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Heterogeneity in Household Characteristics, Forest Resource Utilization and Sustainability in Hills of Uttaranchal: A Case Study

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Abstract. The life of Jaunsaries, a tribal community of Jaunsar Bawar of Dehradun, India, is based on agriculture and forest. Forest utilization is the key for survival due to dependency of agriculture on rain. However, population pressure results into need to conserve forest. This study envisaged for exploring linkages between forest utilization and household characteristics for reducing pressure on forest for conservation. For this, data on relevant parameters were collected from 302 randomly selected households from 35 villages through multi-stage sampling. The regression analysis shows that forest utilization is directly related with farm size and livestock. The non-significance of relationship between forest access and utilization supports that forest utilization is integral part for livelihood of these household. The factor analysis results show that decision, economic, and forest access parameters are important for forest conservation. The non-significance of infrastructure is due to poor development. Therefore, infrastructure development is essential. As forest utilization is an essential component of these households, integrated attention to the requirements and facilities within the whole household production systems and forestry's role would be required to consider conservation and management of the forest. If conservation is a priority, programs are required to support and strengthen households' economic status.
Key words: Forest utilization; forest dependent community; socio-economic linkages; forest management; sustainability

A Heterogeneidade das Características dos Agregados Familiares, Utilização dos Recursos Florestais e Sustentabilidade dos Montes de Uttaranchal: Um Estudo de Caso

Sumário. A vida em Jaunsaries, uma comunidade tribal de Jaunsar Bawar em Dehradun, Índia, tem por base a agricultura e a floresta. O recurso à floresta é a chave da sobrevivência, devido à dependência que a agricultura tem da chuva. No entanto, a pressão da população torna necessário proteger a floresta. Este estudo explora as ligações entre a utilização da floresta e as características dos agregados familiares, de forma a reduzir a pressão sobre a floresta, com o intuito de a preservar. Com este objectivo, colheram-se dados relativos a parâmetros relevantes, em 302 agregados familiares aleatoriamente seleccionados de 35 aldeias, por amostragem múltipla. A análise de regressão mostra que a utilização da floresta está directamente relacionada com a dimensão da exploração e efectivo pecuário. A relação entre o acesso à floresta e a sua utilização não é significativa, o que revela que a floresta é fundamental na economia doméstica. Os resultados da análise factorial demonstram que os parâmetros decisão,

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economia e acesso são importantes para a conservação da floresta. O fraco nível de desenvolvimento justifica que as infraestruturas sejam não-significativas. No entanto, o seu estabelecimento é essencial. Dado que a utilização dos recursos da floresta é uma componente fundamental destes agregados familiares, será necessário ter em consideração as necessidades e conveniências da totalidade do seu sistema produtivo, para a conservação e gestão da floresta. Se for esta a prioridade, será preciso estabelecer programas para apoiar e fortalecer a economia dos agregados familiares.
Palavras-chave: Utilização da floresta; comunidades dependentes da floresta; ligações socio-económicas; gestão florestal; sustentabilidade

L'Hétérogénéité des Caractéristiques des ménages, l'Utilisation des Ressources de la Forêt et la Durabilité dans les Collines d'Uttaranchal: Une Étude de Cas

