Fuelwood Collection from Community Forests in Nepal: Time Allocation, Resource Dependency and the Role of Women

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Dedication

To family, friends and loved ones who have supported me during this endeavor.

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Abstract

The dependency of Nepalese people for fuelwood, fodder and other forest resources led to deforestation of forest under the management of the Government of Nepal in the 1960s and 1970s. Community forests (CF) were established as a means to restore forest resources and proper management of forest use by the local people under their own management. The agrarian rural communities of Nepal across the different regions use forest products for household, energy and fodder purposes. Labor allocation for forest resource collection, household dependency on forest resources and the role of women regarding management and decision making in CF activities are analyzed in this dissertation. The findings of this study will help inform policy at regional levels regarding afforestation, improving livelihoods and well-being, and changing attitudes toward the role of women in rural Nepal.

The market prices of fuelwood and fodder collected from CFs in Nepal are used to impute revenue from their collection and the labor productivity by rural households using CFs. Regression analysis suggests that locational and seasonal variation in labor productivity and revenue generation characterized the surveyed households. Relative income earned by rural households from the collection of forest resources in terms of total household income is defined as a component of dependency and regressed on household demographic variables. The rural communities in the Terai region of Nepal are more dependent on CF for fuelwood and firewood collection compared to households in the Hilly region of Nepal. Livestock owned by respondents was positively associated with forest dependency while land holdings, distance (travel time) to the nearest CF, and private tree ownership (e.g., plantation) were negatively related with household dependency on CF.

Ordered logit regression analysis of Likert scale responses regarding role of women in CF management and decision-making activities were also analyzed. Regional and caste differences were observed in terms of the attitudes/perceptions of surveyed household members. Extension activities and other policies focusing on the importance of women in resource management can benefit from the present study.

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Introduction

Forests have been an integral part of communities in rural Nepal for ages. People in the rural areas of Nepal depend on forest resources for fuelwood, fodder and other forest products to support their day-to-day livelihoods. Looking back at the history of forest legislation in Nepal, privatization of forests was done by the Government of Nepal in the 1950s. Forest use right were under the total control of the government. The privatization of forest coupled with dependence of Nepalese people on forest resources led to the deforestation of Nepalese forests in the Hilly and Terai regions of Nepal. Community forests (CF) were established in the late 1970s with the dual objective of forest conservation and distribution of forest resources. CF were established with the user right granted to the community regarding the use of forest resources while the land ownership remains with the government. CF have been tremendous success in terms of participation by Nepalese people and involvement in forest conservation.

This dissertation consists of three chapters analyzing the importance of forest resources and management issues in present day Nepal. The first chapter deals with labor allocation by rural households in Nepal for to the collection of fuelwood and fodder. Given that most of the fuelwood and fodder collected by a household is consumed by the household, the economic value of fuelwood and fodder collection is imputed by multiplying the market prices of fuelwood and fodder by the amounts households report collecting. The imputed revenue from the collection of forest products is studied in relation to labor productivity and seasonal variation in the study area. Forest dependency, or the (imputed) income generated by the collection of various forest resources relative to total household income, is studied in the second chapter. Socio-economic factors that explain dependency on CFs across two different regions of Nepal

are studied in this chapter. Finally, the attitudes and perceptions of Nepalese people regarding the roles of women in management and decision making in CFs are studied in the third chapter.

Chapter I: Labor Allocation for Fuelwood and Fodder Collection in Rural Nepal: An Empirical Analysis

Chapter I: Abstract

Labor allocation for fuelwood and fodder collection by rural households in developing countries has been extensively researched. Less attention has been given to the imputed revenue generated from the collection of fuelwood and fodder by rural households in relation to labor allocation by household members. This paper uses household survey data on the amounts of fuelwood and fodder collected from community forests in four different districts in Nepal, with the market prices of fuelwood and fodder in those districts, to impute revenue from fuelwood and fodder collection and analyze labor productivity by rural households using community forests. Regression analysis suggests the presence of locational and seasonal variation in labor productivity and revenue generation for the surveyed households. Marginal revenue product of labor was NRS 146.6 for fuelwood in winter season while it was lowest for rainy season with a value of NRS 111.9[1]. Conversely, the marginal revenue product of labor was NRS 118.6 for rainy season while winter season has the lowest value of NRS 83.84 for fodder revenue model. The return to labor allocated to fuelwood collection was higher in the winter season while the return to labor allocated to fodder collection was higher in the rainy season. The findings of this research can help policy makers formulate policies regarding forest management and forest use with a fuller understanding of regional and seasonal differences in the collection of forest resources by rural households in Nepal.

[1] NRS refers to Nepalese Rupee and the conversion rate is currently $1 = NRS 103.8

1.1 Introduction

Nepal is a predominantly agrarian society with 80% of the population residing in rural areas (CBS, 2015). The agriculture and forestry sectors account for 33% of Nepal's national gross domestic product (GDP) (MoF, 2016). Forest area covers around 40% of Nepal's total land area (DFRS, 2015) and accounts for about 70% of residential energy in the form of fuelwood (CBS, 2015). Forest areas such as government, community forests (CF), and private forests are the primary sources of fuelwood and fodder for rural citizens. Agriculture and forest activity supports most households in rural Nepal, where household labor is the major input for subsistence agriculture and forest activities. Thus, forest resources play an important role in the agrarian livelihoods of rural Nepalese people, providing fodder, fuelwood and other forest products for day-to-day living.

Nepal's Community Forest Act of 1978 promoted CF with the dual objectives of restoring forest area and making forests more available to users (Timsina et. al, 2004). Community forest user groups (CFUG) were formed at household and community levels. A CFUG is a group formed by local people for setting rules and regulations for better utilization of forest resources by the community. These institutions are independent and self-governing (Gautam et. al, 2002, Pokharel and Nurse, 2004). CFUGs are formed democratically and registered in District Forest Offices (DFO). Each CFUG has a constitution, which defines the role and rights of forest users (Pokharel and Nurse, 2004). Community forestry has contributed to forest restoration as well as improvement in rural livelihoods through reinvestment of receipts (Pokharel and Nurse, 2004, Gautam et. al, 2004).

Nepal can be divided into three regions i.e., Mountain, Hilly and Terai (Figure 1). This dissertation focuses on the Hilly and Terai regions because more than 90% of Nepal's population

resides in these regions (CBS, 2011). Similarly, mountainous region mostly consists of cold temperature climate making it difficult for human settlement and forest establishment. The CFs in the Terai region are predominantly timber forest compared to non-timber/mixed CFs in the Hilly region of Nepal. The Terai region has been identified as an area of high economic value due to the prevalence of timber trees (Nightangle and OJha, 2013). The Terai region is more fertile than the Hilly region. Average landholdings were 0.57 hectares (ha) in the Hilly region as compared to 0.75 ha in the Terai region (CBS, 2014). Similarly, sub-tropical/tropical forest trees are found in the Terai, while deciduous trees are found in the Hilly region (Abington, 1992). The Terai region is flat land consisting of fertile alluvial soils, while the Hilly region has sloped land (Abington, 1992). Higher population density i.e., 392 people per square kilometer is reported for the Terai region whereas the value was 186 people per square kilometer in the Hilly region of Nepal (CBS, 2014). The land topography is flat in Terai region while the land topography is rough in Hilly region with the absence of roadways. The differences in land holdings, forest type, population density, land topography across these two regions are expected to affect forest resource collection activities. Thus, regional differences in labor productivity in forest resource collection are expected.

The importance of forest use to rural households in Nepal and other developing countries is evidenced by a large body of research examining labor allocated to collect fuelwood and household demographic characteristics of rural households. Pattanayak et al. (2003) used household production theory to model forest product collection as a function of labor, tools, forest condition, and household classes. Household composition and socio-economic factors significantly influenced labor allocation to forest related activities (Pattanayak et al., 2003). Similarly, the wealthiest households collected the least amount of forest products, while poorer

households invested relatively more time to collect forest products (Pattanayak et al. 2003). Sapkota et. al. (2008) found that household wealth status, proximity to forests, and the number of forest visits exerted a strong influence on fuelwood appropriation.

Cooke (2016) investigated the effects of forest user group (FUG) management and household characteristics on the allocation of male and female labor to collect fuelwood in Nepal. Male and female labor allocation for fuelwood collection was influenced by gender-specific opportunity costs of time, fuelwood scarcity, and household demographics (Cooke, 2016). Higher wage earnings by males resulted in less time spent by males and more time spent by females for fuelwood collection. Similarly, higher land and livestock values were associated with less time spent by women for fuelwood collection (Cooke, 2016). Scheurlen (2015) found that women were primarily responsible for fuelwood collection; i.e., in about 70% of the surveyed cases, women were the household's primary collector of fuelwood.

