Community Dependence on Protected Forest Areas: A Study on Valuation of Non-Wood Forest Products in a Region of India[1]

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ABSTRACT

With the increasing demand for non-wood forest products for medicinal purposes and due to its high scope for value addition, these products are increasingly extracted by local communities not only for subsistence use but also to generate cash income. This study explores the factors determining the dependence of local people on a protected forest area for commercial purposes, from a case study in India. The findings go along with that of similar studies that alternative income sources would greatly reduce the dependence on the forest. This paper computes present value of NTFP using the data from a household survey. The projected value for the population, which gives the opportunity cost of prohibiting the use of forest by the local people, would serve as a good indicator for the policy decision on compensation to be paid to the local people for relocating them from the forest area.

Introduction

Forest resources produce a variety of benefits such as direct use values, indirect use values, option values and existence or non-use values. It has been pointed out that a major cause of the failure of sustainable forest management, or the cause of deforestation and transfer of forest to other land uses, is the inadequate recognition and underestimation of the value of many goods and services provided by the forests at the local, national, regional and global level (UN, 1996). Timber has been the most recognized economic product from tropical forests and other non-timber/non-wood forest products (NTFP/NWFP) have been labelled as 'minor forest products'. However, forest is a source of many valuable NWFPs such as parts of plants and animals

for medicinal use, tanning compounds and waxes, extractives such as bark, dyes, fibres, gums, latexes, oils, resins, food such as bush meat, flowers, fruits, honey, nuts, leaves, seeds and spices and other products such as fuel-wood and bamboo. The commercial value of NWFP per hectare of land can even exceed that of wood products (Peters *et al.,* 1989). Studies conducted elsewhere have shown that the forest yields substantial benefits to the household economy (Godoy *et al.,* 2002; Gunatilake *et al.,* 1993; FAO, 1996). Since for most of the products there are no proper markets for transaction, economic valuation becomes difficult and hence they are in general not properly accounted in the estimation of benefits of the forest, which is used in policy decisions. The present study makes an attempt to estimate the use value of NWFPs in a protected area and to examine community dependence on the same for a selected region of India.

The rest of the paper is organised as follows. In section 2 we discuss the problem and objectives. The third section surveys the relevant past studies. Methods and data are discussed in section 4. Section 5 presents the existing institutional mechanism for marketing and management of NWFP. The sixth section provides empirical analysis of community dependence on a protected area. Section 7 concludes the paper.

Focus of the Problem

IUCN (1994) defines a Protected Area (PA) as *"an area of land and /or sea especially dedicated to the protection and maintenance of biological diversity, and of associated cultural and natural resources, and managed through legal and other effective means".* India currently has only national parks and sanctuaries designated as PAs although there are other natural areas, which have been given varying degrees of protection. India has protected 14 million hectares or 4.5 per cent of its total land area in National Parks and Sanctuaries set up under the Wild Life (Protection) Act of 1972. The majority of wildlife reserves in India have rural communities living in and around the reserves. Surveys showed that over 65 per cent of the protected areas were characterised by human settlement and resource use (Kothari *et al.,* 1989). They are subjected to pressure from human population for grazing, cutting trees for firewood and timber, extraction of non-timber forest products, hunting etc. Local people who have limited rights and no security of tenure have little incentive to use the forest in a sustainable way. Attempts to protect PAs from human intervention by coercion have often led to hostile attitudes of local people towards wildlife management and sometimes to open conflict (Nadkarni, 2001).

Western Ghats of the state of Kerala, located in the southern part of India, is one of the 'hot spots' in India with rich plant and animal biological diversity. There are at present 2 National Parks, and 12 Wildlife Sanctuaries in the state covering a total area of 0.23 million hectares. The protected area of Wayanad Wildlife Sanctuary is the second largest in area. The total extent of forest area in Wayanad district is about 539 km^2 of which 344.44km^2 forms the protected area, which is administered for conservation of wildlife and forest bio-diversity. It is a part of the Nilgiri Biosphere Reserve. The forest types in this area are mostly moist deciduous with a few scattered patches of evergreen forests. The forestlands harbour a variety of wood and non-wood forest produce species. People living in and around the forest not only extract products such as food, fodder, fuel-wood for their subsistence needs, but also are engaged in extraction of various non-wood products for commercial purposes. There exists an intense conflict between the forest-dependent rural population and the government agencies in charge of protecting the wildlife sanctuary. Recently, wildlife management proposed a complete ban on extraction of NWFP. In this context, the valuation of forest benefits, especially to the local population, is important to answer what benefits communities need to give up if

biological reserves are to be fully protected.

In contrast to the case of timber, the people benefiting from the sustainable harvesting of NWFP are the population in and around the forest. It has been recognised now that without people's participation, the forest cannot be conserved efficiently. The National Forest Policy of India, 1988 declared that local communities were to be involved in natural resource conservation (GOI, 1988). The Joint Forest Management (JFM) approach in India seeks to develop partnerships between state forest departments as owners and the local community as co-managers for sustainable forest management. Building on the JFM programme, increasing debate on the possibility of Joint Protected Area Management (JPAM) has also been taking place. One such initiative is the Integrated Conservation and Development Projects (ICDP) or 'ecodevelopment' programme, which try to link protected area management with local social and economic development, usually by providing incentives for park neighbours to support conservation and sustainable use (Arnold and Bird, 1999). In this context, it is important to know to what extent the local people depend on the forest and what factors determine the dependence on forest. This study has the following objectives; (a) to examine the

existing institutional mechanism for managing NWFP in the PA (b) to impute income generated from NWFP using household data (c) to examine the extent and nature of dependence on the forest by various local communities in a protected area and factors influencing the dependence and (d) to compute the present worth of foregone benefits to the local community due to loss of access to the forest.

