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FOREST DEPENDENCY OF PERIPHERAL COMMUNITIES : AN EMPIRICAL STUDY IN THE FRINGE OF LAOKHOWA AND BURHACHAPORI WILDLIFE SANCTUARIES IN ASSAM, INDIA

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ABSTRACT

Use of and dependency on common pool resources by fringe communities is almost a universal practice. While the common pool resources supplement the livelihood of the fringe communities, indiscriminate use of it also subjects the resources into tremendous pressure. Forest, a form of common resource, is an important ecosystem that plays a very critical role in the survival of human and other life forms on Earth. Studies have shown that heavy reliance of the peripheral people on the provisioning services of forest has a serious long term environmental implication. The present study is an attempt to estimate the composition of various provisioning services of forest into the income of peripheral people taking the case of Laokhowa and Burhachapori Wildlife Sanctuaries in Assam. It has also attempted to quantify the income share of the sanctuaries to the total household income of these people. Using primary data collected from 302 fringe households, the study finds significant dependency of the fringe villagers on the forest. About 28 percent of the household income of the respondents is found to have originated from forest resources. The regression analysis carried out to examine the determinants of forest dependency has found the age of the household head, education, distance from the forest, land holding size andsize of the cattle population as important determinants of forest dependency.

Key Words : Common pool resource, Provisioning services, Forest dependency, Peripheral community, Subsistence livelihood

INTRODUCTION

Protected areas, a centre of biodiversity conservation, provide a vast array of ecosystem services to support livelihoods of people[1]. Such areas worldwide are harvested exclusively for the provisioning services such as grazing, fuel wood collection and other subsistence needs of the people living beside it. The rural poor are disproportionately dependent on forest resources in the sense that a higher portion of their total income comes from the forest sources[2]. A number of studies on the contribution of provisioning and other services of forests have reported varying degrees of dependency of the fringe people on the forests[3,4,5]. This dependency of the resource poor peripheral people on the forests result in enormous pressures on the forest resources with long term environmental implications. Forests have been an essential source of livelihood for rural populations in India due mainly to a relatively higher incidence of poverty[6]. An understanding of the pattern of forest resource use or forest dependency is very critical for sustainable management of forest since the nature and extent of forest dependency varies across households[4]. The dependency of the fringe people should be taken into account and the factors resulting in such dependency should be identified for formulating policies that are conducive for an equitable sustainable resource management[4,7]. This study is an attempt to estimate the nature and extent of the dependency of the peripheral people on the Laokhowa and Burhachapori Wildlife Sanctuaries (Laokhowa and Burhachapori WLSs) in Assam and identification of the key factors influencing such dependency.

The paper is organized in five sections. While the second section describes the aims and

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objectives of the study, section 3 gives an outline of the method of data collection and other materials used in the study. Section 4 is devoted to the results and discussion of the findings. Finally the fifth section concludes the paper with a set of policy recommendations.

AIMS AND OBJECTIVES

It is really difficult to set aside the forests without allowing the economic needs of the fringe people to be fulfilled from it (the forest). The aim of this empirical study, thus, is to figure out the forest-based activities in the periphery of Laokhowa and Burhachapori WLSs and quantify the provisioning services extracted by the peripheral communities so as to estimate the extent of their dependency on the forest.Thus, the present study has the following objectives:

1. Quantify the forest dependency of the peripheral people on the forest and
2. Identify the factors that drive the fringe people to extract the provisioning services of the forests.