Résumé. La vie en Jaunsaries, communauté tribale de Jaunsar Bawar de Dehradun, Inde, est fondée sur l'agriculture et sur la forêt. L'utilisation de la forêt est la clef de la survie en raison de la dépendance que l'agriculture a de la pluie. Cependant, la pression de la population rend nécessaire le besoin de préserver la forêt. Cette étude a envisagé l'exploration des liens existants entre l'utilisation de la forêt et les caractéristiques de l'ensemble des ménages de façon à réduire la pression sur celle-ci, afin de la préserver Pour cela, des données sur des paramètres pertinents ont été recueillies sur 302 ménages choisis au hasard parmi 35 villages, par l'échantillonnage de multi-étape. L'analyse de régression montre que cette utilisation de la forêt est directement liée à la taille de la ferme et à l'effectif du bétail. Le fait que la relation entre l'accès à la forêt ne soit pas significative, permet d'affirmer que l'utilisation des ressources est essentielle au gagne-pain des ménages. Les résultats de l'analyse factorielle démontrent que les paramètres décision, économie et accès à la forêt sont importants pour la conservation de celle--ci. Le fait que les infrastructures soient peu significatives est dû au faible développement. Le développement d'infrastructures demeure, donc, essentiel. Comme l'utilisation de la forêt est une composante essentielle de ces ménages, l'attention aux conditions et aux facilités dans les systèmes de production du ménage et au rôle de l'exploitation des forêts sera exigée pour la conservation et la gestion de la forêt. Si la conservation est la priorité, des programmes sont exigés pour soutenir et fortifier le statut économique des ménages.
Mots clés: L'utilisation de la forêt; la communauté dépendante de la forêt; les liens socio-économiques; la gestion de la forêt; la durabilité

Introduction

Forests are most important natural resource for poor. They provide large *albeit* different ranges of goods and services for virtually all patterns of human settlement and livelihood such as, food, fuel, medicines, household equipment, building material and raw materials for industrial processing. These may be classified in to three broad categories viz., food security and health, cultural and social values, and income and savings (ARNOLD, 1997).

Forest dependent communities and tribals depend so much on forest that they prefer to live inside the forests rather than with so called modernized human settlements. They get shelter, home and raw materials for house buildings, food, dress material, cultural equipments, spiritual life or pleasure together with psychological contentment from forests. Their way of life is strongly associated to the forests from birth to death.

These interlinked issues of poor and their requirement from forest and forest

products need to be studied critically to frame the policy regarding the forest use. This is important because, despite the policy thrusts and legislative instruments to curtail the use of forests by the locals, the latter continue to find access to the forests (PATHAK, 1994). This indicates that some refinement is essential between the linkages of forest conservation and livelihood options of poor. In fact the decision of forest utilization by the people is for the satisfaction of their basic needs within the limits of resource availability. The poor receive forest products without price by utilizing their surplus labor, the latter has direct bearings with their socio-economic conditions. Thus, it is essential to examine the relationship between forest utilization and socio-economics of people. The findings may be useful to formulate development strategies for the poor and hence reduction in dependency on forest.

The changes in the policy or programmes are not possible without understanding the linkages between the household characteristics and forest utilization. To address this, a study was undertaken in a forest-based tribal community of Jaunsar Bawar and the results of this study are discussed in this paper.

The Jaunsar Bawar and Jaunsaries

The study area, Jaunsar Bawar falls under North and North eastern zone as per Geographical Classification, it is situated in Chakarata and Kalsi tehsils of Dehradun District of Uttaranchal. It lies between latitudes 30^0-31'N and 31^0-3'-30"N and longitudes 77^0-45'E and 78^0-7'-20"E. It is entirely composed of the succession of peculiarly rough and steep hills and mountains, which are broken by numerous streams and nalas, creating a very rugged configuration. The total geographic area is 1002.07 square km, constituting 32.5% area of Dehradun district (PANT and SAMAL, 1998). It is roughly oval in shape with its major axis lying North - South. It is bounded on the Northeast, East and Southeast by Tehri Garhwal district of Uttaranchal, on the West and Northwest by Sirmaur, Himachal Pradesh, and in South by Doon valley. 64% of land area is covered by forests. Forest based industries are rare. Forest is mainly exploited for fuel, fodder, grazing, timber and medicinal plants. Beside this, people also consume some forest fruits, flowers and wild animals.