Definition of NWFP

The term 'non-wood forest products' is a relatively new term used generally to mean forest products other than wood. However, for the present study we have used a modified version suggested by FAO (1995). As per FAO definition, *'Non-wood forest products include all goods of biological origin, as well as services, derived from forest or any land under similar use, and exclude wood in all its forms'*. As per this definition, timber, poles, small wood, fuel-wood and charcoal are excluded. Even though the FAO definition includes forest services such as grazing, viewing wilderness, hunting of wild life etc, we have excluded these services from economic valuation. Hunting of wildlife is excluded from the calculation of value since it is legally banned inside the protected area. For valuation purpose, we have considered many kinds of NWFP that are derived from forests, including fruits, nuts, seeds, medicinal products, herbs and spices, dyes, resin, toiletries and animal products such as honey.

Review of Past Studies

There are some studies which estimated income generated from NTFP/NWFP using household data. We give here the result and some major studies for India as well as other countries. Chopra (1994) examined the role of NTFP for a district in Madhya Pradesh, India. She discussed the user valuation of different NTFP and evaluated the efficiency of marketing channels. The study shows that 40 per cent of the household income was derived from the collection and sale of various non-timber forest products. In a case study of West Bengal, Kant *et al*., (1996) estimated the average contribution of NTFP to tribal and non tribal households as 21 per cent and 13 per cent respectively. According to the estimate provided by Mallik (2000), the percentage of income derived from forest varied from 22 per cent to 41 per cent in different forest areas.

In a recent study, Ninan *et al*., (2000) have tried to estimate the use and non-use values of tropical forests in a case study of Nagarhole Sanctuary, Karnataka. The major objectives of this study were to assess the extent of dependence on forest for various products and services by different socio-economic groups and region. It also analysed the socio-economic and institutional

factors promoting biodiversity conservation. They estimated the willingness to pay and willingness to accept compensation for biodiversity conservation and wildlife protection. Using a household survey, the analysis was done using cost-benefit appraisal and contingent valuation method. They estimated the contribution of NTFP per household and the foregone benefits of conservation indicated by present value assuming 8 per cent discount rate and a time horizon of 25 years. Kramer *et al.*, (1994) used the opportunity cost approach and a contingent valuation method to analyse the economic and social impacts of establishing the Mantadia National Park in Madagasgar on village households living adjacent to tropical rainforests. Contingent valuation method was used to assess villagers' willingness to accept (WTA) compensation for loss of access to the park. The opportunity costs borne by the villagers as a result of lost access to the forest in the park were estimated using a cash flow model constructed from a socio-economic survey and Contingent Valuation Method (CVM). Estimates based on CVM shows that on an average, a compensation of US $108 per year per household would make households as well off with the park as without it. Roba (2000) analysed the factors influencing forest resource use by the local population in Marsabit Forest Reserve, which is part of Marsabit National Park, Kenya. The study assessed the role

of government policy in influencing household decisions in resource use patterns and the implications of different resource uses for the conservation of biological species. The study concludes that the access to the forest products is weakly regulated. A combination of forces such as population pressure resulting from rural-urban migration, resource pricing policy, ill-defined property rights, low license fees etc were identified as factors influencing resource use. Gunatilake *et al.,* (1993) estimated the composition of income in the peripheral communities, particularly from the extraction of non-timber forest products from the National Wilderness Area of Knuckles in Sri Lanka through a household survey. The rural economy was described using a farming system approach and the net income contribution by each activity in the farming system was estimated. NWFP formed 16.2 per cent of the total income of the family. A mix of methods was used for valuing various types of non-timber forest products. For the lowest income group, contribution of NWFP accounts for about 31 per cent of the total income of the family, indicating a greater economic role of NWFP among low-income families.

There are a few studies, which attempted examining the factors determining community dependence on forest (e.g. Gunatilake, 1998 and Hegde and Enters, 2000). They found that income from non-forestry

activities emerge as the most significant variable that reduces forest dependence.

From the survey of past studies, it is very evident there were wide variations in the value of NWFP either on a per household basis or per unit of area. Many studies consider stock of NWFP for valuation purpose. Even though stock is more relevant for forest conservation purpose, for the livelihood of local community the flow concept is more relevant. In the Indian context, none of the studies considered the 'net value' realised by the households. The importance of foregone benefits of forest conservation or the opportunity cost of loss of access to the forest has not received the needed attention in the literature except for a couple of studies. More work on the methodological issues is necessary. This is significant from the viewpoint of policy relevance because government may have to consider compensation when relocating the local people to outside-protected area.

Methodology and Data

Study Area

Wayanad is a hilly district of Kerala lying in the sub-region of the Western Ghats in north Kerala. It is situated at an elevation ranging from 700 to 2100 meters above the mean sea level Wayanad Wildlife Sanctuary is situated contiguous to the protected area network of Negarhole and Bandipur of Karnataka State in the North-East and Mudumalai of Tamil Nadu in the South-East. The whole area is administered under four Wildlife Forest Ranges.

