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Households' Dependence on Protected Forests: Evidence from the Western Ghats

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I

INTRODUCTION

It is generally argued that in rural areas people depend more on natural environment like forest due to the economic compulsions arising out of poverty (Dasgupta and Mäler, 1995). A number of forest resources are complimentary in production and consumption to other goods and services and supplement household incomes especially in times of acute economic stress (Falconer and Arnold, 1989). The contribution of non-timber forest products to the total households' income is found to be a significant factor that support rural livelihood (Nadkarni *et al.*, 1989; Appasamy, 1993; Chopra, 1993; Mallik, 2000). To take the case of Orissa, the non-timber forest products contribute about 22.4 to 54.5 per cent of the total households' income (Mallik, 2000). However, serious constraints on the access and appropriation of these products have been enforced by the state while establishing protected areas[1] as a part of the forest policy. There is evidence to show that setting up of protected forest areas and managing biological resources has worked against the interest of the local population (Kothari *et al.*, 1989). Sometimes, this has resulted in the illegal exploitation of resources and increased conflicts between local people and the State (McNeely, 1993). As a result, formulating strategies to reduce pressures on protected forest areas arising out of socio-economic reasons have become the prime concern of environmental policy makers and international donor agencies (World Bank, 1996). Among the various measures, the recent India-Ecodevelopment Project initiated with the assistance of World Bank aims to address the impact of the local people on the protected areas and the impact of protected areas on the local people merits special mention. The thrust of the project is on the improvement of protected area management with the involvement of local people and their welfare (World Bank, 1996).[2] In order for the people to participate or involve in the management of protected forests, they ought to have or perceive a stake over the resource. Although forests are a source of livelihood, there have been only very limited attempts, so far to understand the stakes of the people living in protected areas where people's participation in protected area management has been invited through the India-

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Ecodevelopment project. Against this background, the modest objectives of this paper are (i) to examine the stake of the households living on the fringe of a protected forest where India Ecodevelopment has been launched and (ii) to explore the socio-economic characteristics of the households depending on it.

The Study Area

The Periyar Tiger Reserve (PTR) established in 1978, which comprises 777 square kilometres of the Western Ghats forests of Kerala State in India, has been taken for an in-depth study. The vegetation types of the reserve can be classified as tropical evergreen forest, semi-evergreen forest, moist deciduous forest and grasslands. About 15,000 of India's flowering plants are found in the wet evergreen forest of the reserve. More than 150 new species and 15 new genera have been described in the last 30 years (Vijayan *et al.*, 1979). It was also found that 85 species of vertebrates are endemic to this area. Endemism is largely confined to smaller mammals, such as, the lion-tailed macaque (*Macaca silenus*), Nilgiri langur (*Trachypithecus johnii*), and the stripe necked mongoose (*Herpestes vitticollis*). About 15 species of birds are also endemic to the region.

Considering the importance of the forest with respect to species diversity and tiger population, the area was chosen for implementing Project Tiger in 1978. The objectives of the project were to ensure maintenance of a viable population of tiger for scientific, economic, aesthetic, cultural and ecological values and to preserve for all times the areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people. In 1982, the core area of PTR was declared as a National Park and in 1996, the India-Ecodevelopment project with the above said objectives were initiated here.