The community of the Jausar Bawar is known as Jaunsaries and their livelihood depend on agriculture and forests (SISHAUDHIA, 1993). In general, forest dependent communities interact closely with forest, derive their economic livelihood and often their cultural and spiritual identity from forests (BYRON and ARNOLD, 1999). Literacy rates vary from 20 to 39 percent in Kalsi and 13 to 27 percent in Chakrata tehcil. Population is sparsely distributed in scattered small-nucleated villages with a density of 88 persons per square kilometer as per 1996 survey. Population of the area was 97,887 in 1991, out of which, 51,930 were males and 45,957 females with a sex ratio of 855 females for 1000 males. The proportion of Schedule Caste population is 24 and 28 percent, respectively in Kalsi and Chakrata blocks.

Availability of jobs to the work force of the Jaunsar Bawar is very low. Hence the livelihood options revolve around the exploitation of natural resources in general and agriculture in particular. The extraction from forest and agriculture

crop are being practiced jointly by the villagers. Due to this, the entire socio-economic structure of the Jaunsari community revolves around the principle of 'joint living and joint agriculture' (SISHAUDHIA, 1981). Among major forms of land use, unirrigated areas occupy the main proportion in both blocks i.e. 48 and 40 percent, respectively. Wastelands occupy another 43 percent in both the tehsils. Out of these, cultivable wasteland proportion is 34 and 33 percents, respectively in Kalsi and Chakrata. However, these lands are largely unsuitable for productive purposes due to hilly tracts and lack of irrigation facilities. The total agriculture land is 36647 acres. Out of it, only 10% land i.e. 3,818 acre is irrigated and 32,829 acre is unirrigated (JOSHI, 1995).

Methodology

The study region, was classified into four zones on the basis of altitude i.e. forest types. This decision was based on the premises that forest utilisation are also governed by available tree species and that the variations can best be captured in and among such strata. At first stage, two zones one from each tehsils, the low and high hill zones - Kalsi Tehsil for low hills and Chakrata Tehsil for high hills - were selected at random. At second level, villages were identified within the selected tehsils. Information pertaining to household characteristics and forest related parameters was collected from 302 randomly selected households in thirty four randomly selected villages. In this area, the number of families residing in a village varied from 8 to over 20. Therefore, 5-12 households were randomly selected from each selected village. Larger sample size could not be considered due to the homogeneous livelihood pattern within a village. Villages were selected by random cluster sampling procedure, keeping in view the homogeneous group of the sampling population.

Due to the interlinked nature of socio-economic determinants, factor analysis was used to identify the influential characteristics with their relative importance. It acts as a tool for remedial measure for multicoliinearity among the independent variables. The principal component analysis was used as the method of factor extraction. Based on the analysis factor scores were estimated using SPSS for regression analysis.

Result and discussion

Jaunsaries: The present senario

Jaunsary are primarily an agriculture-based community. Their agricultural fields are not suitable for cultivation due to the hilly tracts and rocks. These have been made conducive for agriculture by the manual work of the people. Men, women and children are actively engaged in agriculture activities. Farming in Jaunsar is of a subsistence nature and mainly depends on rain, therefore, forest utilisation is key for survival of the people of Jaunsar. Other occupations are labour, value addition work on forest products, salaried job mostly as a guard, peon, driver, etc. Due to resource crunch and limited opportunity for income generation, most of the households are engaged in more than one economic activity for their survival.

Agriculture was the primary activity for 73 percent households. The members of these households performed

cultivation work along with bio-fertilizer preparation from the leaves, twigs from forest and animal waste. Only 16 percent of households were primarily involved in labour works, 3 percent in salaried job and 2 percent in value addition job for the forest products. Since in most cases, the income from primary activity was either not consistent or inadequate, additional sources of income were necessary to meet the basic needs. This survival strategy helps households to cope with food insecurity as they have better alternatives depending on their capabilities to generate income even when they may face disastrous situations particularly during drought and snow. Secondary activities included services, trading of raw materials for basic amenities for villagers, agriculture and forest related activities. Apart from the primary activity, 83 percent households were engaged in other income generating activities for the survival of their families. The rest belonged to relatively better off families, whose earnings from primary sources were considerable or they were the households who did not have any other options and live under extreme poverty.