The forests in the protected area do not form a continuous stretch of habitat. Thousands of people, both tribal and non-tribal, live in and around the sanctuary and benefit from the extraction of forest products. The major tribal communities in the enclosures are Kuruman, Paniyan, Kurichian, Kattinaikkan, Adiyan, and Urali. The Kattunaikkan (KN) community is considered as descendants of a nomadic primitive hunter-gatherer group who roamed on the hilltops and caves. Traditionally they are honey collectors, food gatherers and hunters. The Paniyan (PN) is a numerically dominant tribal community. They occupy small plots of land and cultivate paddy, ginger etc. They form a major proportion of the agricultural laborers in the study area. Kuruman (KR) is another major group of the tribal community. Compared to the other two tribal communities, Kurumans are comparatively better in socio-economic status. Apart from the tribals, the ethnic groups living inside the protected area also depend on the forest for various purposes such as fuel-wood, grazing etc.

Sampling Procedure for Household Survey

To examine the extent and nature of dependence on the forest by these communities with varying socio-economic status, a household survey was done to elicit data (Shylajan, 2001). Both tribal and non-tribal communities living in interior forests and peripheral area are the target groups of the study. For conducting the primary household survey, one Village Panchayat was selected from the main portion of the protected area. Forty percent of the geographical area of the selected panchayat is covered by forest. The panchayat has been divided into ten village wards for administrative purpose. Out of the ten village wards, two from the interior forest area and two from the periphery were selected. As per the data collected from the panchayat, 41 per cent of the households are from the tribal community and the rest are from non-tribal groups. Out of the total residential households, eight percent of the households, i.e., 194 households were selected for the sample survey. A stratified random sampling method was used for the selection of households. First, total households were stratified into tribal and non-tribal groups in proportion to their population. The sample included 80 tribal households and 114 non-tribal households. The tribal households were again stratified in proportion to number of households in each tribal community. Among the tribal communities, numerically dominant communities, namely Kuruman, Pariyans, Kattunaikkan were selected for the primary survey. Out of 80 tribal households, 22 households were from the Kattunaikkan, 29 from the Paniyan and 29 households from the Kuruman community.

The primary data were obtained through a household survey with the use of a questionnaire, both structured and unstructured. A number of villages around the forest and inside the protected area were visited at different periods of time. Information was also gathered from discussion with local people who are major stakeholders of the forest. Before preparing the questionnaire, informal discussions were conducted with secretaries of the co-operative societies, forest range officers, tribal chiefs and other key informants in the study area. A participant observation method was also used to gather details on types of NWFP collected, season of availability of various NWFP, method of extraction of various products, labor time involved and distance travelled for collection of various forest products. The field survey was conducted during April 2000 to November 2000.

Calculation of Household Income from NWFP

One of the commonly used techniques for valuing the gross annual value of NWFP has been the incomes approach or products and services approach, whereby the physical production of goods and services is valued using actual or surrogate market prices of the resource. NWFP can be divided into 'inventory' (the stock) and 'flow' (quantity actually collected by the people) quantities. For the present study, we use the flow variable. We have measured the share of products consumed by the household and that sold in the market. Products consumed at home were valued at their retail purchasing price in the village town. Wherever the market price was not available, we have used price of substitutes. The household members sell the products either to the 'co-operative society' or market them through the private channels. The gross and net returns from non-wood forest products of commercial use are estimated as follows:

$$NR = GR - \Sigma_j C_j \qquad (1)$$

$$GR = \Sigma_i \Sigma_j \Sigma_k P_{ki} Q_{kij} \qquad (2)$$

where
GR = Gross income from NWFPs collected by a household

P_{ki} = The forest-gate price of the product i marketed through k^{th} marketing channel. k = 1 and 2 indicating private market and society.

Q_{kij} = The quantity of non-wood forest product i collected by the jth member of the household and marketed through k^{th} channel during the season

NR = Net income from NWFPs collected by a household

C_j = Combined cost of extraction of all types of NWFPs by the jth member of the household.

The major part of the cost is labor time involved in extraction. Cost of transporting the products to market (if any) is also included. The two main activities in the forest village are agriculture and collection of NWFPs. In the off-season, the NWFP gatherers work as agricultural laborers. Hence, the wage rate at the time of survey is used as opportunity wage to compute cost of labor time involved for collection of NWFPs. For those products, which are extracted during nights, the time spent during the night has also been included to calculate cost of labor[2].

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[2] We have calculated the opportunity wage rate of day time and night time differently, by taking into account of risk factors involved in extraction activities in the forest at night. For labor used in products collected during nights (wild honey for instance), we have imputed wage rate at 50 percent more than what they get in the day time (as equivalent to overtime work/wage rate for risk factor) wage rate.

Computation of Present Worth of NWFP

Present worth of the NWFP was calculated per household. It was calculated for those products that are extracted for commercial use. The estimation was done for two major forest dependent communities; Kattunaikka and Paniya. It was based on the assumption that both the communities derive a constant annual return from the collection of NWFP. These values would serve as a good indicator of minimum compensation to be made to the local communities if they were to be relocated for the purpose of forest biodiversity conservation.

We have used alternative discount rates for calculation. The following formula has been used for estimating present worth.

$$PV = \frac{AV}{r}\left[1-\left(\frac{1}{1+r}\right)^{t}\right] \qquad (3)$$

for a finite time horizon t

$$PV = \frac{AV}{r} \qquad (4)$$

for infinite period

where

AV = annual income from NWFP per household

r = discount rate

t = time horizon

Analysis of Factors Influencing Community Dependence on NWFP

The degree of dependence on the forest by the local communities differs depending on their socio-economic status and legal right to collect forest products. The people depend on the forest for various purposes such as food, construction materials, fuel-wood for own consumption and for sale. However, for analysing the forest dependence and factors that appear to influence the decision of the household, we have used average annual gross income of the household from the sale of NWFP as a proxy for dependence on forest. The analysis is conducted for those households who have legal or customary right to collect various NWFPs from the protected area.

