FOREST DEPENDENCY, PROPERTY RIGHTS AND LOCAL LEVEL INSTITUTIONS: EMPIRICAL EVIDENCE FROM ETHIOPIA

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Abstract

This study examines the role of local level institutions and property right regimes on the forest poverty link using data from a random sample of rural households in Ethiopia. The determinants of forest dependency were examined separately for different types of forest property right regimes. The results of full maximum likelihood estimation suggests that forest dependency measured in terms of total time spent for collection and share of income derived from non wood forest products (NWFPs) from community forests is negatively related to the wealth status of the household. On the other hand, forest resource use from open access areas are positively correlated with wealth suggesting that there is a need to expand the current practice of participatory forest management (PFM) to other open access forest areas. In line with the above argument, it is necessary to identify the constraints for rural households to participate in community forestry. The role of local institutions and socioeconomic characteristics of households on forest dependency on community forests were also examined. Our estimation results, which are consistent across the different measures of forest dependency, suggest that local level institutions are not significant factors in determining use of non wood forest products unlike major forest products such as timber or woody materials in general. Instead, variables such as age of the household head, off farm activities, livestock ownership, forest density and access to private sources are more important than local level institutions. All are negatively related to share of income, total time spent collecting and total income derived from NWFPs from community forests. From the study results we also conclude that generalization on the forest-poverty link depends on the type of forest management and the specific characteristics that prevail in the area.

Keywords: Property rights, forest dependency, labor allocation, heckman, Ethiopia.

I. INTRODUCTION

Empirical evidences from developing countries indicated that forest products play a significant role in rural livelihoods, particularly for the rural poor. Almost a quarter of a billion people live in or around the dry forests of Sub-Saharan Africa (CIFOR, 2008). Most depend on the forests for building materials, food, land on which to grow crops, fuel wood, non wood products and many other things. The reliance of poor people on natural resources for survival leads to depletion of resources and exacerbating environmental stress.

The use and extent of natural resources degradation or forest product extractions in developing countries is often attributed to rapid population growth, rural poverty and open access (Dayal, 2006; Bluffstone, 1998). In the analysis of forest poverty link many people argued that poverty forces rural households to depend on the surrounding natural resources for survival. Scholars on institutional economics believed that it is not only the level of income or wealth that determines the use and level of dependence on forest resources but also the type of institutions and property right regimes that determines how people use the forest and hence their dependence on forest products. It is well known that the success of common property resource management depends to a great extent on the rules and regulations applied and practiced in the management of natural resources (Ostrom, 1990, cited in Mekonnen, 2000). Besides household and village characteristics, institutional factors at the local level such as clarity of rules for accessing the forests, degree of monitoring the forest by villagers, participation of villagers in the forest management, etc. are found to be important in the analysis of poverty-environment nexus in general (Wunder, 2001; Reddy and Chakravarty, 1999) and forest-poverty link in particular (Adhikari, 2004).

It is widely argued that devolution[1] of natural resource management is the most viable option for ecological and economic sustainability of the natural resources. It improves the forest cover and biophysical conditions thereby providing economic benefits to the local people.

[1]Devolution: is the transfer of rights and responsibilities to user groups at the local level.

According to Dayal (2006), the transfer of rights of state managed forests to the local people is the main agenda in the forest policy of many developing countries including Ethiopia. As a result, donors, practitioners, and governments are advocating a change in the management of forest at the local level.

Rural households in Ethiopia have different sources of forest products. These are community (PFM), state (de facto open access) forests, and private sources such as farm forestry and trees around homestead. Experiences from many countries show that the consequence of using open access resources is overexploitation and depletion[2]. Recognizing this fact, as in many other developing countries, Ethiopia has also practiced the transfer of the management of forest to the local community over a decade. As part of its efforts, the participatory forest management program (PFM), which is mainly initiated by non-governmental organizations such as FARM Africa and GTZ, is being practiced in some parts of the country (Oromiya and SNNPR) and is considered as the best strategy to get a win-win situation between the government and the local people. It is believed that the new management style has brought a positive change in environmental outcomes as well as economic benefits to the local people. There is, however, little quantitative empirical evidences on the effect of these institutional changes on the forest-poverty link in Africa in general and Ethiopia in particular. As argued by Shyamsundar et al. (2005) understanding the impacts of these institutional changes is important both for governments and other stakeholders.

The role of environmental resources or forest products (NTFP)[3] in the economic development of local communities and sustainable forest management has been documented by many researchers. Available evidence on developing countries (for example, Arnold and Bird,1999; Cavendish,1997, 1999; Adhikari, 2005; Reddy and Chakravarty, 1999 and Narain et al., 2008) focuses on quantifying the contribution of natural resources or forest products to income of rural people and analyzing the socioeconomic factors that affect forest dependence. Recent studies that carefully tracked household income conclude that non timber

[2]The Hardin's (1968) theory, though failed to distinguish between open access and common property, explains that the consequences of resources which are open for use to all, is over exploitation.

[3]Different definitions are used in the literature on non timber forest products. Various authors used terms such as minor forest products, non-wood forest products, and secondary forest products interchangeably. In this paper, the term NTFPs and NWFPs are used interchangeably to refer to all types of forest products except fuel wood and other woody materials which are derived from forests, wooded land and trees outside forests.

forest products (NTFPs) contribute between 10% and 60% of income (Cavendish, 2000; Reddy and Chakravarty, 1999; Fisher, 2004; Mamo et al., 2006). This contribution varies substantially across households. The contribution of forest resources to the livelihood of rural people varies across studies depending on the nature of forest products included in the study, methods employed in the valuation of products, and the type and management of forests prevailing in the study area.

Though many studies show the strong positive link between poverty and dependence on NTFP use, other researchers have found different relationships and factors influencing NTFP use. For instance, Pattanayak and Sills (2001) found that relatively wealthier households depend on NTFP from forests to reduce risk and smoothen variations in consumption and income. Neumann and Hirsch (2000) argue that while NTFPs contribute to household income in many places, this contribution is uneven geographically and across social groups and can be highly differentiated by gender, class and ethnicity. There are many complex factors that affect use of forest products in rural areas of developing countries.

Despite the importance and understanding of the role of local level institutions and property right regime on the use and dependence of rural households on forest products, the empirical evidence is still limited (Edmonds, 2002). The role played by local level institutions and property right systems on the debate on forest-poverty link has received little attention in the empirical literature in many developing countries. There is a need to evaluate and analyze the forest-poverty linkage at a local level for the design of policies and programs aimed at improving the livelihood of the people as well as the degradation of forests and forest resources. The results of the analysis will be important for policy making as any effort on conservation must address forest–poverty issues as part of its forest policy (Gutman, 2001).

Therefore, our main objective is to examine the factors that affect dependence on forest products with particular emphasis on the role of property right regimes and local level institutions. Moreover, the study tries to assess the contribution of forest products to the livelihood of the rural people. To better understand the role of non wood forest products (NWFPs) in the livelihoods of these households, we focus on their time allocation and share of income derived from the forest. The study contributes to the existing literature by

including institutional variables and property right regime into the forest-poverty analysis. Moreover, this study intends to complement the limited literature on the forest-poverty link in Africa in general and Ethiopia in particular.

