Rural Livelihoods, Forest Access and Time Use: A Study of Forest Communities in Northwest India

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March 2011

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Abstract: This paper investigates the effects of the size of private land holdings and access to forest commons on the labour allocation to livelihood activities. The statistical analysis indicates that land and forests are complementary assets in the rural production process. Differential access to private land and common forests together explain variability in time allocation to rural livelihoods in the forested regions of northwest India. Development and conservation policies that might cause displacements or disruptions to such livelihoods must therefore consider the impact of policy making on private wealth as well as access to the natural commons.

Keywords: time use, rural livelihoods, forest commons, protected areas, South Asia, India

JEL Code: B59, D13, J22, Q12, Q23

1. Introduction

Time is a vital resource in societies where a significant amount of production occurs outside of markets. Investigation of the allocation of labour time is particularly relevant in rural economies of certain developing countries where articulation of markets is low and households are dependent on nonmarket environmental goods. Accordingly, the study of individual time use has garnered attention from various perspectives such as estimation of labour supply curves, investigating the gendered nature of intrahousehold labour time allocation, imputing the value of nonmarket environmental and domestic goods, and estimating alternative measures of poverty. Nonmarket environmental goods, which are in certain cases extracted from the commons, contribute significantly to the economic wellbeing of rural households in low-income countries (Ruiz-Perez and Arnold, 1996; Bryon and Arnold, 1999; Reddy and Chakravarty, 1999; Beck and Ghosh, 2000; Fisher, 2004; Adhikari, 2005; Yemiru et al., 2010). The natural commons may be the sole source of wealth (Takasaki, Barham and Coomes, 2001) and thus an important determinant of income, consumption levels, time use, and expenditure of effort associated with a particular level of economic wellbeing in such socio-economic settings.

There have been numerous studies of labour time utilisation, however, relatively less attention has been devoted to the effect of access to the environmental commons. To the extent that the relationship between time use and access to environmental commons has been addressed, in the context of developing countries, two issues in particular have been emphasised. Firstly, researchers have attempted to quantify the dependence of rural households on environmental commons (Jodha, 1986; Pattanayak and Sills, 2001;

Cavendish, 2000)[1]. Such studies incorporate time in valuation techniques to estimate the value of environmental goods or infer dependence based on time. Despite the utility of such exercises, there is no consideration of the effect of access on time spent in collection activities, nor the impact on rural livelihoods in total; the emphasis tends to be on environmental collection[2]. Secondly, studies have examined the effect of environmental scarcity on time expended in collection of environmental goods (Kumar and Hotchkiss, 1988; Ilahi and Grimard, 1999; Pattanayak and Sills, 2001; Pattanayak, Sills and Kramer, 2004)[3]. The latter group of studies address some of the limitations of valuation studies.

However, access to the commons is not determined by environmental scarcity alone. A large number of developing countries continue to implement colonial policies governing access to the commons, especially the forest commons (Gadgil and Guha, 1994; Guha, 1994; Rajan, 1998; Saberwal, 2000). Restricting access to the forest commons for conservation or development purposes in a non-democratic manner is a common policy tool that, under certain conditions, may be harmful to conservation, rural livelihoods, and wellbeing (Guha, 1990; Reddy and Chakravarthy, 1999; Hayes, 2006). The effect of restricted access to the environmental commons is dependent on the significance of the commons in the production process. For instance, the gendered nature of work suggests that (Juster and Stafford, 1991; Miranda, 2011) access to forest

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[1] It is standard practice in this literature to ignore the cost of household labour (for example, Sjaastad et al., 2005; Vedeld et al., 2004; Narain, Gupta, & van't Veld, 2008; Yemiru et al., 2010).

[2] Certain studies have regressed forest dependence on available household labour and household labour allocation to forest extraction (Adhikari, Di Falco and Lovett, 2004; Adhikari, 2005; Mamo, Sjaastad and Vedeld, 2007).

[3] Following the poverty-environment hypothesis, some studies have identified the amount of time in collection of forests products with forest degradation (for example, Bluffstone, 1995; Fisher, Shively and Buccola, 2005).

commons in South Asia affects women more than men; forests form the material basis of productive activities carried out by women (Agarwal, 2001, 2010). Further, the stock of private wealth is a significant determinant of the substitutability of environmental and human-made goods, and determines the extent to which individuals and households are affected by restrictions to their access of the commons.