The factors that are expected to explain households dependence on NWFP for commercial purpose and could be explained in terms of the following variables; (a) cost of collection (based on distance to the source of forest products) (b) returns from collection of forest products (c) alternative income generating options, (d) overall economic status of the household in terms of total land area under cultivation (e) availability of labor force etc. We assume that the alternative income generating option is probably one of the main factors influencing the intensity of the collection of non-

wood forest products. We consider the following relation to examine the factors determining the extent of forest dependence, which is measured by total cash income derived from collection of NWFP.

$$Y = \beta_O + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6$$

(5)

where

Y   = Annual household income from the sale of NWFP

X_1 = Annual household income from daily wage i.e. occupational income

X_2 = Annual household income from cultivation of own land

X_3 = Area under paddy cultivation

X_4 = Total area under cultivation

X_5 = Number of adult men in the household as a proxy for labor force (people in the group of 14 – 65)

X_6 = Number of educated adults in the age group of 14 – 65 who can read and write

D_1 = Location dummy
    = 1 for interior forest area
    = 0 otherwise

D2 = Community dummy
    = 1 for Kattunaikkan and Paniyan households
    = 0 otherwise

To test the relation between the dependent variable and explanatory variables, the equation is estimated using Censored Regression or Tobit Model. In a Censored sample, some observations on the dependent variable, corresponding to known values of the independent variables, are not observable. We do not observe the dependent variable over the entire range. For instance, suppose the regression model is

$$Y = \beta_x + u \qquad (6)$$

And we observe Y only if Y > 0. Thus our model is

$$Y = \beta_x + u \qquad \text{if } \beta_x + u > 0$$
$$= 0 \qquad \text{otherwise}$$

In this case one cannot use only the observation for which y > 0 to estimate the regression equation by ordinary least squares (OLS) because the residuals do not satisfy the condition E(u) = 0 if we consider only those residuals such that u > -β_x. The appropriate technique is the Tobit model (Tobin, 1958).

In the present study, data on household income from non-wood forest products has zero values corresponding to the households who choose not to collect forest products for commercial purpose. In this case if we undertake Ordinary Least Square (OLS) estimation by omitting the limit observations (zero income observations) it will create bias. Including the limit observations and conducting OLS will result in inconsistency. Hence, we utilise the Tobit model and estimate the model using maximum likelihood method.

Marketing Mechanism for the Sale of NWFP

Management of NWFP in Kerala

There are a number of institutions involved in the management of NWFPs in Kerala. Important among them are 1) Minor Forests Product Committee, (2) Forest Department (3) The Kerala State Scheduled Caste Scheduled Tribe Development Co-operative Federation Limited and (4) Tribal Service Co-operative Societies. A review of historical facts reveals that the tribal communities have been engaged in the collection of various NWFPs since time immemorial. While in the initial stage the collection was for self-consumption, later they started to extract more NWFPs for commercial purposes to meet their livelihood needs. In a later period, British allowed private contractors to collect NWFPs on an annual lease rent basis. However, local people were allowed to collect some specified items. In 1970, the Government of Kerala granted the right of NWFP extraction from public forests to the tribal people. In 1978, a number of Tribal Service Co-operative Societies (hereafter, referred to as Societies) were set up with membership reserved only for the tribal people. These societies have monopoly rights to procure the forest products, which are extracted by the tribal. In 1981, the Government of Kerala established an apex body of tribal societies viz, The Kerala State Scheduled Caste Scheduled Tribe Development Co-operative Federation Limited (hereafter, referred to as the 'Federation') and it was entrusted with the right of monopoly marketing of all NWFPs collected by the Tribal Service Co-operative Societies.

Collection of NWFP

The tribal people are legally permitted to collect various NWFP, which have been notified by the state government. The Minor Forest Products (MFP) Committee, chaired by the Chief Conservator of Forests, takes all the decisions relating to collection, allotment of forest ranges to co-operative societies, fixing lease rent, collection price (the price at which the products are procured from the primary collectors by the society) and selling price of the NWFP. Tribal people form co-operative societies in different localities to organise collection. The Societies procure various NWFP from the tribal people giving them collection price fixed by the Federation. The executive committee of each co-operative society has full liberty to re-fix the MFP price, fixed by the MFP Committee. The society starts procuring various NWFPs in their depots, which are located in the forest area. As per the rule, eighty percent of the sales price is supposed to be given to gatherers as collection

Price[3]. The twenty per cent of the sales value is shared between Society and Federation to meet their expenses.

Marketing of NWFP

The marketing of NWFPs by the private traders has been in existence for a long time and their supremacy in this area continued till the establishment of tribal co-operative societies and the Federation. At present, the Federation is one of the major organized marketing agencies of NWFPs in the State. The Federation is the main institution involved in the collection and marketing of NWFPs in Kerala. Based on the guidelines issued by the MFP Committee, the federation gives instructions to the societies regarding various aspects of the collection and marketing of NWFPs. The federation determines factors such as prices to be paid to the gatherers and selling price of various products. The marketing practices of the Federation include auctions, quotations and negotiations. The Auction is the most common marketing practice for the sale of NWFPs, especially non-perishable items. In the case of quotations, the traders are requested to submit the application stating the highest price that they are willing to pay. Negotiation is used in the case of highly perishable items. The federation enters into an agreement with the party interested in the purchase of the products and supplies the same at the rate mutually agreeable.

