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## RESEARCH ARTICLE

# CORRELATION OF FOREST RESOURCE USE WITH SOCIO-ECONOMIC STATUS IN NORTHWESTERN HIMALAYA: A CASE STUDY OF KULLU, HIMACHAL PRADESH, INDIA

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### ABSTRACT

The Himalayas, a region rich in flora, fauna, and other natural resources, offer numerous crucial resources for the survival of the native population. People rely on a variety of resources, including fuel wood, timber wood, fodder, and numerous other valuable NTFPs, for both personal use and to generate income through sale. A similar situation exists in Himachal Pradesh, a state in the northwestern Himalayas, with no exception. People rely on forests for a variety of purposes, particularly in rural areas, which account for 89.97% of the state's population. The study was carried out for the five villages of the Khadihar Panchayat in Himachal Pradesh's Kullu district. Analysis of various socioeconomic factors and their effects on dependency on forests were the main objectives of the study. The results of the study showed that the social status of the household and the quantity of livestock that families kept were only two major factors that had a substantial impact on forest dependency. It is possible to argue that mass sensitization through awareness campaigns, particularly for socially underprivileged people, should be carried out. In order to enhance the socioeconomic circumstances of these households and lessen their reliance on the forest, skill development programmes should also be introduced.

## INTRODUCTION

The Himalayas being the hotspot of the world's biodiversity are the young folded mountains situated in the south of the Asian continent, covering 6 countries including India. Although the Himalayan mountain region occupies only 18 percent of India's land area, it is home to more than half of the country's forest cover and 40 percent of the subcontinent's endemic species. From the Western to the Central and Eastern Himalaya, the floral variety changes show the diverse range of gradient of flora from tropical vegetation to alpine meadows. One such state showing similar resemblance to the characteristics of Indian Himalayan Region (IHR) is Himachal Pradesh, which resides in Northwestern region of IHR. On the bases of altitude the state is divided into three distinct regions: the Shiwaliks, which have an altitude of up to 1,500 meters, the middle Himalayan region, which has an altitude of 1,500 meters to 3,000 meters, and the Himadris, which have an altitude of more than 3,000 meters. The unique climatic and geographical conditions make this region home to variety of flora and fauna. The state has a total forest cover of total 27.73% of its total geographical area.

Himachal Pradesh forests are split into eight type groups, each of which is further divided into 39 forest types. Coniferous forests and broad-leaved forests are the two types of forests found in the state. Species distribution follows altitudinal zonation. The vegetation ranges from low-altitude dry scrub woodlands to high-altitude alpine pastures. Different vegetation zones of Mixed Deciduous Forests, Bamboo, Chir Pine, Oak, Deodar, Kail, Fir, and Spruce can be found between these two extremes. The Majority of the population (89.97%) dwelling in the state is rural and lives in villages. Because the greater part of the population in the villages relies on agriculture and animal husbandry to make a living in the state, forests serve an essential role in meeting their daily needs for wood, fodder, and NTPs. Since forests provide a variety of benefits to people, therefore making people's reliance on forest resources a multi-dimensional phenomenon, which needs to be studied in detail. Most researchers have studied how forests affect people's socioeconomic conditions, but very few have studied how people's socioeconomic conditions influence their use of forest resources, particularly in the areas, where forests serve as a vital source of livelihood for the majority of people who rely on them directly or indirectly for survival.

The dependency on forests decreased with the increase in land holdings, while easy market access increased dependency on forests as it was easy for people to sell the forest products which were collected by them. Thus, it shows that the aggregate advantages of the forest environment hide fundamentally significant patterns of distribution and the underlying social mechanisms that underlie them. Therefore the objective of this study is to study the social and economic structure of the household of the study area and to study the relation of forest resource use with the socioeconomic status of households.

