NON TIMBER FOREST PRODUCTS AND BIODIVERSITY CONSERVATION- A STUDY OF TRIBALS IN A PROTECTED AREA IN INDIA

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Abstract

This study analyses the economics of Non Timber Forest Products (NTFPs) and the economic values appropriated by tribals in a protected area in India. Using primary data covering a cross section of tribals in the Nagarhole National Park (NNP), South India the study notes that the economic values appropriated by the tribals are quite high. Even after including external costs (i.e. wildlife damages costs and defensive expenditures to protect against wildlife attacks) the Net Present Value of NTFP benefits derived by the tribal households was over Rs 30,378 per household (at 12% discount rate for cash flows summed over 25 years). Interestingly when the external costs borne by third parties (i.e., coffee growers) are taken into account the net NTFP benefits turned negative. In other words, although from the NTFP extractors viewpoint NTFP extraction is a viable activity, from the society's viewpoint this is not so. The estimated net NTFP benefits from NNP after including the external costs borne by NTFP extractors was estimated at between USD 33.5 to 167.5 per ha per year using alternate assumptions regarding the park's catchment area. The tribals have a positive attitude towards biodiversity conservation. Asked to justify and rank the reasons why biodiversity needs to be conserved, the tribals emphasized its livelihood and ecosystem functions. Using contingent valuation method, the study notes that those with income from coffee estates and forest employment, and those residing in the core zone of the national park are less willing to accept compensation and relocate outside the national park. The study suggests improving the incentive structure in order to obtain the support and participation of tribals in biodiversity conservation strategies.

Key Words

Non Timber Forest Products; Biodiversity Conservation; Net Present Values; External Costs; Contingent Valuation Method

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1. Introduction

Non Timber Forest Products (NTFPs) are important from an economic, social, cultural and ecological viewpoint. Apart from providing subsistence, income and employment to tribals and indigenous communities, they are also high value internationally traded products estimated at USD 11 billion a year (SCBD, 2001; Shanley *et.al.*, 2002; Simpson, 1999). Although NTFP values may not compete well with land conversion values, their importance arises more in the context of the role they play in supporting local community incomes (SCBD, 2001). Some NTFPs also have significant cultural value as totems, insense, and other ritual items (www.cifor.org). Whether extraction of NTFPs is compatible with biodiversity conservation or not is widely debated. While some (cf. Peters *et.al.*, 1989) suggest that NTFP extraction is financially viable and ecologically sustainable, others point to its adverse social and ecological consequences (cf. Arnold and Perez, 2001; SCBD, 2001). In view of its significance, this paper seeks to analyse the economics of NTFPs and the economic values appropriated by tribals in a protected area in India, and their value preferences for biodiversity conservation. The Nagarhole National Park (NNP) located in the Western Ghat region in South India, which is one of the 25 biodiversity hotspots in the world is the setting for the study (Myers, 1988; 2000). The NNP is rich in flora and fauna including several endangered species. The biodiversity of the national park is facing threats and immense pressure due to anthropogenic and other factors. Besides there are tribal settlements both within and on the periphery of the park who depend on the park for NTFPs and other benefits.

2. Objectives

In the light of the above, the specific objectives of the paper are as follows:-

1. To estimate the economic values of NTFPs appropriated by the tribal households of NNP.
2. To estimate the net benefits from NTFPs derived by the tribal households both excluding and including the external costs of

wildlife conservation i.e. wildlife damage costs and defensive expenditures to protect against wildlife attacks.

3. To estimate the NTFP benefits obtained by the total local community from the Nagarhole National Park
4. To analyse the local tribal community's Willingness to Accept compensation and relocate outside the national park and the socio-economic and other factors influencing their 'yes' or 'no' responses.

