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Forest-Based Livelihoods Strategies Conditioned by Market Remoteness and Forest Proximity in Jharkhand, India

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Summary. — The study uses a novel method to investigate the role of forest proximity, market remoteness, and caste in determining household income, especially forest income, in an underdeveloped region of India. A high (>50%) proportion of total income is earned in cash. Forest products contribute substantially to total income, with fuelwood as the most important forest product. Proximity to forest is associated with higher forest incomes as expected, but remote villages do not have higher forest incomes or lower cash incomes than less remote villages. Higher off-farm income is associated with better road access and higher income households generally.

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Key words — Asia, India, income, forest products, remoteness, poverty

1. INTRODUCTION

It is widely reported that rural households rely on wild natural resources to help meet current-consumption needs and to provide a safety net in times of hardship (Byron & Arnold, 1999; FAO, 2008; Neumann & Hirsch, 2000). There has also been much speculation about the potential for improving rural livelihoods through increased commercial exploitation of forest products and other natural resources (Belcher & Schreckenber, 2007; Milne, Verardo, & Gupta, 2006; Scherr, White, & Kaimowitz, 2004). However, the empirical basis for these discussions has been weak (Agrawal & Redford, 2006). A large number of studies that purport to assess the importance of forest products have used qualitative methods, producing inventories of useful species but providing little indication of their absolute or relative importance (Neumann & Hirsch, 2000) and Vedeld, Angelsen, Boj , Sjaastad, and Kobugabe Berg (2007) found serious methodological problems compromised many of the quantitative assessments they reviewed. Nevertheless, some exceptions, such as Cavendish (2000), Campbell *et al.* (2002), and the recently published PEN study (Angelsen *et al.*, 2014; Wunder, Angelsen, & Belcher, 2014), a comparative analysis of 33 cases studies, have done careful accounting to find that forest contributions to livelihoods are substantial indeed.

McSweeney (2002) considered the meaning of “forest dependence” and drew attention to the importance of analytic scale and the lens through which data are interpreted. In her case study she noted that village-level assessments reveal very different interpretations than global assessments or household-level assessment. Many assessments of “forest dependency” or “forest reliance” are based on case studies in areas that have high forest cover, which might be expected to have higher levels of available forest resources and therefore higher levels of forest use than areas with less forest resources (Coomes, Barham, & Takasaki, 2004; Fisher, 2004; Kamanga, Vedeld, & Sjaastad, 2009; Zenteno, Zuidema, de Jong, & Boot, 2013). Highly forested areas also tend to be remote from markets, government services, and other urban amenities, with

correspondingly lower income and employment opportunities and with higher levels of poverty and social and political marginalization, all factors that are expected to influence forest use (Sunderlin *et al.*, 2005). Angelsen and Jagger (2014) found that, in comparing sites, agricultural land is negatively correlated with relative and absolute forest income, suggesting that agriculture and forestry are alternative development and specialization pathways. These observations about the role of forest access, road access, and tradeoffs and determinants of livelihood options have important implications for development policy and practice.

This study looks deeper into this issue, providing an empirical analysis of how forest income varies depending on forest access and market access. Specifically, it investigates the influence of forest proximity (as a proxy for forest resource availability) and remoteness (as a proxy for market access) on livelihoods options/choices generally, and on forest resource use specifically, in a poor and underdeveloped region of India. The study also investigates the role of caste (including tribal affiliation) as an important social characteristic that can also influence livelihoods options.

The study is based on a survey of 1,206 households in 27 villages throughout the state of Jharkhand, one of the poorest states in India. We used a geographical information system (GIS) to do a stratified random sampling of the villages, to control for forest resource availability and remoteness. On this basis, it assesses livelihoods status (measured in terms of total

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income) and investigates the absolute and relative contribution of forests and other natural resources to incomes of different socio-economic groups under a range of conditions. This is a novel approach methodologically. By studying current patterns of use and the factors that influence those patterns, we aim to contribute to a better understanding of the potential of forests and forestry to contribute to improving rural livelihoods.

The paper is organized to provide a brief background, rationale, and specific research questions for the study, followed by a description of the study site and the methods used for sampling, data collection, and analysis. The results are then presented and discussed. The last section presents the main conclusions and some policy considerations related to our findings.

2. BACKGROUND, RATIONALE, AND RESEARCH QUESTIONS

Rural livelihoods tend to be highly diversified; families use diverse portfolios of activities to meet basic needs and to improve their standards of living (Ellis, 1998). Ellis's (1998) review observed that diversification is a heterogeneous process driven by a range of social and economic factors, including seasonality, differentiated labor markets, risk spreading, coping, credit market imperfections and inter-temporal savings and investment strategies, but that overall, the capacity to diversify helps improve livelihood security and increase income in contexts where there is no single dominant income source available. Where forest resources are available, people use them to meet subsistence needs, as tradable goods to generate cash income and, where market conditions permit, as raw materials in a variety of processed products (Angelsen & Jagger, 2014).

The role of remoteness in forest conservation has been well examined, often within a von Thünen framework (Angelsen, 2007; Hyde, Amacher, & Magrath, 1996; von Thunen, 1875). In general, there is more pressure to convert more market-accessible forest land to non-forest uses (agriculture; urban development) and, conversely, remote forest land tends to be less valuable and therefore more likely to be conserved.

The same factors that help to conserve forests may also contribute to perpetuating poverty (Angelsen & Wunder, 2003). These areas tend to have poor transportation and other communications infrastructure. They often have steep topography, poor soils, hostile climates, and low agricultural potential. The forest remains, at least in part, because it has been difficult and uneconomical to exploit the timber and because there has been relatively low pressure to convert the land to other uses (Sunderlin, Dewi, Puntodewo, Müller, Angelsen, & Epprecht, 2008).

Remoteness also limits opportunities for alternative employment or income. Markets for inputs and for outputs are distant and costly to access, so people living in the area must rely on mixed, low-intensity, subsistence-oriented systems. Commercial trade of agriculture- and forest-products often requires long journeys to transport products to markets, with high transactions costs in the form of transportation expenses, losses to perished product, official and unofficial tariffs, taxes and bribes, and uncertain demand and prices when they reach market. Often, producers must rely on itinerant traders who typically have a stronger bargaining position than local sellers. These middlemen face the same high costs and risks of transporting goods to market from remote areas, so farm-gate prices remain low relative to retail prices. Higher levels of forest dependency are reported in more remote areas (Sunderlin *et al.*, 2005).