The analysis of existing quality of life suggests the poor conditions of the people. The families, in general, were big in size with an average of 9 members with a maximum of 27 members in some cases. Most of families live in *kuchha* houses; only 27 percent houses were *pucca*. More than 50 percent households had availed loan from various agencies for different uses. The education status was also very poor. Less than 50 percent head of households were literate, and more than 70 percent senior women were illiterate.

Livestock rearing in Jaunsar is essential as it provides a number of benefits to them. They are mainly for agricultural purposes for drought power, farmyard manure etc. The milk and milk products are secondary. The livestock includes mainly buffaloes, cows, goats, sheep and mules. Livestock rearing were dependent on their requirements as well as economic status of the people as revealed during survey. Generally, poor keep mules for transportation purposes particularly of heavy luggage from road head to the village. A single poor household normally possessed as many as 4 mules. The households, who had 4 mules, were generally very poor and their livelihood was dependent on the income earned through these mules since generations. Traditionally, mule keeping is a distinct profession of a given section of the society. However, now-a-days, majority of those have 1 to 2 mules. The rich households have as many as 10 buffaloes. The products obtained from these domestic animals support the households' requirements in general. The animal products are also being used for bartering. The sheep rearing is mainly for wool. The wool, in general, is used for making blankets or clothes, for their personal use.

The forest resource utilization is mainly for consumption goods. However, these resources are also being used as input for other processes, and as durables. The households were using raw materials from forests for agriculture too such as fencing, and support materials, etc. They eat roots, rhizomes, mushrooms and fruits from forest. Besides this, they use forest for social, cultural and medicinal purposes too. Forest supports all the consumption demand of the livestock of the region.

Linkage between household characteristics and forest extraction

Factor analysis was performed to elucidate the uncorrelated factors. The result of factor analysis identifies the important and significant characteristics and affirms the relative importance of the characteristics in the form of uncorrelated factors for elucidation of the relationship between these characteristics. The result of the analysis is given in Table 1 with the factor loadings. From the analysis, it is confirmed that household assets, family composition, head of household, and economic status are important socioeconomic characteristics out of the sixteen studied characteristics that determine the forest utilization for present study. The characteristics with higher loadings in a factor were assigned suitable names. These are Asset Factor, Family Factor, Household Head Factor, Economic Factor and Forest Access Factor (Table 2). These factors' relative importance in terms of the percent variation explained for forest utilization is reported in Table 2. The diagnostic analysis reveals that the assumption of homocedasticity is met by the data.

In order to understand the socioeconomic determinants of forest utilization two different regression models were estimated for fuelwood and fodder collection. These models were developed based on the derived factors and other remaining characteristics, which were not part of the derived factors. For getting the significant factors/ parameters, stepwise regression model, without constant term, was used. The regression results for household characteristics and forest utilisation based on stepwise regression analysis with maximum Adj R^2 were used with other statistics of the model for understanding the relationship.

Table 1 - Result of Factor Analysis for the forest extraction influential parameters

Parameters	Factor					
	1	**2**	**3**	**4**	**5**	**6**
Type of House	0.06	0.07	0.04	0.23	-0.04	-0.22
Sex of Head of Household	0.01	-0.02	-0.03	0.49	0.056	0.089
Age of Head of Household	0.06	-0.03	0.03	0.78	0.08	-0.07
Years in School of Head of Household	0.12	-0.21	-0.03	0.08	0.12	-0.06
Family Size	0.11	0.97	-0.01	0.13	-0.01	-0.03
Number of Children below 5 years	0.06	0.36	-0.05	-0.07	0.03	-0.01
Total Land (In bighas)	0.49	0.20	-0.08	0.16	-0.04	-0.07
Adult Cattle Units	0.26	0.08	-0.26	0.09	0.09	0.05
Loan Availed	-0.03	-0.08	0.93	0.05	0.02	0.10
Marketing Time	-0.06	-0.03	0.06	0.07	-0.11	0.07
Travel to Village Time	-0.04	0.02	-0.03	0.02	-0.04	0.03
Irrigated Land	0.98	0.04	0.04	-0.09	0.08	0.01
Fuel Collection Time	0.01	0.01	0.25	0.02	-0.01	0.59
Fodder Time	0.04	0.05	-0.06	0.05	0.21	0.06
Fuel Collection Distance	-0.02	-0.09	-0.11	0.03	0.19	0.60
Fodder Distance	-0.04	-0.02	0.09	0.09	0.92	0.37

