Forest Dependence and Poverty in the Himalayas—Differences Between India and Nepal

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1   Introduction

There are over 1 billion people around the world who are dependent on forests for a variety of goods and services (World Bank 2016). For such forest-dependent people, forests act as both a constraint to movements out of poverty and a source of economic well-being. Thus, strategies to conserve forests and reduce rural poverty, often, revolve around a legitimate enquiry about how poor households, whose livelihoods depend on forests, can be supported alongside forests.

Poverty reduction in most rural areas is a result of improvements in agricultural productivity, income diversification, or migration (World Bank 2008, ILO 2014). The remote locations where forests are found make it difficult for households to access public infrastructure, services, and markets. This in turn constrains their ability to diversify income sources or build the required human or economic capital. In fact, it is possible that such households are in geographic poverty traps that keep them tied to subsistence activities and relatively unproductive lands (Jalan and Ravillion 2002; Kray and McKensie 2014; Barbier and Hochard 2016).

Forests are also a source of "environmental income" to many households. Families depend on timber and non-timber forest products to meet multiple

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economic needs. Thus, for many rural households, forests act as a means of diversification. Environmental income can act as a buffer during times of economic downturn, allowing households to smooth consumption over time and use forests as a safety net (Pattanayak and Sills 2001; Wunder et al. 2014). There is a large literature that documents the value of nature's rent, i.e., the goods and services freely provided by nature (Cavendish 2000; Sunderlin et al. 2005; Vedeld et al. 2007; Angelsen et al. 2014). An earlier meta-analysis estimated environmental income to be as high as 22% of income, for households who lived in and around forests (Vedeld et al. 2007). More recent analysis suggests that environmental income makes up some 28% of total household income in certain areas. This income is somewhat equivalent to what households obtain from agriculture (Angelsen et al. 2014). Naturally, environmental income varies across geographies and forest condition and depends on whether households use forests for subsistence purposes such as energy and food or whether they use it to market timber and non-timber forest products.

In addition to providing timber and non-timber forest products, forests also provide ecosystem services that make households more resilient to shocks. Forests provide hydrological services, for instance, that serve many needs (MEA 2005). In some cases, the presence of forests can improve water supply, in other cases, sediment filtration results in cleaner water, and, in still other cases, forests can provide storm protection, reducing the impacts of floods (Daily et al. 1997; Das and Vincent 2009; Das and Crepin 2013). Such ecosystem services are increasingly important as households cope with climatic changes.

The complex interconnections between people and forests make deforestation and forest degradation difficult to address without taking care of people's economic needs and vice versa (World Bank Group 2016; Colfer et al. 2015). Reducing poverty in remote rural areas may require targeted geographic investments (Barbier and Hochard 2016; Shyamsundar et al. 2017). It may also need investments that strengthen people's rights over forests, improve the productivity of forests, support the creation of forests and ecosystems-based markets, and build public infrastructure and services that can help households add value to forest products or take advantage of labor markets in distant areas (Shyamsundar et al. 2017).

Globally, an important transformation has occurred in the forests sector over the last few decades that has implications for rural poverty. The rights of local communities over natural resources have slowly been strengthened through power-sharing agreements with the state, increased legal access to natural resources and decentralization within national agencies (World Resources Institute 2005; Shyamsundar and Ghate 2014). Community ownership and management over forests increased from 21% in 2002 to 30% in 2013, even though this trend is largely restricted to Latin America and China (Rights and Resources Initiative 2014). Nepal is a prime example of strengthened local management of forests (Kanel 2008). While evidence of the implications of community forestry on poverty reduction is not very clear, providing rights to communities may be foundational for enabling better use and management of forests (FAO 2011; Shyamsundar and Ghate 2014).

In South Asia, as elsewhere, the rural poor are dependent on forests both for economic goods and for services associated with agricultural productivity, water availability, soil erosion, and flood protection. (Gundimeda and Shyamsundar 2012;

Mukhopadhyay and Shyamsundar 2012; Baland et al. 2010). Some 50% of Indian households use local commons, whether they are pastures or degraded forests (Chopra and Dasgupta 2008). In Nepal, rural property value differs based not only on distance from the forest but also on the types of forest management regimes from where households gather firewood (Nepal et al. 2017a). Evidence suggests a complementarity between community forest management and planting trees in private lands (Nepal et al. 2007). Thus, forests are an important source of rural wealth and well-being, and degradation will have both short-term and long-term impacts on the rural poor (Gundimeda and Shyamsundar 2012).

In the lower Himalayan region, India and Nepal share geographic conditions that are very like each other. However, the two countries have vastly different policies and regulations. India is a much more developed country with a higher per capita income and a relatively large network of roads and markets. On the other hand, in the mid-hills of Nepal, community rights over forests are well developed and rules to manage forests are better established at the local level (Shyamsundar and Ghate 2014). Thus, forest policies and rural development policies differ. But does this matter for how households survive and thrive in and around forests?