The structure of this paper is the following. Section two discusses the methodology. In this section we discussed the conceptual framework and empirical strategies employed for estimation of time spent and share of income derived from non wood forest products. Section three presents the study area and the nature of the data. Some descriptive analysis is also discussed in this section. The results of the empirical analysis are discussed in section four. The last section is the conclusion and policy implications.

2. METHODOLOGY

2.1. Analytical Framework

Farm households in Ethiopia in general and in our study area in particular are both producers and consumers of agricultural and forest products, and that markets for factor inputs (labor) and outputs are weak or absent. The high transaction costs due to lack of information, transportation, communication and other infrastructural facilities are the causes of market imperfection in rural Ethiopia. Households do not hire others to collect forest products in our study area. This is another case of household production with missing markets. Thus, insight into the highly heterogeneous role of forest products in rural household economies can be obtained with micro econometric modelling in the agricultural household production framework (Sills et al., 2003)[4]. The fact that rural households are both consumers and producers of forest products implies we have to use a non separable household model. The basic theory assumes a household that maximize its utility function subject to a set of production, budget, and time constraints. The major implication of this model is that we have to have household specific implicit prices whenever key markets are missing or incomplete. Moreover, the optimization problem of the household yields a solution so that at the margin, households allocate their labor between various activities such as agriculture, non timber forest product collection, and off farm activities at the point where the marginal utility of leisure is equal to the value of the marginal product of labor in each activity. Households

[4]Hyde and Amacher (1996), Cooke (1998), Mekonnen (1999), Kohlin (1998), and Heltberg et al. (2000) applied and report the household model for fuel cases.

allocate their time such that the shadow value of non timber forest products (NTFPs) collection time is equal to the marginal utility of NTFPs obtained by allocating more time to collecting. This is the familiar proposition that marginal cost equals marginal benefit applied to non timber forest product collection. This yields a set of production, consumption and labour allocation equations which are functions of prices and wages, household characteristics, labor endowment, livestock, land size, and the state of the environment. This can be tested empirically using the strategies described in the next section. It is well know that the choice of variables depends on the nature of the data, the objective of the analysis as well as the type of forest product considered in the analysis. The variables are described in section 3.2.

2.2. Empirical Strategies

In order to examine the resource use behaviour of farm households across the different property right regimes, separate regression models were specified (community or PFM), private, and open access. From the theoretical framework we understand that the dependent variable can be NTFP production, consumption or labor allocation. As the model is non-separable, the functional form of the reduced-form equations cannot be derived analytically (Singh et al., 1986). In empirical studies, researchers use descriptive and multiple regression methods that include ordinary least squares (for ex, Adhikari, 2005), discrete choice model, Tobit (Fischer, 2004; Dayal, 2006), instrumental variables, and panel data analysis techniques (Cook, 1998). The econometric estimation strategy employed in this paper is explained below.

2.2.1. Time Allocation

In estimating the determinants of time spent collecting non wood forest products, there may be households who do not participate in collection of NTFPs. Therefore, the resource use is censored at zero. In our study area, not all households are participating in collection of forest products from a particular source. For example, in order to examine the determinants of time spent in a community forest we need to consider the possibility of sample selection bias since some households are not members of the community forest. Note also that only members of the PFM groups are allowed to collect resources from the community forest. Non members or non participants depend only on either their private sources or open access forests. Hence, considering only those who are members of the community forest will yield inconsistent results. Similarly, not all households collect forest resources from private or state forests.

Therefore, rural households in our sample first decide whether or not to participate in collection of the resource from a particular source and then conditional on participation, how much of the forest products to collect or how much time to spend. We follow a two step procedure: first we estimate the determinants of the decision to participate in collection by using a discrete choice model. Those who decide to participate then decide how much time to spend in the forest. We used Heckman's sample selection model to model the participation and amount of time spent to collect forest products. We chose to employ Heckman selection model because some of the variables that affect both the participation decision and amount of time spent to collect NWFPs from a particular source of NWFPs may have opposite effects on these two decisions.

The Heckman technique is based on the following two econometric equations:

$$Y = \alpha_1 + \beta x_i + \delta Z_i + \varepsilon_1 \quad \text{---------- } \textit{Regression model}$$

where Y is the amount of time spent for non timber forest products collection, x_i is a set of household characteristics, while Z_i is a measure of some community variables. The dependent variable Y is observed if and only if:

$$\alpha_2 + \gamma\eta_j + \varepsilon_2 > 0 \quad \text{---------- } \textit{Selection model}$$

with $\varepsilon_1 \sim N(0, \sigma)$, $\varepsilon_2 \sim N(0,1)$ and $cor(\varepsilon_1, \varepsilon_2) = \rho$

where η represents the explanatory variables that describe the probability to engage in collection. The Greek letters α, β, δ and γ are vectors of unknown parameters to be estimated. The two-step approach, computationally less burdensome than the full maximum-likelihood approach, may be preferable in complex selection models. However, the two-step estimator is consistent but not efficient. Hence, we employed the full maximum likelihood approach to estimate time allocation models separately for each sources of forest products[5].

In order to check the robustness of our results we have also considered the share of income and total income derived from each type of property right regime as our dependent variables. We use the same estimation strategy described above to examine the determinants of share of

[5]We used the Chow test in order to investigate whether there are differences in time allocation behavior of households of different groups in the sample (PFM vs NPFM). However, the Chow test fails to reject the null hypothesis that there is no statistical difference between the two. We pool and estimate one equation for all i.e. the unconstrained model.

income and total annual income derived from NWFPs. For estimation of time spent, share of income and total income derived from all sources we employed OLS as almost all households are involving in the collection of NWFPs from at least one source.

2.2.2 Local Level Institutions and Forest Dependency[6] on Community Forests

In analyzing the effect of local level institutions on forest dependency on community forests, we try to analyze the determinants of share of income derived from community forest. In this case we consider only households who are members of the PFM groups. We have also estimated the effect of local level institutional, household and community level variables on the total time spent as well as total income derived from community forests by using OLS regression.

Recent literature has emphasized the endogeneity of forest management institutions. In the presence of endogenous explanatory variables, the OLS estimators are biased and inconsistent. Therefore, one has to employ the instrumental variable regression approach using appropriate instruments. However, in our case potential endogeneity is tested by undertaking the Durbin–Wu–Hausman test. First, the variable 'enforcement strength' is regressed on the other independent variables and then the residuals of this regression are included as independent variables with the other variables in an augmented regression for each equation. We did the same for the second institutional variable i.e. 'Institutional characteristics'. In both cases we fail to reject the hypothesis of no endogeniety. Hence, we estimate by using OLS corrected for heteroscedasticty.