Where off-farm income opportunities are available, this is often a key avenue out of poverty (Haggblade, Hazell, & Reardon, 2010; Ruiz-Pérez, Belcher, Maoyi, & Xiaosheng, 2004). But, with few wage jobs locally in remote forested areas, a large number migrate to urban areas for work. When the young and the strong and the better educated leave, it can further reduce capacity in their home villages, although remittances might be used to invest in profitable farming activities.

Forest resource availability is expected to influence which forest products and what quantities are used and sold. It is expected that villages located in or near forests will have higher total incomes from forest sources. However, closeness to forests and remoteness from markets tend to be positively correlated, though poor market accessibility may limit the advantage of better forest resource availability as a source of cash income. It is possible that villages with good forest resources and better accessibility would be able to generate higher forest-based revenues.

The people who live in forested areas also tend to be politically and economically marginalized. Many are indigenous or culturally conservative, with long-established subsistence-based livelihoods traditions (Sunderlin *et al.*, 2005). Others are migrants who have left poor conditions seeking new economic opportunities, or those who are disadvantaged by their social strata within a community. They may be relatively powerless, with limited political and social capital. For these reasons, and as another consequence of their remoteness, communities in forested areas tend to be overlooked and under-served by government. They suffer poor education, primary health care and agricultural extension and other services and generally low-levels of human capital in self-reinforcing cycles typical of poverty (Belcher & Schreckenberg, 2007).

Culture and ethnicity are also expected to influence resource use decisions. Specifically, it is expected that tribal peoples, with long traditions of forest dwelling and forest use, will include more forest products in their income portfolios. The Indian Constitution recognizes and classifies three categories of "Backward Classes". These are: Scheduled Caste (SC) or Dalit, formerly known as "untouchable" within the Hindu caste system; Scheduled Tribe (ST) or Adivasi, which are aboriginal people; Other Backward Classes (OBC). These communities are recognized to have been socially and economically disadvantaged and the constitution provides for positive discrimination to improve their situation.

The study investigates whether these expectations hold true in the Jharkhand case with several questions relating to remoteness, forest resource availability, and socio-economic class.

Remoteness:

1. Are households in more remote villages poorer than households in more accessible villages?
2. Do households in more remote villages have higher forest based income?
3. Do households in more remote villages rely more on subsistence income and less on cash income than households in more accessible villages?
4. Do more households in more remote villages have lower non-farm income than households in less remote villages?

Forest resource availability:

5. Do villages with higher forest resource availability have higher forest based income?

Socio-economic class:

6. Do poorer households rely more on forest resources than wealthier households?

7. Do Scheduled Tribes have higher forest income than other castes?

3. METHODS

(a) Study area

Jharkhand is one of the least-developed states in India. A relatively new state, created in 2000 when it was separated from Bihar, it is located in east-central India, south of the Ganges River. Jharkhand has relatively high forest cover of 2.5 million ha or 32% of total area, mainly Sal (*Shorea robusta*) and mixed deciduous forest. Most of that forest is classified as State Forest, under the jurisdiction of the Jharkhand Ministry of Environment and Forests (MOEF). There are high levels of poverty in the state, with an estimated 44% of the state population living under the national poverty line (The World Bank, 2007). Transportation and communication infrastructure is poorly developed, and an active Marxist insurgency has prevented infrastructure improvement, especially in the more remote areas. With high levels of rural poverty, poorly developed infrastructure, a large tribal population, large remaining forest areas, it is expected that forest-based income will be important, but to date this has not been well quantified. (Figure 1).

(b) Village and household survey

The study focuses on three key livelihoods determinants: road access, forest proximity and caste. We used a stratified random sample frame to get a representative sampling of

villages in districts with significant forest cover. We purposively selected the three main forested districts of the state (West Singhbhum, Ranchi, and Palamu districts), of a total of 24 districts. Using a forest cover map, road map and village map, we used GIS to classify all villages into one of three zones, according to their proximity to forest (high forest defined as 35% forest cover in the vicinity of the village) and road access (low access defined as greater than 10 km to an all-weather road). This process generated a list of all villages in the three districts, classified into: high forest + low access (HFLA); high forest + high access (HFHA), and; low forest + high access (LFHA). The fourth possible zone, low forest + low access, did not exist. We then randomly selected three villages from each zone in each district for a total sample of 27 ($3 \times 3 \times 3$) villages. As such, the overall data set is representative of the range of village situations within the more forested districts of Jharkhand, and is expected to have many similarities to forested districts in neighboring states.

Field work was conducted between April and October 2006. Survey tools included village-level focus group discussions using participatory rural appraisal techniques such as participatory mapping, cropping calendar discussions, and a checklist of key issues for discussion (Cornwall & Pratt, 2011; Lynam, de Jong, Sheil, Kusumanto, & Evans, 2007). These were designed to learn about village context and conditions: socio-economic conditions, income and employment patterns, resource availability and use trends, recent developments, and forest management and use. The participatory mapping yielded a list and location of all households in the village. Households were numbered and randomly selected for the household survey. Forty-five household heads were interviewed in each village. If a selected household was unavailable