In this paper, we examine forest-dependent households along the Indian and Nepal Himalayas and ask how they differ in the two countries. We seek to understand what affects these differences. In the sections below, we first undertake a brief and broad scan of forests, forest use, and laws that govern use in India and Nepal. We then focus on a group of rural Nepali and Indian households in the Himalayan region who live across the border from each other. We examine their use of forest resources to assess how poor households who start with the same natural endowments may exploit resources differently. We examine dissimilarities in socioeconomic characteristics of Indian and Nepali households and correlates of poverty. We use data from a survey of 652 households (301 in India and 351 in Nepal)[1] to address poverty and forest linkages among households who are just separated by a river and face rules and regulations of two different countries.

2 Forest Use in India and Nepal

A little less than a quarter of the land area in both India and Nepal is designated as forests (see Table 1).[2] Forest use in both countries is closely tied to energy needs. In India, while modern energy sources dominate, fuelwood is regularly used in rural

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[1]These households were surveyed for the project "Valuation of Ecosystem Services of Kailash Sacred Landscape" undertaken jointly by the South Asian Network for Development and Environmental Economics (SANDEE) and the International Center for Integrated Mountain Development (ICIMOD) under the Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI).

[2]This is contested data as latest Nepal forest inventory data indicate that 40% of Nepal's land area is in forests and 4% in shrub (DFRS 2015).

Table 1 Economic and forest indicators in South Asia

Attributes	India	Nepal	South Asia
GNI per capita ($)	1570	730	1496
Population per square km	436	197	360
Under five mortality rate (per 1000 live births)	48	36	53
Agriculture land (% land area)	61	29	57
Electric power consumption per capita (kWh)	765	128	673
Energy from biomass products and waste (% of total)	24.3	80.6	26.3
Forest area (% land area)	23.8	25.4	17.5
Annual deforestation rate (average annual %, 1990–2010)	−0.5	0.5	−0.4
Protected areas (% land area)	5.4	22.9	6.6

Source https://openknowledge.worldbank.org/bitstream/handle/10986/24543/9781464809286.pdf.
Accessed 31st March 2017

areas. In Nepal, nearly 90% of energy used comes from biomass products and waste. In both countries, forests provide fodder and bedding for livestock and timber for housing and agricultural implements. There is also a growing literature that points to the ecosystem services provided by forests.

Given dense populations and large-scale economic development, both India and Nepal confront deforestation and degradation. Nepal's estimated annual rate of deforestation is higher than India, with degradation and deforestation being attributable to forests use for fuelwood, fodder, illegal logging, and forest conversion for agricultural use, roads, and other development activities (Acharya and Dangi 2009; Table 6). In India, positive changes in forest cover are attributable to growth in plantations and community forestry, while negative changes are likely to be a result of shifting cultivation, submergence from dams, etc. (FSI 2011; Table 2.8.1).

The history of forest laws across South Asia reflects a tension between forces for conservation and those for strengthening community user rights over forests. In Nepal, forest nationalization in the 1960s is acknowledged as having triggered deforestation. This caused significant alarm, and, in 1974, a new policy discussion emerged on the role of local communities in forest management. Some 25 years later, in 1986–88, a master plan for the forestry sector was prepared and large areas of forests in the middle-Himalayas were handed over to traditional users (Kanel 2008). Community Forestry User Groups (CFUGs) were established to manage and sustainably use forests. These organizations became independent, self-governing entities with forest access, utilization, and management rights (Kanel 2008). Currently, there are over 14,000 CFUGs scattered across Nepal. Community forestry is viewed as a successful test of decentralized forest management, and improvements in forest cover, in many parts of Nepal, are attributed to community management (Shyamsundar and Ghate 2014).

Forest policy in India has also changed significantly over the past 100 years or so. In British India, forests were mainly a source of commerce, given huge demand for building railways (Guha 1983). However, prior to independence (in 1931),

widespread protests over laws that reduced local control over forests led to the creation of Van Panchayats (forest committees), which were given some autonomy over forest patches. This historic experiment in decentralized forest management was given a boost in the 1980s, when the National Forest Policy of 1988 launched Joint Forest Management (JFM). JFM builds village-level institutions, called Forest Protection Committees (FPCs), which are expected to participate in forest management. By 2009, there were at least 84,000 FPCs in twenty-seven states managing in some way about 17 million ha (approximately 25%) of India's forests (Balooni and Inoue 2009). The Forest Rights Act of 2006 further empowered tribal communities to use forest resources. Thus, India has seen a variety of laws that have both favored stronger conservation and community use of forests over the years.

3   Study Area and Data

Our study is based on data collected from two watersheds, one from India and one from Nepal. The data for this study come from a survey undertaken for a larger study organized jointly by the South Asian Network for Development and Environmental Economics (SANDEE) and the International Center for Integrated Mountain Development (ICIMOD) (Nepal et al. 2017b).

The watersheds we study are the Gwalek Kedar watershed of Baitadi District in Nepal and the Chandak-Aunla Ghat watershed of the Pithoragarh District in India. Figure 1 indicates the location of these two watersheds along the Nepal—India border. The Gwalek Kedar watershed covers an area of more than 5,700 ha. The forest area in the watershed is surrounded by 23 villages under 8 village development committees, with a population of 28,400 and 5,393 households. The Chandak-Aunla Ghat watershed covers a 2323 ha area with 12 Gram Panchayats and 28 Revenue Villages, with 1,774 households. In Gwalek watershed, about 84% of the forest is broad leaf oak and chir pine, while in Chandak-Aunla Ghat watershed, about 79% of the forest area is covered by bush, and above 10% of the forest area is broad leaf oak and chir pine.