3. Data and Methodology

The study is based on a sample survey of 100 tribal households selected from three sets of tribal hamlets, i.e., those residing within the NNP, on the park fringe and a rehabilitated village on the park's periphery. Tribal hamlets were selected purposively and then cluster sampling was used whereby all the households within the selected hamlet were surveyed. Data were collected in the year 2000 through a detailed structured schedule comprising two parts, a socio-economic survey and a contingent valuation survey. For the CVM study, the discrete choice method which seeks simple 'Yes' or 'No' answers to an offered bid is used. The discrete choice method was preferred over other methods (eg. open-ended method) because of its inherent advantages such as this method would be easier for villagers to react to the questions; households could respond keeping some budget or constraint in view, i.e., the upper bounds on bids could be controlled; also this method minimizes any incentive to strategically over-state or under-state WTP/WTA (Loomis, 1988; Moran, 1994). Dichotomous choice methods require the use of parametric (typically logit or probit) probability models relating 'Yes' or 'No' responses to relevant socio-economic and other variables. Opportunity cost method and cost-benefit appraisal have been used to estimate the benefits from NTFPs. Logit model has been used for the contingent valuation analysis.

4. NTFP Benefits

Like most forest communities, the tribal communities of Nagarhole depend on the NNP for a variety of goods and services, and especially for NTFPs. These NTFPs provide subsistence, income and employment for the tribals. Before

analysing our data, it would be useful to review the various cross country estimates of the economic values of NTFPs and their limitations.

4.1 *Economic Value of NTFPs: A Review*

Estimates of the economic values derived from NTFP extraction show wide variation across regions, forest sites, and communities. Reviews by Godoy *et.al.* (1993) and SCBD (2001) covering a cross section of countries observed the net economic values from NTFP extraction to vary widely between USD 1 to USD 420 per ha per year with a median value of USD 50 per ha per year. These wide variations in the estimates of NTFP values are due to differences in the methodology and assumptions employed to estimate the economic value of NTFPs, biological and economic diversity of areas studied, NTFP products valued, etc. It is, however, not clear whether the various estimates from different studies conducted between 1981 to 2000 are expressed in terms of constant US dollars to make them comparable, or in current prices. Godoy *et.al.* (1993), cite several limitations of the studies reviewed by them. First and foremost they failed to make a clear distinction between two types of quantities being valued viz., the inventory or stock quantity of the forest resource, and the flow i.e., actual quantity of forest resources extracted. While some researchers have valued the inventory, and others the flow, still others have valued both. The two are, of course, inter-related. Overharvesting of forest resources (actual flows) will affect the stock of forest resources, which in turn will impact on the potential flow of forest goods (SCBD, 2001). The SCBD (2001) review makes a clear distinction of the various estimates of NTFP values in terms of the stock of goods, potential and actual flows. While in terms of the stock concept, the gross or net benefits from NTFPs across countries and regions varied from USD 377 to 787 per ha per annum, in terms of the flow concept (potential or actual flows) these values ranged between USD 0.3 to USD 188 per ha per annum. Earlier studies are also not clear as to whether the estimates provided by them are gross or net values. From an economic standpoint, it is the net economic value (i.e. gross value minus costs) which is relevant since it is this factor which provides the necessary incentive to extract NTFPs. Further while most studies have either valued only the flora or only the fauna, a proper and full assessment of the economic values derived from NTFP extraction should value both the flora and fauna harvested from the