2.2.3. Constructing Institutional Index

The necessary data for measuring local level institutional strength in the area were collected in order to examine whether these variables have an impact on rural household's dependency on forest resources from community forests i.e for PFM groups only. Here we have observations on institutions for PFM members only. The institutional variables focus on forest management, monitoring, participation and perception of households about the forest use and status. Forest user group members were asked to indicate their agreement or disagreement on a Likert-type of scale (i.e., strongly agree=1, agree=2, no opinion=3, disagree=4 and strongly disagree=5) on all indicator statements. Therefore, answers were

[6]'Forest dependency' in this paper refers to the share of income or total time spent or total income derived from NWFPs only.

recorded on a five point scale. It is practically very difficult to include all the variables in the analysis. As argued by Agrawal (2001), one of the strategies that one has to follow is to construct an index which will combine and reduce the number of closely related variables. We adopt a simple index formula used by UNDP to develop human development index. We calculated an index for each component and took the average of the N indices. That is the score was rescaled to vary between zero and one by using the following formula:

$$INDEX_i = \frac{1}{N}\sum_{i=1}^{N} \frac{Max(X_i) - X_i}{Max(X_i) - Min(X_i)},$$

Where, *Min*(*X*) and *Max*(*X*) are the lowest and highest values the variable *X* can attain in the sample, respectively[7]. N is the number of institutional variables (components) to be included under one index. The result is therefore, a unit free number which represents a simple average of the institutional variables. Therefore, following the literature we come up with two indices: 'Enforcement Strength' and 'Institutional Characteristics'. All the questions related to monitoring, penalties and social sanctions are grouped under the category "Enforcement Strength". While other variables such as clarity of rules and regulations, fairness in distribution of benefits, participation in forest management, etc are grouped under the category of 'Institutional Characteristics".

2.2.4. Valuation and Estimation of Share of Income from NWFPs

The values of NWFPs derived from different sources are obtained based on different approaches that we can found in the literature: First, we estimated the value of tradable products by taking the products of quantities collected and local market price. Second, the value of some non-marketed forest products is estimated by using the time spent to collect the product and the current market wage rate in the area, i.e by using an opportunity cost approach (see for example, Adhikari, 2005). Chopra (1993) also argued that if labor time is the major input required in the accrual of a good or service, its opportunity cost can be treated as an approximation of the use value of the product. However, we found that this method underestimates the true value of some forest products in our study area. Instead, we multiply the value obtained for a unit of time spent (including travel time) in collection of marketed

[7]Bluffstone et al. (2008) also applied the same formula to calculate an index for institutional variables. Here we modified the formula in the numerator to make it compatible with our survey design. We tried to use a principal component analysis method (PCA) to reduce the institutional variables into smaller number of principal components. However, we found it very difficult to get meaningful components for interpretation.

forest products by the total time spent to collect other similar non marketed products. Different alternative methods were also employed to remove some extreme observations or whenever we believe that the reported values or quantity units are not clear. It has to be noted that the contribution of forests to major environmental services such as soil conservation and carbon sequestration, or general aesthetic and spiritual values are not considered in this study[8]. In general, the values reflect the gross economic value of non wood forest products. For this reason scholars agreed that NTFPs or NWFPs have often been undervalued since studies only considered them in terms of their direct-use values (Shackleton et al., 2001).

The share of income derived from NWFPs is obtained by taking the ratio of income derived from NWFPs to the total annual expenditure of the household. As opposed to most other studies[9], we consider expenditure than income since expenditures are less variable, and more closely related to expected lifetime income[10].

3. STUDY AREA, DATA COLLECTION AND DESCRIPTIVE STATITICS

3.1. Study Area and Sampling procedure

The survey was conducted in Gimbo Woreda[11] in the Southern Nations, Nationalities and Peoples' (SNNP) region of Ethiopia. Gimbo Woreda is part of the Southwestern Ethiopian high lands and found in Kaffa Zone, about 450 km of South West of Addis Ababa, the capital city of Ethiopia. The total population of the Woreda is estimated to be 147,905, of which around 78% are located in the rural areas (http://www.Wikipedia). The population density of the Woreda is also estimated to be 116.5 people per square kilometer. Most of the population is Kaffa with small numbers of Menja and Mana tribes. Major crops grown in the area are cereals, pulses, *enset*, sugarcane, coffee and spices. Livestock are also important to the farm economy.

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[8]To measure such kind of environmental services of forests one has to employ specialized valuation techniques such as contingent valuation, travel costs methods, hedonic pricing, or production function approaches (Cavendish, 2000).

[9]Recognizing the problem of current income in measuring forest dependency, Narai et al.(2007) introduced the concept of permanent income in their analysis of resource dependence in rural India.

[10]Though there has not been uniform approach to include expenditure on durable goods, we have tried to calculate and allocate some percentage of expenditure on the good to the year in question depending on the nature of the durable goods. This may minimize underestimation of estimation of annual total expenditure of households. This is, however, subjective.

[11]*Woreda* is an administrative division of Ethiopia managed by local governments which is equivalent to a district.

The largest proportion of today's Ethiopian coffee forests is situated in the South-western part of the country (SNNPR and Oromyia Regional States). However, like other parts of the country the forest areas are declining rapidly due to the conversion of the forest into agricultural land (Bekele, 2003). To alleviate the problem, one of the encouraging efforts made by the FARM Africa-SOS Sahel participatory forest management project was to establish different forest user cooperatives (PFM) that promote sustainable forest resource use and management (Bekele, 2003).

The PFM program was first introduced in the area by FARM-Africa in 1996. PFM is the system of management whereby a community forest is managed by the members of the local community, and changing the traditional role of the local government body to facilitators, capacity builders, advisors, analysts and generators of new technologies (Jirane et al., 2007). The objective is to improve the forest situation by slowing down deforestation and forest degradation and bring economic benefits to the local people. Many stakeholders believe that PFM in Ethiopia provides environmental, economic and social benefits. In PFM, there is a partnership between Forest Department (the government) and Community Forest Management Groups. The local community forest managers and government forestry department sign an agreement specifying rights, obligations and duties of both parties as well as current and future use rights for the local communities including revenue sharing from any sale of forest products. It is also common to use forest products from state or government forests, which are considered as de facto open access, and private sources such as trees around homestead and farms.

Research villages were purposely selected in order to evaluate the impact of the participatory forestry program (PFM) on people's livelihood. A total of 10 focus groups with PFM (5) and without PFM (5) were selected purposely. Households were selected based on the list of users and non users of the community forest. A systematic random sampling method was adopted to ensure the representativeness of the sample. Accordingly, a total of 377 rural households were randomly chosen for interview. The survey questionnaire was prepared in both English and Amharic, which is the local language. A face to face interview was conducted to get all the necessary information. Data were collected on the following areas: household and individual characteristics, forest management institutions, consumption and purchase of various goods and services, labor allocation to forest resource collection, and collection, buying and selling of non timber forest products (NTFPs). Additional data on community

level variables such as population size, location, villagers' perception on forest status, etc. were also collected. The following table shows the list of kebeles[12], name and number of focus groups (both PFM and NPFM), and sample sizes for each focus group.

Table 1: List of sample sites and their respective sample sizes.