## METHODS AND METHODOLOGY

**Study area:** The five villages of Pachahli, Buragran, Pahnallah, Muthal and Kareri in the Khadihar panchayat of Kullu Block, district Kullu, Himachal Pradesh, are included in this study. The study area's latitude extends from 31°54'17"N to 31° 53'40"N, while its longitude ranges from 77°06'20' E to 77°55'16'E. The area's altitude ranges from 1282 m to 1809 meters above sea level. The average distance between these settlements and the district headquarters is about 11 kilometers. These five settlements hold a total of 183 households and a population of 806 people. Male and female make up to 407 and 399 of the total population; respectively. The total populations have 455 people belonging to schedule caste and 361 people from general category.

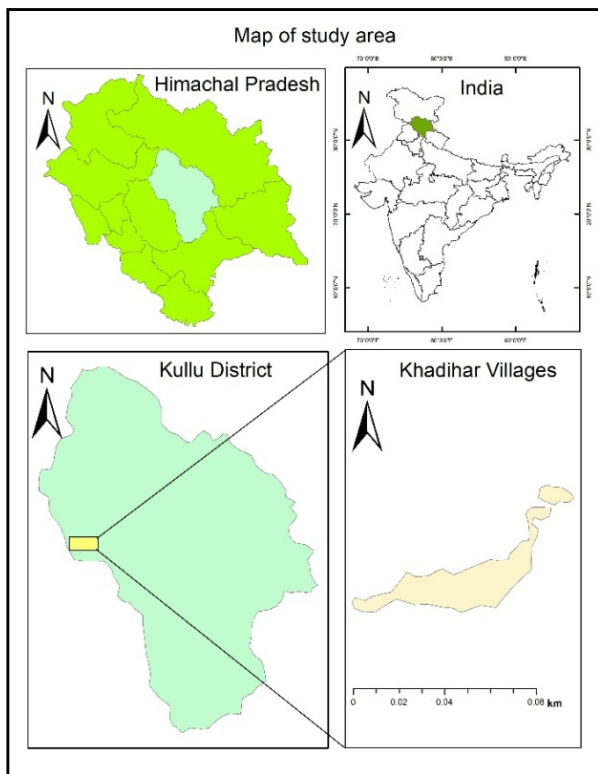


Fig.1. Map of the *Khadihar Panchayat* in the Kullu District, Himachal Pradesh

### Methodology

The study participants were drawn from the villages of Pachahli, Buragran, Muthal, Kareri and Pahnallah of the Khadihar panchayat of Kullu District. The sampled villages consisted of 183 registered households according to the latest *goshabara* record of the village panchayat collected from district block office. Purposive sampling kind of Non probability sampling was used to draw a sample size representing 75.4 % (138) of the entire households in the study area. All of the houses in the villages were surveyed during the survey, however the number of households interviewed was lower than the number indicated in secondary data. This was due to the fact that families living in the same house possessed multiple ration cards,

each of which was registered as a different household in *goshabara* data, but during the survey, some respondents failed to mention the other card holder individuals in the same house due to lack of understanding. Thus, 138 families were surveyed, accounting for 75.4% of the total number of families in the panchayat (i.e. 183 registered families). A standardized semi structured Unnat Bharat Abhiyan questionnaire was administered to the respondents through face to face interview. There were both open-ended and closed-ended questions on the survey form. The Unnat Bahart Abhiyan questionnaire was divided into several sections consisting of basic household information, benefits of government schemes, water and forest products uses, description of different energy sources, land ownership, resources used in agricultural activities, livelihood based on natural/ forest resources, yearly crop production, details about fruit/fodder trees and income generated, details of reared animals, details of income and expenses sources of the family etc. The statistical computing and graphics application R, version 4.1.2, was used to compile and process the data. Descriptive statistics in the form of frequencies, proportions, indices of central tendency, and dispersion were used to summarize the socio-demographic data. The efficacy of socioeconomic characteristics to predict forest dependency was tested using logistic regression analysis. In this study, the explanatory variables age, household size, sex, education, and job were regressed against the outcome variable (forest reliance). These factors were utilized as a stand-in for socioeconomic factors. The parameters were chosen primarily because they span the social and economic spheres, giving rise to a thorough understanding of the pattern of household forest dependency. Forest dependency was measured as a dichotomous response with a value of 1 or 0, where 1 indicates a high level of forest dependency and 0 indicates a low level of forest dependency. (Hosmer *et al.*, 2013; Garekae *et al.*, 2017) utilized a binary logistic regression model to identify the socioeconomic variables affecting households' reliance on forests. The total 14 variables (family head gender, family head education level, economic status of the family, social status of the family, household size, landholding, livestock unit, family income, tandoor use per day, LPG use per day, fodder value, wood value, NTFP value, total forest products collected value) were used to explain the dependency of households on forests. Table 1 gives a detailed description of the various explanatory variables used in the logit model.