Dependence on private wealth and forest commons, both productive assets, is particularly relevant if land and labour markets are thin (Agarwal, 1994, 1998, 2010; Takasaki, Barham and Coomes, 2001; Bardhan, 2005; Barbier, 2010) and may affect time expended in productive activities. Time use analysis is valuable in understanding the importance of environmental commons and other productive assets for livelihoods in an agrarian context. Time spent in work is now considered an indicator of poverty and wellbeing (e.g., Floro, 1995; Ilahi, 2000; Bardasi and Wodon, 2006, 2009, 2010; Antonopoulos and Memis, 2010; Floro and Pichetpongsa, 2010).

Setting aside the issue of time poverty and wellbeing, the objective of this paper is to investigate the effect of private landholdings and the environmental commons (specifically common forests) on time allocated to livelihood activities. The paper draws insights from studies of forest dependence and time use studies, and examines a unique data set collected during fieldwork conducted in 2008 from 204 residents of the forested northwest Himalayan region of India. The paper contributes to the literature on the environment-livelihood relationship and time use by conducting a statistical analysis of the effect of both private and common wealth on time use allocated to diverse work activities. The paper complements studies examining rural livelihoods based on market and imputed income. In addition, this paper adds to the existing literature on time use that

is largely focused on market processes and situated in the urban context. It also incorporates the concept of overlapping time (i.e., the tendency for individuals to engage in simultaneous work). Most time use studies (but see Floro and Miles, 2003; Floro and Pichetpongsa, 2010) ignore overlapping time and this methodological omission has been criticised since it underestimates the intensity of work, particularly of women (Floro, 1995).

The next section proceeds to describe the field setting and data collection method while motivating the theoretical significance of the explanatory variables employed in the regression equations. Section three reports the findings from a statistical analysis of the data set. Section four concludes with a discussion of the relevance of the findings to the debate on rural livelihoods and the importance of the natural commons.

2. Field Setting and Data

2.1 Background of the Study Area and Data Collection

Fieldwork was conducted in Mandi District, which is one of 12 districts located in the Indian state of Himachal Pradesh. The population of Mandi district is primarily rural and a significant proportion is engaged in agriculture (see Table 1 for selected statistics); labour is a significant resource in rural production systems (GoHP, n.d.). Furthermore, labour and land markets are relatively undeveloped in the rural areas of this district and rural production systems are dependent on forests though not homogenously, as is discussed below. Thus, this region provides a suitable study area to investigate hypotheses about the effect of access to forest commons and private endowments on gendered work and time use.

Methodologically, this study approaches the research question by measuring access to private wealth as total land ownership and accessibility of the environmental commons as a binary variable indicating the absence of a given wildlife sanctuary. Twelve villages from a particular development block were selected such that six villages were situated within a specific wildlife sanctuary and six outside although within close proximity to the sanctuary. For each of these villages, a sampling frame was constructed with information about each household's caste, in addition to the names and ages of its members. In the next stage, a probability sample of households was selected. Finally, individuals above the age of 18 were selected from each household in order to ensure gender parity. After dropping some observation due to missing information, data from 204 individuals is used in the statistical analysis.

Table 1: Characteristics of Mandi district

Population size (2011)	999,518 individuals
Percentage of rural population to total population (2001)	93.23 percent
Population density (2011)	253 persons per square kilometre
Literacy rate (2011)	82.81 percent
Sex ratio (2011)	1,012 females per 1,000 males
Net irrigated area as percent of net sown area (2005-2006)	16.07 percent
Net sown area as percent of total geographical area (2005-2006)	15.86 percent
Permanent grazing and pasture lands (2004-2005)	24.23 percent
Altitude	1,200-3,000 meters above sea level
Forests as percent of total geographical area (2005-2006)	15.93 percent

Source: GoI (2001); GoHP (2009, 2011); GoI (2011)

Following validation of the survey instrument, data were collected during two structured interviews with the respondents. The first round of interviews gathered information on the socio-economic position of the households and respondents, and the accessibility of social infrastructure and the forest commons. The second round of interviews were devoted to collecting data on time use data utilising the 24-hour recall time diary method; respondents provided a detailed time accounting of their activities for a 24-hour period from 4 a.m. of the day prior to the interview to 4 a.m. on the day of the interview itself. Interviewers recorded all activities in their chronological order in addition to the corresponding time expenditure. This method is a standard technique in the collection of time use data and considered superior to conventional survey techniques utilised by economists to measure labour supply hours (Juster and Stafford, 1991; INSTRAW, 1995; Esquivel et al., 2008). In addition, data on overlapped activities were recorded. The remainder of this section discusses the relevant characteristics of the sample.