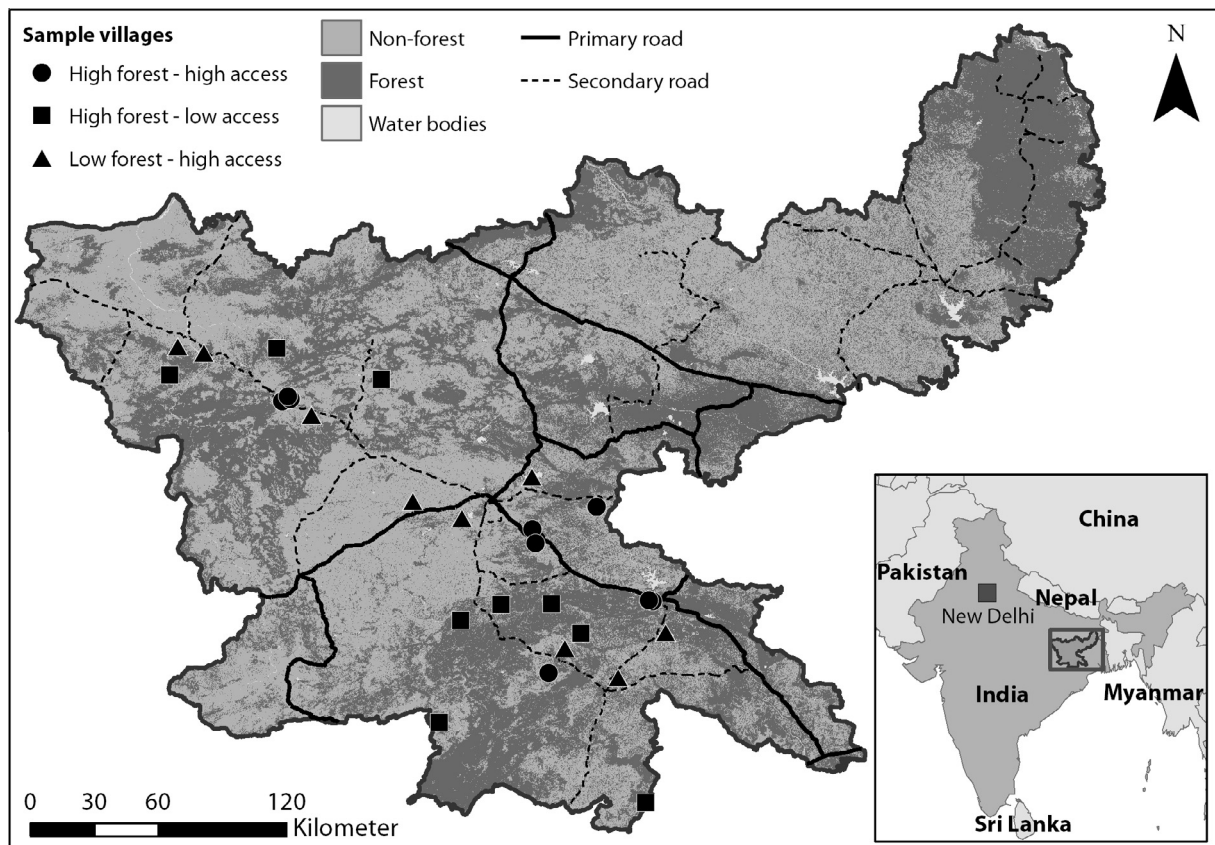


Figure 1. Map of Jharkhand, India.

or unwilling to be interviewed, a replacement household was selected randomly to meet the minimum target of 45 households per village.

The household survey collected data on household demographic characteristics, caste, assets, and detailed information about income by source; e.g., quantities produced/collected, quantities consumed or sold, and prices. The interviewers referred to the cropping calendar and used a checklist of key activities and products generated by the village survey to aid recall of income by source over the 12-month reference period. Income categories included: agriculture; livestock; forest products (products harvested from state forest land); agroforest products (products harvested from private land); forest business; trade, and salary (wage, salary, trade, and business other than forest-based); labor; and remittances.

The data were checked for completeness, uniformity of units and scale, and internal consistency by the survey team and again by the analysis team. Sixteen cases were excluded due to missing or inconsistent data, leaving a total sample of 1203 households.

Asset and income data were converted to rupee values using prices at the village level for products that are traded for cash. Even products that are primarily used as subsistence products are occasionally traded and respondents were able to provide price estimates. Fuelwood is an important subsistence product; it is mainly collected and used within the household, with little local cash trade. Respondents were asked during group discussions to estimate the value of fuelwood. An average of price of Rs. 2/kg, or US\$0.046/kg (US\$1 = Rs. 43.3) was used for the whole sample. While this price may overestimate the true market value, it is the best estimate available.

Households were subdivided into four income classes using multiples of the Indian rural poverty line (Rs. 3312/capita/year, or US\$76.50): Q1 < Rs. 1656; 1656 < Q2 < 3312; 3312 < Q3 < 6624; Q4 > 6624. Note that Rs. 6624 is still less than 34% of the international poverty line of \$1.25/capita/day.

(c) Analysis

Descriptive statistics were used to explore relationships between income, assets, source of income, caste, and location. We compared overall mean subsistence, cash and total income by zone, and then used a more detailed analysis by income category to address questions about different livelihood strategies relating to remoteness and forest proximity. We further disaggregated the data by income class to compare income sources in both absolute and relative terms. We then compared cash and subsistence income by income category by caste and by zone for evidence of caste-specific livelihood strategies. We used Anova Mean test and Kruskal–Wallis test to analyze the differences in mean or median across groups or classes. The Kruskal–Wallis test was used to accommodate the non-parametric distribution of households of different castes in the sample.

Regression analysis was done using both Ordinary Least Squares (OLS) and multi-level (household and village level) analyses to assess the relationships between relevant income categories (1. total income per capita; 2. cash income per capita. 3. forest income per capita) as dependent variables. Household-level explanatory variables were socio-economic characteristics (age, caste) and assets (agricultural land area, number of trees owned), values of total household assets and overall income portfolio. Village level variables were forest access class. Multilevel regression was applied using MLWin v. 2.02. The variance partition coefficient (VPC) indicates the percentage variance explained by adding the second (village) level in the Multilevel Regression Model.

4. RESULTS AND DISCUSSION

(a) Livelihood status and strategies by zone

The survey results show high levels of poverty in the study area, with 48% of households living below the Indian rural poverty line of Rs. 276 per person per month (India Watch, 2007), and all households below the commonly used international poverty line of US\$1.25 per person per day; even the wealthiest households cannot be considered rich in absolute terms.

Income is distributed highly unequally in most villages. The village income Gini coefficients range from 0.28 to 0.74, with a mean of 0.50. Villages with the highest mean incomes tend to have the greatest inequality, as a few relatively wealthier households both raise the mean income and income inequality.

Surprisingly, there are no significant differences between zones in terms of cash and total income. Proportion of subsistence relative to total income is significantly lower in LFHA than in HFHA households (Figure 2).

More than half of total household income is earned in cash, with significant variability (F -test, p -value 0.000) by zone: 58% on average in HFLA, 53% in HFHA and 66% in LFHA. This is a surprising result, considering the extremely underdeveloped infrastructure and markets in the area. Even in low access zones people find ways to generate cash income by selling a range of products and through wage jobs and labor (discussed further below). Once again, these averages disguise large differences among villages in means, variability, and sources of income.