Heltberg et al. (2000) studied forest scarcity and household fuel collection in rural India focusing on the substitution of non-commercialized commons and the private domain. Private sources for forest fuelwood were used as substitutes by households in response to forest scarcity and increased fuelwood collection time (Heltberg et al., 2000). McDonald et al., (1998) used a travel cost model embedded in a household production function to model the decision-making process for determining collection of fuelwood from different sites. Caloric use was used to measure the opportunity costs of collecting fuelwood. The study found that calories and attributes of the site, such as availability of good quality fuelwood, were important factors in determining site choice (McDonald et al. 1998). Similarly, caloric expenditures in fuelwood collection activities have been monetized in terms of labor time using an energy balance framework (Harter and Boston, 2008; McDonald et al., 2001).

Previous studies also focused on the labor used to collect fuelwood as a function of household demographic characteristics. Caloric use was used to proxy the opportunity cost of collecting fuelwood (McDonald et al. 1998; McDonald et al. 2001; Harter and Boston, 2008). However, no study has researched the factors associated with the imputed revenue generated by fuelwood and fodder collection activities. In the present study, the market price of fodder and fuelwood is used to construct an imputed revenue model for fuelwood and fodder collection by households in rural Nepal. The present study analyses how demographics and household characteristics, along with locational and seasonal variables, determine the imputed revenue generated from fuelwood and fodder collection. The findings of this study will signify the importance of forest resources in terms of imputed revenue generation often not realized by the rural households. Moreover, the present study will help analyze the marginal value product of labor (MVPL) involved in fuelwood and fodder collection in relation to forest management rules and regulations. Regional policy related to economic development can have an insight about the standard of livings of the rural households seeing the imputed revenue from CFs and MVPL. Development policy can be focused to rural households pertaining to certain demographic groups like lower caste people or people more involved in agrarian activities.

1.2 Conceptual Model

Rural households are characterized by their dependence on agriculture and forest activities (Sing, Squire and Strauss, 1986). These households constitute two fundamental units of microeconomic analysis; i.e., the household and the firm (Sing, Squire and Strauss, 1986). A portion of goods produced by households is kept for home consumption purposes, the remainder for sale in the markets (Sadoulet and De Janvry, 1995). Other features of rural households are the presence of household members with different opportunity costs and engagement in wage labor opportunities

and microenterprises (von Braun and Pandya-Lorch, 1991; Reardon, Delgado, and Matlon, 1992).

Bardhan and Urdy, (1999) showed that the absence of land and labor markets leads to a breakdown in the separability of household production and consumption decisions. When this occurs, household's consumption and production decisions depend on household preferences and endowments and the decisions are conflated (Bardhan and Urdy, 1999). A non-separable household utility function is assumed in the present study, relying on the fact that household decisions are not separable as complete markets for products, labor and other productive factors are not always present in rural Nepal. When labor and product markets are weak, ill defined, or no-existence, the decision to allocate resources to the production of cash crops (a profit maximizing decision) or resources to subsistence (a utility maximizing/survival decisions) is conflated. Collection of fuelwood and fodder by rural households is expected to vary across districts (region) and season. Survey data from four districts representing two regions in Nepal are used to analyze the marginal value product of labor and imputed revenue generation from fuelwood and fodder collection activities.

Rural households are simultaneously involved in both agricultural and forest resource collection activities. Households may be labor constrained to perform these activities. For example, in 2011, 7.3% of Nepal's working population out-migrated for jobs (CBS, 2011). The marginal value product of labor in forest resource collection; i.e., fuelwood and fodder is the economic return to every hour of labor allocated by these rural households in the aforementioned household activities. Higher value of marginal value product of labor indicates a greater imputed return to an additional hour of labor allocated to fuelwood and fodder collection by these households. Seasonal and regional variation in revenue generated and marginal value product of

labor is expected due to potential differences in household preferences for fuelwood and fodder collection along with regional and seasonal differences**.**

1.3. Survey Data and Data Collection Methods

A household survey was conducted in person from June 2016 to July 2016 in the districts of Chitwan, Nawalparasi, Lamjung and Gorkha, Nepal. Simple random sampling (SRS) was used to choose a CFUG in each of the four districts (Moonan, 1954). The complete lists of CFUG in these districts were obtained from the District Forest Office (DFO). The lottery method of SRS (Kothari, 2004) was used to select one CFUGs from each district. The list of households in each CFUG was obtained from the four CFUGS. Simple random sampling technique was used to select the households to be surveyed in each CFUG. There were a total of 780 households surveyed in the four districts. A total of 250 households were selected from the Udayapur CFUG in Chitwan and 140 housheolds were selected from the Janjagriti CFUG in Nawalparasi, for a total of 390 households in the Terai/inner Terai regions (Table 1). Similarly, 170 housheolds were selected from Birenchowk CFUG in Gorkha and 220 households from Lampata CFUG in Lamjung. Thus, a total of 390 households were surveyed in the Hilly region. The 390 households in each region accounts for the appropriate sample size for the entire population of the Terai (658,352) and Hilly (1,557,932) regions of Nepal (MoF, 2016) with 95% confidence interval and 5% margin of error (Krejcie and Morgan, 1970).

The primary respondents for the survey were contacted by making a visit to their home. The respondents were verbally notified about the research work being carried i.e., verbal consent was done before starting the survey work. In the absence of the respondents or unwillingness of respondents; the respondents were replaced by other rural households following the random sampling procedure. The survey lasted for around 45 minutes to one hour for each respondent,

i.e., the household's primary decision maker. The survey work was conducted by three enumerators who had been trained for the survey work. The enumerators read questions from a written survey instrument and recorded responses on the instrument during the interview. The survey instrument consist of open ended questions consisting of a series of basic demographic questions, followed by questions related to forest resource collection; household agronomic practices and household income sources. The closed ended questions of the survey were mostly related to the perception of the respondents regarding role of women in CFUG management. The collection of fuelwood and fodder was reported in terms of headload (bhari) on daily basis, while the time allocated for their collection (hours) was reported on a daily basis too. Forest resources collected and time spent were aggregated to seasonal and annual totals for each household. Summary statistics of the surveyed households is presented in Table 2.

Focus group discussion among the CF users was conducted in each of the randomly selected CFUGs. Pre-notice was circulated among the CF users in the community to participate in the focus group discussion. The CFUG working committee along with a few CFUG general users were present in the focus group discussion. General information regarding the forest resource collection were gathered during the focus group discussions. Most relevant to this study, the market price of forest resources reported to be collected from the CFs were obtained during the focus group discussions.

The prices of the fuelwood and fodder collected from CFUGs in NRS per headload (bhari) are used for imputing revenue from fodder and fuelwood collection. A headload of fuelwood was estimated to be 35 Kg (Ghimire et al., 2010) which gives a rough idea about the weight of a headload of fuelwood. The quantities (amount) of fuelwood and fodder in number of headload per season were reported from responses of the surveyed households. These reported

headloads were multiplied by prices to impute monetary values on fuelwood and fodder collection activities. The summary statistics of fuelwood and fodder collected along with respective prices and revenues is presented in Table 3.

There are three seasons pertaining to the production of summer crops, rainy crops and winter crops. The summer season spans from 15th February to 15th June. The rainy season spans from 15th June to 15th October; and Season 3 from 15th October to 15th February. The rainy season is the busiest season. Households plant, weed and harvest rice, the staple food crop of Nepal, during this time. This season also includes the biggest festivals in Hindu culture. The summer season is the season for summer crops, i.e., maize and vegetables. The winter season is the season for winter crops i.e., wheat and oilseeds. Given the other activities that occur during the Rainy season, fodder and fuelwood collection is expected to be more intensive in the Summer and Winter seasons, with less fodder and fuelwood collection occurring in the Rainy season.