2.2 Livelihoods and Time use

The economy of the study region is primarily agropastoral but households deploy diverse livelihood strategies to meet their basic needs, minimise risk, and generate an economic surplus (Chambers 1983; Ellis 1998). This livelihood diversification may be the result of necessity or choice (Ellis, 1998, 2000) and depends on capital, claims, entitlements, and access, which affect livelihood capabilities (de Haan and Zoomers, 2005; Scoones, 2009). When questioned about their two primary occupations, 93.55 percent of respondents reported engaging in agricultural work, 60 percent in nonfarm

production and domestic work, 39.16 percent in casual and formal labour markets, and only 5.6 percent were self-employed[4].

Consistent with the research objective, the survey instrument collected data on livelihoods and time use, defining all productive activities as "work" irrespective of their inclusion in the system of national accounts (SNA) production boundary (UNSD, 2005). The taxonomy of work was based on the International Classification of Time Use Activities (ICATUS) developed by the United Nations Statistical Division (UNSD, 2005) which attempts to mitigate some limitations of the SNA. However, modifications were necessitated by the economic context of the study area. Work was classified[5] into the following categories: (a) domestic and care work consisting of cooking, cleaning, child and elder care that typically takes place within the household; (b) agricultural work on own (household) agriculture that relies heavily on household labour[6]; (c) forest product collection and livestock management, in other words, nonfarm household production, also undertaken by household labour; (d) market work consisting of wage work, entrepreneurial activity, and any activity involving sale and purchase of commodities in a market.

Note that focusing merely on market income generated by activities would render work that occurs outside of the scope of the market invisible. Domestic work is not

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[4] Since the question was posed as two primary work activities, the categories are not mutually exclusive.

[5] UNSD recommends that the taxonomy should be modified to reflect local realities (UNSD, 2005). Given its primacy in the economy of the region, agriculture was separated from primary production of goods. Forest collection and livestock management that would fall under primary production are treated as a separate category. Domestic services and unpaid care giving services are combined to form the category domestic work. The resulting categories broadly coincide with Reardon and Vosti's (1995) classification of income strategies in rural economies though they ignore domestic work.

[6] The incidence of agricultural wage work is very low in the region.

included in national account statistics, for example, since such work occurs outside the market and the production boundary of the SNA. Similarly, nonmarket forest collection is uncounted in official statistics even if it is within the production boundary of the SNA. However, such activities are essential for the existence of productive labour and constitute important aspects of the totality of rural production. Ignoring these work activities undercounts the amount of effort expended by women in ensuring the wellbeing of households due to the gendered nature of work (Beneria, 1992; Ilahi, 2000; Esquivel et al., 2008). The methodology of this paper therefore incorporates visible and invisible work.

Respondents also provided information about joint activities, that is, activities conducted simultaneously. Preparing children for school and cooking, or collecting firewood and leading cattle into the forest to graze are examples of joint work activities. Joint activities were recorded as primary or secondary based on the respondents' perception; a maximum of three simultaneous activities were recorded (Floro and Miles, 2003)[7]. Ignoring overlapping work, like most empirical time use studies[8], is considered a serious methodological flaw (United Nations, 1988, 1990; Juster and Stafford, 1991; Beneria, 1992; Floro, 1995) since this assumption entails underestimating total time spent in work. Table 2 reports on participation rates of respondents and time spent in four work activities according to their primacy. A significant proportion of respondents engaged in secondary or overlapping activities in order to complete tasks classified as domestic work, forest collection and livestock management work. Table 3 reports summary

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[7] "An activity episode consists of a starting time, a finishing time, a main activity and possibly other activities, location and a social context". (ABS, 1994 cited in Floro and Miles, 2003).