We study 301 households from Chandak-Aunla Ghat watershed in Pithoragarh District in India and 351 households from Gwalek watershed of Baitadi District in Nepal. These watersheds are on either side of Mahakali River that forms the international boundary between India and Nepal and thus are similar in terms of altitude, climatic and historical natural endowments. However, the anthropogenic pressures and administrative differences have resulted in different socioeconomic and occupational features of these households (Nepal et al. 2017b).

The data collection was undertaken in the summer of 2016 and followed a structured approach: stakeholder consultation, questionnaire development, training and pretesting of questionnaire, and household survey. A series of focus group discussions and consultations were carried out with local villagers; officials of government, local bodies, and non-government organizations, which helped in
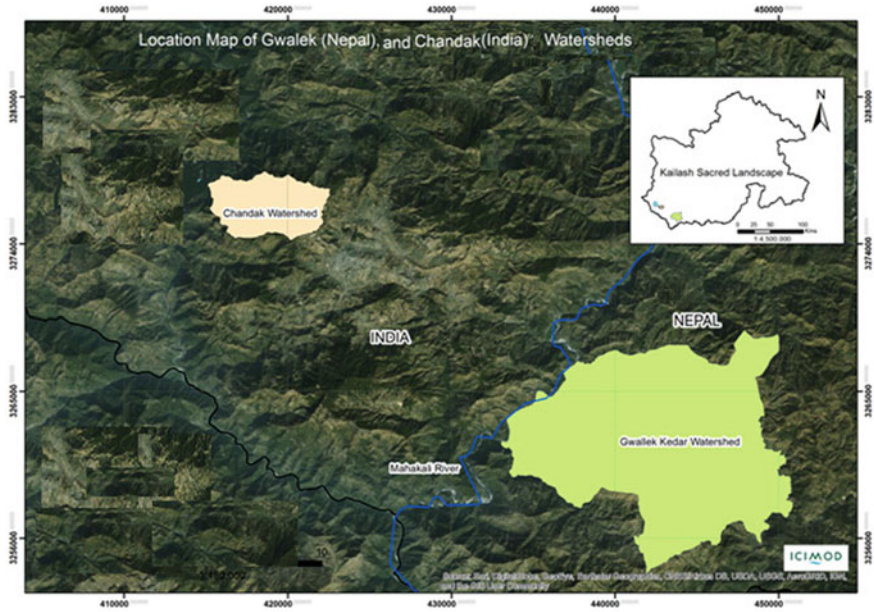
Fig. 1 Study area in Kailash Sacred Landscape region in India and Nepal. *Source* Nepal et al 2017b

developing the survey questionnaire. Households were selected following systematic random sampling. Household heads of either gender of the approached households were interviewed.

4 The Characteristics of the Forest-Dependent Poor

Tables 2 and 3 describe the socioeconomics of the households in the two watersheds on either side of the Mahakali River. Table 2 shows households in Nepal to have larger family sizes, more landholding as well as larger livestock holding. Thus, both in terms of labor and land, Nepali households seem to be better-off relative to their Indian counterparts. Interestingly, more Indian households have concrete (*pucca*) houses, while Nepal has more advanced sanitation facilities; nearly 80% of Nepali household has a *pucca* toilet. On the other hand, 17% of households India are without toilets. Thus, open defecation is likely to be higher on the Indian side of the border.

Households in Nepal have better access to tap water relative to Indian households (Table 3). In dry months, when most households face water stress, nearly half the water (44%) used by the surveyed households in India come from public wells, while less than one-third of water (30%) consumed by Nepali households come

Table 2 Socioeconomic differences between India and Nepal

Features	Chandak-Aunla Ghat, India ($N = 301$)	Gwalek, Nepal ($N = 351$)
Family size	4.7	7
Share of females	0.50	0.51
Age of the respondent (60% were household head)	42 years	47 years
Average education of respondent	Up to 10th standard	Up to class 5
Share of Dalit caste	41	14
Share of general caste	52	86
Share of HHs having concrete houses	71.4	50.1
Share of HHs having pucca toilet	78.9	93.4
Share of HHs having no toilet	17.3	0.6
Share of HHs throwing waste water in open (no sewer connection)	94.9	97.4
Total average agricultural area (in Ropani)	1.63	5.66
Average livestock unit[a]	3.6	6.5
Annual average expenditure in livestock	4709 INR (US$73)	6650 NPR (US$64)
Median household annual income (67% of households)	Less than US$770	US$481–2888

[a]Livestock = (1.1 * no of cattle) + (0.6 * no of buffaloes) + (0.9 * no of goat)

from a well. This appears to have two impacts. Households in India spend a lot more on water treatment (INR 80) relative to households in Nepal (INR 12). Furthermore, since, as shown in Table 3, women are the ones who undertake most of the water collection, Indian women spend much more time than women in Nepal on collecting water. Wells are further away from private or public taps; hence, it takes longer in India to obtain water.

