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Dependency of Local People on Forest Products: A Case Study in Balipara Reserve Forest, North-Eastern India

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ABSTRACT
The dependency of local people on forest products is recognised as an essential driver of sustainable forest conservation and restoration, but empirical studies evaluating it are scant. This study aimed to examine selected household attributes as determinants of people's dependency on forest products in selected villages in Balipara Reserve Forest, Assam, India. A total of 109 households were interviewed through a questionnaire survey in Dharikati and Sopaloga village, along with key informed interviews and focus group discussions with the villagers and government staff. A village-level logit model was used to analyse the pattern and degree of reliance on forest products in the two villages differing in socio-economic profiles. Results suggest that education level, livestock size, and distance to the forest as the key factors that are negatively and significantly associated with forest dependency in Dharikati; whereas, only landholding size was negatively and significantly associated with forest dependency in Sopaloga. On the other hand, the other two variables, family size and age, were insignificant. The income derived from forest has been accounted second-largest share after agricultural income to the total annual household income. Fuelwood was the major forest product and was largely extracted by the local communities. Thus, the results endorse policymakers and the forest department to take initiatives towards higher education accessibility, provision of alternative livelihood portfolios, availability of efficient sources of energy, introduction of advanced agricultural tools and encouraging the active participation of locals in biodiversity conservation and forest management.

Key words: Socio-economic factors, forest dependency, logit model, household income.

INTRODUCTION

Forests provide immense economic and ecological services (Ojea et al. 2016) and support around 1.6 billion people worldwide for their livelihood (Vedeld et al. 2007, FAO 2014). Forest is well recognised in tropical regions for its rich biodiversity (Gaston 2000), and approximately 350 million people inhabiting in and around forest areas are inevitably dependent on subsistence and income (Chao 2012). However, like other natural resources, forests are often threatened by complex and interlinked drivers such as infrastructure development, agricultural expansion (Kant 2004, Gardner et al. 2009) and forestry activities (Davidar et al. 2010). Currently, forest management remains a critical, challenging task in the tropical region (Basu and Nayak 2011). In developing countries such as India, the poor local people who live adjacent to forest are highly dependent on forest products for rural livelihoods (Prado Córdova et al. 2013). Drawing upon various literature on forest livelihood nexus, forest is crucial for subsistence livelihood, as it serves as a means of poverty alleviation by offering savings (Mukul et al. 2016), natural insurance (McSweeney 2004) and a safety net that fills the gaps at the time of emergencies or crisis in rural livelihoods (Shackleton et al. 2007, Angelsen et al. 2014). Numerous literatures on forest dependency have drawn evidence that the degree of reliance on forest and utilisation pattern of forest for subsistence livelihood differ across different communities geographically and over passage of time (Babulo et al. 2008, Bwalya 2013). For instance, the nature of communities is heterogenous, their behaviour towards forest extraction pattern varies from place to place (Prado Córdova et al. 2013).

A case studies approach has the potential to evaluate in-depth determination of household variables that influence forest resources dynamics. Socio-economic variables are the most dominating factors determining livelihoods (Garekae et al. 2017, Ali et al. 2020), where it describes the purpose, mode and intensity of harvesting (Mamo et al. 2007). The factors are grouped as household-specific and village-specific factors. Demographic and socioeconomic characteristics of households such as age, sex, literacy, ethnicity, occupation, family size, landholding, livestock and earning source were considered as household specific factors (Jha 2009, Senganimalunje et al. 2016). On the other hand, proximity to forest product collection, availability of alternate source of forest, accessibility to market and participation in developmental project were considered as village-specific factors (Kabubo-Mariara 2013). Close proximity to the forest can enhance forest dependency when access to the forest is feasible and market is better (Mamo et al. 2007), on the other hand, remote distance from the market and lack of access to forest products can hinder forest dependency (Rodriguez et al. 2009).

Worldwide studies have primarily focussed on the economic model analysis of forest cover change (Namaalwa et al. 2007), identification of key drivers of deforestation and forest degradation in tropical region (Geist and Lambin 2001), forest degradation due to fuelwood collection (Heltberg et al. 2000), rural livelihoods linked to forest dependency (Panta et al. 2009), impacts of forest resources extraction on vegetation ecosystem (Thapa and Chapman 2010) and livelihood of local communities (Enbakom et al. 2017), determinants of household characteristics affecting forest dependency (Garekae et al. 2017, Ali et al. 2020), for example market access/remoteness, sources of income (Belcher et al. 2015), ethnicity and cultural heritage shaping pattern and extent of resource extraction have been the important areas of focus (Baral and Heinen 2007). The importance of forest proximity and village size have been elaborated by Indian researchers (Karanth et al. 2006). Such studies are lacking in the north-eastern region of India, globally recognised for exceptionally high levels of biophysical and cultural diversity.