forests. The prices used to value the NTFPs is another issue which has received inadequate attention. It is suggested that while NTFPs which are marketed ought to be valued at the selling prices, those retained for consumption need to be valued at forest gate or local market prices. In the case of NTFPs that are not traded or for which prices are not available, the price of a close substitute may be used to value such NTFPs. Alternatively, what users of the products are willing to pay for the NTFP in question, as revealed through a contingent valuation survey is also recommended. Moreover, a proper economic valuation of NTFPs should correct for taxes and subsidies or use shadow prices including estimating the externalities of extracting NTFPs (Godoy *et.al.,* 1993). For instance, extraction of NTFPs deprive the wild animals of their food sources; in turn this may lead them to search for alternate food sources in human settlements and habitations resulting in their causing damages to agricultural crops, property, livestock and at times even human life. These externalities of NTFP extraction need to be accounted for while estimating the net benefits from NTFP extraction. In estimating the cost of NTFP extraction some researchers have used the country's official wage rate as an estimate of the unprotected rural wages. But a proper economic valuation should use the wages which people actually pay or wages prevalent at the local level (Godoy *et.al.,* 1993). Moreover, harvesting, consumption or sale of NTFPs occur at different time periods and hence discounting of the values derived from NTFPs is essential. The sustainability of NTFP extraction is another aspect which has been relatively neglected in the studies reviewed (Godoy *et.al.,* 1993; SCBD, 2001). To top it most studies are also not clear as to what they mean by Non-Timber Forest Products. While some exclude fuelwood from the purview of NTFPs, others include it under NTFPs. In our analysis NTFPs are taken to also include fuelwood, but excludes timber, sawn timber, etc.

4.2 *Estimates of NTFP Values*

Keeping in view the above, in our survey information was elicited on both the flora and fauna collected by the sample tribal households from the NNP, prices realised, and quantities retained for self-consumption, etc. To estimate the economic values of the NTFPs, the selling prices quoted by the tribal households have been used to value those NTFPs that were marketed (including that portion retained for

self-consumption); in those cases where the tribal households have not reported any price, the forest gate or local market prices have been used. In the case of those NTFPs which are wholly retained for self-consumption prices quoted by the tribal households or when these were not furnished the forest gate or local market prices have been used. For certain NTFPs like wild edible tubers, green leaves, mushrooms and bush meat for which prices are not available or known the price of a close substitute has been used. In the case of medicinal plants where the tribal respondents were unable to disclose the quantity collected, and problems in valuing them, the opportunity cost of labour time spent for collecting medicinal plants has been used to value them. Although the most scientific method to value the NTFPs is to identify, count, weigh and measure them as they enter the village each day (cf. Godoy *et.al.*, 1993) over all the seasons of the forest cycle, if not over the entire year, due to resource and time constraints most researches such as ours are based on single point time surveys, which rely on the recall method to estimate the quantity and value of the NTFPs collected and consumed or marketed. In doing so care has to be taken during the survey so that no item gets omitted or under or overestimated as well as account for the seasonal availability and collection of NTFPs. In our survey, a structured household questionnaire was used to collect details of NTFPs collected, consumed and/or sold by the tribal respondents. The respondents were asked to furnish details of all NTFPs collected during the preceding thirty days; and in the case of certain NTFP food items over the preceding week. These figures were then used to extrapolate and arrive at the economic values derived by the tribals from NTFP collection per year. In doing so care has been taken to account for the seasonal availability of most forest products.

A summary of the NTFPs extracted and the economic values derived by the sample tribal households from the NNP are furnished in Table 1. As evident fuelwood followed by honey, wild edible tubers, tree seeds, bush meat are the major items collected by the sample tribal households from the NNP.

4.3 *Net NTFP Benefits*

To estimate the benefits derived by the sample tribal households from NNP, the stream of NTFPs benefits need to be converted into present value terms.

Table 1: Summary of the Various NTFP Benefits Appropriated by the Local Tribals of Nagarhole from Nagarhole National Park.