While water is more easily accessible in Nepal, the opposite is true for access to markets and community forests. Nepali households live in very remote areas as indicated in Table 3. The average Nepali household in our survey lives a good one hour walk away from a motorable road. This distance is three times more in Nepal relative to India.

5 Forest Use in Nepal and India

This region has historically been dominated by broadleaf forests, with chir pine seen mainly in steep slopes (Opinion in Focus Group Discussions, see Nepal et al. 2017a for detail). However, over the years, chir pine and scraggy bush have increased. Figure 2 points to some interesting differences in these forests between the two countries.

Table 3 Water deficiency in dry season and access to water and other infrastructure

Type of infrastructure and access		Chandak-Aunla Ghat, India (N = 301)	Gwalek, Nepal (N = 351)
Water deficiency in dry season per day per household		20.9 l	13.3 l
Water sources			
Private tap	Share of total requirement collected	0.29	0.17
	Average walking time[a]	7.4	1.4
Public tap	Share of total requirement collected	0.26	0.53
	Average walking time[a]	16.0	4.3
Public well	Share of total requirement collected	0.44	0.30
	Average walking time[a]	25.1	17.3
Share of households where women collect water		88.7	86.7
Average expenditure on water treatment in a year		80 INR (US$1.23)	12 NPR (US$0.11)
Other public and natural infrastructure	Average walking time to motor able road (min)	14.5	56.9
	Average walking time to community forest (min)	39.5	55
	Share of HHs with broadleaf forests in community forests	40.2	39.3
	Share of HHs with broadleaf forests surrounding villages	9.6	29.3

Note All average differences are significant at 1% level
[a]One-way walking time to source

Approximately 40% of households in both countries indicate that their community forests are mainly broadleaf forests, while 30% of Nepali and 10% of Indian households indicate that forests surrounding their village are broadleaf. As Fig. 2 shows community forests, in both India and Nepal, are largely either pine mixed broadleaf (mixed forest) or broadleaf. However, forests near villages are predominantly bush in India, while mixed forests dominate areas close to Nepali villages. Field observations as well as this data suggest that community forests are less disturbed and are more likely to reflect the historically dominant type of forests in the region, relative to forests that are close to the villages. Forests neighboring villages in India seem to be the most disturbed, most likely through regular unsustainable use. Nepali households, on average, walk 55 min one-way to get to community forests, while their Indian counterparts have a slightly shorter or possibly less steep walk (40 min).

In the hills around the Mahakali River, households are highly dependent on fuelwood for both heating and cooking. Table 4 indicates that Nepali households, on average, burn approximately half as much fuelwood as Indian households.
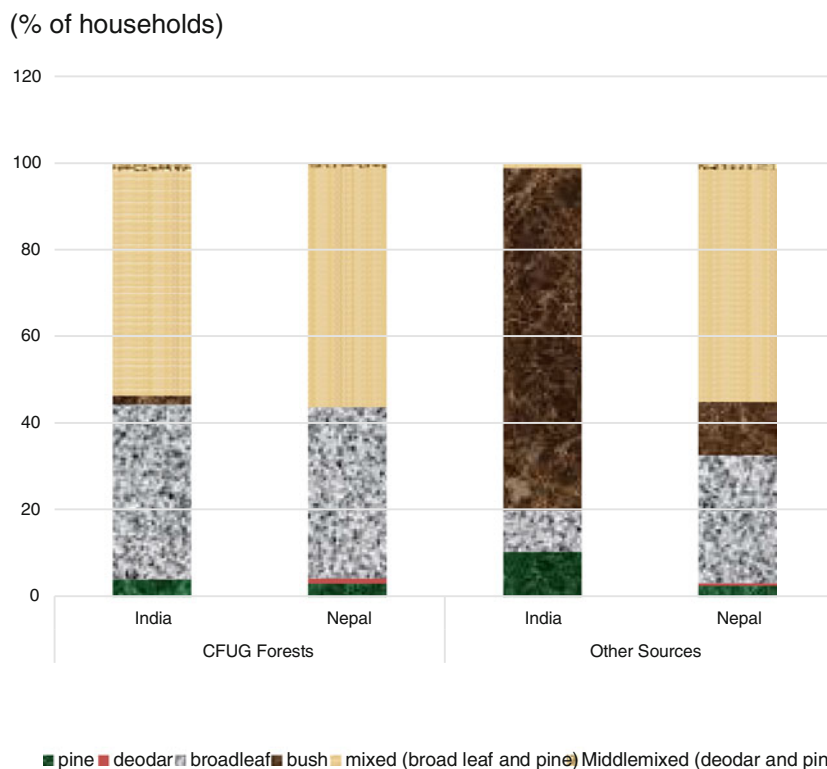
(% of households)

Fig. 2 Dominant forest types found in community and forests surrounding villages in India and Nepal

Table 4 Average forest product collection in India and Nepal

Total collection from all sources (in Bhari)	India	Nepal	Difference
Firewood collection	157.98	74.17	112.87*** ($t = 11.77$)
Fodder collection	315.7	349.8	−33.8** ($t = 2.02$)
Leaf litter	28.18	44.16	−15.97*** ($t = 3.98$)

***, **Imply 1 and 5% level of significance

We do not have data on energy choices and cook stoves, so we cannot say whether this is because Nepali households are using technologies that make them more efficient. Since forests are more abundant in Nepal and roads are further away, it is unlikely that they are using other sources of energy.