1.4 Empirical Model

A household production function is considered where the amount of fuelwood (*FW*) collected (in headload) by a household (*i*) in a district (*j*= 1, 2, 3, 4) and season (*k* = 1, 2, 3) is dependent on the amount of labor allocated *L* and household characteristics *Z*. The quantity of fuelwood collected FW is multiplied by the fuelwood price in district j (p_j) to impute the revenue associated with fuelwood collection:

$$p_j \cdot FW_{i(j)k} = f(L_{i(j)k}, Z_{i(j)k}) \quad (1)$$

Similarly, the amount of fodder (*FU*) collected by household (*i*) clustered in district (*j*) (indicated by "( )") and season (*k*) is dependent on the amount of labor allocated *L*, the number

of livestock owned (*nl*) and household characteristics *Z*. The quantity of fuelwood collected FU_i is multiplied by the market price to impute the revenue associated with fuelwood collection.

$$p_j \cdot FU_{i(j)k} = f(L_{i(j)k}, nl_{i(j)k}, Z_{i(j)k}) \quad (2)$$

The fuelwood and fodder production functions *f* are assumed to be concave with $f' > 0$. The household demographic variables included in the fuelwood and fodder revenue functions are the same; but the number of livestock reared by households appears only in the fodder revenue equation. Rural households collect fodder to supplement straw/hay to feed the livestock reared by the households. Fuelwood provides energy for cooking and heating purposes. Fodder collection and fuelwood collection are two different activities performed by the same household. The fuelwood and fodder revenue models differ in regard to explanatory variables, but some relationship may exist between the unobserved effects associated with each equation because the decision to collect fuelwood and/or fodder may be coterminous. Therefore, unobserved factors determining revenue generated by these activities may be correlated.

Assuming a linear approximation of the revenue functions, the imputed revenue generated from fuelwood collection is

$$R_{1i}^{jk} = \beta_0^k + \beta_1^k L_i^{jk} + \beta_2^k Z_i^{jk} + u_{1i}^{jk} \quad (3)$$

where R_{1i}^{jk} is the product of market price of fuelwood and quantity of fuelwood collected.

Similarly, a linear approximation of the revenue generating function for fodder collection is

$$R_{2i}^{jk} = \beta_0^k + \beta_1^k L_i^{jk} + \beta_2^k Z_i^{jk} + u_{2i}^{jk} \quad (4)$$

where R_{2i}^{jk} is the product of market price of fodder and quantity of fodder collected. The (u_{1i}^{jk}, u_{1i}^{jk}) are error terms with an expected value of zero and constant variances σ_1^{jk} and σ_2^{jk}.

Fuelwood and fodder revenue models are estimated as an aggregated, annual model and for each season. The error terms may be correlated across the fuelwood and fodder revenue models for each model because of the unobserved factors correlated with the decision to allocate time to the collection of fuelwood or fodder. The marginal effect of labor on the total revenue from fuelwood and fodder collection gives the marginal value product of labor for these activities i.e., β_1 in the above equations 3 and 4.Total revenue generated from fuelwood and fodder collection is expected to vary both annually across seasons. The marginal value product of labor is expected to vary across seasons and activities. The null hypothesis is that there is no difference in the marginal value product of labor in the annual and seasonal revenue models for fuelwood and fodder collection. Seasonal preferences for fuelwood and fodder collection along with regional differences might cause differences in the values of marginal value product of labor. The marginal value product of labor is expected to vary across seasons for fuelwood and fodder collection activities. Similarly, the null hypothesis is that there is no differences in the imputed revenue from fuelwood and fodder collection along the different districts. However, the imputed revenue generated from fuelwood and fodder collection is expected to vary across the districts in the annual and seasonal models too due to regional factors associated. Differences in seasonal forest productivity along with different opportunity costs associated with collection fuelwood and fodder might cause for differences in imputed revenue and marginal revenue product of labor.

1.5 Model Diagnostics

The Breusch-Pagan test for error independence (Breusch and Pagan, 1979) indicates if the error

terms are correlated across the fuelwood and fodder revenue equations. The null hypothesis is that there is no error correlation across these equations; i.e., $H_0: Corr\left(u_{1i}^{jk}, u_{2i}^{jk}\right) = 0$. The alternative hypothesis is that the error terms are correlated across equations. The test statistic is distributed as a χ^2 random variable with one degree of freedom. At $\alpha = 0.05$, the critical value for this statistic is 3.84. Rejection of the null hypothesis suggests more efficient estimates could be obtained using Zellner's (1962) Seemingly Unrelated Regression (SUR) estimator.

Regression collinearity diagnostics are used to determine if the independent variables are collinear which could possibly compromise the standard errors. The conditional index of Belsley, Kun and Welsch, (1980) is used to assess multicollinearity. The conditional index value for explanatory variables less than 30 suggests collinearity may not be a problem (Besley et al, 1980).

1.6 Explanatory Variables

1.6.1 Primary Decision Maker Characteristics

Age of a respondent can be a determining factor when it is related to revenue generation from fuelwood and fodder collection. Age has been found to be negatively associated with participation in a CF program (Rahut et al, 2015). Thus, age is hypothesized to be negatively related to imputed revenue from forest resource collection. The respondent's age was recorded in years from birth.

Women are the primary collectors of fodder and fuelwood (Khanal Chhetri, 2005). The gender of the primary respondent is included as a dummy variable (female =1). A positive relationship of gender and revenue generation is expected because women are the primary collectors of forest resources. Respondent being a woman is expected to earn more imputed

revenue from forest resource collection as compared to men who are less involved in fuelwood and fodder collection.

Both the educational attainment of respondents as well as the relative household education are taken into consideration for the present study. The educational level of the respondent was recorded as a dummy variable; i.e., number of years of education equal to or greater than 10 was treated as one, zero otherwise. The educational attainment of the household's primary decision maker is expected to have a negative effect on the imputed revenue the household generated from fuelwood and fodder collection. More education might lead to better opportunities to work for the respondents alone leading to less involvement in forest resource collection. Better opportunities for primary decision makers can also have effects on household wellbeing leading to less forest resource collection.

1.6.2 Household Characteristics

Relative household education was calculated as the sum of total household education in years divided by the number of household members. Households with more relative household education are expected to be less reliant on forest resources with the availability of other opportunities (Adhikari et. al., 2004). Higher value of relative household education signifies more opportunities for family members and, thus, less imputed revenue from the collection of fuelwood and fodder. Relative household education gives an idea about the educational attainment of the family as a whole and the opportunities available to the family members.

The disaggregation of family members in different age groups can give an idea about the marginal effect of age group on the revenue generated from fuelwood and fodder collection. Family members were disaggregated into 3 age groups individuals; less than 15 years i.e, child,

15-60 years i.e., working class and 60 years old or more as elderly class. The Government of Nepal based the grouping on the population classification as children, working class and dependent populations (CBS, 2015). The presence of more working class members in the family is expected to yield more imputed revenue from the forest resource collection activities as compared to young and old age family members.

Caste membership indicates varying roles of people in Nepalese society. The caste of the respondent was indicated with a dummy variable, with the Brahmin and Chhetri castes classified as higher castes (= 1), and the other castes classified as lower caste (= 0). Lower caste people are expected to be collection more forest resources leading to higher imputed revenue from those activities.

Total household income was disaggregated into six different activities; income from agriculture and livestock, business (local household business), wages (income earned by daily labor and agricultural labor), salary (income from government or non-government jobs), remittances, and all other sources. The disaggregation of household income was made to see how rural households with different income sources rely on forest resource collection activities. The distinction between salary and wages is made based on the stability of the flow of income. Stable or recurring income sources (e.g., government jobs) were categorized as salary, while income from sources that were not stable or recurring (e.g., occasional or seasonal daily wages) were categorized as wages. The share of income from non-agricultural activities is expected to have a negative effect on the revenue generated from fuelwood and fodder collection. Family members are involved in non-agricultural activities which leads to less time for collecting forest resources.

The labor used in fuelwood and fodder collection was recorded as aggregate number of hours spent for the collection of the respective quantities of fuelwood and fodder. Meanwhile,

aggregated labor hours were disaggregated into seasonal basis based on Nepal's cropping season, in which there are 3 cropping seasons. The Rainy season is the busiest period while Summer and Winter are quiet periods. Household members are expected to collect more fuelwood and fodder in seasons the Summer and Winter seasons than in the Rainy season. Thus, the marginal value product of labor for forest resource collection is expected to be higher in Summer and Winter than in the Rainy season. During the rainy season making it harder for fuelwood collection but making easy availability of fodder. With the onset of monsoon, more foliage and fodder are available as animal feed. However, fuelwood collection would be not preferred by rural households because of unsuitability of wet trees (fuelwood) to use for energy purpose. Seasonal variation in labor productivity involved in fuelwood and fodder collection is expected due to seasonal factors involved in forest resource collection. More fodder is available in the rainy season while fuelwood collection might be easier during the winter and summer seasons.

1.6.3 Regional and Locational Factors

The exact distance of a rural household to the nearest CF is oftentimes unknown. Thus, the distance to the nearest CFs area was recorded in terms of travel time to the forest. As travel time increases, the amount of fuelwood and fodder collected decreases (Khanal Chhetri, 2005; Sapkota and Oden, 2008).