The present study was carried out in Balipara Reserve Forest (BRF) that lies in the foothills of the Eastern Himalayas in the tropical belt of Sonitpur district of Assam in north-eastern India. Some issues of conservation and livelihood in a village in reserve have been discussed by Sharma and Sarma (2014) and the potential of fragmented stands in biodiversity conservation by Amonge and Kumar (2018). Detailed empirical studies on the dependency of local communities on forest products in the reserve forest are still lacking. Therefore, this study aimed to address the questions: (i) to what extent do households rely on forest products?, (ii) what are the key factors influencing households' dependence on forest?, and (iii) how do local communities with divergent cultural backgrounds differ in respect of forest dependency?

MATERIALS AND METHODS

Study area: Balipara Reserve Forest

The Balipara Reserve Forest (BRF) is one of the oldest reserve forests in the Sonitpur district of Assam, India (notified on 27th October 1878), situated in the foothills of the Eastern Himalayan range of Indo-Burma biodiversity hotspot, North-eastern India. It covers an area of 189 km^2 (26°50'-27°00'N and 92°40'- 92°50'E) (Fig. 1). Potential vegetation is mainly dominated by *Shorea robusta* and covered by East Himalayan Moist Deciduous Forest (I/3/3c/3cb) as per Champion and Seth (1968). The region experiences a sub-tropical monsoon climate with heavy southwest monsoon, hot-humid summer and cold-dry winter. The average annual precipitation is 2393 mm. The maximum temperature is 38°C during summer, and the minimum temperature is 7°C during winter. It has a forest cover area of 78.69 km^2 and has already degraded an area of 1.08 km^2. The reserve is densely populated with 33 villages and seven notified forest villages (established in 1962 under section 72 of Assam Forest Regulation Act 1891). The local people are typically economically marginalised and secure their livelihoods by farming and utilising forest products. Therefore, the local communities are exacerbating deforestation and forest degradation at an alarming rate.

In order to understand the comprehensive pattern and dependency level of local people on Balipara reserve forest, two forest villages, namely Dharikati and Sopaloga, were purposively selected. The villages differed in culture and modes of the utilisation of forest products (Table1).

The sampling procedure was based on a social survey research methodology for assessing driving factors. It included household survey, field observation, key informant interview (KII), market survey and village-level focus group discussion (FGD). For the household survey, a total of 109 sample households (representing 25% of the total households) were randomly selected from Dharikati and Sopaloga villages during the period of August 2019 to October 2019.