Households in the region also collect fodder for livestock and leaf litter, which is mixed with manure and used as a fertilizer in agricultural fields. Nepali households, who have more livestock relative to their Indian counterparts, collect more fodder and leaf litter. Leaf litter appears to be a less important forest product relative to the fodder and fuelwood.

Table 5 Two paired t test of collection from different sources

Forest products	Source of collection	India	Nepal
Firewood collection	Community forest	46.496	52.83
	Other sources	116.40	21.76
	Difference of means	−69.94***	31.07***
Fodder collection	Community forest	75.46	70.94
	Other sources	240.19	278.53
	Difference of means	−164.72****	−207.58***
Leaf litter collection	Community forest	9.58	38.94
	Other sources	18.6	5.22
	Difference of means	−9.01***	33.72***

***Imply 1% level of significance

Table 5 shows that Indian households collect more fuelwood, fodder as well as leaf litter from outside sources rather than community forests. The average Indian household collects a little less than 30% of its annual fuelwood from community forests, while the average Nepali households collect 70% of its annual intake from community forests. Fodder for livestock is predominantly obtained from areas close by in both countries. Thus, community forests are key resource for fuelwood and leaf litter in Nepal. However, in India, forests surrounding the villages are the dominant source for all forest products.

To better understand the correlates of forest products in the two different countries, we ran least squared regressions of total fuelwood and fodder collected on household characteristics, natural features of the region, public services available, and household assets (see Table 6).

In both India and Nepal, fuelwood and fodder increase with household size. Thus, with growth in population, we can expect more use of commonly available forest resources. There is some indication that in India, increases in wealth and road access may reduce fuelwood use. However, these effects are not strong for India and do not appear to matter in Nepal. These effects are reinforced in Fig. 3, which we discuss below. In general, socioeconomic factors are not particularly strongly correlated with forest use. This suggests widespread use of forests among rural households who do not have many other options for making a livelihood and in terms of energy choices.

The strongest influencers of fuelwood and fodder collection are physical attributes. Aspect (direction faced by the trees) is very important as is the type of forests. Households appear to prefer to collect fuelwood, particularly, from pine forests relative to other forest types, including the traditional broadleaf forests. An interesting and important indicator is the presence of deities and sacred forests in India. This contributes to a decline in forest use.

A surprising result is that distance to community forests does not have a negative effect, particularly, on fuelwood collection, as expected. To tease out this result some more, we graph forest product collection in community forests relative to time

Table 6 Factors associated with collection of firewood and fodder in India and Nepal

Independent variables	Estimated OLS coefficients for total collection from community forests and other sources			
	Y = Log (firewood)_IN	Y = Log (firewood)_NP	Y = Log (fodder)_IN	Y = Log (fodder)_NP
Family size	0.086*** (0.032)	0.031* (0.016)	0.047* (0.021)	0.017 (0.0164)
Education above 10 years (1/0)	-0.136 (0.127)	-0.096 (0.113)	0.009 (0.103)	-0.117 (0.127)
Agriculture as main occupation (1/0)	-0.057 (0.313)	-0.081 (0.110)	-0.108 (0.095)	0.005 (0.118)
Dalit caste (1/0)	0.071 (0.148)	0.199 (0.189)	-0.198* (0.102)	0.095 (0.142)
Concrete house (1/0)	0.000 (0.144)	0.164 (0.109)	-0.124 (0.106)	0.301** (0.134)
Permanent toilet (1/0)	0.119 (0.143)	-0.069 (0.206)	0.168 (0.126)	0.369 (0.343)
Aspect: West (1/0)	0.253* (0.140)	0.223 (0.236)	0.314*** (0.113)	-0.016 (0.178)
Aspect: South East (1/0)	-0.035 (0243)	-0.082 (0.196)	0.131 (0.221)	-0.213 (0.162)
Aspect: South West	0.152 (00168)	0.021 (0.223)	0.096 (0.153)	-0.722*** (0.190)
Forest type: broadleaf (1/0)	-0.523*** (0.174)	0.161 (0.193)	-0.211* (0.126)	1.049*** (0.195)
Forest type: bush (1/0)	-0.975*** (0231)	0.001 (0.183)	-0.156 (0.236)	0.782*** (0.188)
Forest type: pine mix	-1.939* (1.153)	-0.379** (0.180)	-0.997** (0.456)	0.735*** (0.181)
Forest offered to deity (1/0)	-0.877*** (0.205)	–	-0.143 (0.172)	–
Travel time between house and community forest (min)	0.006 (0.004)	0.003* (0.001)	0.001 (0.002)	-0.003 (0.002)
No of livestock	0.038* (0.022)	0.015 (0.020)	0.028 (0.017)	0.023 (0.022)
Walking distance between house and motorable road (min)	-0.008 * (0.005)	0.001 (0.001)	-0.002 (0.004)	0.001 (0.001)
Total area (ha)	-0.044* (0.026)	0.029** (0.014)	-0.001 (0.014)	-0.011 (0.0122)
Constant	5.210*** (0.355)	3.635*** (0.323)	5.33*** (0.207)	4.390*** (0.388)
Number of observations	301	351	271	341
F statistic	F (17, 283) = 15.93, P = 0.00	F (16, 334) = 4.25, P = 0.00	F (17, 253) = 2.78, P = 0.00	F (16, 324) = 5.63, P = 0.00
R-squared	0.29	0.13	0.15	0.11