Benefits derived from Nagarhole National Park	Valuation Method	Value of NTFP Benefits derived by Sample Nagarhole Tribal Households in Rs per household per annum (1999 prices)
Fuelwood	Market Based Valuation. The local market Price of fuelwood was Rs 0.85 per kg at 1999 price.	1689.3
Bamboo and tender bamboo shoots	Market based Valuation. The Price of bamboo in the local market was Rs 40 per pole and of tender bamboo shoots – Rs 2 per kg	750.0
Honey and honey wax	Market Based Valuation. The price of honey was Rs 40 per kg and of honey wax about Rs. 47 per kg in the local market	635.3
Wild Edible tubers	Market Based Valuation. The price of a close substitute, that is, cassava (tapioca) has been used for valuation. The price of tapioca was Rs 2.5 per kg in the local market.	378.0
Wild Edible green leaves	Market Based Valuation. The price of a close substitute, that is, vegetable leaves in the local market has been used for valuation, i.e., Rs.2 per kg	316.8
Wild Edible Mushrooms	Market Based Valuation. The price of a close substitute that is domestic mushroom has been used for valuation. The price of mushrooms was about Rs 16.58 per kg in the local market.	254.7
Wild Meat (Bush Meat)	Market Based Valuation. The price of a close substitute, i.e., mutton has been used for valuation. The price of mutton was Rs 100 per kg in the local market.	207.0
Fiber	Market Based Valuation. The local market price of the close substitute of fibre, that is thin coir rope has been used to estimate the value. Value of thin coir rope was Rs 30 per kg at 1999 price.	149.8
Wild Edible Fruits and Nuts	Market based valuation. The local price was around Rs 5 per kg	103.2
Tree seeds	Market Based Valuation. Forest department's price for tree seeds was Rs 9 per basket of 10 kgs at 1999 price. One basket contains approximately 10 kg of seeds	87.3
Gooseberry	Market based valuation. The local market price of gooseberry was around Rs 5 per kg	84.3
Gum	Market Based Valuation. The average local market price of gum was around Rs 30 per kg	26.5
Medicinal Plants	Opportunity Cost of labour time spent for collection has been used	8.9
TOTAL		4691.0

For this purpose, the cash flow of benefits is summed up over a time period of 25 years. This does not seem unreasonable considering that even after more than 25 years after NNP was notified as a national park (in 1975), the tribals continue to appropriate NTFPs from the park. This also assumes that the forest is used sustainably and there is no bar on the local tribals from limited use of the forest. In this case the cash flows will constitute the benefits derived by the tribals from NNP. However, the Indian Wildlife (Protection) Act of 1972 prohibits any human use of national parks in which case the benefits estimated need to be considered as the foregone benefits of biodiversity conservation borne by the tribals of Nagarhole. The cash flow of NTFP benefits derived by the sample tribal households from NNP are estimated using three alternate discount rates, 8, 10 and 12 per cents so as to check the robustness of our estimates For assessing costs, we have taken into account the time spent by the tribals for collecting NTFPs as well as the seasonal nature and duration of the availability and collection of different NTFPs. Further certain items are collected jointly (eg. fuelwood and fodder) and this factor has also been taken note of while estimating costs so as to avoid double counting. The estimated time spent for collecting NTFPs has been imputed at the minimum wage foregone by the tribals for working in nearby coffee estates, i.e., Rs.40 per humanday. Using this information, the Net Present Values (NPVs) of the NTFP benefits derived by the sample tribal households from NNP is presented in Table 2.

As evident, the NPVs of the NTFP benefits derived by the sample tribal households from the NNP is positive and significant. Taking all tribal households as a whole it is seen that the NPVs of Total NTFP benefits realised by the tribals for cash flows summed up over 25 years at 1999 prices varies from over Rs.31,172 to Rs.42,426 per household using alternate discount rates. Non-food items constitute the dominant share of NTFP benefits appropriated by the tribal households residing within the national park, and on the Park's boundary (i.e., Dammanakatte), whereas among the Nagapura tribals the share of food items in total NTFP benefits is slightly higher than non-food items. If forests are used unsustainably this will impact on the benefits by reducing expected benefits and also increase the costs of collection such as more time being needed to spend to collect NTFPs, etc.