[8] Floro and Miles (2003) and Floro and Pichetpongsa (2010) are exceptions.

statistics for total time expenditure in various work activities, including overlapping

activities[9]. These variables will be the dependent variables in the regression analysis[10].

Table 2: Time Allocation to primary and overlapping activities

	Primary Activities		Secondary (Overlapping) activities	
Variable	Participation rate (%)	Average time (min. per day)	Participation rate (%)	Average time (min. per day)
Domestic	77.45	135.51	52.45	77.45
Forest collection and livestock	62.25	178.05	33.82	53.87
Agriculture	53.92	168.85	0	0
Market	36.28	160.15	0	0

Table 3: Total time spent including overlapping activities (minutes per day)*

Variable	Mean	Sample s.d.	Min	Max
Total Domestic	174.8	148.42	0	667.5
Forest collection and livestock	205.38	227.42	0	840
Agriculture	168.85	205.73	0	720
Market	160.15	245.32	0	780

*Secondary activities are deflated by a factor of 0.5.

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[9] While there is a growing consensus that overlapped time should be counted in total time worked, but there are no clear accounting guidelines. The literature suggests either weighting primary and secondary activities equally, or assigning secondary activities half the weight of primary activities (Floro and Miles, 2003; Pichetpongsa, 2004; Floro and Pichetpongsa, 2010). The second alternative acknowledges that engaging in simultaneous activities might decrease productivity, or create production bottlenecks and hence secondary activities should be weighted lower. I employ the latter method of assigning secondary activities half the weight as primary activities.

[10] Note that employing only time spent in primary work as the dependent variable does not change the sign or the statistical significance of the explanatory variables in the regression analysis.

2.3 Land Assets

In rural India, land is a crucial factor of production and a significant predictor of access to credit, social status, and bargaining power (Agarwal, 1994, 2010; Mearns, 1999; Bardhan, 2005; Jackson and Rao, 2009; Basole and Basu, 2011a). Mandi's economy is likewise land dependent, yet the mountainous topography does not permit large unbroken tracts of agricultural or pastoral land. About 47 percent of the respondents belonged to households owning land less than five *bighas* (0.41 hectares)[11]; 30.98 percent belonged to households with landholdings between five to ten *bighas* (0.41 – 0.82 hectares); and 22.12 percent belonged to households with land greater than ten *bighas* (greater than 0.82 hectares). Average landholding was 8.86 *bighas* (0.73 hectares).

The absence of robust land markets means that distribution of this factor of production is mainly governed by inheritance norms. The prevalent patriarchal system in India and Himachal Pradesh, however, ensures that effective land ownership is the province of men. Female ownership is virtually non-existent despite changes in inheritance laws (see Agarwal, 1994). Bearing in mind the consequent limitations of the data set, household landholdings are utilised as a proxy for access to productive assets necessary for private production in rural Mandi. This variable is expected to increase time spent in high-return activities but decrease time spent in low-return work (also see Fisher, 2004).

[1111] 5 *bighas* approximately equal 0.41 hectares.

2.4 Access to Forest Commons

According to the Forest Survey of India, forests covered 42.35 percent of the total geographical area of Mandi district (FSI, 2009). Following the British legacy of forest nationalisation, the state is responsible for managing forests and wildlife. Unlike in other parts of India, the settlement of forest rights in Mandi district (which began after 1878 and ended in 1917) did not lead to a full termination of traditional forests rights allowing all households defined rights to their community forests (Saberwal, 1999; Chhatre, 2003; Vasan, 2003; Chhatre and Saberwal, 2006). Nevertheless, the exercise of these rights is filtered through the legitimacy allowed by the state. Protected areas, including wildlife sanctuaries and national parks, have the most restricted access. The study region consists of a wildlife sanctuary that continues to allow human settlements. Residents of the sanctuary extract forest products, even though the Forest and Wildlife Departments monitor the sanctuary and impose sanctions on violators. This policy increases the costs of access to forest products and community management relative to residents in nonsanctuary forests[12].

Subject to the limits imposed on access to forests, residents of the study region engage in variegated utilisation of forests, including collection of fodder and bedding for livestock; grazing cattle; collection of wood and other biomass; collection of wild vegetables, fruit, and honey; and so forth. Some market substitutes for forest products are available, but extraction of forest products reduces market dependence and hence mitigates the impacts of economic shocks. Moreover, access to the forest commons provides a safety net and equalises inequities in private wealth holdings (Jodha, 1986;

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[12] See Rangan (1997), and Ribot and Peluso (2003) for a broader definition and discussion access to forests and other environmental commons.