II

METHODOLOGY AND DATA

Use Value of Non-Timber Forest Products

In this study, the stakes of the people living in and around the PTR have been examined mainly in terms of their forest dependence for non-timber forest products. As we know, the forest ecosystems support human welfare through the supply of various goods and services which are generally accounted in terms of use and non-use value of the resources.[3] The use value of the resource is further classified into direct productive and consumptive use values (Barrett, 1988). The direct productive values are associated with certain species which are harvested for sale of their product. Since it is commercialised and traded in the market, one can obtain the market values of these species through a straightforward process. Then, there are direct consumptive values which are derived from the consumption of non-commercial activities like harvesting or hunting for own use. In this study, only use value has been taken into account and in order to get an accurate estimate of both consumptive and productive use values separately, we estimated the products going to the market and household separately. The products consumed at home were valued at their retail-purchasing price and the goods sold in the market were valued at their selling price. The price of the close substitute has also been used in case of those products that do not have a market price. The net value of these products has been arrived at by subtracting the gathering cost of the product from the gross value (Godoy *et al.*, 1993). The gathering cost is nothing but the opportunity cost of labour time spent for collecting forest products (Chopra, 1993). Since it was found that there is a choice between forest product collection and agricultural labour works, the agriculture wage rate has been used to estimate the gathering cost of the forest products. The reliability of the data related to non-timber forest products has been ensured by following various criteria suggested by Godoy *et al.* (1993). Since the present study has adopted a single time-point survey, we have asked the quantity of forest products that were collected during the last seven days and last one-month to get reliable data. This was further cross-checked with personal observations.

Although no human-animal conflicts were reported at the PTR during the recent years and at the time of field work, it was found that the households were incurring some costs in the form of crop damages by the wildlife. Estimates of the crop damages so incurred by the households have been provided in this paper.

Households' Forest Dependency

Models pertaining to the household participation in the non-farm sectors pointed out that participation and level of labour supply is a function of the incentives the household faces (in particular the relative returns and risk of farm and non-farm activities) and households' capacity to undertake the activities (Corral and Reardon, 2001). On the other hand, agriculture household models suggest that the determinants of non-farm incomes follow the utility maximising behaviour of households, where the household will maximise their utility subject to several socio-economic constraints (Singh *et al.*, 1986; Bardhan and Udry, 1999). Analogous to these theories, it can be argued that households' decision to depend on forest is also a labour allocation decision which is relevant to the households production function. Therefore, the important factors that affect labour allocation decisions are their factor endowment such as human capital, household assets, and other variables which are related to their preferences to use the forest. Following the above, we specify the important determinants of the probability of being a forest dependent (P_i) to include proxies for variables such as, human capital (household size, sex and education), household assets (land, livestock) and other variables affecting household preferences to continue the forest based activities, such as percapita expenditure, number of years of residence near the forest, etc. In the present study, the impact of these variables on households' decision to depend on PTR has been brought out using a logit model. Logit model is generally used to predict the effects of changes in independent variables on the probability of belonging to a group or category (Aldrich and Forrest, 1984; Maddala, 1983). To generate the dependent variable, people living in the fringe of the forest area has been categorised into two groups, namely, those who collect and those who do not collect forest products. The model has been specified as follows:

$$P_i = E\,(Y = 1/Xi) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}} \qquad \ldots (1)$$

where

$Y = 1.$, if the household depends on the forest, otherwise 0.

'e' is the base of natural logarithm and X_i is a vector of explanatory variables which includes per capita availability of land (PCL), ownership of livestock (LSTOCK), number of years since the household had been settled in the area (STAY), household size (HHSIZE), education level (SCHOOL), per capita expenditure (PCEXP) and sex ratio (SRATIO) of the household.

The Equation 1 can be written as:

$$P_i = \frac{1}{1 + e^{-zi}} \qquad \ldots (2)$$

where

$Zi = \beta_1 + \beta_2 X_i$.

Since P_i, in equation 2 gives the probability that the household depends on the forest, $(1 - P_i)$ gives the probability that the households do not depend on the forest.

$$1 - P_i = \frac{1}{1 + e^{zi}} \qquad \ldots (3)$$

Therefore, the odds ratio in favour of forest dependency is as follows:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Zi}}{1 + e^{-Zi}} = e^{Zi} \qquad \ldots (4)$$

For the purpose of estimation, we make the equation linear by taking the natural log of odds ratio.

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = Z_i = \beta_1 + \beta_i X_i + u_i \qquad \ldots (5)$$

Here L, the log of the odds ratio is linear in X as well as in parameters β_1, β_i etc., where, u_i is the stochastic error term. This model has been estimated using econometric software called LIMDEP.