MATERIAL AND METHODS

Study area

The study has been carried out in the fringe villages of Laokhowa and Burhachapori Wildlife Sanctuaries (Laokhowa and Burha-chapori WLSs), strategically located in between Kaziranga and Orang National Park of Assam and identified as an important wildlife corridor[8]. Laokhowa, a game sanctuary, sprawling over an area of 70.1 sq km was declared Wildlife Sanctuary in the year 1979 while Burhachapori, a professional grazing reserve, with an area of 44.06 sq km were upgraded to Wildlife Sanctuaries in 1996. Both the sanctuaries were ideal habitat for various key species of plants, endangered mammals, reptiles and birds like Rhino, Wild Pig, Buffalo, Royal Bengal Tiger, Elephants, and Bengal Florican etc. The natural and perennial wetlands here were functioning as breeding ground for various fish species that attracted enormous avifauna to the sanctuaries and were one of the prime attractions to the tourists[9]. However, with increased population and resultant pressure on the forest resources, degradation of the WLSs has started in recent years. As these two WLSs are crucial for providing various services to the fringe communities, it is essential to identify the type and extent of forest dependency by the fringe people and valuing the important ecosystem services for chalking out plans for their preservation.

Data

The study is based mainly on primary data although some secondary data were used regarding demographic characteristics of the people living in the fringe villages. Primary data were collected from the peripheral villages of Laokhowa and Burhachapori WLSs. A two stage sampling technique is followed for conducting in depth study. In the first stage, the villages were selected purposively on the basis of communities living, population pressures, distance to the forest and socio-economic conditions of the people. Thus, on the basis of above parameters, nine villages were selected comprising about 20 per cent of the fringe villages located in a radius of 2 kilometer from the forest boundary.

In the second stage, households residing in the villages were identified for collecting the ultimate information. Census data were consulted for selecting the number of households to be studied. Information was collected from about 10 per cent of the total households of each village. An effort was also made to incorporate heterogeneity in communities living and distances of the households across the sample villages from the forest boundary.

In order to study the nature and extent of dependency of the peripheral people semi-structured questionnaire was administered in the selected villages. Various socio-economic data and information on extraction of provisioning services from Laokhowa and Burhachapori WLSs were gathered through door to door survey of the sample households. The field survey was conducted in two phases during April – November of 2016.

Methods

The survey data are used to present descriptive statistics and a suitable econometric technique, namely multivariate regression. Descriptive statistics are presented to describe various issues related with forest dependency of the

fringe dwellers of both the sanctuaries. The socio-economic and demographic characteristics, the demand and supply of the provisioning services, quantification and valuation of these services, etc. are analysed from the data collected through questionnaire. Market price method is administered to estimate the value of the provisioning services extracted from the forest and fodder consumed by the livestock of the peripheral people. In calculating the fodder requirement for each cattle the concept of animal unit has been applied in order to obtain an average fodder intake and thereby the total fodder requirement. Moreover, a survey is carried out in the forest gate markets to obtain the prices of these services harvested and transacted in the market. Forest dependency is measured as the proportion of income derived from the forest to the total household income[10-12].

Thus,

Household Forest Dependency = Total Forest income / Total HH income.

Regression technique has been used to identify the factors determining the dependency of the peripheral people on the two WLSs. The relationship has been modeled in the following functional form:

$$Y_i = \beta_i + \beta_i X_i + \varepsilon_i$$

where, Y_i denotes proportion of forest income into total household income, X_i is a vector of independent variables such as education, family size, annual household income, distance to the forest from respective household and land holding, etc. influencing the forest dependency, β_i is a vector of coefficients to be estimated ε_i is the error term.

RESULTS AND DISCUSSION

It is observed from the analysis of the household data that 68 percent of the sample households rely on Laokhowa and Burhachapori WLSs for various provisioning services. The locals keep large number of cattle population which freely graze the forest. Thus, inclusion of grazing dependency shoots up the percentage of the dependent households to 87 percent. The *taungya* villages are resided by the Tiwa and Bodo tribes who have the expertise of identifying the wild edibles and thus collect forty seven species of plant origin (mainly edible herbs) and nine species of biological origin. These items may not have much economic values but has tremendous nutritious values for the resource poor villagers. The poor and marginalized people, living mostly in kutcha houses, also remove different construction materials except timber. Such products, though collected for domestic consumption purpose, are sold in the village markets to generate cash to supplement their meagre income from the normal sources. **Table 1** gives a detail account of the provisioning services extracted by the sample households from Laokhowa and Burhachapori WLSs.