Reddy and Chakravarty, 1999; Beck and Ghosh, 2000; but see Adhikari, 2005; Adhikari, Di Falco and Lovett, 2004 for results to the contrary).

3. Statistical Analysis

We proceed to a statistical investigation of the effect of access to private wealth and environmental commons on time allocated to livelihood activities. Rural livelihood activities are categorised into domestic, agricultural, nonagrarian household, and market work as discussed above. Access to private wealth is measured as total land ownership and accessibility of the environmental commons as a binary variable indicating the presence of the given wildlife sanctuary. The regression analysis involves estimation of a corner-solution tobit model for each livelihood activity,

$$T_{ij}^* = \beta_j + \sum_{i=1}^{k_j} \beta_{ij} x_{ij} + u_{ij}$$

$$T_{ij} = 0 \qquad \text{if } T_{ij}^* \leq 0$$

$$T_{ij}^* = T_{ij} \qquad \text{if } T_{ij}^* > 0$$

where i identifies a particular individual in the sample, j identifies a particular work activity, and k_j denotes the number of regressors in equation j. T_{ij} measures total time spent by i in a particular work category j including overlapping time, T_{ij}^* is the index variable, $u_{ij} \sim N(0, \sigma_j^2)$, β_{ij} denotes a particular coefficient in the model j, and x_{ij} denotes a regressor. The explanatory variables include a binary variable indicating whether the respondent lives inside the sanctuary; total landholdings of the respondent's household; individual characteristics such as sex of the respondent, age, education, and whether the day was abnormally busy for the respondent; and, household characteristics

such as sex of the household head, its size, caste, and livestock holdings. This specification is consistent with other time use studies (for example Juster and Stafford, 1991; Skoufias, 1993). Table 4 explains the regressors and the descriptive statistics are presented in Table 5.

The regression equations are subject to corner (also known as boundary) solution outcomes since certain respondents were not engaged in particular activities on the dates of the interviews. Hence, the dependent variable is zero with positive probability but is continuous over positive values. Application of OLS is therefore inappropriate and tobit analysis is utilised (Wooldridge, 2002)[13]. Table 6 reports the maximum likelihood estimates of the marginal effects for the censored means,

$$\frac{\partial E[T_j \mid \mathbf{x}_0]}{\partial \mathbf{x}_j} = \Phi\left(\frac{\mathbf{x}_0^T \mathbf{b}_j}{s_j} \right) \mathbf{b}_j$$

where $\Phi(w)$ is the standard normal cumulative distribution function. Two specification issues that arise in such models, heteroscedasticity and nonnormality, were considered in order to verify the consistency of the maximum likelihood estimator. Note that conditional moment tests fail to reject the null hypothesis that the error terms are normally distributed at the one percent level of significance (Skeels and Vella, 1999). To account for heteroscedasticity, moreover, White's robust standard errors are reported in parentheses.

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[13] Note that the Heckman selection model is not applicable since the model assumes that values are unobserved for some respondents, which is not the case here.

Table 4: Description of Explanatory Variables

Variables	Descriptions
resp_sex	Dummy variable defined as unity if respondent is female and zero otherwise.
resp_age	Age of the respondent in years.
resp_educ	Education received by the respondent in years.
abnormal_day	Dummy variable denoting whether the amount of work was higher than normal. It takes the value unity if work intensity was higher than normal.
hh_sex	Binary variable defined as zero if household head is male and unity if household head is female.
hhsize	Household size.
caste	Binary variable defined as unity if the respondent belongs to an upper caste and zero if the respondent belongs to a lower caste.
mkt_income	Total market income of the household from all livelihood sources including wage labour and petty commodity production (rupees per annum.
livestock	Number of total livestock held by respondent's household.
land	Total land held by the respondent's household, measured in *bighas*.
sanctuary	Dummy variable defined as unity if the respondent lives in a sanctuary area and zero if not.