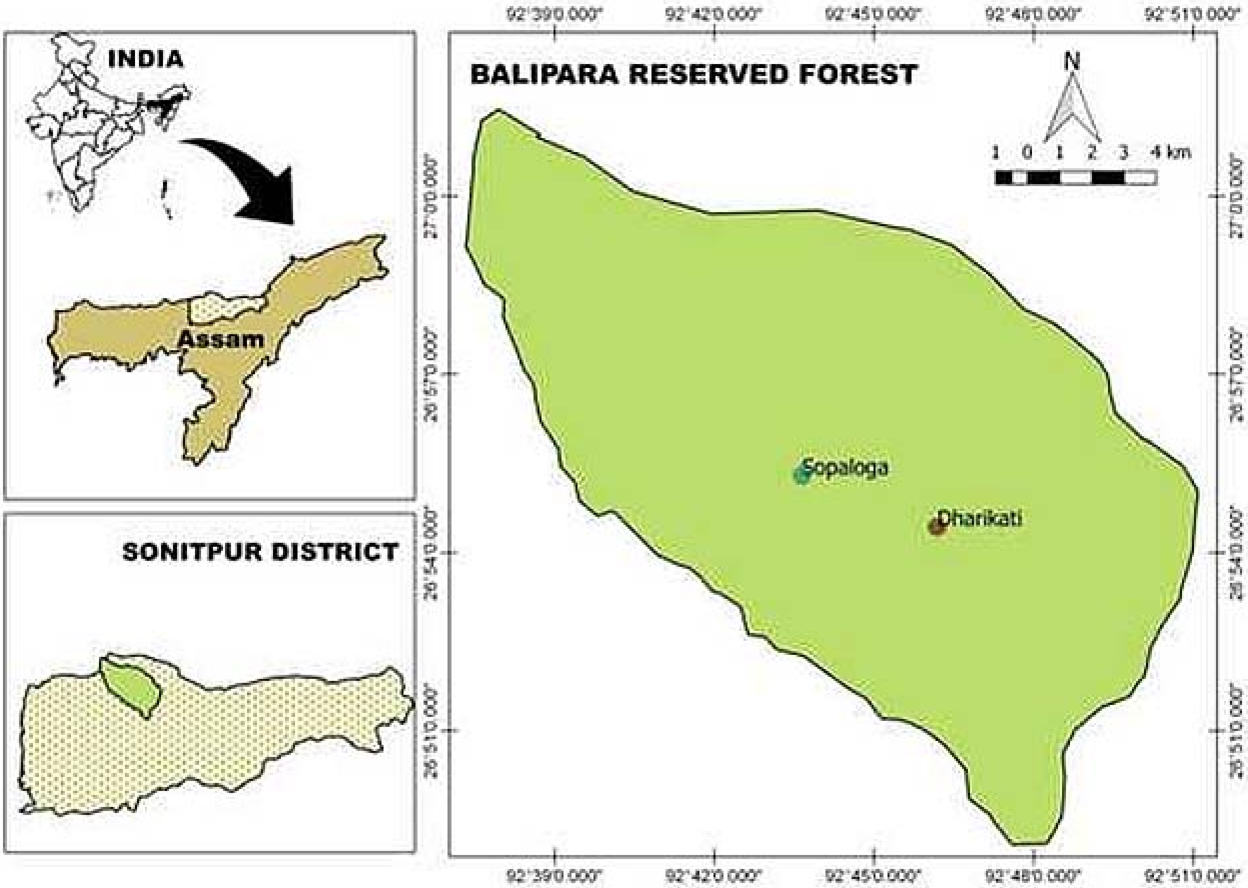

Figure 1. Balipara Reserve Forest with study villages Sopaloga and Dharikati

Table 1. Selected attributes of the two study villages

Attributes	Dharikati	Sopaloga
Households	339	97
Population size	1842	460
Male population	946	240
Female population	896	220
Literacy rate (%)	71	84
Land area (ha)	215	99
Altitude (m, amsl)	95	150
Local community	*Mishing*	*Koch*

(Source: Population Census, 2011)

A semi-structured questionnaire in English was prepared to conduct household survey, which was then orally translated into Assamese, the local dialect around Balipara reserve forest. The questionnaire was then administered through face-to-face interview with household respondents. During the interview, two local assistants were hired in order to develop rapport with the respondents. The questionnaire covered mainly two sections to collect primary information from the respondents. The first questionnaire section included data on family and socio-economic characteristics such as age, sex, education, caste, religion, family size, the origin of residency, landholding (size and fragmentation), livestock (size, composition, age structure and economic yields), sources of income, sources of energy, and cropping system (crop species variety, management practices and crop yields).

The second questionnaire section comprises information related to forest products usages. Individuals collecting forest products were asked about product usages, collection location, distance travelled and preferred plant species in each usage category. The reported information was then cross-checked through field observation. Additionally, a market-based approach was carried out in a nearby local market to identify the marketable forest products and record their prices. A village-level focus group discussion and key informant interviews, including people of different ages, gender, ethnicity and length of residency, were carried out to gather information on forest use pattern to understand the comprehensive scenario of prevailing forest status and livelihood condition of the local people in and around reserve forest.

The total annual household income was computed by the addition of all incomes derived from four different sources as describe below (Jain and Sajjad 2016, Wen et al. 2017).

Total annual household income = $\sum$ (Agriculture income +Livestock income + Forest income + Off-farm income)

Agricultural income includes the income derived from both livestock rearing and cultivation of crop. Annual household production, consumption, storage, traded and damaged crop and livestock components were estimated. Agricultural and livestock income was estimated by multiplying the quantities with their respective prices in the market.

Forest income was computed based on respondent's recall of memory for one previous year, the weekly or monthly or yearly amount of each forest product collected, domestically consumed, stored, sold out and damaged were assessed, and their incomes were cross-checked with the market survey data. The commercial values of products such as firewood, mushrooms, timber, bamboo, sand, stone and gravel were calculated by multiplying each item's quantity with its market prices, while the values of subsistence products such as medicinal plants, wild edible foods, grass and leaf fodder were calculated with substitute market price. Some households also earned income from forest tourism (as safari drivers and guards) and forest plantation programme, which were both counted as forest income.

Off-farm income was derived from various sources was assessed based on the reported number of employment days and previous daily wage rates in a month and the reported monthly income from other sources like a government job, pension, private shop, business and remittance.

Estimation of the forest dependency model

To investigate households' dependency on forest products in the BRF, a forest dependency index (FDI) was used. It was calculated as the ratio of annual forest income to the total annual household income. In this study, binary logit regression model was followed to identify the socio-economic factors influencing household's forest dependence. The average value of forest dependency across the sample villages was considered as cut-off point for categorising level of household as 'low' and 'high' forest dependency. Hence, forest dependency of 0.3, the lowest value, was used as cut-off point by following Masozera and Alavalapati (2004), Jain and Sajjad (2015) and Garekae et al. (2017). As binary regression has a dichotomous outcome, the forest dependency was encoded as value of '0' denoted as 'low forest dependency' when household dependent on forest was below than or equal to 0.3. On the contrary, a value of '1' denoted as 'high forest dependency' when household dependent on forest was greater than 0.3.