Sample Selection

In this study, households have been selected from the south western fringe of the reserve, namely, Moozhical-Pampavalley settlements. The households in these settlements on an average occupy about 0.78 hectares of land for cultivation without any legal right. It has been reported that some of the settlers have received land as a part of the 'grow more food campaign' in the mid-1940s (Moench, 1990). Most of the agriculturalists in these settlements cultivate rubber (*Hevea braziliensis*) intercropped with arecanut (*Areca catechu*), coconut (*Cocos nucifera*) and pepper (*Piper nigrum*). There are few agriculturists who cultivate other crops, such as, tapioca (*Manihot utilissima*), banana (*Musa paradisiacal*) and jackfruit (*Artocarpus heterophyllus*). A stratified random sampling method based on the size of land-holding has been adopted to select the sample households (Table 1).

TABLE 1. DISTRIBUTION OF HOUSEHOLDS IN THE STUDY AREA

Land class in acres* (1)	Total number of households (2)	Sample (3)
Less than 1	190	112
1 – 3	266	158
3 –5	103	60
Above 5	41	24
Total	600	354

Note: * 1 hectare = 2.45 acres.

III

RESULTS AND DISCUSSION

Lean Season of Agriculture and Forest Dependence: An Observation

In the study area, we found that about 96 per cent of the total land owned by the households is used for agricultural purposes while the remaining 4 per cent has been used for housing and cattleshed. Rubber is the dominant cash crop occupying about 59.47 per cent of the total cropped area. Other important cash crops grown in the area are arecanut and coconut occupying 14.65 and 6.68 per cent of the total cropped area respectively. An important root crop grown in the area is tapioca, which constitutes about 1.26 per cent of the total cropped area. The remaining 4.08 per cent of the total cropped area is under miscellaneous tree crops. A discussion with the villagers prior to the survey revealed an interesting relationship between non-timber forest products collection and seasonality of agriculture. As is evident from Table 2, the period between May to August can be considered as lean agricultural season. As far as the collection of various forest products is concerned, the lean season is during June to August. Collection of forest products are relatively more during March to May with a peak period during April-May, that is, during the months before the onset of monsoon. This implies that the peak of the collection of forest products prior to the lean monsoon seasons when supply is also more is largely to supplement their agricultural incomes during the ensuing lean monsoon months. In this context, it is worthwhile to point out that none of the households solely depends on the forest for meeting their subsistence requirements but only to supplement their agricultural income. Now the question is in what ways and to what extent does the collection of forest products supplement the household incomes.

TABLE 2. SEASONALITY IN THE CULTIVATION OF AGRICULTURAL CROPS AND COLLECTION OF VARIOUS FOREST PRODUCTS IN THE STUDY AREA

Agricultural products	Non-Monsoon					Monsoon			Non-Monsoon			
	January	February	March	April	May	June	July	August	September	October	November	December
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Tapioca	ĩ	■	■	■	ĩ	ĩ	ĩ	ĩ	■	■	■	ĩ
Banana	■	■	▼	▼	▼	▼	▼	▼	■	■	■	■
Coconut	▼	▼	▼	■	■	■	▼	▼	▼	▼	▼	▼
Arecanut	■	■	■	ĩ	ĩ	ĩ	■	■	■	■	■	■
Rubber	■	■	■	■	ĩ	ĩ	ĩ	■	■	■	■	■
Pepper	ĩ	ĩ	■	■	■	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ
Jackfruit	■	■	■	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ

Forest products	Non-Monsoon					Monsoon			Non-Monsoon			
	January	February	March	April	May	June	July	August	September	October	November	December
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Reed	■	■	■	■	■	▼	▼	▼	■	■	■	■
Honey	ĩ	ĩ	ĩ	■	■	■	ĩ	▼	ĩ	ĩ	ĩ	ĩ
Medicinal products	ĩ	ĩ	■	■	■	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ	ĩ
Fodder	■	■	■	■	■	▼	▼	▼	■	■	■	■
Fuel wood	■	■	■	■	■	ĩ	ĩ	▼	■	■	■	■

Source: Primary data.
Note: More cultivation/collection ■; Less cultivation/collection ▼; Not cultivated/collected ĩ.