Marketing Channels

In Kerala, the NWFPs are marketed through different channels depending upon a variety of factors such as the nature of the product, demand, distance of the market etc. (Muraleedharan *et al.,* 1999). In the first channel, the products are marketed through the 'Federation'. In the second channel, the products are marketed through private traders. In some parts of the State, the Forest Department also practices marketing of some products. The primary collectors of the products also sell the products to retail shops. They are mostly owners of small provision stores in the locality.

The Pattern of Extraction of NTFP Over Time

The forest in Wayanad, especially the protected area, is rich in both plant and animal diversity. In the forests of Kerala, 500 species providing NWFPs are found (Nambiar *et al*., 1985). There are 153 items of non-wood forest producing

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3. The collection price paid to the collectors (tribals) by the societies is, at least theoretically, the cost of labour involved in the collection of NWFP (Muraleedharan *et al.,* 1997).

species recorded from the district. Most of the items are products of medicinal value. of the 119 commercially important NWFPs listed by the Forest Department in Kerala, people in protected area of Wayanad collect a few easily marketable items. For instance, during 1983 to 1999, only 34 items have been commercially extracted from the location of study. The major products, which have been collected, are wild honey, various types of medicinal plants, spices, seeds, and gooseberry. The pharmaceutical companies (Ayurvedic), are main consumers of the majority of the products collected from the study area. From the preliminary analysis of data recorded by the Society, it was found that wild honey is one of the major products collected in terms of quantity and value. However, there has been considerable fluctuation in the quantity collected over time. This may be due to many reasons such as climatic conditions, change in price of the product or demand or unsustainable extraction.

Another important NWFP item, which has been collected in large quantities from the study area, is *Phylanthus emplica* (gooseberry). It is one of the highly demanded products by Ayurvedic companies in Kerala. It is also marketed through both society and private channels. The collection of gooseberry has also fluctuated over the period. Till 1990-91, there were wide yearly fluctuations in the quantity collected by the co-operative society. From 1990-91 onwards, the collection has increased tremendously. There has not been much increase in real price of gooseberry from 1990-91 onwards when compared to rise in the price of honey. The collection price was almost stagnant during 1990 to 1999 - 2000. In the absence of any alternative employment opportunities, NWFP gatherers, whose opportunity cost of labor seemed to be comparatively low, spend their labor in collecting NWFP, thus making the product less price elastic.

Local Community and Forest Dependence- An Empirical Analysis

Forest products, besides providing food and other basic needs to the rural population, are a source of inputs into the agricultural system. However, these values are specific to a site and probably vary widely. The intensity of extraction of various products and forest dependency may vary among different communities, among households within communities, and between locations in the forest. The socio-economic and cultural factors of the forest communities and existing institutional mechanisms of forest management influence the forest dependence and the intensity of extraction of various forest resources by the local communities.

Table 1: Demographic Details of Sample Households

Particulars	Tribal Communities				Non-Tribe	Total
	KN	PN	KR	Total Tribe		
No. of sample households	22	29	29	80	114	194
Male Population	49	72	77	198	253	451
Female Population	44	70	63	177	256	433
Total Population	93	142	140	375	509	884
Average Family Size	4.23	4.89	4.83	4.68	4.46	4.56
Sex Ratio*	897	972	818	894	1011	960

Note: KN = Kattunaikkan, PN = Paniyan, KR = Kuruman
* Number of females per 1000 males.
The overall dependence on the forest by the sample households for various purposes based on their community is given in table 2.

The understanding of the nature and extent of dependence on the forest by the local community necessitates household level analysis. This section focuses on estimating income from NWFP at the household level and analysing the extent of dependence on NWFP by the local community.

Demographic particulars of the sample

The demographic details of the sample households classified by the community are given in table 1. Out of the 194 sample households, around 59 percent are non-tribal and the remaining 41 percent belong to three different tribal communities, viz. Kattunaikan (KN), Paniyan (PN) and Kuruman (KR). The average family size is 4.56. The average family size is almost the same for tribal and non-tribal.

All the sample households in the Kattunaikan community depend on the forest for the collection of NWFP for sale and collection of food items for subsistence use. While the Paniyan community also largely depends on the forest for these two purposes (79.39 percent and 72.41 percent of households respectively); the dependency of Kuruman and non-tribal households on the forest for these two purposes is meagre. The households in these two communities depend on the forest mainly for the collection of grass and bamboo, which are for their own use. It shows that the households' dependency on the forest by the Kattunaikan community households is as expected.

Table 2: Number and Percentage Distribution of Sample Households Depending on Forest for Various Purposes

Particulars	Community					
	KN (n=22)	PN (n=29)	KR (n=29)	Total Tribal (n=80)	NT (n=114)	Grand Total (194)
Collection of Non-wood Forest Products for Sale	22 (100)	23 (79.39)	2 (6.89)	47 (58.75)	7 (6.14)	54 (27.83)
Collection of Food Items for subsistence use	22 (100)	21 (72.41)	5 (17.24)	48 (60.00)	11 (9.65)	59 (30.41)
Fishing for subsistence use	16 (72.72)	19 (65.52)	8 (27.59)	43 (53.75)	9 (7.89)	52 (26.80)
Animal Food for subsistence use	7 (31.82)	2 (6.89)	1 (3.45)	10 (12.50)	-	10 (5.15)
Collection of Grass and Bamboo	21 (95.45)	16 (55.17)	11 (37.93)	48 (60.00)	47 (41.23)	95 (48.96)
Material for Agricultural purpose	0	0	9 (31.03)	9 (11.25)	13 (11.40)	22 (11.34)

Note: Figures in the parentheses are percentage of households in the particular community depending on forest to the total sample members in the community.