Geographical differences may be important because of variations in the geography of the surveyed area encompassing the districts. Dummy variables for Nawalparasi, Lamjung, Gorkha, and Chitwan are included to control for unobserved effects attributable to differences across districts. Chitwan had the largest number of observations, and it is the reference group. Resource collection in terms of fuelwood and fodder and labor productivity in these activities is expected

to vary across districts. No priori hypothesis can be formulated regarding which district would have higher imputed revenue.

1.6.4 Household Land Use Characteristics

Individual household landholdings of the respondents were recorded in hectares. A negative relation between landholdings and revenue from forest resource collection is expected. Rural households with greater landholdings may have higher opportunity costs as they may be busy on agricultural activities.

Private trees grown by a household substitute for fuelwood and fodder from other sources. A negative relationship between private trees planted on the respondent's land and the amount of fuelwood and fodder collected is expected (Cooke, 2016; Heltberg et. al., 2000 ; Van't vald et. al., 2007). The private trees grown by the households are recorded as the numbers of trees.

Fodder from CFs is likely to be an important feed source for livestock in rural Nepal. The number of livestock is expected to be positively related to the amount of fodder collected (Adhikari et. al., 2004). Only the ruminant animals who feed on fodder are considered in the present study. The livestock reared were recorded in numbers.

1.7 Results and Discussion

The conditional index value for explanatory variables in fuelwood and fodder revenue model was 13.38. This global indicator suggests multicollinearity is not likely affecting estimates of the standard errors.

The null hypothesis that the error terms across the fodder and fuelwood collection equations were uncorrelated was rejected at the 95% confidence level for the Annual, Summer,

and Winter season models (Table 4). The null hypothesis of no cross equation correlation could not be rejected for Rainy season. Therefore, the Annual, Summer and Winter season fuelwood and fodder collection models were estimated with SUR. Fuelwood and fodder collection by households in Rainy season was estimated with OLS.

1.7.1 Annual Revenue Model

Geographical differences in SUR aggregate revenue generated from fuelwood and fodder collection is evident. Revenue generated from fuelwood collection was higher in the Chitwan district compared to the Lamjung, Gorkha and Nawalparasi districts (Table 5). Rural households engaged in fuelwood collection were earning NRS 4,765, NRS 5,886 and NRS 3,928 less in Lamjung, Gorkha and Nawalparasi districts, respectively compared to households in the Chitwan district (NRS 7,283). Rural households engaged in fodder collection were earning NRS 2,986 and NRS 1,399 less in Gorkha and Lamjung district, compared to Chitwan.

Gender was a significant factor in determining the aggregated revenue from fuelwood collection. On average, annual revenue from fuelwood collection was NRS 863 lower for the respondent being a woman. Differences in revenue from fodder collection were not different between genders.

There were differences in revenue generated from fodder collection along household age groups. An increase in one member of working group, i.e., 15-60 years, increases the imputed revenue from fodder collection by NRS 218.

Revenue generated by households that were farther away from CFs was relatively lower. For an additional minute of travel time to the CFUG, revenue generated from fuelwood collection decreased by NRS 32. Revenue from fodder collection was also associated with travel

time to the nearest CF. For an additional minute in travel time to the CF, revenue generate from fodder collection decreased by 45 NRS.

The marginal value product for labor is an indicator of economic return to an additional hour of labor allocated in resource collection activity. All else equal, for every extra hour spent collecting fuelwood, household revenue increases by 118 NRS. For fodder collection, the MVPL is 114 NRS.

1.7.2 Seasonal Fuelwood Revenue Models

1.7.2.1 Imputed Revenue from Fuelwood Collection for the Summer Season

The R^2 for SUR Summer fuelwood revenue model was 0.84 (Table 6). Geographical differences were evident for the Summer season imputed revenue model from fuelwood collection too. The imputed revenue collected in the Summer season from fuelwood collection was significant and higher for Chitwan district compared to the Lamjung, Gorkha and Nawalparasi districts (Table 8). The Summer revenue from fuelwood collection in Lamjung, Gorkha and Nawalparasi districts were less by NRS 1,868, NRS 1,869 and NRS 1,349 respectively as compared to Chitwan district.

Gender of the respondent was negative and statistically significant for the Summer season fuelwood revenue model. On average, revenue generated from fuelwood collection during the Winter season is NRS 313 lower than men. An increase in travel time to the nearest CFs is expected to decrease the revenue from fuelwood collection. The travel time to the nearest CF area was negative and significant for the Summer season fuelwood revenue model. With one-unit increase in travel time, the revenue from fuelwood collection would decrease by NRS 9 for Summer season.

The marginal value product of labor was positive and significant for fuelwood collection in Summer season. One more hour spent collecting fuelwood collection would increase the revenue by NRS 126 in Summer season. Summer season is among less busy seasons in terms of agricultural and cultural activities.

1.7.2.2 Results and Discussion for Rainy Season Revenue from Fuelwood Collection

The adjusted R^2 value for the Rainy season revenue model for fuelwood collection was 0.89 (Table 7).

The revenue generated from fuelwood collection in Rainy season was positive and statistically significant for Lamjung district. The seasonal revenue was greater by NRS 533 in the Lamjung district as compared to the Chitwan district.

The increase in number of private trees grown would decrease the imputed revenue from fuelwood collection in Rainy season. For one more private tree grown, the revenue would decrease by NRS 1.

The marginal value product of labor in Rainy season from fuelwood collection was positive and significant. The revenue from fuelwood collection would increase by NRS 114 for an additional hour spent in fuelwood collection in Rainy season.

1.7.2.3 Results and Discussion for the Seemingly Unrelated Regression for Winter Season Revenue from Fuelwood Collection

The R^2 value for SUR Winter season fuelwood revenue model was 0.72 that shows good model fit (Table 8). Geographical differences were evident for the Winter season revenue models from fuelwood collection too. The revenue collected in Winter season from fuelwood collection was significant and higher for Chitwan district as compared to the Lamjung, Gorkha and Nawalparasi

districts (Table 8). The seasonal revenue from fuelwood collection for Winter season in Lamjung, Gorkha and Nawalparasi districts were less by NRS 3,304, NRS 4,090 and NRS 2,733 respectively as compared to Chitwan district.

Respondent gender was negative and statistically significant for the Winter season fuelwood revenue model. On average, revenue generated from fuelwood collection during the Winter season is NRS 473 lower than men.

Increase in travel time to the nearest CFs is expected to decrease the revenue from fuelwood collection. The distance to the nearest CF area was negative and significant for SUR for the Winter season fuelwood revenue model too. For an additional minute in travel time to the nearest CFs, the revenue from fuelwood collection would decrease by NRS 23 for the winter season.

The marginal value product of labor was positive and significant for fuelwood collection in the Winter season. An additional hour spent in fuelwood collection would increase the revenue by NRS132 in the Winter season. Winter season is the most preferred season for fuelwood collection because households are less busy in this season in terms of agricultural and cultural activities. Since Winter season is a dry season, fuelwood collection would be more preferred by households.

1.7.3 Results and Discussion for Seasonal Fodder Revenue Models

1.7.3.1 Results and Discussion for Seemingly Unrelated Regression for Summer Season Revenue from Fodder Collection

The R^2 value for SUR Summer season fodder revenue model was 0.85 (Table 6). Geographical differences were evident for Summer season revenue models from fodder collection. The revenue collected in Summer season from fodder collection was significant and higher in the

Chitwan district as compared to the Gorkha district (Table 6). The seasonal revenue from fodder collection for the Summer season in the Gorkha district was NRS 1,303 lower than revenue in the Chitwan district.

The inclusion of working class (i.e., 15-60) year group was positive and significant for the Summer season fodder revenue model. The seasonal fodder revenue would increase by NRS 128 for inclusion of 1 more family member of the working class.

An increase in distance is expected to decrease the revenue from fodder collection. The effect of travel time to the nearest CF area was negative and significant for the Summer season fodder revenue model. With a one-minute increase in travel time to the nearest CF, revenue from fodder collection decreases by NRS 13.

The marginal value product of labor was positive and significant for fodder collection in Summer season. An additional hour spent collecting fodder increases household revenue by NRS 117 in Summer season.

1.7.3.2 Results and Discussion for Rainy Season Revenue from Fodder Collection

The adjusted R^2 value for the Rainy season revenue model from fodder collection was 0.94 (Table 7). Geographical variation in imputed revenue from fodder collection was evident. Households involved in fodder collection were generating NRS 60 less in Gorkha compared to Chitwan.