## RESULTS

**Village and Household Profiles:** During a survey of five villages in Khadihar Panchayat, namely Pahnallah, Pachahli, Buragran, Muthal, and Kareri, it was discovered that these villages have a total of 138 households. The families were primarily from two social classes: schedule cast and general. The majority of the houses (72) belonged to the schedule cast, while 66 families belonged to the general cast. The number of family members in these household ranged from 1 to 13 with mean and standard deviation 4.6 and 1.9 respectively (Table 1). These settlements had a combined population of 643 people, with 318 females and 325 males which is 49.5% and 50.5 % of total population respectively. The male to female ratio in the settlement was 102, meaning there were 102 male for every 100 female. The mean age of the population was 32.43 with shows a standard deviation of 20.27. These communities had a combined literacy rate of 79.48 % (excluding equal to and less than 6 years age group). Male literacy was 90.20 % in this population of 585 people over the age of six, while female literacy was 69.23 % (Table 2). The comparison was also performed to see what level of education males and females had. Figure 11 shows that girls outnumber males at post-graduation, primary, and basic literacy levels, but males completed middle, high, secondary, and graduate levels in greater numbers than females (Figure 1).

**Sources of Income and Mean Annual Income:** The most common source of employment for the villagers was working as daily wage labourers, which was practiced by the members of 123 households out of total 138.

**Table-1. The description of the explanatory variables used in the logistic regression model.**

Variable	Explanation	Expected relationship with forest dependency
Age	Age of head of household in years	Positive
Education	Education level of household head: 0=illiterate, 1= literate, 2= 5 <sup>th</sup> pass 3= 8 <sup>th</sup> pass 4=10 <sup>th</sup> pass, 5=12 <sup>th</sup> pass, 6=Graduate	Negative
Economic status	BPL (below poverty line)=0, APL (above poverty line) = 1	Negative
Social status	Schedule Cast=0, General=1	Negative
Household size	Number of family members in the household	Positive
Landholding	In hectare	Negative
Livestock unit	1 LU = 1 cow = 1 buffalo = 2 calves = 10 sheep/goat	Positive
Family Income	Annual income in INR	Negative
Tandoor Use	Total hours per day	Positive
LPG Use	Total hours per day	Negative

**Table 2. Demographic data of the study area**

Demographic factor	Count	%
Total Population	643	
Gender		
Female	318	49.5
Male	325	50.5
Age		
Below or equal to 20 years old	198	30.8
Between 21 to 30 years old	146	22.7
Between 31 to 40 years old	88	13.7
Between 41 to 50 years old	94	14.6
Between 51 to 60 years old	57	8.9
Above 61 years old	60	9.3

**Table 3. Households occupation and earnings**

Type of occupation	No of families	Average income	Total income
Agriculture	112	39402	4413000
Animal husbandry	74	8892	658000
Labour	123	54073	6651000
Other arrangements	92	15250	1403000
Pension	49	39931	1956600
Total	138	109414	15208600