Location

Location of the households in the protected area is one of the important factors that are hypothesised to influence the extent of dependence. Out of the 71 sample households in the interior area, 36 percent of the households collect various NWFPs for sale. On the other hand, in the peripheral area, percentage share of households who go for extraction is less (22 percent). This is expected due to two major reasons. In the interior area, the major activity of the households is collection of NWFP. In the peripheral area, alternative sources of livelihood are more compared to the interior area. Income from occupation and cultivation is more for people living in the peripheral area. The percentage of households who consume various forest products as food is also higher in the interior forest area. For instance, 46 percent of the households in the interior area collect various NWFP of plant origin as food items. The location-wise details of the forest dependence are given in table 3.

Table 3: Location Wise Distribution of Number and Percentage of Sample
Households Depending on Forest

Particulars	Location		
	Periphery (n= 123)	Interior (n=71)	Total (n=194)
Collection of Non-Wood Forest Products for Sale	28 (22.76)	26 (36.62)	54 (27.83)
Collection of Food Items for subsistence use	26 (21.14)	33 (46.48)	59 (30.41)
Fishing for subsistence use	29 (23.58)	23 (32.39)	52 (26.80)
Animal Food for subsistence use	7 (5.69)	3 (4.22)	10 (5.15)
Collection of Grass and Bamboo	50 (40.65)	45 (63.38)	95 (48.96)
Material for Agricultural purpose	14 (11.38)	8 (11.27)	22 (11.34)

Note: Figures in parentheses are percentages to total number of sample households in the respective locations

Income Derived from NWFP

The shares of NWFP going to the household and to the market are valued separately. The distinction is considered to be important[4]. Products consumed at home are valued at their retail purchasing price in the village/ town and products sold on the market are valued at their forest gate price.

Table 4 shows the gross income from NWFP per tribal household for the major group of NWFP items. The major group of NWFP are edible products, which include honey and gooseberry, and medicinal plants. While 76 percent was derived from sale of edible products, medicinal plants accounted for 17 percent. Since edible products, such as honey and gooseberry have a private market in the nearby town, the intensity of extraction of these products is much higher compared to other products. The major items collected for self-consumption are honey, gooseberry, various types of tuberous roots and mushrooms. The values of these items were calculated from the market price, if available, or from the price of the substitutes. The value derived from the products for consumption amounted to Rs. 49 per household.

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[4]The value of products used for domestic consumption by the gatherers are valued at the retail purchasing price in the village because it is at this price the local forest dweller would buy these products for additional consumption. This includes cost of transportation and processing cost if any. Hence retail price is the opportunity price for consumption. The products marketed fetch the collection price offered by the Society. Refer Godoy *et al.,* (1993).

Table 4: Mean Annual Income from NWFP per Tribal Household (Both for Sale and Consumption) – Item-wise Classification

NWFP items	Value per household (in Rs.)	% to Sub-Total
A) NWFP for Commercial Use		
Edible Products*	2673.19	75.66
Medicinal Plants	604.37	17.11
Other Items	255.41	7.23
Sub-Total (A)	3532.97	100.00
B) NWFP for Consumption		
Honey	22.00	44.84
Tuberous Roots	7.95	16.20
Gooseberry*	15.40	31.38
Mushroom*	3.72	7.58
Sub-Total (B)	49.07	100.00
Grand Total (A+B)	3582.04	

* Value includes collection by non-tribes also but it is negligible.

Table 5: Mean Annual Household Income from NWFPs for Commercial Use

Community	Gross income (in Rs.)	Net income (in Rs.)*
Kattunaikka (KN)	9542.59	4265.36
Paniya (PN)	1936.86	325.10

* Net value is calculated after deducting labor cost of collection and transportation cost.

Table 5 shows per household income from NWFP collected for commercial use by the two major communities, Kattunaikan and Paniyan, who depend on the forest more than the other tribal community. Gross incomes per household are Rs. 9,542 and Rs.1,936 for Kattunaikan and Paniyan communities respectively. If we deduct cost of collection and transportation, the net incomes are derived as Rs. 4,265 and Rs. 325 per household respectively. The cost of labor time spent in collection of NWFP is imputed from the opportunity wage rate prevailing in the village. Further, if we allow for cost of labor time spent during the night in collecting honey, net income per household becomes less. For instance, net income per household for the Kattunaikan community, who are traditionally honey collectors, works out to Rs.3,544, an additional 17 percent decrease in value.

Present Worth of NWFP

The degree of dependence on NWFP is different among the local communities. A knowledge of the extent of dependence is important for managing the protected area to

Table 6: Present Worth of NWFP (Gross) Per Household Extracted for Commercial Use (In Rs.)