List of Kebeles	Number of focus groups	Name of Focus Group	
		PFM	NPFM
Yebito (88)	2	Agama (58)	Mula and Hindata (30)
Bita Chega (49)	1	Dara (49)	--
Mitchiti (80)	3	Beka (32), Matapha (24)	Chira and Botera (24)
Woka Araba (50)	1	---	Woka Araba (50)
Keja Araba (47)	1	---	Keja Araba (47)
Maligawa (63)	2	Sheka (37)	Sheka (26)
TOTAL	10	200	177

*the numbers in brackets refers to sample sizes.

The total number of sample households in the PFM group was 200 (53%) and the rest are from the Non PFM group (177) i.e. they are non participants.

3.2. Some Descriptive Statistics

The definitions of explanatory variables used for the analysis, together with their descriptive statistics, are presented in the following table (Table 2).

Table 2: Description of variables and descriptive statistics

Variable	**Description of variable names**	**Mean**	**S.D**	**Min**	**Max**
AGE	Age of the household head in years	43.54	14.13	18	90
SEX	Sex of the household head (male=1, female=0)	0.94	0.25	0	1
DEDUCAN	Education of head (read and write=1, none=0)	0.42	0.49	0	1
LANDSIZE	Size of land owned by the household in ha	2.34	1.57	0	10
LIVESTLU	Number of livestock ownership in TLU	4.32	2.64	0	19.9
DISTTOWN	Distance of household from the nearest town in kms	6.84	3.83	0.01	20
ADUFEM10	Number of female members age greater or equal to 10	1.87	1.07	0	7
ADUMAL10	Number of male members age greater or equal to 10	1.96	1.11	0	6
OFFFARM	Dummy whether any member from the family is participating in off farm activities (yes=1, No=0)	0.11	0.31	0	1
DISMARKET	Distance of the village from the nearest market (in minutes)	79.68	32.46	35	140
DISFOREST	Distance of the household from the community forest (in minutes)	45.35	57.78	1	500
FAMSIZEeqv	Family size in adult equivalent	5.07	1.9	1.97	12.4
DENSITY*	Number of households per hectare of forest	0.47	0.28	0.1	0.96

* DENSITY here refers to the PFM groups only. We do not have a complete data for the NPFM groups.
* The variables are in level form while some of the variables in the regression analysis are in logarithmic.

[12] *Kebele* is the lowest administrative unit in the country

Note that market prices and wages are assumed to be exogenous to the household. Since there is no variation in wages we assume that education level of the household head is included to account for unobserved labor market opportunities (Heltberg et al., 2000). Because there is a missing market for NWFPs, prices of forest products were not included in the empirical specification. It is indeed difficult to consider price when one deals with aggregated goods. Because of the nature of the NWFPs and limitation of data we were unable to calculate shadow prices. It is therefore assumed that the impacts of these prices on collection behaviour can be captured indirectly through the household and village characteristics.

The theoretical model also informs us the importance of the state of the forest in non timber forest production. However, we do not have objective measure for the state of forest. Density (number of households per hectare of forest) is used as a proxy for state of forest. Low density will increase the marginal product of labor and hence reduce the time required to collect a unit of forest product. The information on density is available only for PFM groups. In the absence of objective measure another proxy variable could be to consider the perception of households regarding the stock of the forest. However, we do not have sufficient variation in household's perception regarding the forest condition.

Of the household characteristics, education is negatively correlated to forest resource use because the opportunity cost of educated people is very high. Higher family size affects demand for forest products positively and tends to extract more forest resources. Such families are expected to have enough labor for both forest resource extraction and other activities. Much has been said on the effect of income on household level of dependency on forest products. Because of the problem of measuring income in rural households many researchers used some kind of wealth indicators. For example, amount of livestock and house type were used as a measure of wealth by Edmonds (2002) and Dayal (2006), respectively. We also consider livestock ownership and land size as a measure of wealth. The mean values of these variables are 4.32 (TLU) and 2.34 Ha, respectively. Much of the literature predicts a negative correlation between wealth or income and collection of non timber forest products due to changing preferences, opportunity cost of time, or effective risk (Sills et al., 2003). A detail work by Cavendish (1999) is a good empirical evidence for this. On the other hand studies such as Adhikari (2005) found that the rich are more dependent on natural resources

than the relatively poor in community forests in Nepal. However, one can find little evidence on the nature of this link across different forest management regimes.

Infrastructural facilities such as access to market and distance to town are expected to have a negative impact on forest resource use and, hence, households allocate less time to forest resource collection. Availability of these facilities usually promotes involvement of rural households in other off farm activities. Many studies indicated that off farm activities reduce time spend in forestry activities and contribute to the decrease in forest degradation and deforestation. Note, however, that some studies indicated that infrastructural facilities; especially roads may increase deforestation and hence depletion of forest products. The table below presents summary of household and community level variables by type of forest property right regimes.

Table 3: Descriptive statistics by source of forest products.

	Community (N=198)		Open Access (N=129)		Private (N=182)	
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.
AGE	43.65	13.56	43.82	13.93	43.41	13.95
SEX	0.92	0.27	0.95	0.21	0.94	0.24
DEDUCAN	0.41	0.49	0.43	0.50	0.42	0.50
LANDSIZE	2.27	1.47	2.60	1.55	2.32	1.47
LIVESTLU	4.21	2.48	4.66	2.87	4.52	2.60
ADUFEM10	1.88	1.11	1.90	1.03	1.90	1.02
ADUMAL10	1.97	1.10	1.89	1.09	2.04	1.07
DISTTOWN	6.34	3.90	7.57	3.58	7.16	3.94
DISFOREST	23.15	27.58	70.83	74.31	52.04	54.27
DISMARKET	75.86	32.62	81.24	29.42	82.14	32.41
FAMSIZEeqv	5.15	1.92	4.99	1.85	5.15	1.90
OFFFARM	0.13	0.34	0.07	0.26	0.10	0.31
DENSITY	0.47	0.28	0.60	0.36	0.49	0.28

From the above table we can see that the mean values of most of the household characteristics are more or less the same across the three regimes (for example, age of the household head, education and sex of head). It seems that they are different in terms of access to community forests. Those who are members of the PFM are closer to the community forest than those who depend on open access (OA) forests or those who are mostly dependent on

private sources. This shows that most of the participants of community forestry are those residing around the forest. Table 4 presents a descriptive analysis of time allocation, share of income and total income derived from NWFPs from different types of forest property right regimes.

Table 4: Mean values of time allocated, share and total income from NWFPs by sources.

Sources	No.	TIME (Hr/Month)	SHARE (%)	TOTAL INOCME (Birr/Year)[13]
COMMUNTIY	198	2.379	5.4	655.24
OPEN ACESS	129	3.233	6.4	750.92
PRIVATE	182	3.091	7.2	873.29
TOTAL	373	3.975	8.7	1042.54

The above statistics shows that, on average, households spend more time in the open access forests compared to the private and community forests. This is not surprising given the nature of the open access forests which is free for everybody. This is because the government lacks the institutional capacity to control and prevent them from unwise use and overexploitation. The share of income and total income derived from NWFPs will be discussed in later section.