The table shows the magnitude and variety of the provisioning services extracted from Laokhowa and Burhachapori WLSs and the amount transacted in the market. Fuel wood is among the most important forest products collected by 65.5 percent of the sample households of the study area. Due to various constraints the locals still stick to the fuel wood as their only source of energy for cooking, heating, etc. A tiny part of the fuel wood collected (11.72 percent of the total collection) is reported to be sold though it is collected mostly to meet the domestic demand of energy for cooking. Each collector spends a little over 4 hours per trip to collect the fuel wood from the forest. Similarly, 28 percent of the sample households catch fish from wetlands located inside the forest. But, unlike fuel wood, the lion's share of the fishes (63 percent) harvested are sold in the market to generate substantial amount of cash. Each fisherman spends about 5 hours to catch fish from inside the forest. The fishes sold fetch very high price and thus fishing provides gainful employment and thus income during slack season of the agricultural cycle and ensures a buffer against risk and household emergencies. As mentioned earlier, the forest dependency is defined as the share of the forest income in total household income. The income from forest has been estimated by multiplying the volume extracted with the market price. The amount which is not sold in the market also has been expressed in terms of market price and calculated as income from forest. Thus, the total income from forest has been calculated and the forest dependency is estimated by finding out what amount of the total income comes from the forest product.

Table 1 : Details of the collection of provisioning services

NTFPs	Amount extracted	Average time spent (hrs)	Total income generated (Rs.)	Amount sold of extraction (%)
Fuel wood	554290@	4.29	2771450 (8.9)	11.72
Fodder	5680*	3.37	5680 (.01)	0
Wild edibles	453.5@	1.25	9070 (.02)	0
Wild fruits	2573@	2.74	25730 (.08)	48.19
Leafy vegetables	78915*	1.85	15783 (.05)	77.9
Simul cotton pods	9713@	4.08	582780 (1.87)	71.4
Fish	15395@	4.52	1539500 (4.96)	63
Thatch	19170*	4.04	95850 (.30)	62.4
Construction materials	8230*	3.27	82300 (.26)	33.4
Grazing	3633441	–	3633441 (11.71)	–
Total	–	–	8761584 (28.2)	–

N = 207
@Kg, *bundle
Figures in parenthesis represents % of forest income to total household income.
Source : Primary survey, 2016

Studies conducted by different researchers give different account of forest dependency of the fringe people in their respective study areas, i.e., between 37 and 76 percent[13]; 6 to 44 percent[11]. The present study in the fringe of Laokhowa and Burhachapori WLSs has also found the income share to be 28.25 percent of the total income **(Table 1)**. The highest contribution to the total household income comes from grazing which is 11.71 percent followed by fuel wood, fish and Simul Cotton which is 8.9, 4.96 and 1.87 percent respectively. The contribution of other forest products to the total household income is negligible.

The provisioning services of forests provide both assured subsistence and cash income to the households relying on it. Thus, it is particularly important in relieving the hunger periods in the agricultural cycle and in smoothing out other seasonal fluctuation. About 40 percent of the households are found to have soldtiny amount of their collection to generate cash as well. In a study in Bangladesh, Kar and Jacobson[14] reported that one third of the surveyed households sold their NTFPs for cash incomes.

Composition and relative contribution of forest provisioning services to total forest income: It is now clear that the fringe dwellers of the study area extract various services from the Laokhowa and Burhachapori WLSs. However, the contribution of wild fruits, wild edibles, leafy vegetables, etc. are minimal but their contribution to the household nutrition is significant since these products are full of medicinal and nutritional value. Mean forest income for the entire sample households is Rs. 33,314while individual income obtained from the forest varies from as low as Rs. 328 to as high as Rs. 3,78,020.