Discount Rate (%)	10 Years		20 Years		Infinite Stream	
	KN	PN	KN	PN	KN	PN
8	64030.78	12996.33	93696.30	19017.54	119282.37	24210.75
10	58639.21	11902.00	81245.61	16490.43	95425.90	19368.60
12	53915.63	10943.26	71275.19	14466.73	79521.58	16140.50

Note: Present worth is calculated on the assumption that the quantity extracted remains constant over time. .

Table 7: Present Worth of NWFP (Gross) of Commercial Use Projected for the Population (in Million Rs.)

Discount Rate (%)	10 Years		20 Years		Infinite Stream	
	KN	PN	KN	PN	KN	PN
8	17.74	4.64	25.95	6.79	33.04	8.64
10	16.24	4.25	22.50	5.89	26.43	6.91
12	14.93	3.91	19.74	5.16	22.03	5.76

achieve long term objectives. For instance, one of the major objectives of the Management Working Plan of the protected area of Wayanad is to conserve forest biodiversity by relocating various forest dependent communities from the interior part of the PA to the outside of the protected area. In this context, it is important to know the foregone benefits of extraction of NWFP due to complete protection of the sanctuary. Table 6 describes the present worth of gross annual income from NWFP per household calculated for different time horizons and at different discount rates. We have calculated the present worth for two major tribal communities, namely the Kattunaikkan (KN) and Paniyan (PN). The present worth of gross income per household for the Kattunaikan community is Rs. 64,030 at 8 percent discount rate for a time horizon of 10 years. The gross income projected for the population of this particular community is Rs.17.74 million at 8 percent discount rate for the ten-year period (Table 7). On the other hand, for the Paniyan Community, the present worth of gross income per household is Rs. 12,996 at the same rate of discount and time period. The value projected for the population is around Rs.4.60 million, which is comparatively low compared to the other community. Similarly, the values estimated at various discount rates and different time horizon is self-explanatory. The Planning Commission of India has been using 12 percent social rate of discount for taking investment decisions. Kramer *et al*., (1994) used a 10 per cent discount rate for estimating net present value of the opportunity costs borne by the villagers of Mantadia

Table 8:   Net Present Worth (NPW) of NWFP for an Infinite Stream

Discount Rate (%)	KN		PN	
	NPW per household (in Rs.)	Projected for population (in million Rs.)	NPW per household (in Rs.)	Projected for population (in million Rs)
8	53317.00	14.77	4063.75	1.45
10	42653.60	11.81	3251.00	1.16
12	35544.66	9.85	2709.17	0.97

National Park in Madagascar as a result of lost access to the park.

Net present worth (NPW) of non-wood forest products per household and projected for population is reported in table 8. It is derived after deducting cost of labor time spent for collection of various forest products and cost of transportation. The calculation is done on the assumption that NWFP extractors have positive opportunity cost of labor. Net present worth projected for population of the KN community for infinite time horizon at 10 per cent discount rate is Rs. 11.81 million while for the Paniyan community it is Rs. 1.16 million. As mentioned by Ninan *et al*., (2000), the values estimated by the above procedure could be interpreted as the foregone benefits of biodiversity conservation from NWFP. These values would serve as good indicators of minimum compensation to be made to the local community, if they are to be relocated for the purpose of forest/biodiversity conservation.

Quantitative Estimates of Factors Influencing Community Dependence on NWFP

In this section we estimate the extent of influence of various factors on forest dependency, specifically dependence on NWFP. For reasons mentioned earlier, Censored Regression Model (Tobit Model) is used to estimate the parameters. The sample is restricted to tribal communities who are legally permitted to collect various forest products. The definition of the variables used in the model and their expected signs are given in table 9. The estimated results are given in table 10. As we have mentioned earlier, the dependent variable is gross annual household income from non-wood forest products that have a market. It is assumed that the income derived from collection of NWFP, or dependence on forest, tends to be negatively correlated with total household income derived from other sources, either from occupation or cultivation. The signs expected for the variables such as income from other sources is negative because more the income from the other

Table 9: Definitions and Terms Used in Tobit Model and their Expected Signs

Variable	Definition	Expected Sign
OCCU-INCOME	Annual Household Income from Occupation (Rs.)	Negative
CULT-INCOME	Annual Household Income from Cultivation (Rs.)	Negative
ADULTMEN	Number of adult men in the age-group 14-65	Positive
PADDY AREA	Area under cultivation of paddy (Area in cents)	Negative
TOTAL AREA	Total Land Area under Cultivation (Area in cents)	Negative
LOCATION	Location Dummy D = 1 if the household is located in the Interior = 0 otherwise	Positive
COMMUNITY	Community Dummy D = 1 for KN and PN = 0 otherwise	Positive
EDU-ADULTS	Number of adults in the age-group 14-65 who can read and write	Negative

Dependent variable: Gross annual household income from the sale of Non Wood Forest Products (Rs.)

sources, less the dependence on NWFP. Similarly, ownership of land also makes the communities depend less on the forest and therefore the sign is expected to be negative. We hypothesise that relatively more number of adult males available in a family induces them to go for more extraction. However the dependence is expected to be less if there are more educated adults in a family. The distance to be travelled to the source of product origin is another important factor which influences the household decision to extract forest products. Our assumption is that if people live near the source of forest products, there is a greater chance of extracting the products more intensively. To see if there is any such significant relationship, a dummy variable for location is used.