Table 2 - Derived factor details

Original Characteristics	Derived Factor Name	Explained Variation (in %)
Fuel Collection Time Fuel Collection Distance Fodder Collection Distance Fodder Collection Time	Forest Access Factor	V (7%)
Total Land Irrigated Land	Asset Factor	I (12 %)
Family Size Children below 5 years	Family Factor	II (11 %)
Age and Sex of Head of Household	Decision Factor	IV (8 %)
Loan	Economic Factor	III (9 %)

The result of the Jaunsar Bawar region as a whole clearly depict that the fuel and fodder collection was governed by capital issue, decision-making issue of household and infrastructure issue of the region. The non-significance of forest access factor is mainly due to the open access forest to the people of the region. The significance of ACU (Adult Cattle Units) for fuel wood may be due to the requirement of compost, which is being prepared by putting these leaves, twigs and small branches as a bed for the livestock. This clearly reflects the high demand of compost for farm by the household and therefore the high dependency on the forest. The negative significance of decision factor may be interpreted as being mature enough. It may be possible that the households are adjusting and adjudging the optimum allocation of external and internal resources of the households. The equations for explaining the fuel wood and fodder use variation among household are elaborated below.

Fuel = 6.62 Type of house + 0.48 Head Education – 1.53 Asset Factor + 1.04 ACU – 2.04 Economic Factor + 2.78 Travel Time + 0.91 Marketing Time – 1.59 Decision Factor

Adj. R^2 = 0.79; Durbin Watson = 1.43; SE = 11.15; F = 148.65 (0.00)

Fodder = 11.89 Type of house + 0.70 Head Education – 5.34 Decision Factor + 1.15 ACU + 6.77 Economic Factor + 2.95 Travel Time + 3.23 Marketing Time

Adj. R^2 = 0.63; Durbin Watson = 1.43; SE = 24.60; F = 78.75 (0.00)

The significance of decision factor for fuel wood collection shows an interesting gender biased pattern. The female headed household extract less from forest than male headed household. This findings support the result of KOHLIN (1998) and ADIKARI (2002), who observed that males contribute more significantly to fuel wood collection than females in the hilly terrains of Nepal. However, this is against the traditional accepted fact of female dominancy in producing energy. The in-depth probe of this finding reflects that the low proportion of female-headed household and high work pressure on females may be the potential reason for this finding. In this region, female are not the sole collector of fuel wood, which is same as reported by AMACHER *et al.* (1993) for similar situation in Nepal. The positive significant impact of head's education on fuel wood collection is against the