3.3. Summary of Institutional Variables

Let us now turn to the institutional variables included in the analysis of the forest poverty link in community forestry. We grouped the sub components in to two groups based on some criteria in the literature and by looking at their correlation matrix. Some variables are negatively correlated and hence omitted from the calculation of indices. The indices refer to 'Enforcement strength' (ENFORINDEX) and 'institutional characteristics' (INSTINDEX) at household level. The mean values for the variables ENFORINDEX and INSTINDEX are 0.80 and 0.84, respectively. This may be considered as indication of strong local level institutions regarding the management and use of forests in the study area. The following table describes the pattern of descriptive statistics of the two institutional variables for each community forest (or PFM group).

[13] The exchange rate was 1 USD ≈ Birr 12.615 during the survey period.

Table 5: The mean values of the institutional indices for each community forest

Name of community Forest(PFM Groups)	ENFORINDEX				INSTINDEX			
	Mean	S.D	Min	Max	Mean	S.D	Min	Max
Agama(58)	0.80	0.15	0.29	1	0.80	0.22	0.08	1
Beka(31)	0.76	0.21	0.17	1	0.87	0.17	0.25	1
Dara(48)	0.82	0.15	0.54	1	0.87	0.14	0.42	1
Matapa(24)	0.81	0.15	0.50	1	0.91	0.15	0.33	1
Sheka(37)	0.80	0.17	0.25	1	0.81	0.18	0.42	1

*the numbers in the brackets are the sample sizes

As we can see from the above table there is no significant difference between each focus group. The mean values of the institutional characteristics index are slightly larger than the mean values of the enforcement index in all focus groups.

4. RESULTS AND DISCUSSION

In this section we present the results of empirical analysis of the determinants of time spent by households across different types of forest property right regimes. We employed the full maximum likelihood method. We will first discuss the determinants of participation decision of households followed by discussion on the socioeconomic and community level factors that affect the amount of time allocated to non wood forest product collection. To check the robustness of our results, we have also estimated the determinants of both the share of income and the total income derived from NWFPs for each regime.

4.1. Time Allocation

Table 6 below presents the estimation results of the determinants of participation decision of households as well as time spent for collection of forest products from community, private and OA forests. The right side of the table presents the regression results of time spent in collection of forest resources. The left part shows the selection equation.

To test for sample selection bias, we examine the relationship between the residuals for the two stages, the participation and outcome equation. If the residuals in the selection model are correlated with the residuals in the outcome equation, we will have biased estimates without correction. This is the case in our estimation for open access regimes. The Wald test of

independent equations rejects the null hypothesis of no correlation (rho=0) between the two disturbance terms (i.e in the regression equation and participation equation) at 1% level of significance for the case of OA estimation. Hence, Heckman selection model should be used to avoid inconsistent results. On the other hand, if the residuals in the selection equation are unrelated to the residuals in the outcome equation, then we can say that the selection equation does not affect the results of the regression equation, a case in the estimation of time spent collecting NWFPs from community forests (table 6). The Wald test also shows that sample selection bias does not seem to be a problem for the private source (insignificant at 10.7 % level of significance).

The negative sign of rho at the bottom of the regression for time spent in OA forests shows that the unobservable factors that reduce the probability of participation in OA forests increase the amount of time spent collecting NWFPs and vice-versa. The positive sign for rho in the other two regressions (though insignificant) shows that the unobservable factors that are absorbed in the error terms will generally affect the probability of participation and time spent for collection in the same direction. In heckman sample selection estimation one of the practical difficulties is to obtain a valid exclusion restriction. Using our intuitive we consider distance to community forest as our identifying variable. It affects household's decision to participate in a given source of forest products but may not have any impact on the total time spent collecting NWFPs. We checked it by including in the regression equation and found that it is not significant.

The dependent variable, age (in the regression equation), land size, livestock, and distance to town and distance to community forest are in log form throughout the paper.

Table 6: Estimates of Time Allocation to NWFPs collection

	SELECTION			REGRESSION			
Variables	COM	O. A	PR	COM	O.A	PR	TOTAL[a]
AGE	0.089**	-0.000	-0.113***	-0.315**	-0.585**	0.113	-0.284**
	(0.04)	(0.04)	(0.04)	(0.15)	(0.23)	(0.20)	(0.13)
AGESQUARE	-0.001**	0.000	0.001***				
	(0.00)	(0.00)	(0.00)				
SEX	0.156	-0.103	-0.250	0.267*	0.362**	0.237	0.223*
	(0.38)	(0.35)	(0.43)	(0.16)	(0.17)	(0.21)	(0.12)
DEDUCAN	-0.257	0.208	0.468**	0.099	-0.192	0.124	0.074
	(0.21)	(0.20)	(0.23)	(0.11)	(0.16)	(0.12)	(0.09)
LANDSIZE	0.034	0.545**	-0.570**	-0.008	0.414***	0.267*	0.273***
	(0.22)	(0.24)	(0.24)	(0.12)	(0.14)	(0.15)	(0.10)
LIVESTLU	-0.031	-0.051	0.062	-0.165*	0.069	0.018	-0.055
	(0.20)	(0.17)	(0.19)	(0.09)	(0.13)	(0.12)	(0.08)
ADUMAL10	-0.074	-0.190**	0.248**	0.050	0.017	0.056	0.041
	(0.10)	(0.08)	(0.10)	(0.04)	(0.07)	(0.07)	(0.04)
ADUFEM10	-0.030	-0.042	-0.018	-0.013	-0.050	0.066	0.013
	(0.08)	(0.08)	(0.09)	(0.04)	(0.07)	(0.06)	(0.04)
DISTTOWN	-0.731***	0.671***	0.071	0.162*	0.123	-0.035	0.229***
	(0.18)	(0.17)	(0.18)	(0.09)	(0.15)	(0.10)	(0.08)
DISFOREST	-0.875***	0.401***	0.425***				
	(0.10)	(0.09)	(0.09)				
DCOMM_private	9.240***			-0.418***			
	(0.37)			(0.12)			
DOACESS_private		2.624***			-0.906***		
		(0.34)			(0.18)		
DPRIVATE_Openacess			8.621***			0.195	
			(0.94)			(0.28)	
DPRIVATE_community			9.668***			0.517*	
			(0.71)			(0.28)	
Dtwo_sources							0.011
							(0.08)
_cons	2.097**	-3.697***	0.090	1.819***	2.75***	-0.437*	1.34
	(0.95)	(1.08)	(1.03)	(0.61)	(0.92)	(0.72)	(0.51)
Rho	0.154	-0.365***	0.508				
	(0.16)	(0.12)	(0.26)				
N	373	373	373	198	129	182	365

[a] Estimation is by using OLS, corrected for heteroskedasticity. *, **and *** represent 10, 5, and 1% level of significance. DCOMM_private, DOACESS_private, DPRIVATE_Openacess, DPRIVATE_community and Dtwo_sources are all dummy variables referring to whether community forest members are collecting resources from private source, OA users are also collecting from private source, private users are collecting from OA forest , private users are also collecting resource from community forest , and whether the household is collecting NWFPs from two or more than two sources, respectively. They can be considered as indicators of availability of substitutes.