The important forest products collected from the reserve include fuel wood, fodder, reed, honey and medicinal products like fruits, nuts, gum, bark, etc. Although a few individuals agreed that they collect wild animal products, they were not willing to disclose any further information on this aspect. However, informal discussions with the local people reveal that they collect animal products (meat) for their home consumption. The most targeted animals are wild boar, sambar and small Indian civet. They also confessed that collecting wild meat from the protected forest is highly punishable as per the Indian Wild Life Act.

A closer look into the estimated value of the forest products collected by the households' shows that, on an average, they collect forest products worth of Rs. 6,250.95 in a year (Table 3). The households on an average spend about 33.24 person days for the collection of forest products and that amounts to an opportunity cost of about Rs. 2,991.60 per household per annum at the current wage rate (for unskilled agricultural works) of Rs. 90 per day. After deducting the costs incurred in the collection of various forest products,[4] the net value derived is about Rs. 3,259.30

in a year. This shows that the low opportunity cost of labour in the region acts as an important incentive for the continuance of forest dependence. One can also observe wide variations in the value of forest products collected by the households according to their landholding size which is provided in Table 3.

TABLE 3. AVERAGE VALUE OF FOREST PRODUCTS COLLECTED PER YEAR FROM THE PERIYAR TIGER RESERVE AND GROSS INCOME LANDHOLDING SIZE

(Rs.)

Land class in acres	Consumptive value	Productive value	Gross value	Opportunity cost	Net value	Gross income (excluding NTFP)	Gross income (including NTFP)	Contribution of NTFP (per cent)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)=(4+7)	(9)
<1	2,139.75 (20.26)	8,466.75 (80.17)	10,561.50	5,124.60	5,436.90	31,392.00	41,953.95	25.18
1 to 3	1,368.00 (31.30)	4,369.95 (76.16)	5,737.95	2,612.70	3,125.20	63,335.70	69,073.65	8.32
3 to 5	511.60 (26.97)	1,896.75 (78.76)	2,408.40	1,238.40	1,170.00	86,243.85	88,652.70	2.72
>5	-	-	-	-	-	160,740.00	160,740.00	-
Total	1,339.65 (27.28)	4,911.30 (78.57)	6,250.95	2,991.60	3,259.30	63,047.70	69,283.80	9.00

Source: Primary data.
Figures in parentheses are percentage to the gross value.

The study observed high forest dependence among low landholding group. The lower landholding category is the poorest in the study area. It was found that the gross income (excluding income from forest-based products) and the area of land operated by the households are positively correlated with a correlation coefficient of 0.67 which is found to be statistically significant at 1 per cent significance level. When we take into account the gross income of the households from other sources including agriculture and from the collection of non-timber forest products together, the contribution of non-timber forest products is about 9 per cent for all the households taken together. Here again it is pertinent to note that the share of non-timber forest products is as high as 25.18 per cent for the lowest land holding class and almost negligible for the largest land holding class. This means that in the case of dependence on PTR by the local people, it is the poor landholding groups who depend relatively more both in absolute and relative terms. In a different socio-economic context, Nadkarni *et al.* (1989) found that it was the rich who made greater use of forest in absolute terms because they need more manure for their land holdings and also because they had more animals which depend on forest for grazing. But in relative terms, that is, in relation to the total income of the households, the dependence of the poor households was significant. Here mention may be made that, in the present case, the livestock ownership by the richer households expressed in terms of animal units was about 0.33 as against 0.54 for the poorer households.