Table 5: Descriptive Statistics for Explanatory Variables

Variable	Mean	Std. Dev.	Min	Max
resp_age (years)	42.34	9.95	21	71
resp_educ (years)	3.7	3.65	0	12
hhsize	5.18	2.01	1	12
mkt_income (Rs.)	47,304.53	30,798.82	0	184,730
livestock (total number)	9.12	23.69	0	203
land (*bighas*)	8.86	8.5	0	75

Variable	Proportion
resp_sex (females = 1)	0.54
abnormal_day (busier than normal)	0.43
hh_sex (female headed household = 1)	0.19
caste (upper caste = 1)	0.83
sanctuary (living in sanctuary forest = 1)	0.51

3.1 Time Allocated to Domestic Work

The results indicate *sex_resp* and *hhsize* are statistically significant in explaining the variation in total time spent on domestic work. The former has a positive effect, suggesting that women spend a greater proportion of their time on total domestic work. This finding is consistent with the literature on time use across countries, which shows that women spend higher amounts of time on invisible domestic work. The inclusion of an interaction term between landholdings and sex (not presented in the paper) is statistically insignificant and hence women spend more time in invisible work outside of the market irrespective of the wealth of households (i.e., in activities not considered "productive" by the UN-SNA). Landholdings and forest access do not affect the amount of time spent in domestic work in a statistically significant manner.

3.2 Time Allocated to Forest Collection and Livestock Maintenance

The two variables *land* and *sanctuary* are statistically significantly regressors in the equation for nonagrarian household production even after controlling for livestock holdings. Wealthy respondents spend relatively more time in forest collection and livestock maintenance. This finding is contrary to the results obtained by certain studies positing that households with lower private wealth tend to be more dependent on extractive activities (Jodha, 1986, 1990; Heltberg, 2001; Fisher, 2004; Fisher, Shively and Buccola; 2005; Narain, Gupta and Van't Veld, 2008; Kamanga, Vedeld and Sjaastad, 2009). Under the assumption of constant unit labour cost, in contrast, the findings in this paper are consistent with research demonstrating that households with more land tend to

collect more forest products (Kumar and Hotchkiss, 1988; Takasaki, Barham and Coomes, 2001; Adhikari, di Falco, and Lovett, 2004; Adhikari, Nagata and Adhikari, 2004)[14].

The seemingly contradictory results in the literature stem from the differences in economic contexts. In rural South Asia, biomass is an important factor of agricultural production on account of its direct utility as a fertilizer. It also provides feed and bedding for livestock maintenance and management that indirectly produces manure for fertilizer (Jodha, 1990; Bluffstone, 1995; Cooke, 1998b). It can be extracted either from the forest commons or from private land. In the former case, higher land holding require higher biomass extraction. If, however, biomass is extracted from private land, higher landholdings will decrease amount of time spent in extractive activities (Balasubramanian and Selvaraj, 2003; Boyce, 2003; Cavendish, 2000; Fisher, 2004; Jodha, 1995, 2001). The findings of the statistical analysis suggest that for this data set, wealthy individuals tend to extract relatively large quantities of biomass from the commons indicating the high net return from nonagrarian production. The claim is not that market income from this activity category is high. Higher time spent in this activity could be a result of the relative difficulty in obtaining market substitutes.

The negative sign for the coefficient of *sanctuary*, on the other hand, suggests that residents of the sanctuary tend to spend less time in forest collection and livestock management[15]. The findings of Van't Veld et al. (2006) and Heltberg, Arndt and Sekhar

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[14] Note that other studies discuss the effect of income on forest dependence, but since wealth and income have different effects, they are not relevant to our discussion.
[15] The literature dealing with environmental scarcity in South Asia finds that increasing forest degradation and hence lower access to environmental goods is positively correlated with the time spent on forest collection (Kumar and Hotchkiss, 1988; Cooke, 1998a,

(2000) suggest that a reduction in firewood availability causes households in their sample, from the Indian states of Madhya Pradesh and Rajasthan, to substitute towards firewood on private land or inferior quality agricultural wastes (also see Amacher, Hyde and Joshee, 1993; Cooke, 1998a for similar results for Nepal). On account of the higher costs of extraction (associated with the probability of being caught and paying a fine) in sanctuary forests, individuals are forced to substitute collection away from common forests and towards producing biomass on their private land.