The results from the selection equation show that many variables affect the participation decision of households. Younger households are more inclined to be a member of the community forest. To assess the extent to which labor allocation to NWFPs collection changes over the life cycle of the household head, we include in the regressions the square of the age of the household head. Results suggest that as the age of the household head increases the probability of participating in community forestry will decrease. Education level of the household head is not significant and does not affect the decision to participate in community forests. As expected, a measure of access to forest (distance to forest) and distance to town are both negatively and significantly related to the participation decision of households.

As a measure of wealth, we have included the amount of livestock owned in tropical livestock units in both the selection and regression equations. The size of land is also included in both equations. Both indicators of wealth are found to be highly insignificant in the decision of the household to participate in community forestry. This implies that for rural households in the study area there is no relationship between household's economic status and the decision to participate in community forestry. The decision is influenced more by other factors than household's economic status.

In the regression equation, we are more interested in the relationship between forest resource use (from community forests) and wealth. The coefficient of livestock ownership is negative at 10 % level of significance indicating that relatively poor households spend much time in forestry activities than the relatively rich households. A 10 percent increase in the amount of livestock (TLU) is associated with a 1.65 percent reduction in the amount of time spent in community forest activities. As opposed to Adhikari (2005) who argued that richer households collect more forest products from community forests in Nepal, this study shows that wealth is negatively correlated to forest product collection from community forests. Similar studies who reached the same conclusion with our findings argued that richer households have more resources such as land that enable them to easily substitute community forest products for products from private sources, showing that private resources may act as a substitute for forest products from community forests. In rural India, Heltberg et al. (2000) also found that large land owners substitute private fuels generated on the farm for forest fuel wood. Our findings may suggest that communities are managing the local resources effectively and derive the benefits in an equitable manner. The regression results of time spent collecting NWFPs in OA forests shows that the relatively rich households have the

incentive to shift to other open access areas since they have the necessary assets for exploiting the resources. This may also be considered as evidence in favour of the idea that the participation of the local community in the management of local commons may enhance access to the poor by discouraging the relatively rich from overexploiting the resources.

It was also found that the amount of time spent collecting NWFPs from community forests is significantly affected by household characteristics such as age (negatively) and sex (positively) of the household head. While the effect of distance to town is negative on the participation decision of households, its effect on the amount of time spent for collection is positive and significant at 10 % level.

Finally our result also shows that there is a possible substitution pattern between community forests and private sources. If members of community forestry are also collecting forest products from their own sources then resource use from community forest will reduce significantly. Therefore, there is a need to integrate the management of community forestry with the private sources so that households will be less dependent on forest resources from commons and hence keep the ecological and biodiversity of the natural resources. In this regard, the role of government organizations and NGOs working on the area of forest conservation and development should be enhanced by distributing seedlings and providing technical assistance to the rural households.

The relationship between forests and poverty depends on the type of property right regime. The regression results for OA forests shows that most of the household characteristics such as age and education of the household head are all statistically insignificant in the decision of the household to collect forest resources from OA forests. The probability of participation in collection from OA forests increases with the distance of the community forest. This is consistent with the results of the estimate of time allocated to NWFPS in community forests. That is, distance to community forest reduces the probability to participate in community forests and we expect households to shift to other sources of forest products. This finding may also suggest that households will substitute resources from community forests for resources from OA forest areas as the distance to community forest increases.

Another location variable, distance to town, has a positive and significant influence on the participation decision. Those residing closer to towns have a better opportunity to engage in

other off farm activities such as trading of grains and livestock and reduce their dependence on OA forests. As argued by Bluffstone (1995), the presence of off farm labor market help stabilize forest stocks, despite open access to the resources, and absence of off farm opportunities leads to further degradation and deforestation. Land size has a positive and significant influence on the decision of households to participate in collection of forest resources from OA areas.

In the regression equation we have also included variables indicating human capital, wealth, and a measure for labor availability. We found that households with younger and educated heads are less interested to allocate their labor to forest resources collection from OA areas, though the latter is not significant. The interesting result is the effect of wealth on use of resources from OA forests. The result is positive for livestock though insignificant. However, the coefficient of land size is positive and statistically significant at one percent level, showing that the relatively rich are more dependent on OA resources than the relatively poor households. An increase in land size by 10 percent will increase the amount of time spent collecting from OA forests by 5.2 percent. Recall our findings of the determinants of household's forest use from community forests discussed earlier. We found that wealth is negatively related to forest resource use from community forests. As some empirical evidences shows, livestock-rich households demand more fodder and therefore collect more grass and leaf litter from common forest lands. Similarly, studies showed that households rich in resource-collection tools devote more time to collection and thereby derive more forest income. Both arguments are not valid for community forests in the study area but could be valid for forests with no property right. This can also be considered as another evidence for the substitution possibility between community forest and OA forests i.e., for the relatively rich households the OA forests is a substitute for community forests. This has important policy implication in that it is necessary to bring the open access areas under the management of the community so that the poor can benefit from the forest. Moreover, with such measures it is possible to maintain the environmental and ecological services of the forest in a sustainable manner. Therefore, as argued by Cavendish (1997), it is difficult to make broad generalizations about the relationship between income and environmental change, in part because this relationship is varied and in part because there are many other determinants of environmental demands.

The estimation results reported above show that younger and male headed households are less interested to collect forest products from own sources. Regional or location variables such as distance to community forest and distance to nearest town have a positive and significant impact on the probability of participation in collection from own sources. Most of the households who are far from the forest are non members of the community forest who are dependent on either private sources or OA forests. Our indicator of wealth, ownership of livestock, has a positive and significant effect on the probability of collection of forest products from own source. This result reinforce our earlier finding that relatively rich households are more dependent on either own resources or OA forests.

The results of the regression equation for time allocated to collection of NWFPs from private sources indicate that size of land and ownership of livestock (not significant) are positively related to time spent on private sources. Consistent with the selection equation, access to the community forests is positively and significantly related to both the participation decision and the amount of time spent in private sources. Given the previous explanation of substitution possibility between different sources, this result is unexpected.

To conclude, we have tried to investigate whether there are differences in collection behaviour of households across different forest property right regimes. The discussion so far tells us that the determinants of the link between household's socioeconomic characteristics and forest resource use varies depending on the nature of the forest property right regimes. For example, household poverty and forest dependency on community forests are positively correlated while this relationship is negative in the case of OA forests.

4.2. Share of Income

We have also examined the determinants of share of income derived from NWFPs across various types of regimes. The estimation results are found in Appendix 1. Similar with the previous estimation results, the share of income derived from NWFPs from community forests is negatively related to the wealth status of the household. That means the relatively rich households are less dependent on community forests compared with the relatively poor. However, the result is different when we see the link between wealth and forest dependency on OA forests. The share of income derived from OA forests increases with the increase in land size. The sign and significance of most of the variables in the regression of share of income from OA forests turnout to be largely consistent with our estimation results of time

spent collecting NWFPs from OA forests. Therefore, from the above findings we can argue that it may not be appropriate to have general statements such as 'the rich are appropriating more in absolute terms but gain less in terms of share of income'. The link between household economic status and forest resource use depends on the type of forest products and type of forest property right regime prevailing in the local area.