Income portfolios are highly diversified. The most important income categories (including both cash and subsistence) are: agriculture; forest product; trade and salary (which includes wage jobs, small businesses, and petty trading), and labor (mainly seasonal work on other people's farms). Livestock is important as an asset and as a supplementary source of subsistence and cash income in many households, and many households receive remittance payments from migrant workers. This pattern of highly diversified income portfolios, engaging in several activities simultaneously or sequentially in order to make a living, is typical of poor rural areas throughout the developing world (Ellis, 2000).

The proportions of income from different sources differ by zone, with significantly higher forest product incomes (cash and subsistence) in HFLA and HFHA villages, and significantly higher agroforest incomes in the more remote HFLA

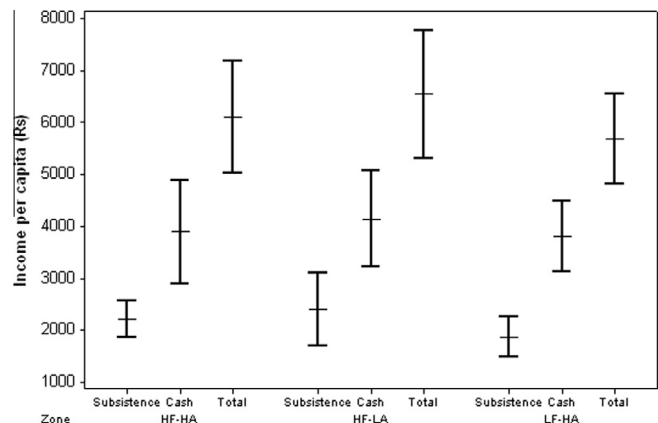


Figure 2. Total, cash and subsistence income by zone.

villages. Incomes from trade and salary and from labor are significantly higher in the LFHA zone, while other income sources are not significantly different by zone (Table 1).

(b) *Income, livelihood strategies, and forest products*

Disaggregating the households further by income class, we find that the overall portfolios of cash and subsistence income are qualitatively similar across income classes within zones, but with notable differences across zones. Figure 3 displays the relative contributions of the different income sources (with three combined categories displayed: Agriculture includes agroforest and livestock; nonfarm includes labor, trade and salary, forest business and remittance income) in terms of cash and subsistence income by income class and access zone.

“Nonfarm” is the most important income category across all zones and it is especially important to higher income groups and in more accessible locations, despite the generally low level of economic development in the area. Forest income contributes 12–42% (village means), with important subsistence contributions in all zones, and important cash contributions in some villages. Forest Products is the most important income source in HFHA and LFHA villages. Agriculture (include Agriculture, Agroforest, and Livestock) has a steady role as the second most important source of income, providing roughly 30% in most income classes, with a slightly lower proportional contributions in low/middle-income groups, and always increasing in absolute terms from low- to high-income groups within each zone. Remittance payments make up a relatively small but still important component of income in all classes and all access zones.

Looking in more detail at the make-up of the forest products income (Table 2), it is startling to see the predominant role of fuelwood. It is by far the most important forest product and it is universally important, in all villages and in almost all households, though with substantially lower fuelwood used in LFHA villages. This is consistent with recent findings by the Poverty and Environment Network’s comparative analysis, where fuelwood emerged as the single most important forest product across a series of cases from throughout the tropics, contributing over 35% of forest income on an average (Angelsen & Jagger, 2014). In the Jharkhand study villages, only a small amount of fuelwood is sold, with more than 90% consumed within the household.

It is possible that the local (village) market price we used to value subsistence products resulted in some over-valuation, i.e., that the price of actual exchanges is higher than subsistence users would be willing or able to pay. However, the local fuelwood price of Rs. 2/kg, or about US\$0.046/kg, is consistent with household level prices reported from other villages in Jharkhand and neighboring Orissa (Pravat Kumar Mishra, Pers. Comm.) and is well within the range of subsistence fuelwood prices found in the PEN studies.

As expected, forest products contribute more to livelihoods in both absolute and relative terms in the zones with higher forest cover. Several villages have some commercial fuelwood production and sales. The other main forest products with significant value are kendu leaf (*Diospyros melanoxylon*) that is used as cigarette wrappers in traditional cigarettes, a range of grass species used for fodder, and small amounts of timber, bamboo, and various NTFPs used in small quantities.

The findings provide an important contrast to the impression that is given by qualitative studies of forest products collection, use, and trade that typically generate extensive lists of useful products (de Beer & McDermott, 1989; Neumann & Hirsch, 2000). While there is a wide diversity of useful forest products (there is an impressive range of NTFPs available at local markets in Jharkhand), very few contribute substantially in value terms to household incomes, even in remote forested areas. It must be kept in mind, however, that there are restrictions on the use of state forests by local people, and these restrictions are enforced by state forest guards. Without these restrictions, local people might be able to benefit more from the nearby forests. It is also possible that there was under-reporting of harvesting that is currently illegal.

Kendu leaf is the only regulated NTFP¹ in the list, with government controls on the market. Other studies have highlighted the inefficiencies of the managed market for kendu (Saxena, 2003). In Jharkhand, the trade is managed by the Jharkhand State Forest Development Corporation (JSFDC), which authorizes traders and controls price. The JSFDC has a large staff with commensurate overhead and is criticized for the low prices received by leaf harvesters. A new system of minimum support price for minor forest products was introduced in 2011 to deal with some of these problems (Sambhav, 2011). Efforts to facilitate an open market while providing information and support to producers could result in higher earnings and reduced waste. It might be possible to

Table 1. *Annual cash and subsistence income per capita by source*

	Source of income	HF-LA	HF-HA	LF-HA	F-Test	p-Value
Cash	Forest product**	817.02	1,047.72	43.06	5.410	0.005
	Agroforest**	642.30	37.34	30.77	13.158	0.000
	Agriculture	266.27	205.49	498.02	0.619	0.539
	Livestock	169.66	187.46	93.83	1.902	0.150
	Labor*	433.52	334.14	537.35	2.363	0.095
	Trade and salary*	1,467.77	1,810.63	2,306.44	2.926	0.054
	Forest business	79.52	60.57	62.50	0.102	0.903
	Remittance	258.07	205.98	224.89	0.224	0.799
	Cash total	4,134.15	3,889.33	3,796.86	0.153	0.859
	Forest product**	1,082.36	1,165.62	626.93	9.324	0.000
Agroforest	85.34	62.87	87.43	0.303	0.739	
Subsistence	Agriculture	1,147.53	895.51	1,090.75	0.318	0.727
	Livestock	78.16	82.29	62.08	0.244	0.783
	Subsistence total	2,393.39	2,206.29	1,867.18	1.090	0.336

* Significant variable at alpha level 0.1.