Fig. 1 shows the relative share of various forest services into the total forest income extracted by the fringe dwellers. It is clear from the figure that while 41 percent of the forest income is derived from cattle grazing, fuel wood contributes 32 percent of the forest income. Fish is another important forest product contributing 18 percent to the total forest income. Fuel wood is primarily collected for domestic consumption while fish is collected to supplement the subsistence income of the households.

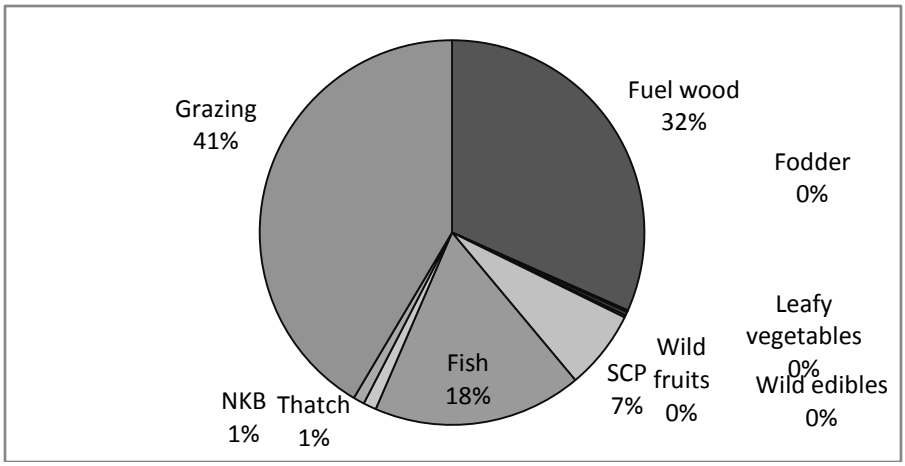

Fig. 1 : Relative contribution of different NTFP to forest income

Source : Authors estimation based on Primary Survey, 2016

Determinants of forest dependency

Drawing upon from various studies[4,2,15] the present study hypothesises that the dependency of the fringe villagers on Laokhowa and Burhachapori WLSs for various goods and services would be the result of a number of factors such as, age, education, occupation of the household head, size of the family, income, land holding, livestock population, proximity to the forest, etc. In order to investigate how these socio-economic factors influence the extent and pattern of fringe peoples' dependency, a linear regression model is used. **Table 2** presents the definition of the variables together with the descriptive statistics, used in the regression for a better understanding:

Table 2 : Definitions of variables and measurement

Variables	Type	Definition and measurement	Expected sign
Dependent variable			
Forest dependency	Continuous	Proportion of forest income into total household income	
Independent variables			
Age	Continuous	Age of the household head in completed years	-
Edu	Continuous	Education in years of schooling	-
H_structure	Dummy	Housing structure of the households. 1 if kuccha house, 0 otherwise	+
Dis_forest	Continuous	Distance to the forest in km.	-
F_size	Continuous	Number of household members	+
Land_hold	Continuous	Land holding in hectare	-
Cattle_unit	Continuous	Number expressed in standard cattle unit	+
HH_income	Continuous	Household income excluding forest income. Amount in Indian rupee.	-
BPL	Dummy	= 1 if BPL, 0 otherwise	+
Occupation	Dummy	= 1 if household head is engaged in farm sector, 0 otherwise.	+

Descriptive statistics

The descriptive statistics with the key variables are presented in **Table 3**. As observed in the table, the mean dependency of the peripheral people on Laokhowa Burhachapori WLSs is 26.93 percent.

Table 3 : Descriptive statistics of different variables

Variable	Mean	Standard deviation	Min	Max
Proportion of forest income (%)	26.93	21.08	0	74.41
Age	46.18	13.67	22	105
Edu	3.34	4.23	0	17
H_structure	-	-	0	1
Dis_forest	.48	.50	0	2
F_size	5.42	2.41	2	18
Land_hold	.52	.70	0	4.66
Cattle_unit	5.80	15.92	0	176.2
HH_income	86887.71	88934.71	15000	700000
BPL	-	-	0	1
Occupation	-	-	0	1

Source : Authors own estimation based on primary data.