**Table 4. Major Forest species collected for Fodder, Firewood and NTFPs**

<b>Major Fodder Trees</b>			
S.No.	Local Name	Scientific Name	Family
1	Phagda	Ficus palmata Forssk.	Moraceae
2	Kahu	Olea ferruginea Wall. ex Aitch.	Oleaceae
3	Biyul	Grewia optiva J.R.Drumm. ex Burret	Malvaceae
4	Mahun	Ulmus wallichiana Planch.	Ulmaceae
5	Robinia	Robinia pseudacacia L.	Fabaceae
6	Mohru	Quercus floribunda Lindl. Ex A.Camus	Fagaceae
7	Baan	Quercus oblongata D.Don	Fagaceae
8	Chimmu/Chora	Morus serrata Roxb.	Moraceae
9	Khirak	Celtis australis L	Cannabaceae
<b>Major Firewood Trees</b>			
1	Kail	Pinus wallichiana A.B.Jacks.	Pinaceae
2	Mohru	Quercus floribunda Lindl. Ex A.Camus	Fagaceae
3	Tosh	Abies pindrow (Royle ex D.Don) Royle	Pinaceae
4	Rai	Picea smithiana (Wall.) Boiss.	Pinaceae
5	Tosh	Abies spectabilis (D. Don) Spach	Pinaceae
6	Kosh	Alnus nitida (Spach) Endl.	Betulaceae
<b>Major Non Timber Forest Products</b>			
1	Guchi	Morchella esculenta	Morchellaceae
2	Lingri	Diplazium esculentum (Retz.) Sw.	Athyriaceae
3	Nargaal	Drepanostachyum falcatum (Nees) Keng f.	Poaceae

Agriculture, which included horticultural activities, was the village's second largest source of employment, practiced by 112 families on a marginal scale on small farms in the village. Other arrangements, including government and private work, small businesses, and NFTP collection, were the villages' third-largest source of employment. Fourth largest source of employment was Animal Husbandry which was practiced by 74 households out of 138 in these villages (Table 3). The mean annual income in Indian national rupees per household in the surveyed village was Rs 1,09414 (US \$14275.05).

#### Household dependency on forests

**Livestock and fodder consumption:** In the villages, the forest provides the primary source of green fodder and bedding material for cattle. Because most agricultural activities are now performed with the help of tiller machines, only 74 families in the study areas owned livestock, the majority of which were cows. There were a total of 242 (104 cows, 49 calves, 14 bullocks and 75 goats) livestock in these settlements, and they required 1641 kg of green fodder and 711 kg of dry fodder to feed them every day.

