolia	Rubiaceae	Tree	0	x
Morinda tinctoria	Rubiaceae	Tree	x	x
Wendlandia tinctoria	Rubiaceae	Tree	x	x
Chloroxylon swietenia	Rutaceae	Tree	x	x
Dodonaea viscose	Sapindaceae	Shrub	0	x
Schleichera oleosa	Sapindaceae	Tree	x	x
Helicteres isora	Sterculiaceae	Shrub	0	x
Strychnos nuxvomica	Sterculiaceae	Tree	x	x
Grewia sp.	Tiliaceae	Shrub	x	0
Trema orientalis	Ulmaceae	Tree	0	x
Celtis philippensis	Ulmaceae	Tree	0	x
Holoptelea integrifolia	Ulmaceae	Tree	0	x
Tectona grandis	Verbenaceae	Tree	x	x
Trewia nudiflora	Verbenaceae	Tree	x	x