Table 2 : Net Present Value of Non-Timber Forest Products (NTFPs) Benefits derived by Sample Tribal Households of Nagarhole from Nagarhole National Park in Rs per household for cash flows summed up over 25 years at 1999 prices

Tribal Villages / Hamlets	Discount Rate %	Net Present Value of Benefits derived from Non-Timber Forest Products		
		Food items	Non-Food items	Total
		(Rs per household)		
Nagapura (Rehabilitated village on Park Periphery)	8	12908.9	12052.0	24960.9
	10	10976.7	10248.2	21224.9
	12	9484.6	8855.1	18339.7
Dammanakatte (Village on Park Boundary)	8	17342.1	37865.8	55207.9
	10	14746.5	32198.3	46944.8
	12	12741.9	27821.3	40563.2
Villages Inside the National Park	8	20321.9	34094.2	54416.1
	10	17280.2	28991.2	46271.4
	12	14931.2	25050.2	39981.4
All Villages / Hamlets	8	16954.9	25471.7	42426.6
	10	14417.1	21659.3	36076.4
	12	12457.3	18715.0	31172.3

One approach suggested by Markandya and Pearce (1987) to adjudge whether NTFP extraction rates are sustainable or not is to estimate the value of NTFPs after adjusting the cost of extraction by adding a depletion premium based on the expected rate of extraction (Godoy *et.al.*, 1993). The alternate approach is to do a sensitivity analysis of the estimate of net benefits from NTFP extraction which is attempted here. A sensitivity analysis using alternate assumptions indicates that if the expected benefits were to reduce by 50 per cent, and costs rise by a similar proportion, the NPVs will decline sharply to just around Rs.9967 per household at 12 per cent discount rate (Table 3).

5. NTFP Benefits and Externalities

In assessing the net NTFP benefits one needs to account for the externalities of NTFP extraction. As stated earlier, extraction of NTFPs from the national park deprives the wild animals of their food sources, leading them to search for alternative food sources in human settlements and agricultural lands resulting in

their causing damages to crops, property, livestock and humans. Extraction of NTFPs thus give rise to negative externalities in the form of wildlife damages to crop and property of NTFP extractors and third parties. The sample tribal households reported wildlife damage costs of over Rs.101 per household during 1999-2000. However, it is not only the NTFP extractors who are affected by the negative externalities of NTFP extraction but also third parties. In our study, for instance, the sample households of Maldari, a coffee growing village bordering NNP reported wildlife damages costs and defensive expenditures to protect against attacks

Table 3: Sensitivity Analysis of the Net Present Value of Non-Timber Forest Products (NTFPs) Benefits derived by the Sample Tribal Households of Nagarhole from the Nagarhole National Park in Rs per household for cash flows summed up over 25 years at 1999 prices

Assumption made	Discount Rate %	Net Present Values of Benefits derived from Non-Timber Forest Products		
		Food items	Non-Food items	Total
		(Rs per household)		
Benefits reduced by 25%	8	12027.0	17881.1	29908.1
	10	10226.9	15204.8	25431.7
	12	8836.7	13137.9	21974.6
Cost rise by 25%	8	16265.7	24249.1	40514.8
	10	13831.2	20619.6	34450.8
	12	11951.0	17816.7	29767.7
Benefits reduced by 25%, and costs rise by 25%	8	11337.9	16658.5	27996.4
	10	9640.9	14165.1	23806.0
	12	8330.4	12239.6	20570.0
Benefits reduced by 50%, and costs rise by 50%	8	5721.0	7845.2	13566.2
	10	4864.7	6671.0	11535.7
	12	4203.4	5764.2	9967.6

from wildlife. It could be argued that NTFP extraction by the tribals of Nagarhole not only affected them but also third parties such as the coffee growers of Maldari. These external costs need to be accounted for while estimating the net benefits from NTFP extraction. Table 4 presents the estimates of net NTFP benefits derived by the sample tribal households of Nagarhole both excluding and including these external costs. It is interesting to note that even after including these external costs

borne by the sample tribal households, i.e., the NTFP extractors the net NTFP benefits are positive and high. But most interesting is that if the external costs borne by a third party (i.e. coffee growers of Maldari) are also added to costs the net NTFP benefits turns negative (Rs –510.7 per household per year or Rs. –3212 at 12% discount rate for cash flows summed up over 25 years). It is thus clear that although from the perspective of the tribals, NTFP extraction yields positive and high returns, when the negative externalities of NTFP extraction borne by third parties are also taken note of the net NTFP benefits turn negative.