Notes Robust standard errors are in parenthesis
***, **, *Imply level of significance at 1, 5, and 10%, respectively

taken to walk to community forests in Fig. 3. In India, we see a downward trend for fodder but not for the other two forests products. The same pattern is observed in Nepal, where a larger percentage of households source their products from community forests. This information seems to suggest that because of the lack of
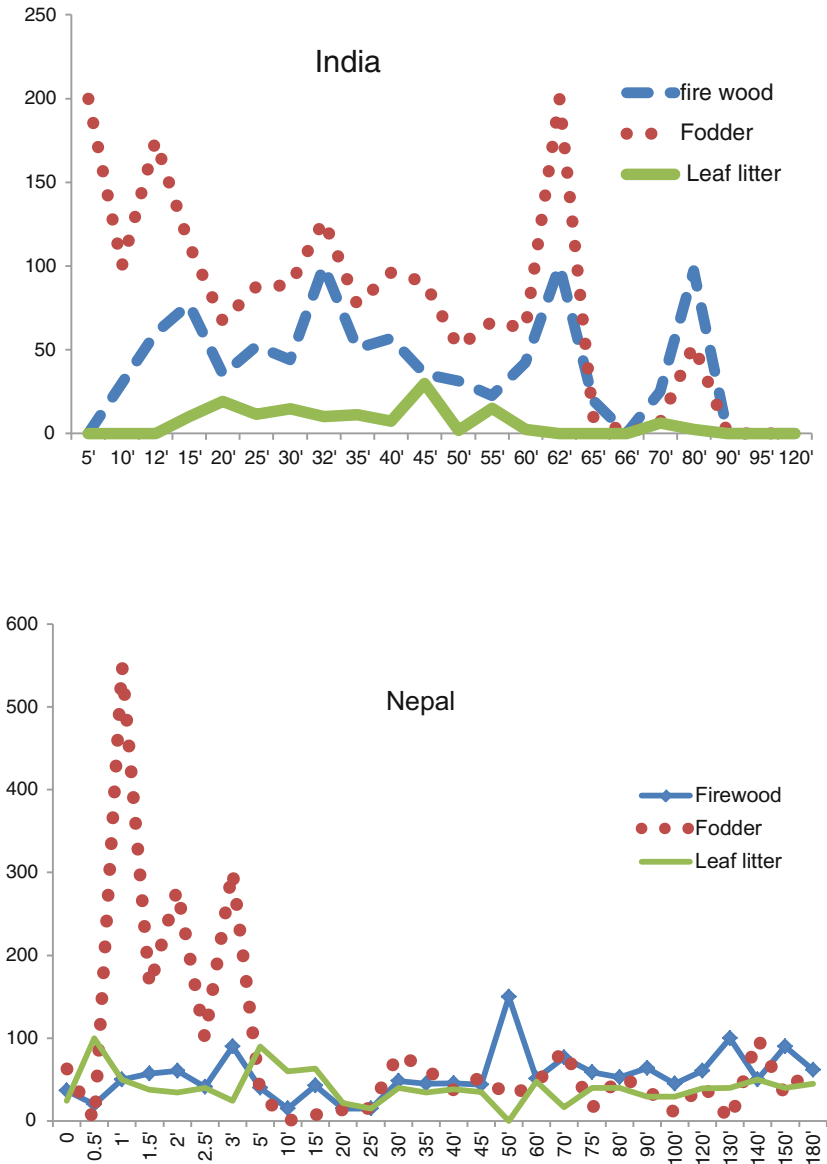

Fig. 3 Collection from community forests relative to distance to community forest, India and Nepal. Except fodder, there seems to be no pattern
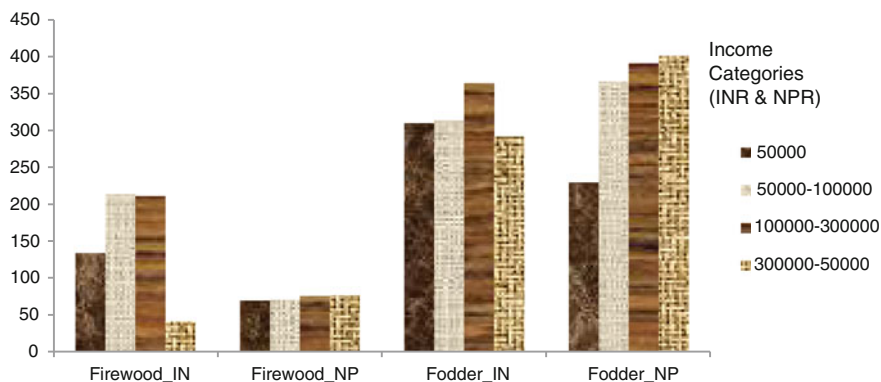
Fig. 4 Total collection of firewood and fodder by different income groups. There seem to be an inverted U-shape in India, but not in Nepal

alternatives, distances walked do not matter to remote rural households in India and Nepal. However, this does not mean that walking these long distances is not a costly endeavor.