The logit is the natural logarithm (ln) of odds of Y (forest dependency), where odds ratio is the ratio of probability (P) of occurring Y to probability (1-P) of not occurring Y. The estimation of odds ratio (Y) was to predict the potential of each socio-economic variables affecting forest dependency. The model equation was used as follows (Gujarati 1995, Burns and Burns 2009):

$$Logit\ (Y) = ln\left(\frac{P_i}{1-P_i}\right) = \hat{a}_0 + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \ldots + \hat{a}_n X_n$$

Where subscript i denotes the i^{th} observation in the sample; $\hat{a}_0$ is the Y-intercept and; $\hat{a}_1, \hat{a}_2, \ldots, \hat{a}_n$ are the beta coefficients associated with each explanatory variable $X_1, X_2, \ldots, X_n$.

Based on the literature and preliminary survey, the socio-economic variables included in the model as explanatory variables were age, gender, family size, education level, landholding size, livestock holding size and distance to the forest. These variables were chosen to examine the determinants and the trends for forest extraction at reserve forest. In this model, gender is a categorical variable coded as dummy i.e., 0 or 1, and rest of the variables were continuous variables and coded as continuous values. A detailed explanation of each variable is provided in Table 2. A preliminary analysis of multivariate correlation statistics was performed to check the multicollinearity test. Only one variable, gender, was diagnosed with a higher degree of collinearity with other variables, and thus it was dropped from the

Table 2. Description of explanatory variables and their expected hypothesis in the model

Variables	Description	Expected hypotheses
Forest Dependency	It is a variable estimating forest dependency level	Not assigned
Age	Age of respondents in years	Positive/ Negative
Gender	Sex of the respondents; 1 as male and 0 as female	Positive
Landholding size	Size of agricultural land area owned by a household (ha)	Negative
Livestock size	Total livestock rearing in a household (cattle, goats, chickens, ducks and pigs)	Positive/ Negative
Distance travelled	Distance from dwelling to forest area (km)	Negative
Family size	Number of family members in a household	Positive
Education level	Number of years attained in education system by the household's head	Negative

model. However, the other six explanatory variables showed tolerance values greater than 0.1 and Variance Inflation Factor (VIF) less than 10. This signifies the absence of multicollinearity among the variables in the model for both the villages.

Data analysis

All the data were compiled and analysed using Excel 2010 to generate descriptive statistics such as mean, percentage, frequency, standard deviation and bar chart to address the household characteristics and income from different sources. Prior to binary logit regression analysis, log-likelihood ratio and multicollinearity tests were performed using Statistical Package for Social Sciences (SPSS version 24) to address socio-economic factors driving households' reliance on reserve.

RESULTS AND DISCUSSION

Household characteristics

The descriptive analyses of the socio-economic characteristics of 109 households are presented in Table 3. About 100% of the respondents were males in Sopaloga. A similar pattern was observed in Dharikati, where male respondents (78.4%) were more than females (21.57%). The average age of respondents was higher in Sopaloga (55.79 year, SD = 15.76) as compared to Dharikati (49.33 year, SD = 15.21). The average household size was higher in Dharikati (6.13, SD = 2.47) than in Sopaloga (5.83, SD = 2.34). Most interestingly, most of the respondents of Sopaloga (4.95 years, SD = 4.46) and Dharikati (3.96 years, SD= 4.28) had attained average education up to primary level.

Agriculture was the main occupation for the villagers living around the reserved forest. Households in Sopaloga own more agricultural land (0.45, SD = 0.34) than those in Dharikati (0.24, SD = 0.16). Interestingly, fewer households were landless in Sopaloga (3.92%) as compared to Dharikati (13.04%). Similarly, average livestock own by households in Sopaloga (12.92, SD = 10.86) are higher than Dharikati (10.39, SD = 6.59). In Sopaloga, all of the households were Hindu, whereas, in Dharikati, households of 54.9% were of Hindu while 45.1% were Christian. Only 15.68% were migrants in village Dharikati, while majority of residents were native (84.31%) in origin of settlement. The average distance travelled from households at Dharikati to forest area was reported about 1 km, whereas households at Sopaloga travelled up to 2.5 km to extract forest products (Table 3).