## Level of Education ( $\geq 6$ years)

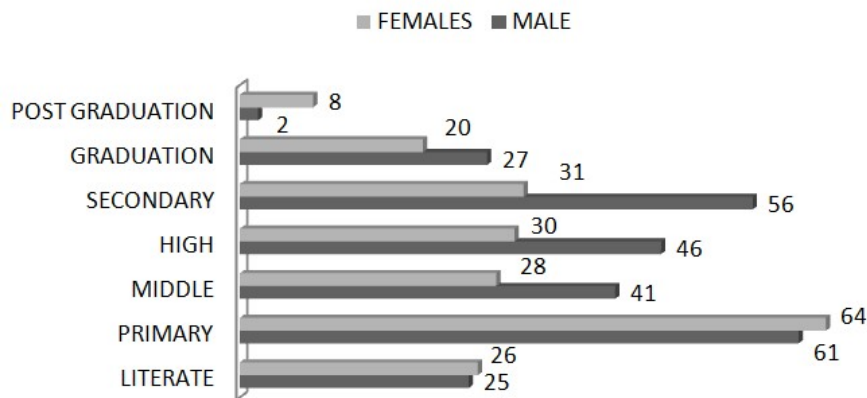


Fig. 2. Level of education of population in the study area

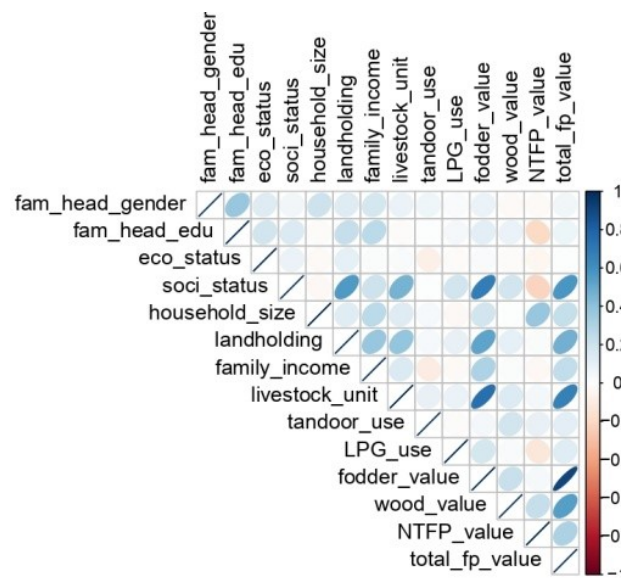


Fig.3. Correlation of various explanatory variables with forest dependency

**Fuel and energy use:** As witnessed in Himalayan villages, the majority of cooking fuel is generated from forest wood, resulting in an increased demand for forest wood, particularly during the winter months when the wood is also used for both cooking and room heating. Through the survey, it was discovered that 138 out of 138 families used wood for cooking and heating, notably during the winter months. During the winter months, the average use of a wooden stove for cooking and heating was 4.7 hours, using 24.64 kg of wood per family. During these months (October-March), 3375.8 kg of wood was required every day by all of the households.

**Dependence of forests products for selling in market:** Some households in the research area demonstrated dependence on a small number of NTFPs, including guchhi mushrooms (*Morchella esculenta*), lingri (*Diplazium esculentum* (Retz.) Sw.), and nargal (*Drepanostachyum falcatum* (Nees) Keng f.). Overall, 86 families overall relied on these forest products for a portion of their income. During the rainy season, the majority of the families, or 68 of them, harvested guchhi mushrooms. On average, these families harvested 1.01 kg of mushrooms (dry weight), earning them an average income of 4817 INR. In addition, eight families who individually harvested an average of 54 kg of lingri fern sold it for 678 INR in the market during the wet season. The other product gathered was nargaal, a type of grass (*Drepanostachyum falcatum* (Nees) Keng f.) used to make various basket-like goods locally known as kilta, tokra, and other terms by village households.

In total, ten families collect nargal and utilise it to make products. These households harvest 240 kg of nargal on average during the year, which earns them an income of roughly 9100 INR. List of different species harvested from forest as fuel wood, fodder and NTFP's is given in Table- 4.

**Socio economic factors influencing household dependence on forests:** Binary logistic regression model was run to assess the predictive ability of the selected socio-economic factors on household forest dependency. When multicollinearity was tested in preliminary analyses, no violations were found. No variable from the 10 input variables has collinearity problem. The linear correlation coefficients ranges between: min correlation (tandoor\_use~fam\_head\_edu): 0.003963673 max correlation (landholding~soci\_status): 0.5624505. All the explanatory variables were above the conventional cut-off point for tolerance and variance inflation factor (VIF): none of them had tolerance less than 0.10 and greater than 10 for VIF. The highest value for the VIF was shown by the Social status (1.727165) followed by landholdings (1.715721) while lowest value of VIF was observed for LPG use (1.042007) followed by tandoor use (1.043054).

**Likelihood Ratio:** For the likelihood ratio two regression models was run to compare their significance. Model 1 which showed the relationship of different factors (family head gender + family head education level + economic status of the family + Social status of the family+ household size + landholding + livestock unit + Family



income + tandoor use per day + LPG use per day) on forest dependency while Model 2 considered social status of the family + livestock unit + LPG use per day factors influencing forest dependency. p value is more than 0.05 which shows that model 1 is better than model 2. It means the full model is better and partial model is not better as compared with the full model 1. This finding indicates that a significant relationship exists between the explanatory variables of Model 1 and forest dependency (outcome variable). The likelihood ratio test shows that the regression model is significant ( $\chi^2 = (9, n = 150) = 21.00, p = .01$ ). This finding indicates that a significant relationship exists between the explanatory variables and forest dependency (outcome variable). The model as a whole explained between 13.1% (Cox and Snell  $R^2$ ) and 17.4% (Nagelkerke  $R^2$ ) of the variance on forest dependency and correctly classified 66% of the cases.