Table 4 : The results of the multiple regression analysis of forest dependency

Variables	Coefficient	Standard error	t – value
Age	-.1009	.0750	-1.35
Edu	-.5904***	.2142	-2.76
H_structure	5.9738***	1.9772	3.02
Dis_forest	-14.1331***	1.6720	-8.45
F_size	-.3390	.4314	-0.79
Land_hold	-2.9380***	1.4366	-2.05
Cattle_unit	.3132***	.0598	5.24
HH_income	-.00003***	.00001	-2.06
bpl	12.8620***	2.0471	6.28
Occupation	10.6750***	1.8354	5.82
Constant	27.3774***	3.7999	7.20
R-squared	0.5657		
F-value	37.90***		
No of observation	302		

Source : Author's own estimation based on primary data
*** represents significant at 0.01 level.

RESULTS OF REGRESSION

The results of the regression are presented in **Table 4**. The highly significant F-statistics and relatively high R^2value show that the model constructed is fairly good. The problem of multicollinearity among the explanatory variables is found absent as the mean VIF is found to be 1.50. It is evident from the table that the variables, education of the household head, structure of the house, distance from the house to the forests, size of the land holding, household income, BPL, size of the cattle unit and occupation are significant in explaining dependence of the households on the forest.

The negatively significant coefficient of the education of the household head shows that more the level of schooling, less is the dependence on the forest. The finding is consistent with the previous studies of forest dependency[12]. The structures of the houses have a positive and significant association with forest dependency indicating that households

living in kutcha houses are more dependent on the forest for various construction materials found in abundance in the forests. The negative and significant coefficient of the variable 'distance to the forest' indicates that as distance to the forest increases, people are reluctant to take up forest activities for livelihood. The study by Balama et al[16] also confirms this finding. The variables, size of landholding and household income are representative of wealth and capabilities of the households. It is found that size of the land holding and households' income are negatively associated with forest dependency. This indicates that higher the resource of the households, lower is the dependency on the forests. This is quite obvious as relatively rich people possess alternative means for livelihood. Similar findings are abounding in literature[4,12,15,17]. Similarly, the variable 'BPL' has a positive and significant association with the forest dependency. It indicates that forest collection is an inferior choice for the people and until found a new and gainful opportunity the poverty ridden people will keep on engaging themselves in the forest foraging activities. Similar results are also reported by other researchers[7,17]. The table also shows that cattle unit has a positive and significant association with forest dependency. It indicates that the greater the cattle unit of a household, the greater is the predicted forest dependency.[18-20] The result is consistent with Jain and Sajjad[12]. The variable' occupation' is found to have positive and significant association with forest dependency meaning that people engaged in farming activities are more dependent on the forest.[21,22] It is in consistent with the findings of other researchers[14,23].

CONCLUSION AND RECOMMENDATIONS

The people of the study area are very poor with 49 percent of the sample households living below poverty line. The study confirms the common understanding that the rural poor resort to diverse livelihood prospects whenever required and the forest products are important element of their livelihood portfolio. The forest in the study area makes an important contribution and provides substantial cash income during the lean period to fall back upon apart from providing various regulating services. The study shows a high dependency, i.e., 28.2 percent, of the fringe people on the forest resources. As such the provisioning services of Laokhowa and Burhachapori WLSs provide these dependent households a substantial amount of cash income.

Understanding household forest dependency is critical for designing conservation strategies. In the face of social and economic problems, rural poverty will exacerbate the need for more forest resources. Therefore, policy measures that aim at increasing household income and generating off-farm employment opportunities for rural communities are needed to reduce the forest dependency and enhance forest conservation. The community engagement with proper education and massive awareness programme needs to be undertaken as education being one of the important determinants of forest dependency.

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