Contribution of different sources of income to total household income

In this study, the four significant sources of income identified were agricultural, livestock, forest and off-farm income. Among the four income sources (Fig. 2), agriculture was the primary source of income and accounted for the highest shares in the total household income, followed by forest income for both villages, Dharikati and Sopaloga. The contribution of livestock income to the total household income accounted the least in Sopaloga,

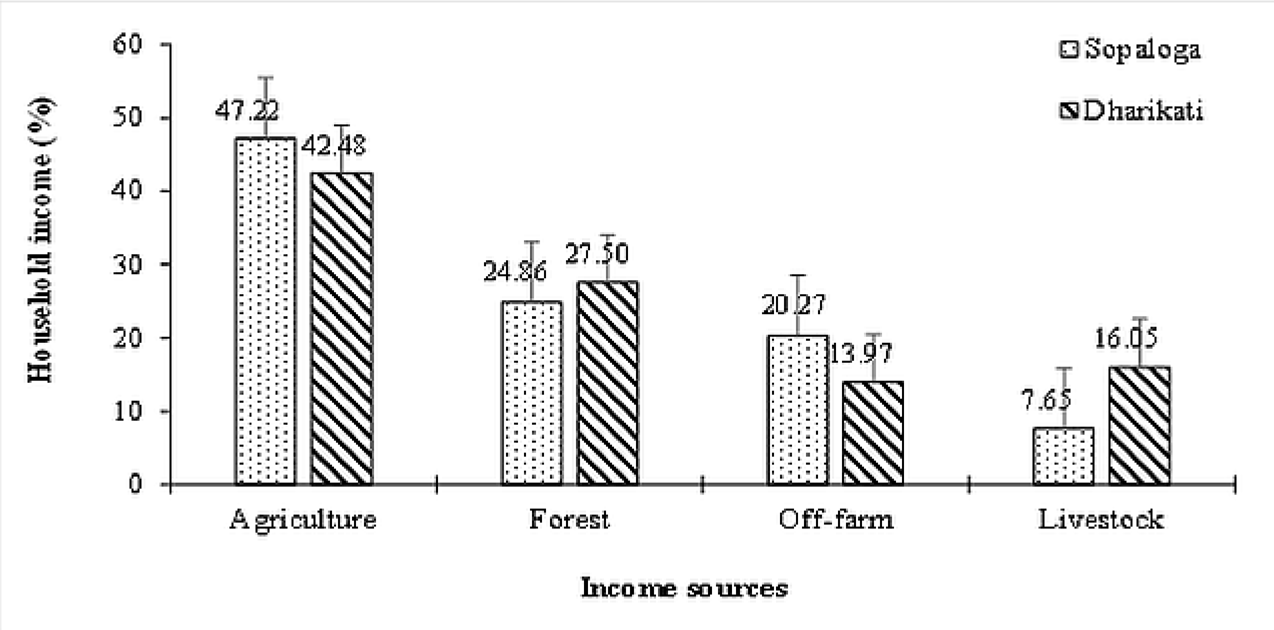

Figure 2. Proportion of household income (standard error in bars) from different sources of income in Dharikati and Sopaloga villages

Table 3. Descriptive analysis of socio-economic characteristics of households of the two villages.

Household characteristics	**Sopaloga (N = 24) Mean ± SD**	**Dharikati (N = 85) Mean ± SD**
Age of respondent (years)	55.79 ± 15.76	49.33 ± 15.21
Family size (head count)	5.83 ± 2.34	6.13 ± 2.47
Livestock size per household	12.92 ± 10.86	10.39 ± 6.59
Education level (No. of schooling years)	4.95 ± 4.46	3.96 ± 4.28
Landholding size per household (ha)	0.45 ± 0.34	0.24 ± 0.16
Distance travelled for forest products collection (km)	2.47 ± 0.68	1.05 ± 0.61
Landless per household (ha) (in percent)	3.92	13.04
Religion (in per cent)		
Hindu	100	54.90
Christian	Nil	45.10
Origin of residency (in per cent)		
Natives	100	84.31
Migrants	Nil	15.68
Gender (in per cent)		
Male	100	78.43
Female	Nil	21.57

Note: SD = Standard Deviation; N = number of sample households.

while in Dharikati, off-farm income contributed the least to the total household income. The contribution of agricultural income to the total household income was higher in Sopaloga (47.21%) compared to Dharikati (42.48%). Similarly, the contribution of off-farm income to the total household income was higher in Sopaloga (20.27%) than Dharikati (13.96%) (Fig. 2).

On the other hand, the contribution of forest income to the total household income was higher in Dharikati (27.50%) than in Sopaloga (24.85%). Likewise, the contribution of livestock income to the total household income was two times higher in Dharikati (16.05%) than in Sopaloga (7.65%) (Fig. 2). As a result of the findings, it was confirmed that local communities rely heavily on crops and forests for their sustenance of livelihoods.