**Odd Ratio:** As presented in Fig 00, only two predictors: Social status and livestock unit made a statistically significant contribution towards predicting forest dependency. Since the coefficient of social status was positive, the odds of reporting high forest dependency decreased with general category family social status (OR = 6.893). This suggests that a households belonging to backward social classes i.e. Schedule caste showed more forest dependency by a factor of 6.89 than households belonging to general category. Similarly, the coefficients of livestock unit was positive and the chances of reporting high forest dependency increased with increase in livestock units (OR = 1.337). The result suggests that household belonging to backward social classes and households having more livestock's showed more dependency on forests. On the other hand, the variables such as family head gender, family head education, economic status, household size, landholdig, family income tandoor use, LPG use were not statistically significant but showed both positive and negative association with forest dependency. The null deviation was 189.449 on 137 degrees of freedom, while residual deviation was 92.779 on 127 degrees of freedom. The Akaike information criterion (AIC) used to evaluate how well a model fits the data it was generated from was observed 114.78 for the model.

**Relationship between household factors and forest dependency:** Regression analysis calculates the likelihood that the target variable will occur given a linear combination of the predictors. 0 or 1 are the only two possible values for the binary target variable in a regression model called binary logistic regression (LR). Given that the result is represented as readmitted (1) or not readmitted, it is the most widely used regression model for readmission prediction (0). A binary logistic regression model was used to evaluate how much the indicated socioeconomic factors could predict household forest dependency. When correlations were tested in preliminary analyses, no violations were found. The correlation was found between the livestock unit and fodder value i.e. 0.75, while social status and fodder value too had a strong correlation of 0.68 (Figure 2). The green animal feed that was gathered was transformed into 4 rupees per kg, illuminating the monetary worth of the forest products. The value of fodder grew for the family as the quantity of livestock in the household increased along with the amount of fodder used by the livestock, increasing the family's reliance on the forests and the ecosystem service that they provide in the form of fodder. Also, the social status of the family impacted the value of total forest products collected from the forests, which shows a regression correlation of 0.58 and 0.68 with the value of fodder collected. It means that the families from social backward classes were depending more on forests as compared to general class families.

## DISCUSSION

The focus group's demographics demonstrate that it is a diverse community with nuclear families, with an average family size of four. The family was one of many living in the same house. Some of the families shared a large house but had separate ration cards, classifying them in government records as different households. The sample household's overall literacy rate was similar to the district's average,