3.3 Time Allocated to Agricultural Work

Regression (3) suggests that the size of landholdings exhibits a positive correlation with time expenditure in agrarian activities. Given that agricultural income is proportional to the size of landholdings (Basole and Basu, 2011a), this result is expected in the context of an agrarian economy. Land is the most important factor of production. All else constant, expenditure of time in agricultural work will increase as endowments of this factor of production increase (also see Takasaki, Barham and Coomes, 2001). Residents of sanctuary forests, furthermore, expend relatively more time in agricultural work. Consistent with the discussion above, if higher landholdings indicate access to superior economic opportunities, then agriculture is a relatively high-return activity relative to other economic opportunities available[16].

1998b). In this paper, however, restricted access does not arise due to environmental degradation but forest policies.

[16] Agricultural activities is not a high return activity in absolute terms as demonstrated by recent studies such as Basole and Basu (2011a).

Table 6: Estimated Time Expenditure Equations

	Domestic (1)	Forest and livestock (2)	Agriculture (3)	Market-related (4)
resp_sex	255.488***	332.622***	-46.764	-123.532**
	(21.714)	(49.45)	(41.895)	(49.189)
resp_age	-1.303	-0.849	2.814	-2.448*
	(1.016)	(1.734)	(1.919)	(1.429)
resp_educ	1.499	1.335	9.83	-3.853
	(2.892)	(5.204)	(6.52)	(2.838)
abnormal_day	-6.683	27.267	142.732***	-22.523
	(16.9)	(29.61)	(37.408)	(25.583)
hhsize	-15.069***	12.125	-0.522	-0.092
	(5.006)	(9.389)	(10.372)	(6.025)
hh_sex	3.477	-24.059	-64.727	22.467
	(21.404)	(40.423)	(53.405)	(29.139)
caste	19.206	-6.694	-107.88*	6.495
	(29.77)	(47.738)	(62.485)	(26.6)
mkt_income	0.0003	-0.001***	-0.0006	0.0009*
	(0.0003)	(0.0005)	(0.0007)	(0.0005)
livestock		0.166		
		(0.480)		
land	-0.397	5.472***	11.014***	-9.056**
	(1.029)	(1.626)	(3.393)	(4.14)
land_sanc			-13.855***	8.136**
			(4.769)	(3.818)
sanctuary	-0.728	-81.611**	203.366**	9.097
	(24.495)	(41.073)	(91.517)	(41.519)
$\hat{\sigma}$	106.606	226.439	278.256	425.127
N	204	204	204	204
Log likelihood	-1003.681	-964.685	-833.196	-606.752

Maximum likelihood estimates for the censored mean are reported where *resp_sex* = 1, *caste* = 0, *hh_sex* = 0, *santuary* = 1, and *abnormal_day* = 0. Robust standard errors computed by delta method are shown in parantheses. ***Significant at 1 percent level; **Significant at 5 percent level; *Significant at 10 percent level.

Despite the relatively greater expenditure of time in agricultural work, sanctuary

residents tend to receive lower agricultural incomes. Investigation of annual household

agricultural income reveals that the means do not differ between nonsanctuary and

sanctuary areas[17]. There are two plausible explanations. The forest commons is an important productive asset and a reduction in access reduces labour productivity, forcing an increase in total time spent in agricultural work. Secondly, a decrease in forest collection entails an increase in the time spent producing fuel or fertilizers from agricultural waste to satisfy livelihood requirements.

This increase in time expenditure for agricultural work due to a reduction in forest access does not obtain for individuals with larger landholdings. This is indicated by the coefficient for the interaction term between *land* and *sanctuary*. With respect to agricultural work, reduction in either productive asset reduces time spent in this activity.

3.4 Time Allocated to Direct Market Work

Wealthy households spend less time in market work, all else constant. However, the interaction term between land and sanctuary suggests that conditional on reduced access to forests, amount of time spent in market work increases with an increase in private wealth. This finding suggests that market activities are undertaken to compensate for lower access to a productive asset as an 'option of last resort'. There is evidence that small, marginal, and landless farmers in India have a higher dependence on wage income at the state level (for example, Srivastava, 1997; Wilson, 1997; Sharma, 2005) and at the national level (Basole and Basu, 2011a, 2011b). The results for this data set are consistent with the aforementioned results but additionally indicate that a loss in access to the forest commons induces an increase in dependence on market activities. Consistent with the estimated equation for agricultural work, a loss in productive assets represents a decrease

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[17] The Kruskal-Wallis test for the hypothesis that mean annual agricultural incomes are equal for both groups yields a p-value of 0.166.

in labour productivity and necessitates an increase in market work to compensate for any potential loss in wellbeing.