Households use of forest products

From the survey of households, key informant interviews and focus group discussions, a total plant species of 62 from Dharikati and 39 from Sopaloga were identified that are used for different purposes in their daily livelihoods (Table 4). These plant species were categorised into seven use categories which includes fuelwood, wild edible food, fodder, construction materials, medicinal plants, rituals and ceremonies, and other non-timber forest products (NTFPs). Based on the household preference for specific plant species used in each use category according to their needs and preferences in their daily functions, fuelwood had the highest demand in Dharikati (27.55%), and Sopaloga (26.86%) where it is used as daily source of energy for cooking meal and fodder, body warming and boiling water. Construction materials (19.39%) were the second highest usage in Dharikati, followed by medicinal usages (18.37%), wild edible food (13.36%), fodder (9.18%), other NTFPs (8.16%) and the least was rituals and ceremonies (4.08%). While in Sopaloga, fodder (20.89%) was listed as second most preferred usage followed by construction materials (17.91%), medicinal usages (14.92%), wild edible foods (8.95%), other NTFPs (7.46%), and the least was rituals and ceremonies (2.98%). This finding concluded that the local community's usage of forest products differs between villages based on proximity and product availability. Overall, Dharikati extracted a greater number of plant species from the forest than Sopaloga. In Sopaloga, households stressed more usage of fuelwood, fodder for cattle rearing and timber logging for construction materials whereas, in Dharikati, the emphasis was more on fuelwood, timber logging for construction materials and medicinal plants.

Table 4. Proportion of plant species used in each use category of forest products in the two villages

Use Category	**Number of plant species used (%)**	
	Sopaloga	**Dharikati**
Fuelwood	18 (26.86)	27 (27.55)
Fodder	14 (20.89	9 (9.18)
Construction material	12 (17.91)	19 (19.39)
Medicinal plants	10 (14.92)	18 (18.37)
Wild edible food	6 (8.95)	13 (13.36)
Rituals and ceremonies	2 (2.98)	4 (4.08)
Other Non-Timber Forest Products	5 (7.46)	8 (8.16)
Total number of plant species extracted	**39**	**62**

Forest dependency level

Figure 3. reported that the average forest dependency level of all households within the sampled villages. The value of forest dependency index for Dharikati was comparatively higher (0.37 and SD =9.51) than Sopaloga (0.30 and SD = 8.89) indicating that households were moderately dependent on forest products.

Factors influencing households' forest dependency

Results of the logit model explaining the socio-economic variables influencing households' reliance on Balipara reserve forest are presented in Table 5. The likelihood ratio statistics expressed that the regression model is significant with a chi-square value of 34.35 ($p < 0.01$) for Dharikati and 14.72 ($p < 0.01$) for Sopaloga. This illustrated that the rationality for the selection of these variables had a significant predictive potential on forest dependency for both villages. The value of Cox and Snell R^2 (49%) and Nagelkerke R^2 (69.8%) for Dharikati is greater as compared with the value of Cox and Snell R^2 (47.3%) and Nagelkerke R^2 (63.1%) for Sopaloga, which signifies reasonable descriptive power of this