4.3. Forest Dependency and Local level Institutions

In empirical evidences little attention is given to the analysis of the impact of local level institutions on the poverty-environment hypothesis in areas where the community participate in the management and use of resources. Though there are limited empirical evidences, several qualitative studies have reported that forest cover and biophysical conditions have improved in many developing countries where transfer of ownership and rights were given to the local community thereby provide economic benefits to the local people. However, transfer of ownership to the community per se will not guarantee proper and sustainable use of forest resources. It is necessary to consider the degree of perception of households regarding the different rules, regulations, monitoring, participation and other management issues since they reflect the level of strength of the local institutions in that particular area. In many developing countries on-the-ground management can often correspond poorly with stated policies. Perceptions therefore have the potential to better reflect reality (Bluffstone et al., 2008). Hence, we need to have a broader understanding of the role of local level institutions on the use of forest products from community forests. Therefore, this section tries to answer the question, "How do local level institutions influence rural household's resource use or level of dependency on community forests"? It also examines the extent of income derived from community forests.

In section 2.2.3, we described and explained the nature and construction of the two institutional variables: 'Enforcement Strength' and 'Institutional Characteristics'. The correlation coefficient between the two indices is 0.12, showing that we have managed to categorize the variables into two uncorrelated variables.

Table 7:Regression results for forest dependency on community forests /Institutions/

Variables	SHARE NWFPS	COLLECTION TIME	Total income NWFPs
AGE	-0.001***	-0.007**	-0.006
	(0.00)	(0.00)	(0.01)
SEX	0.023	0.378**	1.26*
	(0.02)	(0.17)	(0.69)
DEDUCAN	0.010	0.077	-0.005
	(0.01)	(0.11)	(0.30)
FAMSIZEeqv	0.000	0.038	0.188***
	(0.00)	(0.02)	(0.07)
OFFFARM	-0.033***	-0.327***	-0.968**
	(0.01)	(0.12)	(0.44)
LIVESTLU	-0.025**	-0.173*	-0.138
	(0.01)	(0.09)	(0.25)
DISTTOWN	0.011	0.223**	0.129
	(0.01)	(0.10)	(0.33)
DISMARKET	0.020	0.305	0.676
	(0.02)	(0.19)	(0.60)
DISFOREST	-0.001	0.052	0.008
	(0.00)	(0.05)	(0.15)
DENSITY	-0.061***	-0.673**	-1.454*
	0.02	(0.27)	(0.84)
ENFORINDEX	0.020	-0.153	1.268
	(0.03)	(0.30)	(1.01)
INSTINDEX	0.005	0.204	0.639
	(0.03)	(0.27)	(0.82)
DCOM_private	- 0.033***	-0.514***	-1.503***
	(0.01)	(0.09)	(0.30)
_cons	0.030	-0.404	0.462***
	(0.09)	(0.76)	(2.46)
N	198	198	198

The numbers in the brackets are the White-robust standard errors. The dependent variables (collection time and total income), livestock ownership (LIVESTLU), distance to town (DISTTOWN), distance to market (DISMARKET) and distance to forest (DISFOREST) are also in log form. There was no serious multicollinearity problem as the Variance inflation factor (vif) was less that 5 for all variables. *, **, and *** represent 10%, 5% and 1 % significance level, respectively.

As discussed earlier, forest dependency can be measured in several ways. We consider share of income derived from NWFPs, total income and total time spent collecting NWFPs from community forests. The importance of non wood forest products to the locals can be understood by considering the total value of forest products collected by the household. The mean annual income obtained from community forests (only non wood forest products) is Birr 655. This means households, on average, derive 5.4 % of their total income from NWFPs. Almost 95 % of the total households (of the PFM groups) earn up to 18 % of their total income from non wood forest products. The upper 5 percent get between 19 and 41

percent of their total income from NWFPs. The overall contribution of NWFPs to the total income of the household has been discussed in section 3.2 and summarized in table 4. Table 7 above shows the effect of local level institutions and other household and community level variables on the various indicators of forest dependency on community forests: share of income, total time spent and total income derived from community forests.

The results of the analysis show that both enforcement and institutional characteristics indices (ENFORINDEX and INSTINDEX) are not important factors in explaining forest resource use by rural households in the study area. The results, however, should be interpreted with caution. It does not mean that local level institutions are not important in natural resource management. As indicated in the descriptive statistics, members of the community forestry (PFM groups) are well acquainted with the rules, regulation and management of the community forest. Therefore, one possible explanation for the insignificant of these variables could be due to little or no significant variation in the perception of households regarding the various local rules and institutions governing the community forest. Another possible justification might be the nature of forest products we considered for this study. The institutional variables might not be very important as far as non wood forest products are considered. The various rules and regulations may be applied and practiced in the case of major forest products such as timber or other woody materials like fuel wood. To check the robustness of our results, we run a regression of the total income and total time spent on NWFPs on various explanatory variables. Consistent with the above findings, the institutional variables were found to be insignificant. Instead forest dependency is affected by other socioeconomic factors such as age of the household head, participation in off farm activities and wealth status of the household. For example, the relatively rich are less dependent on community forests products than the relatively poor as indicated by the negative and significant coefficient of livestock ownership. This result is consistent with many other studies in that as income increases the share of income obtained from forest products will decline. Off farm opportunities and forest density (number of households per hectare of forest) will also reduce dependence on forest resources. The measure of forest stock, forest density, is directly related to the impact of population pressure on resource use. As we have tried to explain before, unavailability of alternative sources of income may put pressure on forests which will result in degradation and deforestation problems in the region. The result also tells us the importance of private sources in reducing households' dependency on NWFPs. In general, the result of the regression analysis is so consistent across the different estimations in that variables such as

age of the household head, off farm activities, livestock ownership, forest density and access to private sources are all negatively correlated to share of income, time spent and total income derived from NWFPs.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This paper has tried to understand the role of property rights regimes and local level institutions on forest resource use in the south Western part of Ethiopia. We used a household survey conducted in the region to examine the link between forest and poverty under different property right regimes.

The findings of our study show that devolution of forest management will enhance forest resource use by the poor and reduce dependency of rich households. We could not find evidence, as claimed by some scholars, that richer households may influence formal or informal restrictions on access to resource stocks in their own favour in a situation where the forest belongs to the community.

On the other hand, resources from OA forests are more exploited by the relatively rich households suggesting that there is a need to expand the current practice of participatory forest management (PFM) to other OA forest areas. This means natural asset-based poverty alleviation policies will have to include measures that expand its current management practices to these areas so that the poor will have equal opportunity to benefit from the resource. In line with the above argument it is necessary to identify the constraints for rural households to participate in community forestry. In OA forests the intervention should target the relatively rich households as they are the most to degrade the environment in this particular situation. Local government officials, policy makers and development planners need to take into account the differential impact of their intervention program on household forest use depending on type of forest management.