Figure 4 looks at how forest product use varies with income. The expectation is that forest use is income elastic and as households become wealthier they may reduce their use of forests. It is interesting to note that an inverted U shaped relationship is prevalent to some extent in India. However, in Nepal, forest products are so fundamental that increases in income do not change their consumption. The lack of substitutes is probably the main reason for this pattern.

6 Correlates of Poverty

One of the questions we are interested in is how households in India and Nepal differ in terms poverty. Our data suggest that in terms of assets and income, households in Nepal are comparatively better off than their Indian counterparts (see Table 2). Table 7 presents a more disaggregate picture of occupational dependence and sources of household income.

Table 7 shows that agricultural households dominate in both countries, with 91% of households in India and 67% in Nepal depending on agriculture. Interestingly, nearly 70% of Indian households' state that their main source of income is agriculture, while only 56% in Nepal consider agriculture to be their main source of income. Remittances, which constitute the second major source of income in Nepal, do not play a major role in India. While it is not clear from our data if households have diverse sources of income, at least at the aggregate level, there is much more income diversification in Nepal versus India.

Table 7 Primary occupation and main source of income (share of households)

	Chandak-Aunla Ghat, India (N = 301)	Gwalek, Nepal (N = 351)
Primary occupation		
Agriculture	91.0	67.2
Traditional work	1.0	7.7
Government job	2.3	10.5
Others (wage labor + business + NGO or private job)	5.6	14.5
Main source of Income		
Agriculture	69.8	55.6
Pension	16.0	9.4
Remittances	14.0	30.8
Other sources	0.3	4.3

To understand better what may be contributing to transitions out of poverty, we examine the correlates of poverty. We use household income as a measure of household welfare. In rural agrarian settings, measuring household income with any given level of precision is a challenging task. Therefore, we collected data on an indicator of household income instead of the actual amount. Households were asked to indicate their monthly income-bracket from a list of less than Rs. 50,000; between Rs. 50,000 and Rs. 100,000; between Rs. 100,000 and 200,000, and above Rs. 200,000 per month. Their responses were coded as 1, 2, 3, and 4, where 1 being the lowest and 4 being the highest income brackets.

For understanding the correlates of poverty, we regress the household income indicator on socioeconomic status, demographic characteristics, household assets, different features of forests that the households have access to for collecting fire-wood, from where they get their water supply, distance between forest and house, and access to motorable roads, measured by the travel time between nearest motorable road and the house.

As a starting point, we first estimate the income equation using the ordinary least squared (OLS) method. Since our income measure is reported as an indicator variable, we also estimate the same model using an ordered logit regression. Table 8 presents both the OLS coefficients and the marginal effects as measured from the ordered logit coefficients of the covariates of household income. These coefficients indicate the degree and direction of the association between household income and other household, public and geographic characteristics.

Table 8 indicates that the determinants of household income vary between two countries. In India, household income is positively associated with the household head's education level, presence of permanent (concrete) toilet, and size of land-holdings; while in Nepal, household size and concrete house structure have positive association with household income. In Nepal, households have more land and more households get remittances. Thus, larger household sizes in Nepal may be

Table 8 Determinants of household income

Variables	India		Nepal	
	OLS	Ordered logit[a]	OLS	Ordered logit[a]
Total number of people in family	0.026	0.131	0.034	0.091
	(−1.24)	(−1.51)	(2.46)*	(2.65)**
Education above 10 years (1/0)	0.241	0.917	0.098	0.263
	(3.03)**	(2.33)*	(−1.03)	(−1.14)
Agriculture as main occupation (1/0)	−0.531	−1.359	−0.496	−1.166
	(2.79)**	(2.72)**	(4.79)**	(4.63)**
Dalit (1/0)	−0.081	−0.523	−0.234	−0.647
	(−0.95)	(−1.26)	(−1.55)	(−1.83)
Concrete house (1/0)	−0.084	−0.384	0.362	0.857
	(−1.25)	(1.27)	(3.81)**	(3.78)**
Permanent toilet (1/0)	0.305	1.513	0.307	0.737
	(4.68)**	(3.68)**	(−1.66)	(−1.57)
Aspect: West (1/0)	−0.261	−1.217	−0.241	−0.43
	(2.50)*	(2.68)**	(−1)	(−0.72)
Aspect: South_East (1/0)	−0.81	−3.708	−0.093	−0.131
	(5.38)**	(5.07)**	(−0.52)	(−0.34)
Aspect: South_West (1/0)	−0.063	−0.332	−0.599	−1.348
	(−0.55)	(−0.68)	(2.69)**	(2.69)**
Forest type: broadleaf (1/0)	−0.069	−0.363	0.841	2.212
	(−0.4)	(−0.67)	(3.44)**	(2.60)**
Forest type: bush (1/0)	0.157	0.444	1.012	2.648
	(−0.91)	(−0.78)	(3.77)**	(2.91)**
Forest type: pine_mix (1/0)	0.806	1.67	0.993	2.56
	(2.57)*	(2.69)**	(4.19)**	(3.02)**
Forest offered to deity (1/0)	−0.472	−1.805	–	–
	(3.39)**	(3.52)**	–	–
Travel time between house and community forest (min)	0.004	0.017	−0.004	−0.009
	(−1.85)	(−1.81)	(3.07)**	(2.94)**
No. of livestock units	−0.023	−0.085	−0.009	−0.026
	(2.06)*	(−1.45)	(−0.68)	(−0.78)