4. Conclusions

Notwithstanding the reduction in its contribution to GDP, the rural economy continues to support a significant proportion of the population of India. The study of the rural sector remains critical in view of the slow pace of agricultural transformation, inadequate employment opportunities outside of agriculture (see Bernstein 2004; NCEUS, 2007, 2009; Lerche, 2011), and continued dependence on the natural commons (Beck and Ghosh, 2000; Narain, Gupta and Van't Veld, 2008). The issue of access to assets has been of concern to those engaged in livelihood research, including those focused on rural livelihoods dependent on the natural commons. Livelihood outcomes have been studied from diverse perspectives (Ellis, 2000; Leach, Mearns and Scoones, 1999; Scoones, 2009) and offer insights into structures, institutions, processes, and mechanisms determining livelihood activities. Despite these insights, however, inadequate attention has been devoted to time expenditures in livelihood activities. Therefore, this paper investigated the effects of access to the forest commons and private landholdings on labour allocation to work and livelihood activities.

The analysis, however, has at least three caveats. Firstly, forest dwellers living in sanctuary forests in the study region have not been evicted despite notification of certain forest areas as a wildlife sanctuary. This does not reflect the situation in other protected areas in the country. Secondly, this paper only focuses on the legal aspects of forest access and ignores other dimensions of access (refer to Rangan, 1997; Ribot and Peluso,

2003 for a detailed discussion on access). Thirdly, labour, land, and product markets are thin in Mandi but forest dwellers are not divorced from markets.

This paper offers insights into labour allocations in agrarian economies in a specific socio-economic context. The findings indicate that labour allocations to various work activities are gendered and hence women spend a considerable amount of time outside formal markets. Access to land and legal access to the forest commons determines time expenditure across livelihood activities excluding domestic work. Land holdings exhibit a positive correlation with time spent by individuals in rural farm and nonfarm activities but a negative correlation with time spent in market work. Land has the highest impact on time spent in agricultural work compared to other activities. Sanctuary residence exhibits a negative correlation with time spent in forest management and livestock management but a positive correlation with time spent in agricultural activities and market work, with its highest impact on time expenditure in agricultural work. Furthermore, residents of sanctuaries with relatively large landholdings tend to reduce time spent in agriculture but increase time spent in market work. In other words, differences in access to private land and common forests, both of which are productive assets, explain differential time allocation in livelihood strategies.

These findings have three key implications. Firstly, agriculture is an important livelihood activity in the region that benefits from access to the forest commons. Agricultural incomes, however, for those residing within and outside the sanctuary area are comparable even though the former expend a higher level of labour time in agricultural work. This suggests that the increase in labour expenditure by sanctuary residents is a coping strategy borne out of necessity rather than an accumulation strategy.

Secondly, when access to both productive assets is high, individuals expend more time in rural farm and nonfarm production rather than market work. Thirdly, wealthy sanctuary residents withdraw their labour from agricultural work; however, they increase time in market work. In summary, not only private assets but also the forest commons are important to labour allocated to rural livelihood strategies.

Additionally, the issue of forest access is particularly relevant in the context of ongoing climate change negotiations. The Bali Action Plan arising out of the United Nations Climate Conference in 2007 calls for conservation, sustainable forest management and enhancement of forest carbon stocks to reduce emissions from deforestation and forest degradation (REDD) in developing countries. While various financing mechanisms are being discussed to fund such initiatives, some scholars are concerned about their implications for democratic participation in forest management (for example, Agrawal and Chhatre, 2009) and the wellbeing of forest dwellers. In addition, both coercive conservation and "development" policies in India have played a significant role in reducing access to common as well as private assets, thereby worsening the economic situation of some of the most marginalized sections of Indian society (Gohain, 2010; Naidu and Manolakos, 2010). Thus, as development and conservation policies are being crafted it is essential to bear in mind their true impact on access to both private as well as the natural commons and the subsequent impacts on the wellbeing of rural forest dwellers.

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