We have also observed that the contribution of NWFPs to the household income cannot be undermined. On average, households derive around 8.7 percent of their total income from NWFPs from all sources. Participants of community forestry derive 5.4 percent of their total income from NWFPs. The percentage of income obtained from open access and private sources are 6.4 and 7.2 percent, respectively. The use of NWFPs from private sources is

negatively correlated with use of forest resources from other sources. This suggests that development agents and government organizations need to encourage households to develop, maintain and use their private sources as these will ease pressure on forests.

The role of local institutions and socioeconomic characteristics of households on forest dependency on community forests were also examined. We found that local level institutions do not have any significant impact on level of forest dependency as measured by share of income derived from non wood forest products. Our result is consistent across the different measures of forest dependency. We should not conclude that local level institutions are not important in the management of natural resources in general and forests and forest resources in particular. The institutional variables are found to be insignificant may be because the participatory forest management program in the area is so strong that households are fully aware of the forest use, regulations, management and importance of the community forest. The data show that the mean values of the institutional variables are high and there is no much variation in the perception of households regarding the use and management of the community forest. The result may also suggest that local level institutions are not significant factors in determining use of non wood forest products unlike major forest products such as timber or woody materials in general. Instead, variables such as age of the household head, off farm activities, livestock ownership, forest density and access to private sources are more important than local level institutions. All are negatively related to share of income, time spent and total income obtained from NWFPs.

From the findings of this study, we conclude that generalization on the forest-poverty link depends on the type of forest management and the specific characteristics that prevail in the area. Future research on this area may consider the dynamic nature of the link between forest resource uses, institutions and household wellbeing.

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Appendix 1. Determinants of Share of income from NWFPs by source of NWFPs

	SELECTION			REGRESSION			
Variables	COM	O.A	PR	COM	O.A	PR	TOT
AGE	0.091**	0.006	-0.093**	- 0.035**	-0.041*	0.026	-0.023
	(0.04)	(0.04)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)
AGESQUARE	-0.001**	0.000	0.001**				
	(0.00)	(0.00)	(0.00)				
SEX	0.167	-0.066	0.184	0.018	0.013	0.003	0.015
	(0.38)	(0.35)	(0.57)	(0.02)	(0.03)	(0.02)	(0.02)
DEDUCAN	-0.233	0.179	0.415*	0.012	-0.018	0.015	0.008
	(0.21)	(0.20)	(0.21)	(0.01)	(0.02)	(0.01)	(0.01)
LANDSIZE	0.043	0.551**	-0.488**	-0.009	0.051***	0.044**	0.041***
	(0.23)	(0.23)	(0.24)	(0.01)	(0.02)	(0.02)	(0.01)
LIVESTLU	-0.047	-0.046	0.091	-0.023**	-0.000	0.001	-0.007
	(0.20)	(0.17)	(0.19)	(0.01)	(0.01)	(0.01)	(0.01)
ADUMAL10	-0.077	-0.200**	0.205**	0.001	-0.001	-0.008	-0.005
	(0.10)	(0.08)	(0.09)	(0.00)	(0.01)	(0.01)	(0.00)
ADUFEM10	-0.035	-0.035	-0.024	-0.004	-0.008	-0.001	-0.004
	(0.08)	(0.08)	(0.09)	(0.00)	(0.01)	(0.01)	(0.00)
DISTTOWN	-0.722***	0.665***	0.027	0.005	0.001	-0.003	0.013
	(0.18)	(0.17)	(0.18)	(0.01)	(0.02)	(0.01)	(0.01)
DISFOREST	-0.878***	0.396***	0.363***				
	(0.10)	(0.087)	(0.09)				
DCOM_private	9.031***			-0.033***			
	(0.46)			(0.01)			
DOACESS_private		2.628***			-0.083***		
		(0.35)			(0.02)		
DPRIVATE_openacess			8.427***			0.017	
			(0.47)			(0.09)	
DPRIVATE_community			3.578***			0.012	
			(0.47)			(0.04)	
Dtwo_sources							-0.005
							(0.01)
_cons	2.071**	-3.818***	-0.499	0.217***	0.23**	- 0.066	0.116*
	(0.97)	(1.10)	(1.14)	(0.06)	(0.10)	(0.08)	(0.06)
Rho	-0.065	-0.332**	0.256				
	(0.13)	(0.13)	(0.37)				
N	373	373	373	198	129	182	365

Appendix 2: Determinants of total income obtained from non wood forest products by source of NWFPs /Heckman Sample Selection/

	SELECTION			REGRESSION			
Variables	COM	OA	PR	COM	OA	PR	ALL
AGE	0.083**	0.005	-0.107***	-0.489	-0.785**	0.007	-0.450*
	(0.04)	(0.04)	(0.03)	(0.43)	(0.42)	(0.33)	(0.24)
AGESQUARE	-0.001**	0.000	0.001***				
	(0.00)	(0.00)	(0.00)				
SEX	0.171	-0.062	0.29	1.049	-0.159	0.41	0.419
	(0.37)	(0.34)	(0.54)	(0.69)	(0.46)	(0.55)	(0.36)
DEDUCAN	-0.237	0.203	0.459***	0.014	-0.315	0.269	0.199
	(0.21)	(0.19)	(0.19)	(0.29)	(0.27)	(0.21)	(0.17)
LANDSIZE	0.062	0.526**	-0.514**	0.108	0.781**	0.864***	0.696***
	(0.22)	(0.23)	(0.21)	(0.32)	(0.31)	(0.25)	(0.19)
LIVESTLU	-0.038	-0.044	0.108	-0.046	0.099	0.094	0.054
	(0.20)	(0.17)	(0.19)	(0.25)	(0.23)	(0.20)	(0.14)
ADUMAL10	-0.066	-0.189**	0.208**	0.191*	0.038	0.034	0.024
	(0.10)	(0.08)	(0.09)	(0.11)	(0.15)	(0.09)	(0.09)
ADUFEM10	-0.021	-0.039	-0.026	0.099	-0.082	0.073	0.007
	(0.08)	(0.08)	(0.08)	(0.11)	(0.14)	(0.10)	(0.07)
DISTTOWN	-0.735***	0.664***	0.068	-0.087	0.087	-0.24	0.083
	(0.18)	(0.17)	(0.15)	(0.37)	(0.28)	(0.19)	(0.14)
DISFOREST	-0.858***	0.364***	0.352***				
	(0.12)	(0.08)	(0.09)				
DCOM_Private	9.385***			-1.062**			
	(0.67)			(0.54)			
DOACESS_private		2.665***			-1.264***		
		(0.34)			(0.44)		
DPRIVATE_openacess			6.663***			1.36***	
			(1.95)			(0.43)	
DPRIVATE_community			3.995***			1.25***	
			(0.43)			(0.41)	
Dtwo_Sources							-0.032
							(0.14)
_cons	2.12**	-3.70***	-0.048	6.02***	8.63***	3.25**	6.37***
	(0.94)	(1.08)	(0.85)	(1.98)	(1.67)	(1.41)	(0.92)
Rho	0.303	-0.325	0.908**				
	(0.35)	(0.23)	(0.12)				
N	373	373	373	198	129	182	365