Table 4: Net Non-Timber Forest Products (NTFP) Benefits Excluding and Including External Costs

Item	Net NTFP Benefits		
	Excluding External Costs[1]	**Including External Costs borne by Sample Tribal Households (i.e. NTFP Extractors)[2]**	**Including External Costs borne by Sample Tribal Households and third parties[3]**
	Rs per household per year		
Undiscounted Values	3974.5	3873.3	-510.7
Discounted Values at following discount rates:	Rs per household (for Cash Flows summed up over 25 years at 1999 prices)		
8%	42426.6	41346.3	-4371.6
10%	36076.4	35157.8	-3717.3
12%	31172.3	30378.6	-3212.0

Note: 1. External Costs refers to Wildlife damage costs and defensive expenditures to protect against wildlife attack.
2. Net NTFP Benefits here is calculated after deducting costs of extraction plus the external costs (wildlife damage costs) borne by the sample tribal households (i.e. NTFP Extractors) from Gross NTFP Benefits.
3. Net NTFP Benefits here is calculated after deducting costs as above plus also the external costs (i.e. wildlife damage costs and defensive expenditures) borne by a third party, viz., the sample households of Maldari, the coffee growing village, which is close to the Nagarhole National Park boundary in Kodagu district of Karnataka State.

6. Estimate of NTFP Benefits for Nagarhole National Park

To estimate the economic value of NTFPs appropriated from NNP we need to extrapolate the benchmark values obtained from our survey and generalise for the

park as a whole, as well as convert these values from per household to per ha terms. This is also to facilitate comparison of our estimate with those of other studies. However, in undertaking such an exercise one faces a number of problems. One is how far appropriate it is to generalise based on the benchmark values obtained from a small area of forest to wider areas or the entire forest. The benchmark values may not necessarily be typical of the entire forest. The second is that in order to estimate the NTFP values on per ha basis we need to know the park catchment area that is accessible and used by the tribals and local people for appropriating NTFPs. Typically NTFP values ought to be higher in more accessible forest areas, and lower in less accessible areas as the costs of extraction rise when higher distances need to be covered for extracting NTFPs. SCBD (2001) lists other problems viz., that in a hypothetical world where the whole forest was exploited for NTFPs, prices and hence profitability of NTFP production should fall; failure to define whether the values in question relate to the stock of goods and services or their potential or actual flows; failure to account for post-harvest losses, etc.

In order to extrapolate the benchmark values and arrive at the estimated total value of NTFPs extracted by the population as a whole we need information about the number of households within and on the periphery of the National Park. As per a World Bank document (World Bank, 1996) there are about 1550 households residing within the NNP and 14779 households residing in the periphery of NNP i.e., a total of 16329 households over which the benchmark values need to be extrapolated. However, NTFP extraction rates would vary across forest sites and regions and the benchmark values may not adequately reflect the NTFP values appropriated by the population as a whole. Another important question is regarding the Park catchment area that is accessible and from which the tribals and locals extract NTFPs. This becomes all the more complicated when the villages and human settlements are not clustered or concentrated in any particular part of the national park or protected area but spread widely across the park and its surroundings, as is the case in our study area. In the NNP there are tribal settlements spread across the core and non-core zones of the park, and almost all round the park's periphery. Zeroing in on any particular figure to represent the park catchment area thus becomes all the more difficult. Keeping this in mind in our