A decomposition of the total value of forest products collected into consumptive and productive use values reveals that almost Rs. 4,911.30 (78.57 per cent) is in the form of productive use value. Here, one can observe that variations across different landholding categories with the lowest landholding category having the minimum consumptive use value. This implies that in order to supplement their money income they sell most of the products collected from the forest. An earlier study (Appasamy, 1993) has also observed that forest ecosystems supplements rural household income in a larger way.

Apart from these direct benefits, there are costs borne by the local people due to wildlife protection. It has been reported that in the present study area these costs are in the form of crop damages by wildlife. Out of the total sample, 108 households reported damages to crops like tapioca by wild boars. The average estimated cost incurred by the households on account of crop damage varies from Rs. 145 to Rs. 479 from the lowest to highest landholding class and the average is about of Rs. 455 when all the households are taken together.

Socio-Economic Characteristics of the Forest Dependents

To adopt proper conservation policies, in the wake of India-Ecodevelopment which invites involvement of local people at the micro level in protected area management, it is important to examine the characteristics of the households depending on the protected area. Out of the 354 households surveyed 212 households (60 per cent) reported that they were collecting various products from the forest. The results of the logit model used to analyse the socio-economic characteristics of the forest dependents have been presented in Table 4. The model has a high explanatory power which is evident from the Pseudo R^2 of 0.3416. It is also found that the regression is statistically significant at 1 per cent significance level with a likelihood ratio test of the hypothesis that seven coefficients are zero based on a chi-square value of 162.89 with 7 degrees of freedom.

Ownership of livestock (LSTOCK), per capita availability of land (PCL), number of years since the household had been settled in the area (STAY), and household size (HHSIZE), are the important variables whose coefficients are found to be statistically significant in the model. Large families (HHSIZE) and those households who own livestock (LSTOCK) are more likely to depend on the forest. The dependence of larger families with limited land resources on forest could be due to two reasons. Firstly, the larger the family size, the per capita availability of land will be less and this exerts more pressure on the available land resources. This will accentuate the need to supplement household income from other sources and an obvious choice is to depend on forest. Secondly, larger families also mean that there are more members, who can actually engage in the collection of forest products without affecting household chores and agricultural activities. Since cash crops dominate the cropping pattern, the availability of homegrown cattle feed is less and the substitute paddy straw is scarce or costly in the study area. Therefore, the households tend to collect fodder from the forest indicating that the households who own livestock (LSTOCK) are more likely to depend on the forest.

TABLE 4. EFFECTS OF SOCIO-ECONOMIC CHARACTERISTICS ON THE PROBABILITY OF BEING A FOREST DEPENDENT (RESULTS OF LOGIT ANALYSIS)

Variables (1)	Co-efficient (2)	Standard error (3)	t-ratio (4)	P-value (5)
CONSTANT	1.627731	1.060294	1.54	0.125
LSTOCK (with livestock = 1, otherwise = 0)	2.316454	0.418903	5.53	0.000
PCL (land in hectares)	-2.705904	0.493235	-5.49	0.000
STAY (in years)	-0.0331977	0.0105458	-3.15	0.002
HHSIZE (in number)	0.2636593	0.1386951	1.90	0.057
SCHOOL (in years)	-0.056426	0.060611	-0.93	0.352
PCEXP (in rupees)	-0.0001032	0.00086	-0.12	0.905
SRATIO (female sex ratio)	-0.000125	0.00179	-0.70	0.485
Number of observations = 354				
Likelihood ratio chi^2 (7) = 162.89				
Prob > chi^2 = 0.0000				
Pseudo R^2 = 0.3416				
Log likelihood = -156.96367				
Restricted (slopes=0) Log-likelihood = -238.96367				

Source: Primary data.