The education of the respondents was positive and statistically significant in the Rainy season fodder revenue model. The seasonal fodder revenue would be higher by NRS 3 for the respondent being educated (=1). The finding is opposite to what was hypothesized about the relationship between education attainment of respondent and revenue generated from fodder collection.

For an additional hour spent in collecting fodder, the revenue increases by NRS 123 in Rainy season. More availability of fodder with the onset of the summer monsoon during the Rainy season might lead to less time spent collecting fodder. Similarly, fodder available in the nearest CFs results in lower time allocation for fodder collection.

1.7.3.3 Results and Discussion for the Seemingly Unrelated Regression for Winter Season Revenue from Fodder Collection

The R^2 value for SUR Winter season fodder revenue model was 0.82 (Table 8). The revenue collected in Winter season from fodder collection was significant and higher for the Chitwan district compared to the Lamjung, Gorkha and Nawalparasi districts (Table 8). The seasonal revenue from fodder collection for Winter season in Lamjung, Gorkha and Nawalparasi districts were less by NRS 2,220, NRS 1,614 and NRS 886 respectively as compared to the Chitwan district.

Increase in household member of working class i.e., 15-60 years will increase the imputed revenue from fodder collection by NRS 147. Similarly, caste of the respondents was positive and significant. The higher caste respondents were generating NRS 356 more than the other caste peoples.

Agricultural income and imputed fodder revenue generation were positively related for the Winter season fodder revenue model. Increase in income from agriculture by one percent increases the imputed fodder revenue by NRS 10 in the Winter season.

An increase in distance to the nearest CFs will decrease the revenue from fodder collection. The coefficient on travel time to the nearest CF area was negative and significant for the Winter season fodder revenue model. For one-minute increase in travel time to the nearest CF, the revenue from fodder collection decreases by NRS 26.

The marginal value product of labor was positive and significant for fodder collection in the Winter season. An additional hour spent in collecting fuelwood increases the revenue by NRS 93 in the Winter season. Winter season is the dry season for fodder collection. Collection of fodder in this season requires more time and thus lower the revenue is generating for each hour of labor spent.

1.8 Conclusion

The present study analyzes the imputed revenue generated from fuelwood and fodder collection by rural households in Nepal. The revenue generated from fuelwood and fodder production varied across districts and seasons as expected in priori hypothesis. The difference in the market price along with differences in quantities collected may be a reason for differences in revenue generated across the Terai region and Hilly regions of Nepal. The market price of fuelwood and fodder was higher in Terai region as compared to Hilly region. Similarly, seasonal variation in revenue generation signifies the seasonal preferences of the communities for the collection of fuelwood and fodder. Marginal revenue product of labor for fuelwood and fodder collection varied across seasons. Rainy season has the highest marginal value product for fodder collection while season 3 has the highest marginal value product of labor for fuelwood collection. The economic return to labor for fodder collection was higher in rainy season while it was higher in winter season for fodder collection. Similarly, socio-economic demographics exerted significant effect on the revenue collected by forest activities i.e., fuelwood and fodder collection. Regional policy makers can be benefit from the present study in terms of managing fuelwood and fodder collection activities along with the seasonal preferences of the rural communities. Moreover, fuelwood and fodder collection can be done seasonally depending upon the economic return of labor involved in those activities. Regional policies targeted to rural people's livelihood can get

an insight about the labor market and importance of CFs in rural Nepalese scenarios. Regional development policies can encompass the findings of this research in development activities to uplift the wellbeing of rural peoples.

The findings of the study may suffer from recall bias because the respondent's response and the data collected in this study are based on recall. Similarly, only four districts were covered in the survey, which restricts the results and findings to these localities only. A broader study with more respondents covering a wider region will help generalize the results to the whole country.

1. A. Appendix

1. A.1 Tables

Table 1: List of CFUGs surveyed

S. No.	District / Region	Name of CFUG	Total number of households of CFUG	Total area of CFUG (hectares)	Total number of households selected
1	Chitwan (Terai/Inner-Terai)	Udayapur	4028	199.19	250
2	Nawalparasi (Terai/Inner-Terai)	Janjagriti	278	83.50	140
3	Gorkha (Hilly)	Birenchowk	197	101	170
4	Lamjung (Hilly)	Lampata	285	84	220

Table 2: Summary statistics of independent variables used in analysis

Variable	Units	Mean	Std. Dev.	Min	Max
Gender (1 = female)	1 = female	0.42	0.50	0	1
Education of household	years	9.90	18.15	0	91
Total family members	count	5.16	1.70	1	13
Age	years	45.49	32.22	21	85
<15 age group	count	1.53	0.69	0	5
15-60 age group	count	3.54	1.41	1	8
>60 age group	count	1.47	0.73	0	3
Caste dummy	1 = higher caste	0.39	0.49	0	1
income from agriculture	percentage	12.01	18.05	0	22.078
income from business	percentage	14.31	27.54	0	100
income from wage	percentage	14.44	28.58	0	100
income from job	percentage	24.36	36.29	0	100
income from remittance	percentage	35.30	52.40	0	93.83
income from others	percentage	0.43	3.09	0	47.77
Travel time to the nearest CF	minutes	27.12	23.26	2	400
Number of livestock	count	4.04	3.78	0	20
Landholding (ha)	count	0.27	0.25	0.02	2.50
Number of private trees planted	count	15.06	32.42	0	520
Number of Observations					780

Table 3: Summary statistics of dependent variable used in analysis

Variables	Name of CFUG (district)	Observation	Mean	Std. Dev.	Max	Min
	Udayapur (Chitwan)					
Fuelwood collected (in headload)		250	35.00	20.45	80	0
Fodder collected (in headload)		250	35.75	29.43	245	0
Price of fuelwood (NRS/headload)		1	400	-	-	-
Price of fodder (NRS/headload)		1	250	-	-	-
Revenue from fodder collection (NRS)		250	13984	8173	32000	0
Revenue from fuelwood collection (NRS)		250	8938	7360	61250	0
	Janjagriti (Nawalparasi)					
Fuelwood collected (in headload)		140	39.65	21.30	104	0
Fodder collected (in headload)		140	38.44	57.47	288	0
Price of fuelwood (NRS/headload)		1	400	-	-	-
Price of fodder (NRS/headload)		1	250	-	-	-
Revenue from fodder collection (NRS)		140	9610	14370	72000	0
Revenue from fuelwood collection (NRS)		140	15860	8521	41600	0

Note: $1 is equivalent to NRS 103.8

Table 3: Summary statistics of dependent variable used in analysis (continued)

Variables	Name of CFUG (district)	Observation	Mean	Std. Dev.	Max	Min
	Lampata (Lamjung)					
Fuelwood collected (in headload)		220	31.38	9.93	58	12
Fodder collected (in headload)		220	22.53	53.06	300	0
Price of fuelwood (NRS/headload)		1	300	-	-	-
Price of fodder (NRS/headload)		1	200	-	-	-
Revenue from fodder collection (NRS)		220	4506	10612	60000	0
Revenue from fuelwood collection (NRS)		220	9415	2982	17400	3600
	Birenchowk (Gorkha)					
Fuelwood collected (in headload)		170	27.38	24.97	145	0
Fodder collected (in headload)		170	49.72	46.51	185	0
Price of fuelwood (NRS/headload)		1	300	-	-	-
Price of fodder (NRS/headload)		1	200	-	-	-
Revenue from fodder collection (NRS)		170	9945	9302	37000	0
Revenue from fuelwood collection (NRS)		170	8217	7492	43500	0

Note: $1 is equivalent to NRS 103.8

Table 4: Breusch Pagan* Statistics for the fuelwood and fodder revenue models

Model	Chi-square statistic	Critical value**
Annual revenue from fuelwood and fodder collection	55.53	3.84
Summer Season revenue from fuelwood and fodder collection	48.43	3.84
Rainy Season revenue from fuelwood and fodder collection	0.03	3.84
Winter Season revenue from fuelwood and fodder collection	56.66	3.84

Note: *the null hypothesis is H_0: Corr(u_1^{jk}, u_2^{jk}) = 0; ** critical value at $\alpha = 0.05$ with one degree of freedom.