The estimated results given in table 10 shows that except for two variables, all the others have expected signs. There is a significant negative relationship between the dependent variable and annual household income from cultivation. The inverse relationship between household income from non-wood forest products and income from cultivation indicates that households with higher agricultural income depend less on NWFP. It shows that for a unit increase in income from cultivation of land, there will be a 50

Table 10: Estimated Results of the Forest Dependence Model

Variable:	Coefficient		t	P > t
OCCU-INCOME	-0.0388	0.0720	-0.54	0.591
CULT-INCOME	-0.5042	0.2306	-2.19*	0.032
ADULTMEN	-233.97	886.36	-0.26	0.793
PADDY AREA	-98.32	47.31	-2.08*	0.041
TOTAL AREA	111.07	40.68	2.73*	0.008
LOCATION	1464.21	1444.83	1.01	0.314
COMMUNITY	10370.62	3179.78	3.26*	0.002
EDU-ADULTS	-1345.03	725.76	-1.85	0.068
CONSTANT	-4900.13	3521.10	-1.39	0.168

*Significant at 5% level.

Number of Observations	= 80
LR Chi^2 (8)	= 64.17
Pseudo R^2	= 0.0630
Log Likelihood	= - 477.275
Left – censored observations at AHINNWFP P < = 0	= 33
Uncensored Observations	= 47

percent reduction in the collection of NWFP. The inverse relationship between the dependent variable and area under paddy cultivation clearly shows that households who have alternative secured source of livelihood may prefer not to depend on the forest for extraction of various NWFP. It shows that for a one cent[5] increase in area under paddy cultivation, average household income from NWFP will decrease by Rs.98 per annum.

"Location" is a dummy variable introduced to know whether the settlement or hamlet in the forest area influences the intensity of extraction of various forest products. The coefficient of the dummy variable for location has the expected sign but is not statistically significant

at the 5 percent level. On average, a household living in the interior forest area derives an additional income of Rs.1464 per annum from NWFP compared to households living in the periphery, holding all the other factors constant. It is evident that households located in the interior area of the forest have more access to available forest resources and a greater chance of extracting more products. Since the major source of income of the households located in the interior area is forest products, the intensity of extraction and pressure on the forest will be much higher. "Community" is a dummy variable, which is consistent with the observation that both Kattunaikkan and Paniyan Communities collect more NWFP and earn more income

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[5] 100 cents = 1 acre

compared to the Kuruman community. On average, a household belonging to either Kattunaikkan or Paniya Community derive an additional income of Rs. 10,370 per annum as compared to the Kuruman community, other things being equal. The coefficient is statistically significant.

Another important variable that determines the decision to depend on NWFP is level of education. The inverse relationship between income from NWFP and number of educated adults in the household indicates that higher the educational level more will be the exposure to the employment opportunities outside PA. The educated adults may prefer other types of employment to collection of forest products, which is considered to be a low profile occupation. The coefficient of total land area is significant but it does not have the expected sign. It shows that the mere possession of land may not provide economic security or source of income. If the households could not cultivate and earn a reasonable income, rural households may depend on the forest for earning an income such as collection of NWFP. Sometimes, households possessing cultivable land are not able to cultivate due to fear of crop damage from wild animals. Similarly, due to fear of relocation of the households from the protected area to the outside, people may hesitate to grow cash crops, which give a yield in later years. Another important factor,

the coefficient of which has a sign against the hypothesis, is the number of adult men in the household. The result shows that there is a negative relationship between number of adult men in the household and income from forest products. However, the result is not statistically significant. The reason may be that the women also actively participate in extraction activities. The negative relationship between annual household occupational income and the dependent variable is as expected.

Summary and Conclusions

The conflict between management and the local people is an unresolved issue in the protection of forest biodiversity. The existing institutional mechanism for collection and marketing of NWFP in the study area faces many weaknesses. The Co-operative Society, which is in charge of procuring various products from the extractors, procures only a few selected items, which have high demand. The pattern of extraction of various NWFP over time shows that there has been a considerable fluctuation in the quantity collected by the Society. An analysis of price series over time has shown that for selective products, price has acted as an incentive to the collectors to extract more of the same product. It was observed from the data recorded by the Co-operative Society that it has promoted extraction of those products, which have high demand

and the selection of products for procurement has no bearing with sustainable extraction. Again, in the present marketing system by the Federation, there are many intermediaries between marketing agency and final consumer. Higher marketing margin by these middlemen results in higher consumer prices and low collection price received by the NWFP collectors. An analysis of price spread by a study (Mythili and Shylajan, 2002) of the same protected area has given a result that the percentage difference between final consumer price and the collection price was almost 60% for some products. Hence, existing institutional mechanism for collection and marketing has to be improved by eliminating middlemen. This will improve the economic well being of the local people for a given level of effort on the extraction of the products.

When the institutional weakness in the marketing is removed, the local people will get their due share and this will enhance their economic opportunities. But this will not entirely solve the problem of protection of forest and its rich biodiversity. The overall socio-economic upliftment of forest dependent communities will reduce the human pressure on PA and help conservation of biological diversity. Hence the principle is to make the local people less dependent on forest. The household analysis on overall dependence on forest shows that income from other sources like cultivation is inversely related to extraction of NWFP. This study corroborated with the other studies that providing alternate source of income for the livelihood either through employment opportunities or by a secured source of income from cultivation will help reduce the pressure on protected area. Relocating the forest dependent communities from interior part of the sanctuary to outside may also help to reduce human-wildlife conflict provided they are assured of adequate compensation and secured source of income for the livelihood. This may be the long-term solution because the forest ecosystem in the protected area provides benefits, which are non-substitutable, and the damage to the forest ecosystem may be irreversible.

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