Table 8 (continued)

Variables	India		Nepal	
	OLS	Ordered logit[a]	OLS	Ordered logit[a]
Travel time between house and motorable road (min)	0.002	0.005	−0.002	−0.004
	(0.62)	(0.44)	(1.94)	(2.14)*
Land area (ha)	0.039	0.077	0.013	0.03
	(2.38)*	(1.88)	(1.24)	(1.09)
Constant	1.653	–	1.495	–
	(6.28)**		(3.89)**	
Observations	301	301	349	349
R-squared	0.35		0.27	

Notes Robust *z* statistics in parentheses
*Significant at 5%; **significant at 1%
[a]The estimates are marginal effects of ordered logit regressions

contributing to income through both agriculture and remittances. In India, where there appears to be less diversification in income, sources and households are largely dependent on agriculture, area of land matters. In both countries, the variable households with agriculture as the main occupation are negatively associated with household income. This seems to suggest, as would be expected, that agriculture alone is not a pathway out of poverty.

In India, communities sometimes offer their forests to deities for a fixed term (usually 5–10 years) when forest degradation becomes a major issue. As expected, such an arrangement tends to lower household income since households may not be able to fulfill their need for forest products. In Nepal, access to forests other than pine forest is positively associated with household income, while this is not the case in India.

7 Discussion and Conclusion

Our analyses of communities on either side of the Mahakali River in India and Nepal suggest that households from Nepal have more land and livestock, yet are not entirely dependent on agriculture for their livelihood. Indicators related to income and assets suggest that Nepali households are better off than their Indian counterparts.

India is a richer country with a per capita income that is twice that of Nepal and a larger road network. However, this does not translate to better indicators of well-being in this remote pocket of rural India. We are not fully able to explain why the Nepali households are better off than their Indian counterparts, even though they live in more remote areas with even less access to markets and transportation than

the Indians. However, our data suggest that remittances may play an important role as nearly 30% of the households in Nepal receive money from outside. Diversification is an important pathway out of poverty, and these remittances may be allowing Nepali households to further diversify or recover faster from any economic or health shocks. Our statistical analysis also shows a strong correlation between agricultural households and poverty. Solely relying on agriculture, without some diversification in income, is unlikely to be a pathway out of poverty. Another socioeconomic difference that may affect Indian households is caste structure. Some 41% of the households on the Indian side are Dalits and this may influence how well they are able to use social networks to seize new opportunities.

Do natural resources matter for poverty reduction? The Nepali watershed seems better endowed with both water and forest resources. Nepali women spend less time collecting and managing water. The average walking time a household spends to collect water in Nepal is 56 percent less than India. Nepal also has better sanitation infrastructure, while nearly 20% of Indian households do not have a toilet in their home. This may translate health disparities between these countries.

Nepal's forests are in better health than Indian forests. Forests in India, particularly those surrounding villages, are degraded. This is likely because Indian households collect a large share of fuelwood from nearby areas and not from community forests. The average Indian household collects less than 30% of its annual fuelwood from community forests, while Nepali households collect 70% of their annual intake from community forests. Forests are further away, and roads are further away in Nepal. Yet, because of the lack of alternatives, distances walked do not seem to reduce how much wood is collected. Furthermore, while there is some limited evidence of income elasticity in fuelwood use in India, like distances walked, income growth does not seem to reduce fuelwood consumption in Nepal. Given the degraded bush forests that dominate areas around villages in India, it is a good sign that fuelwood use seems to be a bit responsive to income changes.

In per capita term, Indians use and collect more than twice as much fuelwood as do Nepalese. This may be because they get most of their fuelwood from around their villages. It is also possible that Indians sell some fuelwood because they are relatively close to motorable roads. Another possible reason could be that Nepalese households use other household energy sources. This may have led to lower collection of firewood by these households. In summary, our analyses suggests that there are key differences between Nepali and Indian forest dependent households. It is likely that a combination of norms, technology and institutional differences make fuelwood use and where resources are sourced from very different across India and Nepal.

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