findings of GUNATILAKE (1998) and ADHIKARI (2002) for the similar forest based community. This is against the accepted point of view that education level is indirectly linked with forest utilization. It was observed that due to its free availability from forest as well as lack of other options with non affordability were the probable causes, which overshadow the influence of the education. Moreover, it was non significant as high proportion of household heads were either illiterate or having low level of education. The positive significance of livestock on fuel wood was due to their greater involvement for cattle tending in forest. Due to animal grazing in forest, they were tempted to collect fuelwood, which otherwise they wouldn't have collected (NEGI, 1997). The significance of infrastructure facility for fuel wood collection clearly advocated the real story of forest dependency of these poor of Jaunsar. This excess fuel wood collection may be advocated by the lack of infrastructure, which enforced household labor to work for their sustenance which was otherwise not a part of household labor and therefore marginal productivity of labor decreases for the non availability of other income generating activities. Therefore, there is no option other than dependency on forest. GUNATILAKE (1998) has also reported similar findings and advocated that people who are living far away from the market depend more on the local commons / forests to sustain their livelihoods. The positive significance of type of house may be interpreted that poor were relatively drawing less than the well off people. This is against the accepted fact that poor rely more on forest than the relatively well off. This supports the findings of JODHA (1985) for the dry regions of India. This is further supported by the negative significance of loan availing i.e. economic factor. That is in general, requirement of money for other important household functions enforced them for loan. Therefore, the loan takers had to perform something extra than the normal income for repayment. Since the income generating activities were less and cash was not directly available from forest or forest related activities, the person has to do other jobs including migration, therefore reduction in the time for forest exploitation. The negative finding of asset factor with fuel wood is self-exploratory (NEGI, 1997). The bigger the size of farm, the more is labor requirement. It is also true since agriculture is time consuming as well as labor-intensive activity. This labor has to be from family labor force in general, therefore reduction in availability of labor for forest collection.

The combined impact of various factors shows that asset, economic, decision environment and infrastructure were important issues to be tackled for forest management. The significance of infrastructure, which is a state affaire should be strengthened.

These results have significant implications for proper management and conservation of forest in the region. If conservation is to be a policy emphasis, programs are required that support and strengthen households economic status. As forest utilization is essential component of the Jaunsaries households, integrated attention to the requirements and facilities within whole household production systems and forestry's role would be required to consider for conservation and management of forest.

Conclusion and policy implications

Resources, particularly natural resources are subjected to households dependence at their regional and institutional location. These have direct and indirect impact on the household attributes. Janusar, a hilly topographic region, has agriculture and forest resources as the only survival options for the households. Land, labour and capital availability affect the pattern of forest utilization and subsistence earning processes for individual households. Other household resources and attributes like livestock, family type and composition, households' educational and social status also influence the livelihood support system and forest utilization.

The study shows that Jaunsary household dependency on forests is primarily for fuel wood, fodder, leaf litter and to some extent for auxiliary non-timber forest products. As hypothesized, econometric analysis suggests that labour allocation decisions for forest extraction activities are functions of various socio-economic and demographic attributes like sex of head of household, land and livestock holding and gender, education, and some other local differences.

The differential influences of economic and other factors on poor and rich in the hill regions indicate probable aggregate and selective responses to public policies. The rich are relatively less dependent on forest for livelihood and more capable than poor. They have more uncultivated lands that have higher probabilities of earning income by utilizing their surplus labor and state sponsored supportive policies. Poor though willing to shift their dependence on forests, are more constrained to do so. To ensure proper management and conservation of forests, the particular constraints of the households need to be addressed.

This study suggests that household and community characteristics, as well as relative management regimes need to be carefully considered for framing policies that would modify household resources and decision environment. Analysis of the determinants of household and forest contribution through regression analysis indicates a strong relationship between private endowments of households and forest dependency. In other words, heterogeneity does matter household wealth, education, and gender has considerable influences on collection of forest products. The important influencing factors suggesting policy emphasis that target households' constraints are:

1) Increasing effective land assets and its intensification,

2) Strengthening household capital investible capacity,

3) Improving infrastructural facilities, and

4) Managing forest for cash through proper marketing,

Depending on the regional context, programs could incorporate additional targets that address differential household attributes.

Policy measures should include the empowerment of women and politically marginalized users, more representation of weaker sections of community in the decision-making process, non-timber forest product oriented management systems, and participatory roles to all community members. The challenge is to develop management institutions that are efficient, equitable, and ensure an

egalitarian access to the resource base. Since patterns of forest use differ among rural households, forest policy in this respect must be directed towards diversifying the products that meet the demand of different interest groups within the community.

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