** Significant variable at alpha level 0.05.

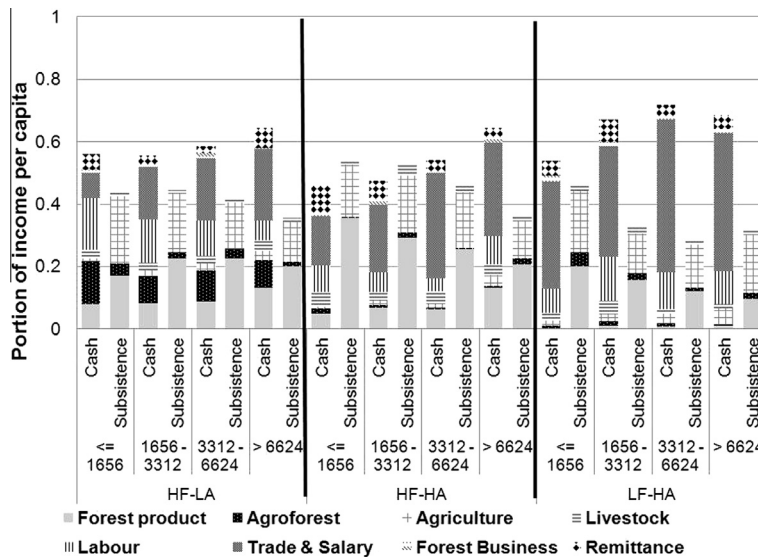


Figure 3. Proportion of household income in cash and subsistence from all sources across income classes by zone.

Table 2. Annual income per capita by product by access class

Class	Mean				Kruskal–Wallis test		
	HF–LA	HF–HA	LF–HA	Total	Chi-square	df	p-Value
Fodder**	49.5	141.3	79.6	90.0	18.1	2	0.000
Fuel wood**	1431.0	1163.9	526.1	1040.0	66.0	2	0.000
Lac*	12.5	0.6	0.0	4.4	5.3	2	0.072
Kendu**	50.7	543.2	21.1	204.1	73.4	2	0.000
Fruits**	55.6	33.4	6.0	31.7	238.9	2	0.000
Medicinal plant**	22.0	210.7	3.1	78.3	72.2	2	0.000
Mahua**	123.2	22.0	3.7	49.7	239.0	2	0.000
Timber**	20.6	65.5	15.9	33.9	36.6	2	0.000
Other forest products**	134.3	32.7	14.5	60.5	139.4	2	0.000
Forest products**	1899.4	2213.4	670.0	1592.7	101.4	2	0.000

* Significant variable at alpha level 0.1.

** Significant variable at alpha level 0.05.

increase opportunities in that sector through policy, institutional, and technical interventions.

It is noteworthy that the “forest business income” category is very low in all villages. There is little post-harvest processing and little local value-added. The main exceptions are leaf plates, which are produced in rudimentary household operations, and so called “country liquor” distilled from fermented mahua flowers. (The distilling process creates high demand for fuelwood.) Considering the extremely poorly developed economy in the study area, it is reasonable to speculate that forest products could contribute more under better circumstances. With little bargaining power, high competition because of the lack of alternative income sources, and poor infrastructure, it is difficult for producers to capture the benefits of improved quality, so there is little incentive to invest in improved production, processing, or marketing. But unless and until the opportunities forest business income will be severely constrained.

Several important agroforest products are produced in the study area. Lac (a resin produced by the insect *Kerria lacca* (Kerr)), used as the main ingredient in wood polish, pharmaceutical glazes, and food additives, is produced on wild and planted trees such as Ber (*Ziziphus mauritiana*) and Kusum (*Schleichera oleosa*), mainly on land outside of the forest

estate. Mahua flower (*Madhuca longifolia*) is used in brewing “country liquor”, and as food and fodder. Mahua is a long lived, sometimes very large tree produced mainly on private land, outside the forest estate.

Tree products produced on farms (agroforestry) provide significant rural income in the HFLA zone, but not elsewhere. It is counterintuitive that the contribution from agroforest products is highest in villages where forest cover is high and road access is low (Figure 3). For our study area, the most significant agroforest product is lac, which is found only in a few villages in a particular district in the HFLA zone. This does not seem to be a response to remoteness but reflects the context specificity of land, planting materials, and the available market network. A local entrepreneur has specialized in lac trading, helping to build a market that in turn has stimulated increased production by local farmers. This suggests that there is potential to increase the contribution of trees on farms if basic enabling conditions (especially market access) are fulfilled.

(c) Forest reliance

In the overall set of households, levels of forest income well within the typical range of we find the oft-reported pattern

(Kamanga *et al.*, 2009; Vedeld *et al.*, 2007) that relative income from forest products tends to be higher for the poorest even while the absolute income from forest products is higher for better-off households. Many analysts have attributed significance to this fact, suggesting that high “forest reliance” or “forest dependency” (defined as the forest-based proportion of total income) of poorer households indicates that forests are disproportionately important to the poor for poverty mitigation and serve to reduce income inequality.

In the Jharkhand case, the pattern seems to be an artifact of the fact that all households use fuelwood, fodder (where livestock are important), and other forest products to meet subsistence needs and for generating cash income. Forest is only slightly more important for subsistence than for cash income in the two HF zones, where more resources are available, while in the LFHA zone forest products are primarily used for subsistence purposes. But, as noted above, the overall village income portfolios have very similar composition, differing mainly in quantities of some components across income classes within zones. Lower income households tend to have disproportionately less of some categories of income, most notably “trade and salary” income, thus increasing the proportion of forest income by default. If poorer households rely more on forests in relative terms, it is likely a passive effect of lower overall income.