study the NTFPs values obtained from the tribal hamlets located within the NNP have been used to extrapolate and generalise for the 1550 households living within NNP. The NTFP values of Nagapura have been used to generalise for all the households in the periphery of the national park. Using the above procedure the total NTFP values aggregated over all households living within and around the NNP works out to about Rs 48.20 million excluding external costs, and Rs 46.40 million when the external costs (i.e. wildlife damage costs) borne by the NTFP extractors are included. The external costs borne by coffee growers is not included due to lack of information on the coffee growers in the Park's vicinity. Moreover, these external costs will vary depending on the distance and location of the coffee estates from the Park boundary, etc. The estimated values then need to be converted into per ha basis. Keeping in view the limitations mentioned earlier, a range of values is estimated based on alternative assumptions, namely, that 10, 25 or 50 per cent of the national park constitutes the Park catchment area from which the tribals and locals can access and harvest NTFPs. The NTFP values expressed in terms of Rs and US dollars per ha per year are presented in Table 5. As evident the NTFP values after including the external costs borne by the NTFP extractors for NNP vary from over Rs.1442 to Rs.7212 per ha per year (or US dollars 33.5 to 167.5 per ha per year) depending on the assumptions made regarding the Park catchment area. Interestingly our estimates fall within the range of NTFP values of US dollars 1 to 188 per ha per year indicated by the various studies reviewed in SCBD (2001).

7. Valuing Local Tribal Community's Preferences For Biodiversity Conservation

The fact that the national park is a major source of livelihood for the tribal communities living within and on the periphery of the national park poses a serious challenge for biodiversity conservation efforts. Although the Government had initiated a programme for rehabilitation of tribals living inside protected areas by offering a package to them to relocate outside protected areas, out of around 1550 households residing within the NNP only 50 tribal households accepted the rehabilitation package at the time of our survey.

Table 5: Estimated Net Non-Timber Forest Products Benefits from Nagarhole National Park in Rupees and US Dollars per hectare per year

Assumed Park Catchment Area as % to Total National Park Area	Net NTFP Benefits	
	Excluding External Costs	Including External Costs incurred by NTFP Extractors
	Rupees per ha per year	
10	7492.1	7212.4
25	2996.8	2884.9
50	1498.4	1442.5
	US Dollars per ha per year	
10	174.0	167.5
25	69.6	67.0
50	34.8	33.5

Note: 1. Park Catchment Area refers to that proportion of the National Park Area that is assumed to be accessible and used by the households living within and on the periphery of the Nagarhole National Park for NTFP extraction.
2. External costs refers to wildlife damage costs.
3. The figures in Indian Rupees has been converted into US Dollar terms by using the exchange rate of 1 USD = Rs.43.0552 in 1999.

An obvious question that arises is as to why many of the tribal households have not accepted the package and moved out of the forest. Leaving aside the institutional hurdles in the rehabilitation programme, we tried to capture what determines the probability of their accepting the compensation and rehabilitation package offered by the Government. To study this we conducted a contingent valuation survey. The CVM survey was conducted as per the guidelines of the NOAA panel such as pre-testing of questionnaires, sufficient sample size, etc. Those tribal households who had not accepted the offer were asked to state whether they are ready to play a major role in biodiversity conservation by expressing their willingness to accept the rehabilitation package offered by the government and leave the park so as to provide a better habitat for the wildlife. The respondents were given a dichotomous choice of answering ‘yes’ or ‘no’ to the question.

To estimate the valuation function, the ‘yes’ or ‘no’ responses were regressed on a number of socio economic variables. In addition to age, literacy status, sex, household size of the respondents, we included variables to represent the income from NTFPs, coffee employment and forest employment, and whether the respondents were staying within the core zone of the NNP or outside. It was

hypothesised that although the state or Forest Department would desire that all human settlements within the national park should be relocated outside the Park limits, official concern and pressure is likely to be more on those tribals residing within the core zone of the national park. Hence, the attitude of the tribals residing within the core zone of the park may differ from those residing in the non-core zone. Due to space constraints, the summary statistics of the variables used to model the valuation function is not presented here.