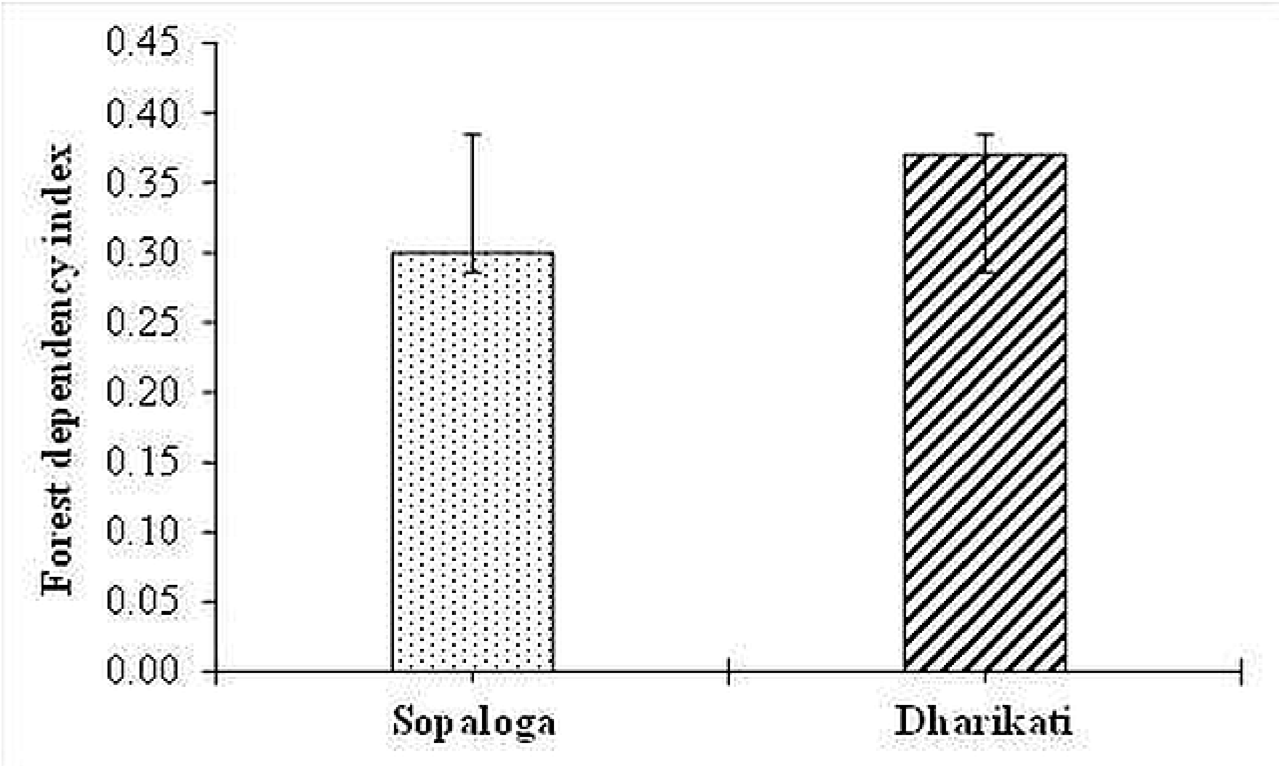

Figure 3. Forest dependency index (±SD) for Sopaloga and Dharikati villages

Table 5. Binary logit regression model for factors influencing forest dependency for each village.

Variables	**Sopaloga**			**Dharikati**		
	B	**SE**	**Exp(*B*)**	***B***	**SE**	**Exp(*B*)**
Age	0.026	0.047	1.026	-0.028	0.038	0.973
Family size	0.975	0.127	4.419	0.116	0.230	1.123
Landholding size	-15.325	7.535	**0.000***	-0.184	3.076	0.832
Livestock holding size	0.230	0.077	1.023	-0.232	0.109	**0.793***
Education level	-0.179	0.345	0.836	-0.316	0.140	**0.729***
Distance travelled	-0.866	1.209	0.420	-3.273	1.376	**0.038***
Constant	-2.978	3.710	0.051	10.482	3.724	3.567
X square	14.724			34.357		
Log likelihood	17.117			27.434		
Cox and Snell R^2	0.473			0.490		
Nagelkerke R^2	0.631			0.698		
Correct prediction	82.6%			86.3%		

Note: N = number of observations: Sopaloga = 24, Dharikati = 85; *B*= Beta coefficients; Exp (*B*) = Odds ratio; SE = Standard Error; Bold letters = significant factors; * Significant at 5% level.

model. Moreover, forest dependency models' accuracy was higher for both Dharikati (86.3%) and Sopaloga (82.6%) (Table 5).

Result of Table 5, illustrates that only one variable i.e., landholding size was the key factor predicting forest dependency in Sopaloga village. However, in Dharikati village, three variables viz. education level, livestock holding size and distance to the forest made a statistically significant association with forest dependency. While remaining two variables viz. age of the household head and family size were not statistically significant but showed both positive and negative association with forest dependency in both the villages.

The coefficient of landholding size showed inverse relationship with forest dependency for both the villages but had a statistically significant ($P<0.05$) with 0.000 odds value only in Sopaloga. This indicates that an increase of each unit landholding size may decline forest dependency by a factor of 0.000. This is because local communities of this area were primarily dependent on agriculture for revenue and subsistence livelihood. Therefore, households with large agricultural land do have adequate food supply and income shifting them away from dependence on forest products. This observation is corroborated with several studies of (Shova and Hubacek 2011, Jain and Sajjad 2016, Wen et al. 2017, Suleiman et al. 2017, Walle and Nayak 2020).

On the contrary, studies of Angelsen et al. (2014) and Kamanga et al. (2009) found that households with more agricultural land are positively correlated with forest dependency because material used in the manufacture of agricultural implements and manure were mainly extracted from the forest. Noteworthy, the finding of this study was reverse, the possible explanation would be that households with large agricultural land are considered to be wealthier that can afford to buy manures and fertilisers and have gradually switched from traditional ploughing methods to modern technology with tractors and power tillers resulting in increased income and production. On the other hand, poor households with small agricultural land or no agricltural land, cannot afford modern technologies and simply rely on traditional ploughing methods, which necessitate agricultural implements made from forest products. Nevertheless, in the current study, the demand of agricultural implements is limited due to small size of their agricultural land. Likewise, the agricultural soils of this area were fertile without addition of artificial manures due to seasonal sedimentation from the river Jia-Bhoroli. As a result, in this study the agricultural implements and manure from forest were negligible and households with large cropland were found to be less dependent on forest.