Table 3 shows that higher income classes use significantly more forest products than lower income classes. Higher income households have disproportionately higher incomes from some forest product types. For example, the highest

income class in the HFLA zone uses more than four times as much fuelwood as the next lower income class and nearly 25 times the quantity used by the lowest income class. Medicinal plants are also significantly more important in higher income classes in all zones while fodder, kendu, fruit, and timber are all significantly higher in higher income households in the two HF zones. On average, the highest income households earn more than 16 times as much from forest products as the lowest income households, and for some households this forest income is sufficient to raise the household one or more classes.

This is because wealthier households have higher throughput by definition, with higher subsistence and cash income measured in absolute terms. It is reasonable to expect that a wealthier household will require more cooking fuel, more fodder, and other inputs to household production and reproduction. Likewise, wealthier households may have the capacity and opportunity to harvest and market more forest products than poorer households. The HF villages that specialize in fuelwood trade contribute to the higher means. Also, in Jharkhand there is an active but illegal home brewing tradition. We observed numerous small stills that require substantial quantities of fuelwood. This may account for some of the unexpectedly high domestic household fuelwood consumption in some households.

There is also a problem of the direction of causality in any discussion of income sources and wealth categories. A low (or high) estimate of fuelwood use (for example) by a respondent could change that household’s overall income estimate enough to move it down (or up) a class.

Table 3. Forest product income by income quartile and access class

		Mean				Kruskal–Wallis test			
		≤1656	1656–3312	3312–6624	>6624	Total	Chi-square	df	p-Value
HF–LA	Fodder**	0.6	3.6	10.1	210.8	49.5	13.37	3	0.004
	Fuel wood**	178.4	492.6	1,031.1	4,419.3	1,431.0	75.14	3	0.000
	Lac	–	–	–	58.1	12.5	3.64	3	0.303
	Kendu**	6.1	29.1	44.5	128.6	50.7	10.53	3	0.015
	Fruits**	21.8	44.8	60.0	94.3	55.6	24.28	3	0.000
	Medicinal plant**	1.0	4.8	32.0	53.2	22.0	19.19	3	0.000
	Mahua**	37.2	96.9	153.7	195.6	123.2	8.33	3	0.040
	Timber**	8.2	23.3	31.1	13.1	20.6	9.58	3	0.023
	Other forest products**	11.7	40.7	54.3	481.2	134.3	13.88	3	0.003
HF–HA	Fodder**	16.5	55.7	57.0	475.7	141.3	9.68	3	0.021
	Fuel wood**	249.6	649.4	1,209.4	2,592.6	1,163.9	ib	bi	ib
	Lac	1.2	–	0.7	0.6	0.6	1.73	3	0.631
	Kendu**	1.0	83.2	75.8	2,239.7	543.2	33.75	3	0.000
	Fruits**	8.4	4.1	16.6	115.5	33.4	17.33	3	0.001
	Medicinal plant**	0.9	0.4	2.5	943.7	210.7	8.71	3	0.033
	Mahua	7.7	17.3	30.4	30.0	22.0	2.91	3	0.406
	Timber**	4.8	10.8	101.1	142.6	65.5	25.24	3	0.000
	Other forest products**	13.5	5.0	33.4	83.8	32.7	19.20	3	0.000
LF–HA	Fodder	23.6	10.7	98.3	166.0	79.6	3.16	3	0.367
	Fuel wood**	167.7	361.3	400.4	1,081.4	526.1	20.15	3	0.000
	Lac	–	–	–	–	–	–	3	1.000
	Kendu	3.5	4.8	8.1	63.1	21.1	2.79	3	0.425
	Fruits	1.6	5.6	12.1	3.5	6.0	0.41	3	0.938
	Medicinal plant**	0.2	1.6	1.9	7.9	3.1	8.57	3	0.036
	Mahua	1.3	4.5	7.0	1.5	3.7	2.00	3	0.572
	Timber	1.8	1.6	35.4	19.6	15.9	5.01	3	0.171
	Other forest products	8.8	4.7	27.5	14.3	14.5	1.27	3	0.737

*Significant variable at alpha level 0.1.

**Significant variable at alpha level 0.05.

Table 4. Household number by caste and access class

		Zone			Total
		HF-LA	HF-HA	LF-HA	
Caste	ST	312	252	224	788
	SC	40	50	110	200
	OBC	46	93	57	196
	General/unreserved	1	0	8	9
	Total	399	395	399	1193

Poorer households have lower income in all income categories, particularly the cash component of income, and from trade and salary. The subsistence component of income, which is made up primarily of agriculture and forest products, is higher for the poorest (see Figure 3) than for other categories

of income, presumably because forest products are free goods available to everyone. High relative forest income among the poorest should primarily be interpreted to reflect limited opportunities in other sectors. It is likely that the same logic applies in other cases where this phenomenon has been