Table 5: Seemingly unrelated regression for annual revenue from fuelwood and fodder collection

Variable	Annual revenue from fuelwood	Annual revenue from fodder
Gender of respondent (1 =	-862.5*	4.61
female)	(295.6)	(263.2)
Age of respondent (years)	5.760	4.47
	(4.48)	(3.99)
Education of respondent (years)	-5.81	2.21
	(172.3)	(16.91)
<15 age group (number)	8.33	0.88
	(172.3)	(158.3)
15-60 age group (number)	-17.15	217.7*
	(116.6)	(104.5)
>60 age group (number)	124.3	-139.8
	(177.6)	(158.3)
Relative HH education	41.92	59.78
	(66.30)	(59.15)
Caste (higher caste =1)	-188.2	383.3
	(306.2)	(274.0)
% of agricultural income	7.28	14.13
	(8.80)	(7.89)

Table 5: Seemingly unrelated regression for annual revenue from fuelwood and fodder collection (continued)

Variable	Annual revenue from fuelwood	Annual revenue from fodder
% of income from business	-7.25	-0.60
	(7.02)	(6.28)
% of income from wage	-2.66	7.61
	(7.18)	(6.41)
% of income from job	0.03	3.66
	(6.23)	(5.56)
% of income from remittances	-2.78	0.73
	(4.38)	(3.91)
% of income from others	44.89	10.21
income sources	(46.63)	(41.57)
Travel time (minutes)	-31.67***	-50***
	(6.42)	(5.77)
Land holding(ha)	-91.95	-83.74
	(628.7)	(564.2)
Number of private trees planted	-5.70	-0.644
	(4.75)	(4.27)
Nawalparasi	-3927.6***	97.65
	(446.0)	(382.7)

Table 5: Seemingly unrelated regression for annual revenue from fuelwood and fodder collection (continued)

Variable	Annual revenue from fuelwood	Annual revenue from fodder
Lamjung	-4765.0***	-1398.5*
	(753.9)	(673.9)
Gorkha	-5886.0***	-2985.5***
	(422.6)	(380.2)
Labor	118.3***	114.3***
	(2.81)	(-2.608)
Livestock		39.64
		(37.98)
Constant	7282.9***	724.3
	(932.9)	(825.6)
Observations	780	780
R^2	0.73	0.88

Notes:
Standard error in parenthesis
* = significant at 95 % level of significance
** = significant at 90 % level of significance
*** = significant at 99 % level of significance

Table 6: Seemingly unrelated regression for summer season revenue from fuelwood and fodder collection

Variable	Summer season revenue from fuelwood	Summer season revenue from fodder
Gender of respondent (1 =	-313.3*	15.84
female)	(107.2)	(120.6)
Age of respondent (years)	4.36*	1.41
	(1.65)	(1.83)
Education of respondent (years)	-1.59	-4.06
	(6.87)	(7.75)
<15 age group (number)	15.76	44.86
	(62.51)	(70.40)
15-60 age group (number)	12.54	127.7**
	(42.30)	(48.00)
>60 age group (number)	8.87	-63.44
	(64.30)	(72.47)
Relative HH education	10.34	15.66
	(24.06)	(27.10)
Caste (higher caste =1)	-50.92	190.3
	(111.1)	(125.2)
% of agricultural income	0.14	6.72
	(3.19)	(3.62)

Table 6: Seemingly unrelated regression for summer season revenue from fuelwood and fodder collection (continued)

Variable	Summer season revenue from fuelwood	Summer season revenue from fodder
% of income from business	-0.11	-0.84
	(2.55)	(2.88)
% of income from wage	0.86	2.29
	(2.61)	(2.94)
% of income from job	2.16	1.62
	(2.26)	(2.55)
% of income from remittances	-0.05	0.26
	(1.59)	(1.79)
% of income from others income	46.37**	10.76
sources	(16.92)	(19.05)
Travel time (minutes)	-8.87**	-13.39***
	(2.33)	(2.61)
Land holding(ha)	93.45	7.06
	(228.0)	(258.6)
Number of private trees planted	-0.84	0.87
	(1.72)	(1.95)
Nawalparasi	-1349.1***	232.8
	(159.4)	(180.3)

Table 6: Seemingly unrelated regression for summer season revenue from fuelwood and fodder collection (continued)

Variable	Summer season revenue from fuelwood	Summer season revenue from fodder
Lamjung	-1867.7***	-278.8
	(277.6)	(307.8)
Gorkha	-1869.2***	-1302.5***
	(153.2)	(178.6)
Labor	125.7***	117.0***
	(2.35)	(1.48)
Livestock		7.91
		(17.23)
Constant	1779.0***	-161.6
	(335.8)	(378.4)
Observations	780	780
R^2	0.85	0.91

Notes:
Standard error in parenthesis
* = significant at 95 % level of significance
** = significant at 90 % level of significance
*** = significant at 99 % level of significance

Table 7: Ordinary Least Squares results for the fuelwood and fodder revenue model for rainy season

Variable	Rainy season revenue from fuelwood	Rainy season revenue from fodder
Gender of respondent	-98.29	-13.66
(1 = female)	(58.02)	(14.82)
Age of respondent (years)	-0.50	-0.12
	(0.63)	(0.09)
Education of respondent (years)	-3.44	2.74**
	(1.32)	(0.31)
<15 age group (number)	-23.97	-22.70
	(31.06)	(11.13)
15-60 age group (number)	-6.91	8.28
	(20.97)	(3.66)
>60 age group (number)	4.87	8.11
	(7.79)	(6.44)
Relative HH education	2.49	2.35
	(6.23)	(2.49)
Caste (higher caste =1)	-23.16	-20.39
	(21.36)	(18.08)
% of agricultural income	-0.34	0.94
	(1.26)	(1.55)
% of income from business	-2.58	-0.07
	(1.45)	(0.12)

Table 7: Ordinary Least Squares results for the fuelwood and fodder revenue model for rainy season (Continued)

Variable	Rainy season revenue from fuelwood	Rainy season revenue from fodder
% of income from wage	-2.12	-0.02
	(1.31)	(0.89)
% of income from job	-0.53	-0.24
	(0.64)	(0.31)
% of income from remittances	-0.90	-0.02
	(0.41)	(0.11)
% of income from other income sources	-1.94	-0.51
	(5.34)	(0.42)
Travel time (minutes)	-2.28	-1.18
	(1.61)	(1.06)
Land holding (ha)	-154.9	-74.29
	(88.13)	(62.98)
Number of private trees planted	-0.69*	0.58
	(0.19)	(0.34)
Livestock		1.14
		(0.97)
Nawalparasi	51.96	9.58
	(129.8)	(13.55)
Lamjung	532.9*	-75.31
	(115.1)	(50.43)

Table 7: Ordinary Least Squares results for the fuelwood and fodder revenue model for rainy season (Continued)

Variable	Rainy season revenue from fuelwood	Rainy season revenue from fodder
Gorkha	-10.22	-59.91*
	(22.52)	(16.91)
Labor	114.2***	122.8***
	(7.41)	(6.58)
Constant	359.6	52.40
	(224.2)	(65.22)
Observations	780	780
Adjusted R^2	0.89	0.94

Notes:
Standard error in parenthesis
* = significant at 95 % level of significance
** = significant at 90 % level of significance
*** = significant at 99 % level of significance

Table 8 : Seemingly unrelated regression for winter season revenue from fuelwood and fodder collection

Variable	Winter season revenue from fuelwood	Winter season revenue from fodder
Gender of respondent (1 =	-473.3*	174.0
female)	(194.6)	(161.2)
Age of respondent (years)	0.47	3.55
	(2.95)	(2.45)
Education of respondent (years)	-3.06	-27.42**
	(12.48)	(10.35)
<15 age group (number)	20.68	49.67
	(113.6)	(94.20)
15-60 age group (number)	-1.38	147.3*
	(76.86)	(63.88)
>60 age group (number)	73.67	-137.1
	(117.3)	(97.04)
Relative HH education	30.95	-52.87
	(43.69)	(36.24)
Caste (higher caste =1)	-4.15	356.0*
	(201.4)	(167.6)
% of agricultural income	6.02	10.27*
	(5.80)	(4.83)
% of income from business	-4.18	0.79
	(4.63)	(3.84)

Table 8: Seemingly unrelated regression for winter season revenue from fuelwood and fodder collection (continued)

Variable	Winter season revenue from fuelwood	Winter season revenue from fodder
% of income from wage	-2.01	4.47
	(4.73)	(3.93)
% of income from job	-1.09	5.16
	(4.10)	(3.40)
% of income from remittance	-1.60	0.93
	(2.89)	(2.41)
% of income from others	5.74	-8.23
income sources	(30.77)	(25.47)
Travel time (minutes)	-23.32***	-26.13***
	(4.22)	(3.41)
Land holding(ha)	15.80	169.4
	(414.2)	(345.5)
Number of private trees planted	-2.27	-10.45***
	(3.13)	(2.61)
Nawalparasi	-2732.9***	-855.9***
	(284.0)	(235.3)
Lamjung	-3304.0***	-2219.7***
	(497.5)	(416.9)
Gorkha	-4089.5***	-1613.7*
	(287.7)	(233.5)