In Dharikati, the coefficient of livestock had a negative significant ($P<0.05$) corelation with forest dependency with an odds value of 0.793. This signifies that with increase in every unit of livestock size, the probability of forest dependency decreases by 0.793 times. The plausible explanation could be that the inhabitants of Dharikati are part of '*Mishing*' tribe community, may have traditionally reared of livestock such as pig, duck, chicken, goat and cattle. These livestock are considered as indicators of wealth accumulation because in the time of any social shocks, they would act as a liquid asset that can be sold to meet their livelihood income and reduce their pressure on the forest. Moreover, these livestock were feed on household wastes or crop residue rather than fodder from the forest. Thus, households with large number of livestock were less likely to be relying on forests, which was also corroborated by Lepetu et al. (2009), Fikir et al. (2016) and Hussain et al. (2019).

On the contrary, the coefficient of livestock size showed a positive and non-significant correlation with forest dependency in Sopaloga. This could be because the '*Kuch*' communities in Sopaloga are non-tribal; they are involved in cattle and goat rearing activities only. There was a higher demand for fodder and hence there existed year-round grazing pressure on the forestland to cater to the needs for feeding the stomach of their cattle. The study of Ali et al. (2020) reported the similar observation in their study.

The variable education level of respondents was negatively corelated with forest dependency for both Dharikati and Sopaloga villages. However, a statistically significant ($P < 0.05$) with odds of 0.836 was observed only in Dharikati, which illustrated that the likelihood of forest harvesting decreased by 0.836 times with each unit of education level increase. This suggests that respondents with a lower or no formal education were more likely to be dependent on the forest than those with higher level of education. Perhaps, as educated people have more diversified and better off-farm opportunities, education diverts livelihood portfolios away from subsistence agriculture and forest activities. This observation has also been supported by the following researchers (Wen et al. 2017, Bhandari and Jianhua 2017, Garekae et al. 2017, Ali et al. 2020, Walle and Nayak 2020).

The coefficient of distance travelled to the forest was inversely associated to forest dependency in both the villages. However, it was statistically significant ($P<0.05$) with 0.038 as odds value in Dharikati village. This implied that with an increase in one unit of distance to the forest, the inclination towards forest extraction decreases by a portion of 0.038. This negative correlation suggests that the households that travelled for longer distance for forest product collection were less likely to put pressure on forest products. The possible explanation would be that this reserve is under state government and their law enforcement is not that strict, which may encourage households living in close proximity to the forest to access more easily than remote households. This finding showed an uniformity with the investigations of (Fonta and Ayuk 2013, Melaku et al. 2014, Suleiman et al. 2017).

CONCLUSION

The findings confirm that forest products are the critical source of sustenance of livelihoods for local communities in Balipara reserve forest. The forest dependency level was higher in Dharikati as compared to Sopaloga. The two communities were moderately dependent on forest products, and it was evident that the contribution of forest income to the total household income was the second highest after agriculture income. Among the different categories of forest products, fuelwood has the highest demand both for cooking meals and fodder, boiling water and room heating purposes. Therefore, policymakers or forest management authorities may try establishing of alternative energy sources such as solar power, liquified petrol gas (LPG), kerosene, and biogas to reduce pressure on forests and conserve the reserve. Understanding the socio-economic factors influencing households to extract more forest products is critical for designing new or modifying existing forest management strategies in the reserve. Furthermore, the outcomes of logit analysis reveal that many village-specific factors influence forest dependency. In Dharikati, households with lesser livestock size, lower education level and people living proximity to the forest were the main driving factors that significantly enhanced forest dependency. Therefore, policy measures must to be adopted to improve such villagers access to higher education, provide diverse earning livelihood options and divert them away from forest extraction activities. Example of such alternative livelihood can be inspired by the best practices in the country, for example, story of Mangalajodi ecotourism, where poachers were transformed as forest guides and forest guards of a bird century, could be made as role model in combating the problem depicted in the study.

Likewise, in Sopaloga, the key factor determinant was household's with more agricultural land size were less reliant on forest products. Therefore, stakeholders should focus more on crop depredation prevention by introducing a wide range of high yielding variety of seeds and advance technology to boost agricultural income along with production. Finally, the findings of this study also encourage local communities to participate in forest plantation programmes which aids in improving a balance between forest conservation and household livelihood.

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