Table 5. Per capita income by source per caste and access class

Class	Source	Mean for each Caste				Mean total	Kruskal Wallis test			
		ST	SC	OBC	Unreserved		Chi-square	df	p-Value	
HF-LA	Cash	Forest product	981	203	254	125	817	5.357	3	0.147
	Cash	Agroforest	809	79	15	–	642	5.986	3	0.112
	Cash	Agriculture**	289	192	136	2,250	266	12.034	3	0.007
	Cash	Labor	469	447	194	–	434	9.928	3	0.019
	Cash	Trade and salary	1,464	1,934	1,037	3,750	1,468	5.172	3	0.160
	Cash	Forest business	89	28	65	–	80	2.660	3	0.447
	Cash	Remittance	178	894	257	–	258	2.092	3	0.553
	Cash	Livestock**	183	114	130	–	170	19.262	3	0.000
	Cash	Total cash*	4,461	3,891	2,088	6,125	4,134	1.424	3	0.700
	Subsistence	Agriculture**	857	3,891	712	2,125	1,148	11.998	3	0.007
	Subsistence	Livestock	86	35	61	120	78	1.301	3	0.729
	Subsistence	Agroforest*	99	50	24	–	85	7.438	3	0.059
	Subsistence	Forest product	1,096	1,098	995	143	1,082	1.980	3	0.576
	Subsistence	Total subsistence*	2,138	5,074	1,793	2,388	2,393	6.836	3	0.077
HF-HA	Cash	Forest product	895	617	1,703	–	1,050	1.356	2	0.508
	Cash	Agroforest	28	16	75	–	37	0.687	2	0.709
	Cash	Agriculture	102	45	575	–	206	2.360	2	0.307
	Cash	Labor	343	347	260	–	324	3.438	2	0.179
	Cash	Trade and salary**	1,512	2,413	2,282	–	1,807	13.534	2	0.001
	Cash	Forest business	49	35	105	–	61	1.116	2	0.572
	Cash	Remittance**	245	65	178	–	207	8.124	2	0.017
	Cash	Livestock	171	71	297	–	188	2.116	2	0.347
	Cash	Total cash*	3,345	3,608	5,477	–	3,881	5.269	2	0.072
	Subsistence	Agriculture**	1,019	486	791	–	898	9.829	2	0.007
	Subsistence	Livestock**	97	6	85	–	82	21.727	2	0.000
	Subsistence	Agroforest	54	18	111	–	63	2.324	2	0.313
	Subsistence	Forest product	1,280	1,183	858	–	1,169	3.795	2	0.150
	Subsistence	Total subsistence*	2,450	1,692	1,845	–	2,212	4.864	2	0.088
LF-HA	Cash	Forest product	30	90	11	5	43	1.449	3	0.694
	Cash	Agroforest**	32	46	2	–	31	31.611	3	0.000
	Cash	Agriculture*	102	236	526	15,002	498	7.418	3	0.060
	Cash	Labor**	720	287	371	63	537	17.687	3	0.001
	Cash	Trade and salary**	2,310	2,436	2,076	2,071	2,306	39.648	3	0.000
	Cash	Forest business**	82	48	21	–	63	15.939	3	0.001
	Cash	Remittance	176	203	328	1,146	225	2.821	3	0.420
	Cash	Livestock	51	143	166	98	94	0.845	3	0.839
	Cash	Total cash**	3,502	3,490	3,501	18,384	3,797	8.864	3	0.031
	Subsistence	Agriculture**	842	931	1,740	5,642	1,091	7.899	3	0.048
	Subsistence	Livestock	80	38	43	12	62	3.621	3	0.305
	Subsistence	Agroforest*	86	127	26	13	87	14.935	3	0.002
	Subsistence	Forest product	566	817	458	922	627	2.773	3	0.428
	Subsistence	Total subsistence	1,574	1,913	2,267	6,590	1,867	3.092	3	0.378

*Significant variable at alpha level 0.1.

**Significant variable at alpha level 0.05.

observed, as noted also by Córdova, Wunder, Smith-Hall, and Börner (2013).

(d) *Caste*

Sixty-six percent of the households were from Scheduled Tribes, just under 17% each were Scheduled Castes and Other Backward Castes, with the remainder being from the general/unreserved population (Table 4). There were significant differences in mean total income by caste. The main income categories that contributed to these differences were agriculture, livestock, trade and salary, and agroforest (Table 5). In low access (HFLA) villages, ST and SC households tend to have higher incomes than OBC households, while the reverse is true in high access (HFHA, LFHA) villages. However, contrary to expectations, forest income was not significantly different across castes in any zone. This is consistent with the finding (below) that village plays a large role in determining income strategies; ethnicity seems to be less important than market and resource opportunities in determining livelihood choice.

(e) *Income models at household and village levels*

The multilevel regression results are presented in Table 6. Caste is the only household demographic characteristic that is significantly correlated with income. Being part of an unreserved caste is associated with higher total income and higher cash income. There are very few such household in the sample, mostly in the LFHA, but they tend to have relatively high total incomes and lower forest products incomes (though not significant in this analysis).

In terms of household assets, tree ownership (number of trees owned) is important as a contributor to total income. The products from these managed trees (agroforestry) are used for both subsistence and cash income. The analysis included indicators of quality (Don1) and quantity of land managed. There is a significant negative relationship between the quality of land managed (as well as an insignificant negative relationship between area of land managed) and forest product income. This is consistent with expectations; households with better land at their disposal are able to earn more from agriculture and rely less on forest income. As might be expected, the value of total household assets has a positive relationship with total income, though it is not certain if this is a cause or

an effect. It is likely both cause and effect in that higher income permits households to build assets and some of those are productive assets that contribute to higher earnings. Household location relative to the forest (distance to forest) has no significant association with income. This is not surprising given that households tend to be located close to one another in the villages, so there is not great variability in distance to forest within villages.

Income portfolio, a measure of the diversity of income sources at the household level, is strongly correlated with forest income as well as to cash income. Households that have multiple sources of income in their livelihood strategies tend to rely more on forests in an opportunistic coping strategy. They also tend to have higher cash income, particularly in High Access Villages.

Village access class does show a significant relationship with forest product income. Households in Low Forest and High Access villages, which have better access to market and less access to forest, earn less income from Forest products compared to the two other high forest classes. Moreover, the multilevel regression analysis shows that being located in a particular village is an important determinant of household income earning. The Variance Partition Coefficient (VPC) is 13% for income per capita, 16% for forest income and 19% of cash income. That is, between 13% and 19% of household income (depending on type of income) can be explained by which village the household is located in. This seems puzzling at first: village is important, but several variables that are theoretically important do not have a significant role empirically. It may be explained in a couple of ways. It seems that the village classification based on GIS layers has limits. Forest proximity may not fully reflect *de facto* resource quality or access. Physical distance to paved roads, used in this analysis as a proxy for market access, may not fully capture the quality of connecting roads or bridges, for example. In such a poor environment, with the attendant threat of insurgents, there may not even be vehicle transit available when needed, regardless of distance to market or quality of the road. There are also other village characteristics not captured in the analysis that can be expected to influence livelihoods, including individual entrepreneurship, village leadership, vehicle ownership, the presence of missionaries, political connections, or the presence or absence of insurgents in the area, to name just a few possible factors.