Table 8: Seemingly unrelated regression for winter season revenue from fuelwood and fodder collection (continued)

Variable	Winter season revenue from fuelwood	Winter season revenue from fodder
Season 3 labor	132.2***	92.79***
	(3.22)	(1.88)
Livestock		12.22
		(23.33)
Constant	4410.8***	1793.6***
	(617.2)	(507.2)
Observations	780	780
R^2	0.772	0.71

Notes:
Standard error in parenthesis
* = significant at 95 % level of significance
** = significant at 90 % level of significance
*** = significant at 99 % level of significanc

Chapter II: An Analysis of Household Dependence on Community Forests Across the Terai and Hilly Regions of Nepal

Chapter II: Abstract

Forests play an important role in the agrarian economy of rural Nepal by providing households with fuelwood, fodder and other needed forest resources. This research analyzes the dependency of rural households on community forest (CF) resources using data collected from an in-person survey of households in four districts (Chitwan, Lamjung, Gorkha and Nawalparasi) in Nepal. Household dependency on forest resources, represented here by the ratio of imputed income earned by rural households divided by total household income is regressed on household characteristics. Imputed income refers to the income earned by rural households by monetizing the forest resources using market price of the respective forest resources. The results suggest that households in the Terai region of Nepal are more dependent on fuelwood and firewood from CFs than are households in the Hilly region of Nepal. The number of livestock reared by respondents was positively associated with forest dependency. Land holdings, travel time (a proxy for distance) to the nearest CF, and number of privately-owned trees were negatively correlated with household dependency on CF. Private trees owned by rural households may be an alternative to CFs. Private tree plantations might encourage afforestation and reduce management issues related to resource distribution in CFs.

2.1 Introduction and Study Rationale

High dependence of the Nepalese people on forest resources for fuelwood, fodder, thatching and housing materials, and other non-timber forest products (NTFS) coupled with the government's inability to restrict unauthorized harvesting of forest resources in the 1960's and 1970's, caused widespread deforestation of Nepal's forests (Gautam et al. 2004). Nepal implemented community-based forestry in 1978 to conserve forest resources and alleviate poverty by providing access to forest products for subsistence needs (Warner, 1997; Chettri, Larsen, & Smith-hall, 2012). Under Nepal's community forest (CF) program, the government retains ownership of the land, while user rights are granted to Community Forest User Groups (CFUGs). These groups are responsible for making land and forest management decisions (Gautam et al. 2004). Thus, with the granting of user rights, local residents have an incentive to conserve forest resources. Currently, there are over 17,685 legally-recognized CFUGs managing over 1.6 million hectares, or about 45% of Nepal's forest land (MOFSC, 2015).

CFs yield direct and indirect benefits to local communities in a number of ways. The reduction and control of crop residues and animal dung for fodder and fuel use respectively are the direct benefits of using CFs for fuelwood and fodder. Thus, the use of crop residues and animal dung as farm fertilizer instead for energy purpose are expected to increase agricultural production (Babulo, 2007; Jagger and Pender, 2003; Mekuria et al., 2011; Shylendra, 2002; Tefera et al., 2005). Similarly, CFs offer environmental services by reducing soil erosion and downstream siltation (Babulo, 2007; Mekonnen, 2000; Mekuria et al., 2011; Shylendra, 2002; Tefera et al., 2005). The hill communities of Nepal are dependent on private trees and CFs for fodder and green grasses (Pandey, 1982; Eric 1992). Griffin et al. (1988) reports that CFs in the hilly region of Nepal supply at least 20% of the total fodder needed for livestock rearing.

Rural Nepalese households rely on forest resources from national, community, and private forests to support themselves in a variety of ways, including as fuelwood and fodder for energy and animal feed (Frozen and Oberholder 1984; Mahat et al. 1986; Wallacea 1988; Bartlett and Malla 1992; Chetri and Pandey 1994; Dahal 1994). Forest resources provides natural assets, cultural values, physical and biological products, and other services vital to communities (USDA, 2007; NRC, 2008). Rural Nepalese households are subsistence users of forest products (FAO, 2009; Maharjan et al., 2009). The dependency of Nepalese people on the use of fuelwood for cooking and house heating activities accounted for 83% of the total energy consumption in Nepal as of year 2001(Gautam, 2004; SOE, 2001; ADB, 2004). Currently, around 70% of total energy consumption in Nepal i.e., fuelwood originates from the forestry sector (MOF, 2015). The percentage of households using fuelwood for cooking increased from 77 to 84% from 1995-1996 to 2003-2004, according to the 1995-96 and 2003-04 Living Standards Measurement Surveys (Nepal, Nepal and Grismud, 2010). Rayamajhi et. al (2014) found that the income generated from forest resources was around 3 – 11% of the total household income in three community managed forests in Nepal. Similarly, household level studies in developing countries report that income from forests accounts for 15 – 39% of the total household income (Babulo et al., 2008, 2009; Cavendish, 2000; Kamanga, Vedeld, & Sjaastad, 2009; Mamo, Sjaastad, & Vedeld, 2007; McElwee, 2008; Uberhuaga, Smith- Hall, & Helles, 2012). Varied degree of dependence of rural households on CFs is expected across the Terai and Hilly regions of Nepal. No priori hypothesis can be formulated to state which region would have higher dependence as household data are used in present study. The regional characteristics of the Terai and Hilly regions are discussed in Chapter 1.

Adhikari et. al. (2004) used qualitative and quantitative analysis i.e., regression model to analyze the relationship between key household characteristics and the use of forest resources with the institutional change i.e., CFs formation in mid Hills of Nepal (Kabhre palanchowk and Sindhu Palchowk districts). A total of 330 surveyed households were stratified based on wealth status. The poorer households were having restricted benefits from CFs as compared to other economic status group i.e., medium and high. Similarly, livestock and land holdings were positively related to forest dependency while education of family members was negatively related to forest resource collection. Higher caste people were appropriating more benefits from the CFs.

Khanal Chhetri (2005) studied the factors influencing participation of rural households in CF management activities, i.e., forest protection, resource utilization and decision-making in Nepal's Kaski district representing the Hilly region of Nepal. The study investigated the variation in degree of dependence on CF income in relation to the key household characteristics among the 176 rural households. Female members of households were collecting most of the forest resources in the study area. Ordered logit regression showed respondent's sex (1 = female) and household size were statistically significant and positive regarding resource utilization. However, travel time to the CF was negative and significant.

Sapkota and Oden (2008) studied fuelwood collection from CFs in relation to household characteristics in a heterogeneous community in Rupandehi district representing Terai region of Nepal. Household survey was conducted among the 52 randomly selected households. Household income status exerted significant influence on fuelwood collection from CFs. Poor households were more dependent on CFs in terms of fuelwood collection. Similarly, distance to

CFs was negative and statistically significant. The quantity of fuelwood collected from the CFs was treated as an indicator of household dependence on CF.

A similar study by Panta et. al. (2009) in the Chitwan district representing Terai region of Nepal analyzed the forest dependency of rural households in terms of household economic status. Gini coefficient and Head count poverty index were constructed and analyzed. The study found that the income status of rural households was a major indicator of forest dependency in terms of fuelwood, fodder and other forest resources collected from CFs. Poor and medium income status households were collecting more forest resources compared to high income status households.

In the present study, all forest products collected by rural households are quantified and monetized based on a market price to calculate the imputed income from forest resources. However, unlike previous studies, no stratification of households in terms of economic status is done in the present study. Moreover, forest dependency is analyzed simultaneously across the Terai and Hilly region of Nepal, which gives uniqueness to the present study. The influence of socio-economic attributes of households on household dependence on CFs is analyzed in this chapter. The imputed share of household income generated from the collection of forest resources from forests is used to proxy household dependence on forest resources.

Higher dependence on forest resources might signify more use of forest resources by the rural households from the CFs and other forest sources too. Increased demand of forest resources might lead to more pressure on forests leading to deforestation of the CFs. CFs are formed with the objective of afforestation and local management of forest resources for better use of forest resources. Deforestation and degradation of CFs directly affect household wellbeing. Similarly, dependency also signifies the importance of forest resources to the rural households. Rural

households with greater dependence are more vulnerable to the adverse effects of unsustainable use of forest resources. The present study analyzes the household characteristics influencing forest dependence across four districts in Nepal's Terai and Hilly regions. Regional differences in forest dependency might require different forest management and forest policies across the two regions with regard to economic development. The findings of the present study can assist regional policy formulation in efforts to promote forest conservation through the promotion of private tree plantation. Proper management and utilization of forest resources is supposed to increase household wellbeing of rural people.