Table 6 presents the results of the estimated equation using logit maximum likelihood estimates. As evident, the dummy variable for households living inside or outside the core zone of the national park is negative and statistically significant. This implies that the probability of the respondent to say 'Yes' to the WTA question is less when the respondent is from the core zone of the national park. Further, people having more income from employment in coffee estates and forest employment are less inclined to move out of the forest. This could be due to their fear about losing their employment in the coffee estates and forest if they are rehabilitated outside the forest. Alternatively this indicates that they are not fully convinced about the economic activities that they could undertake after rehabilitation. Although the tribal households derive considerable NTFP benefits from the national park, it is perplexing to note that the coefficient for the variable income from NTFPs has a positive sign, though not statistically significant. It may be noted that extraction of NTFPs from protected areas is illegal as per the Indian Wildlife (Protection) Act of 1972 which may also explain as to why the respondents are more concerned about losing the income from employment in coffee estates and forest in case they have to relocate outside the national park. The estimated model is highly significant with a likelihood ratio test of the hypothesis that the 7 coefficients are zero based on a chi-square value of 12.51. The Pseudo R^2 is 0.20 which is a good fit for cross-section data.

Table 6: Maximum Likelihood Estimates using Logit Model of Willingness to Accept Compensation (Rehabilitation Package) by Sample Tribal Households of Nagarhole National Park and relocate outside the Park

Variable	MLE Coefficients	Standard Error	t-ratio
Constant	-0.0834	1.869	-0.045
Age of the respondent	0.008	0.30	0.270
Dummy for the Sex of the respondent D=1 for male, and D=0 for female	0.639	0.780	0.819
Dummy for the Literacy Status of the Respondent D = 1 for Literates; and D = 0 for Illiterate	0.490	0.779	0.629
Household Size of the Respondent	0.040	0.326	0.123
Dummy for households living inside and outside the Core Zone of the National Park D=1 for households living inside the Core Zone of the Park D=0 for households living outside the Core Zone of the Park	-1.379***	0.736	-1.873
Income of the respondent from work in Coffee Estates and Forest Employment per year	-0.00006***	0.00003	-1.784
Net Income from Non-Timber Forest Products Marketed per year	0.003	0.002	1.342
Log Likelihood value	- -24.857		
LR Chi Squared (7)	- 12.51		
Significance Level of Chi Square	- 0.0849		
Pseudo R^2	- 0.2011		
No. of Observations	- 59		

Note: *** - indicates statistically significant at 10 per cent level of significance

8. Conclusion

The analysis indicates that the tribal households of Nagarhole derive considerable NTFP benefits from the Nagarhole National Park. They collect NTFPs for meeting their subsistence needs and also earn income. Even after including external costs (i.e. wildlife damage costs) the net NTFP benefits derived by the sample tribal households (i.e. the NTFP extractors) are quite high and significant. However, when the external costs borne by third parties (i.e. coffee growers in our case) are also included, these net NTFP values turn negative. In other words, although from the viewpoint of the NTFP extractors harvesting of NTFPs is viable even after including the external costs borne by them, from the society's viewpoint this is not so. The estimated NTFP values (after including external costs borne by

NTFP extractors only) appropriated from the NNP using alternate assumptions regarding the park's catchment area that is accessed by the tribals for harvesting NTFPs averages about Rs.1442 to over Rs.7212 or USD 33.5 to 167.5 per ha per year. The analysis shows that although the forgone benefits of NTFPs for the tribal communities are high, still the tribal communities have a positive attitude towards the conservation of NNP. The logit analysis shows that the probability of saying 'Yes' to the WTA question is lesser if the tribals are residing within the core zone of the national park, and also if they have higher income from employment in coffee estates and the forest. The study suggests improving the incentive structure in order to obtain the support and participation of tribals in biodiversity conservation strategies.

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