However, the probability to depend on the reserve is negatively related to the per capita landholding size (PCL). The result was expected because larger asset base for cash crop cultivation results in high income and better standard of living that in turn leads to less dependency on forest resources. A negative relationship between people who have lived for longer duration in the fringe of the reserve (STAY) and forest dependency is observed. This may be due to their relatively poor asset base when compared to earlier settlers and their vulnerability to income fluctuations. Even though it was expected that the households' education level (SCHOOL) could influence the forest dependence, the coefficient of the variable although showed expected negative sign was not statistically significant. Similar was the case with per capita expenditure (PCEXP) and sex ratio (SRATIO) of the household.

Since the per capita expenditure indicates the standard of living of the household, it was expected that those with higher per capita expenditure are less likely to depend on the forest. Although the coefficient of the variable PCEXP had the expected sign, it was not statistically significant. Similarly, the coefficient of the variable SRATIO that was included to capture whether the households with more number of women members are more likely to depend on the forest (for example, in the collection of fuel wood, etc.) was not statistically significant. Against the expectation, the coefficient shows a negative sign. However, this should not be taken as a surprise. Women tend to depend more on common property resources mainly to meet household's food and fuel requirements which are mainly in the form of consumptive use value. This is not the case in the context of the present study because the analysis in the previous section shows that most of the value derived from the collection of forest products is in the form of productive use value.

IV

CONCLUSIONS

This paper provides some recent evidence regarding forest dependence of households living around the Periyar Tiger Reserve in India where the India-Eco-development project has been launched. The study observed that landownership, seasonality in agriculture and cropping pattern of the area considerably influence the dependence of households on the protected forests. The low wage rates and lack of alternative income earning opportunities in the region leaves them to an obvious choice of forest dependence. In fact, the difference between gross value appropriated from the collection of non-timber forest products and gathering cost acts as an economic incentive to the people to continue forests-based activities. Significantly, most part of the value derived from the collection of forest products is in the form of direct productive use value, which implies that non-timber forest products play a crucial role in supplementing rural household income. This is particularly true in the case of the households belonging to the lower landholding strata. In other words, people belonging to the lower landholding strata have more stakes over the reserve than those belonging to the higher landholding strata. The analysis of the socio-economic characteristics of the households using logit regression shows that households with higher per capita availability of land and those who had been staying on the fringe for longer duration are less likely to depend on the forest. But, households with larger family size and those with livestock ownership are more likely to depend on the forest.

On the whole, it is seen that the level of forest dependency varies with respect to the socio-economic characteristics of the households and the stakes of the local people over the protected forest varies across different socio-economic groups. For example, the poor and large households in terms of low asset holding and large family size depend more on the forest resource as a source for supplementing their income. Therefore, when it comes to the policy point of view, especially in inviting the participation of local people in the protected area management, it makes sense to believe that the poorer households would be more interested in participation. Otherwise adopting a passive role by the poor would leave them to the vulnerabilities of policy changes regarding the use or collection of forest resources which in reality is an important source for supplementing their household incomes. It is also important to control population pressure by way of checking in-migration to the area as the recent migrants own a lesser amount of land and are more likely to depend on the forest.

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NOTES

1. The most comprehensive legislation in this respect is the Indian Wild Life Act of 1972, which affords varying degrees of protection to a wide range of species and habitats. The Act enables setting up of protected areas that include national parks and wildlife sanctuaries. The network of protected areas in India now comprises 84 national parks and 447 wildlife sanctuaries that constitute nearly 4.8 per cent of the total geographical area of the country.

2. The India-Ecodevelopment project selected seven protected areas such as the Buxa Tiger Reserve in the West Bengal, Gir National Park in Gujarat, Nagarhole National Park in Karnataka, Palamau Tiger Reserve in Bihar, Pench Tiger Reserve in Madhya Pradesh, Periyar Tiger Reserve in Kerala and Rathambor Tiger Reserve in Rajasthan (World Bank, 1996).

3. Use value is concerned with actual and present use of a resource while non-use value is the residual between total economic value and use value.

4. Since many of the products are collected together, a separate estimation of the gathering costs may lead to double counting. In order to take care of this problem the gathering cost has been estimated by taking into consideration all the products together.

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