which for Kullu was 79.40% (Census, 2011). Male literacy in the study area was 2.81% higher than in the district, while female literacy was 1.68% lower than female literacy in the district, which can be ascribed to awareness and various social factors prevailing in these villages. The difference in the educational levels of males and females can be seen from the results of educational qualifications. According to educational qualifications, more women than men completed elementary school. Females also showed higher enrollment in higher education, demonstrating the strength of women in the educational field. The low enrollment of male students in higher education can be due to their lack of interest in the subject and social pressures to find employment as soon as they graduate from high school or complete their secondary education. For earning their livelihood, the majority of the inhabitants are engaged as daily paid labour as the bulk of the inhabitants of these villages are unskilled, with the majority having only completed secondary schooling. On the other hand, the scarcity of agricultural land has led the adult population to work as daily paid labour, making it the highest income earning sector. The villagers mostly worked for government welfare schemes such as MNREGA and also worked in adjacent areas as construction, agricultural, and horticultural laborers. Due to the hilly terrain of the region, the agricultural and horticultural practices are done on a marginal scale on small farms, forming the second highest source of income for the people. Farmers rely heavily on seasonal cash crops like cabbage, peas, tomatoes, and cauliflower, as well as seasonal fruits like apples, plums, and persimmons. Some farmers also cultivated traditional grains such as wheat, maize, and millets on the land, which was only used for self-consumption. The pension earning population, which included social pension schemes such as old age pension, widow pension, etc. by the government and pensions received by the retired government employees, formed the fifth highest source of service and earned the third highest income for the people. The animal products, mainly milk, from animal husbandry formed the least income-generating employment sector as the quantity of milk produced was very small and were mostly self-consumed by the households. According to the results of the forest dependency from the questionnaire survey, every household in the study area relied on forests to provide them with wood, which was then used as fuel for the tandoor. The village's nearby forests were where the wood was gathered from. Wood from the reserve forest area wasn't collected due to restrictions imposed by the forest law. There is a significant reliance on forest resources because of the use of tandoor, which needs wood as a fuel. Through a number of initiatives, including the Himachal Grihani Suvudha Yojna of the state government and the Pradhanmantri Ujjwala Yojana of the central government, they have made LPG gas affordable for BPL families, making it available to all households, and reducing their reliance on forests, particularly during the summer. But during the winter, there is a significant reliance on forests for wood because it is not only used for cooking but also for heating homes' interiors. In a similar study done by Soman and Anitha in 2020 on Parambikulam tiger reserve, the same results regarding fuel wood dependence were found where dependence on wood was shown by the respondents despite having LPG connections, which was attributed to the free availability of the firewood and high prices of LPG, which encouraged the collection of firewood from the reserve. Furthermore, heating houses with electric heaters in the winter is quite expensive and inefficient for the respondents, leaving wood from forests as the only primary source. A total of 91 families were engaged in animal husbandry in the villages under study, which included raising cows, bullocks, calves, goats, and sheep. These households were indirectly benefited by the fodder species because they could raise animals like cows, oxen, goats, and sheep, which helped the villagers, make money by selling their milk or the sheep's meat or by using the ox to plough the fields. Both the crops and the forests provided the necessary feed for them. The crop residue was primarily preserved as dry feed, and for the majority of the year, forests served as the primary supply of green fodder, which primarily consisted of tree species. As seen from the results, livestock numbers played a significant role in forest dependency. The number of animals reared by a family had a positive relationship with forest dependency; the greater the number of animals, the greater the dependence on forests.

These results were similar to the results of Ali *et al.*, 2020; Jain and Sajjad, 2016; Lakerveld *et al.*, 2015. From the results, it was also known that the forest's dependency was significantly influenced by the social status of the families. The socially backward classes were more dependent on forests as compared to the general class households. The findings are explained by the concept of cultural identity (caste identification), which influences people's preferences and ideas about what constitutes an appropriate way of life. The majority of the households collecting NTFPs, especially nargal, were from socially backward classes. These families made local products such as baskets and other such products from these forest products. Local forest-dependent communities are an amalgamation of subcultures, (Scheduled Tribes people, rice farmers, grazers, and Scheduled Castes basket makers), all of whom have unique livelihood practices, social institutions, values, identities, and relationships as well as socio-historical backgrounds and particular settlement histories, which further emphasized the significance of historical analysis in resource allocation.

## CONCLUSION

The findings revealed that, aside from feed and NTFP, which exhibited moderate dependence, the research area's communities have a high reliance on forest resources, particularly for fuel wood. As a result, the forest was important to the villagers' day-to-day lives and provided a key source of income for some of the families. We have learned about the socioeconomic structure of these villages by examining the relationship between a family's social background and their dependence on the forest. Therefore, it is necessary to address this issue by incentivizing members of the backward socioeconomic classes about forest conservation and promoting various technical skill development programmes, particularly for young people, so that they can become less reliant on the forest and work as skilled workers, increasing their income. In addition, there is a need to reduce the dependency on forests for fuel wood because it is higher than that for any other resource and the majority of families rely on forests for it. In order to reduce reliance on forests, better fuel wood and fodder species can be planted on the village's fallow land. An alternative to the tandoor, which plays a crucial part in these people's daily lives, particularly in the winter, is also urgently needed. The requirement for wood can be reduced by using more economical and fuel-efficient tandoors, which will lessen the pressure on the forests. In addition to this, it is important to educate local populations about the value of forests and to support efforts to conserve and reforest them.

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