Table 6. *Regression of log of per capita income with socio economic variables*

Independent variable		Level	Income per capita	Cash income per capita	Forest product income per capita
Intercept			8.255(0.167) ^a	6.744(0.369) ^a	4.365(0.434) ^a
Demography	Age of head of household	Household	-0.010(0.031)	-0.085(0.058)	-0.043(0.073)
	Caste 2 – SC	Household	0.159(0.097)	0.353(0.186)	-0.055(0.233)
	Caste 3 – OBC	Household	-0.031(0.094)	0.272(0.181)	-0.223(0.227)
	Caste 4 – General/unreserved	Household	0.751(0.348) ^a	1.342(0.664) ^a	-0.849(0.835)
Assets and income	Don1	Household	-0.004(0.031)	0.010(0.060)	-0.229(0.075) ^a
	Land managed	Household	0.043(0.030)	0.058(0.057)	-0.074(0.072)
	Number of trees owned	Household	0.080(0.031) ^a	0.058(0.059)	0.093(0.074)
	Value of total household asset	Household	0.081(0.032) ^a	0.074(0.061)	-0.082(0.077)
Village characteristics	Income portfolio	Household	-0.049(0.041)	0.251(0.078) ^a	0.716(0.098) ^a
	Class of forest and access-2 (HFHA)	Village	-0.113(0.196)	-0.717(0.455)	0.117(0.525)
	Class of forest and access-3 (LFHA)	Village	-0.063(0.197)	-0.058(0.457)	-1.262(0.527) ^a
u	u		0.148	0.843	1.097
e	e		0.99	3.588	5.69
-2 log likelihood	-2 log likelihood		3348.352	4864.053	5398.389
Contribution by adding village level		13%	19%	16%	

^a Statistically significant.

5. CONCLUSIONS

The study analyses the role of remoteness, availability of forest resources, and caste in determining livelihoods options/choices generally and forest resource use specifically, and raises questions about the conventional interpretation of “forest dependence” by low-income households.

The study area is very poor, with almost half of households living below the Indian rural poverty line and all households well below the international poverty line of US\$1.25 per person per day. The study supports the common understanding that poor rural people depend on diversified livelihoods strategies—diversification was associated with higher cash, forest product, and trade and salary incomes—and that forest products are an important element of those overall livelihoods portfolios. Forests make an important contribution to subsistence income, and provide substantial cash incomes for some households and villages.

The first set of research questions relate to the impact of remoteness on total income and sub-categories of income. We found that remote villages in the study area are not systematically poorer than more accessible villages. Households in more remote villages do not have higher forest income nor do they have higher subsistence income or lower cash incomes than households in more accessible villages, contrary to expectations. Cash income is earned in similar amounts even in the less accessible villages in the study, a surprising result considering the low level of development in the state. (Higher subsistence income was associated with more forest resources, but not with different access levels.) Remoteness had the expected negative effect on income from non-farm (“trade and salary”) sources; non farm incomes were highest in LFHA and substantially higher in HFHA villages than in HFLA villages.

The second set of questions relates to the role of forest resource availability. Villages in HF zones have much higher subsistence and cash incomes from forest products than villages in LF zones. Fuelwood is dominant in the overall set of forest products, with a few NTFPs, such as kendu leaf, mahua, fodder, and a range of minor forest products, playing important roles in particular villages, where resource availability and/or market access facilitate their production and trade. Forest product earnings can be sufficient to elevate a household one or more income classes. HFLA villages also have significantly larger cash income from agroforest products such as lac and mahua. That forest products are not even more important in local incomes, particularly in the more forested regions, may reflect the fact that forests are protected and legally inaccessible for most harvesting. For example, timber incomes are very low across all categories. We recognize that this may be due to the fact that local people are prevented by law from using many forest resources or it may indicate under-reporting of illegal products by survey respondents.

The third set of questions concerns forest use across socio-economic class and caste. The aggregated sample displayed the commonly reported pattern of higher relative forest income in poorer households and higher absolute forest income in the higher income households. However, overall income portfolios are similar in composition (income sources) across income classes within zones, but with lower income households earning disproportionately less of certain income categories, most notably “trade and salary” income. The differences in relative forest income between income classes are

largely explained by differences in income from other categories. In other words, the proportion of income from forest products is higher because other income is lower. That poorer households rely more on forests in relative terms is a default effect of lower overall income rather than an active strategy of increased forest. We therefore caution against the common interpretation in the literature that higher relative forest income indicates that forests are particularly important to the poorest, and indeed that the poor are more “dependent” or “reliant” on forest products as safety nets and to meet subsistence needs (see Wunder, Börner, Shively, & Wyman, 2014 for a discussion of the use of forests as a shock response). Caste was associated with different income patterns, but there was no significant relationship between caste and forest income in either the descriptive analysis or the regression model. This contradicts the expectation that tribal people (ST), who are traditionally associated with forest-based livelihoods, will have higher forest incomes, and points to the importance of village in determining livelihood opportunities.

Overall, the stratification of villages based on forest cover and road access revealed some important patterns. There was still a high level of diversity between households within villages and between villages. Different villages have particular economic characteristics and contexts. The importance of village context in determining livelihood strategies was underlined by the multi-level regression analyses in which adding the village level improved the strength of the models. But the village classification used in this study, based on GIS data, has limits. The classification using forest proximity and distance to paved roads does not fully reflect *de facto* resource quality or market access. There are also other village characteristics not captured in the analysis that can be expected to influence livelihoods, such as individual entrepreneurship, village leadership, and other social capital and physical capital, as well as negative influences such as the presence of insurgents in the area.

From a policy perspective, it is clear that forests and forest products are important in current livelihoods throughout the study area. This value needs to be recognized and protected. Planning should take into account quality, quantity, and convenience of the supply to guarantee sustainability. It remains unclear whether or not the forest sector offers good potential for development or for supporting poverty alleviation/livelihoods improvement. The current environment is extremely limiting due to poor services, infrastructure, and markets and the threat posed by armed insurgents. As a result, there is little forest-based enterprise development (forest business), or indeed any other types of business. However, there are some forest and agroforest products with current market value even under these restricted conditions, which indicates that there may be potential for higher and more efficient production, processing and marketing.

Looking at the overall situation, the development priorities should be rural infrastructure development and service provision. While the study did not reveal a strong livelihoods advantage to those with better education, the very rudimentary levels of basic health care, education indicate a high need for improved services. The low productivity of agriculture also presents a great challenge and opportunity for substantial improvements through improved water management and basic agricultural extension. Unfortunately the combination of weak government and the ongoing insurgency present serious obstacles that need to be overcome.

NOTE

1. Regulated in the sense that trade is controlled by the government.

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