2.2 Survey Design and Data Collection

Survey design and Data Collection methods are the same as those mentioned above in Chapter 1 in section 1.3.

2.3 Empirical Model

Regional variation in household characteristics and preferences is expected to cause differences in dependency on CFs by the rural households in the Terai and Hilly regions of Nepal. Regional differences in household dependency are also expected because of differences in the CFs across the two regions, differences in land topography, average land holdings as well as other unobserved differences between the two regions. A dummy variable, representing household residence in the Terai region (Terai = 1), is used in a regression model to analyze the regional differences in forest dependency. Interacting the regional variable with the household characteristics provides insight into how the effects of the household characteristics on forest dependency differ between Nepal's Hilly and Terai regions. Potential differences in the two surveyed regions will be evident with statistically significant coefficient values for the regional

dummy variables as well as the interaction terms. The following linear specification of the regression model is used for the empirical analysis:

$$y = \beta_0 + \delta_0 * d + \beta_1 * X + \delta_1 * d * X + \mu \quad (1)$$

where *y* is the relative imputed income from forest resources

X are the independent variables i.e., household characteristics

d is a regional dummy variable (1 = Terai) and

μ is the error term

The error terms (μ) is assumed to be normally distributed with mean zero and a variance of σ^2.

The dependent variable *y* is computed as follows:

$$y = \frac{Imputed\ income\ from\ forest\ resources}{Total\ household\ income(includeing\ imputed\ income\ from\ forest\ resources)} \quad (2)$$

where imputed income from forest resources are calculated based on the market price and reported quantities of the respective forest resources; and

total household income included household income from different sources i.e., job, wage, agriculture, business, remittance and all other income sources (as described in Chapter 1).

2.4 Specification of Independent and Dependent Variables

The imputed relative income each household generates from CF is the dependent variable in this study. The different products each household appropriates from the CF are monetized based on local market prices as determined through a focus group discussions in each district (as discussed in more detail in Chapter 1). The quantities of forest resources collected i.e., forest fruits, vegetables, herbs etc. was done in local units and were minimal in respect to fuelwood and fodder collected. Approximate values reported by the households were used for imputed income calculation. Relative imputed income is calculated for each household by dividing the product of the market prices and quantities of forest products collected by the household's aggregate actual

income. The price of one bahri (headload) of fuelwood varied across Hilly and Terai regions with the price slightly higher in Terai region as compared to the Hilly region. No previous studies have quantified the fodder value per headload so the headload value of straw/hay is used to proxy the headload value of fodder collected from CF. The price of headload of straw/hay varied in Hilly region and Terai regions as reported during focus group discussions. Similarly, the local price of the forest products reported during the focus group discussion is used to calculate the income generated from those products for example herbs, forest fruits and vegetables.

2.4.1 Independent variables

Aggregate household education is calculated for the surveyed household by dividing the total number of years of schooling of household members by the total number of household members. Families with relatively more household education (RHE) are expected to be less dependent on forest resources (Table 9). More education means more diverse, stable, and preferable employment opportunities for family members and, thus, higher opportunity costs to forest resource collection. Similarly, higher levels of relative education for household may imply ongoing engagement of household members in schooling activities, potentially making them less available for forest related collection activities.

The number of livestock (LIVESTOCK) owned by each household is expected to be positively correlated with household dependency on forest resources (Adhikari et. al., 2004). Households with relatively more livestock need more fodder to feed them.

A household's landholdings (LAND) is expected to be negatively associated with dependency on forest products. With more land, household members are busy in agricultural activities and can allocate less labor for fuelwood and fodder collection.

The number of trees owned by the household (TREES) is expected to be negatively correlated with dependency on forests for fuelwood and fodder for both the Terai and Hilly regions (Cooke, 2016); Heltberg et al. (2000); and Van't vend et al. (2007)). Household needs for fuel and fodder can be met from private trees grown on their own land. Thus, privately-owned trees likely act as a substitute to fuelwood and fodder collected from CF. Rural households are dependent on CF mostly for these two resources i.e., fuelwood to use as energy source and fodder to feed animals.

Rural people in Nepal may be unaware of the actual distance from their household to the nearest CF, so travel time to the nearest CF is used to proxy distance (DIST). The travel time to the nearest CF (in minutes) is expected to have a negative relationship with forest dependency in general across both the regions (Khanal Chhetri (2005); Sapkota and Oden (2008)). Longer travel time to the CFs increases the cost of collecting forest resources and may correspond with less fuelwood and fodder collected by households.

The independent variable income (INCOME) is a binary variable equal to one for households with aggregate income from salary, business and remittances sources greater than aggregate income from agriculture and wage sources and zero otherwise. Rural households with more income from agriculture and wages are agrarian households. These households are less wealthy than other rural households. Rural households with INCOME equal to one are expected to be less reliant on forest resources for fuelwood because they may opt for cleaner source of energy use. Higher levels of household income also imply involvement of household members in other opportunities rather than involvement in forest resource collection activities.

The number of family members in a particular household (FAMILY) is expected to be correlated with household dependency on forest resources (Table 9). Family members with low

opportunity cost would increase the forest dependence while presence of family members with high opportunity cost will lead to decrease in forest dependency. No priori hypothesis can be formulated as family members might be positively/negatively correlated with forest dependency.

Caste and gender play a prominent role in Nepalese society. Caste (CASTE) is presented as a dummy variable with one for higher castes (i.e., Brahmin and Chhetri) and zero otherwise. Lower caste households are expected to be more dependent on forest resources as these households are resource poor. Lower caste households also lack means to use alternative sources of energy. Similarly, lower caste people are more engaged in labor-oriented jobs leading them to low income groups.

A regional dummy variable for households in the Terai region (REGION) (=1 for Terai region and 0 otherwise) is expected to be positively correlated with forest dependence (Table 9). Flat topography in Terai region; absence of sloppy undulated land for private tree plantation coupled with higher demand for fuelwood and fodder might be a reason for this.

2.5 Model Diagnostics

An F-test is used to test the restriction that the coefficients of the independent variables are same across the two regions using a regional dummy variable i.e., H_0: $\delta_0 = \delta_1 = 0$. With 8 degrees of freedom in the numerator and 762 degrees of freedom in the denominator, the critical value of the F test is 3.26 at the 0.001 level of significance. Rejection of the null hypothesis indicates that the determinants of household dependency on forest resources (as measured by the imputed share of income from forest products) vary in terms of their effects on dependency in the Hilly and Terai regions.

Regression collinearity diagnostic of the explanatory variables and the conditional index for the independent variables are calculated for the independent variables (Besley, Kun and

Welsh, 1980). The conditional index value for all the explanatory variables less than 30 implies multicollinearity is not a problem in terms of inflating standard errors (Besley et al, 1980).

2.6 Results and Discussion

2.6.1 Summary statistics and Socio-economic demographics along Terai and Hilly Regions

The relative income from forest resources ranged from 0 to 57.88 percent of total household income, with a mean value of 11.55 for the entire sample of surveyed households (Table 9). The average number of family members was five with the maximum being 13 and the minimum being one. The mean of relative household education was six, with a maximum value of 21 and minimum value of zero. Average travel time to the nearest CF was 27 minutes. The maximum travel time was 120 minutes while the minimum travel time was 2 minutes. The mean number of livestock was four with the maximum number of 20 and minimum number of 0. The average number of private trees was 15 with a maximum of 520 and a minimum of 0. Similarly, the average landholdings was 0.27 hectares (ha) with a maximum of 2.5 hectares and a minimum of 0.02 ha.

The mean quantity of fuelwood collected from CFs is 36.64 headload in the Terai region whereas it is 29.66 headload for the Hilly region (Table 10). The difference in fuelwood collected across the two regions was statistically significant implying households were collecting more fuelwood from CFs in Terai region as compared to households in Hilly region. The findings give an idea about the amount of fuelwood collected in average by the surveyed households. Similarly, fuelwood collection time was statistically different for the two regions and higher for the Hilly region. The rough topography and absence of proper roads in the Hilly region may have attributed to these findings. Households in the Hilly region had more privately-owned trees. The difference in the number of livestock reared was statistically significant across

the two regions i.e., five in the Hilly region as compared to three in the Terai region. Contrary to reports by CBS (2014), landholdings averaged about 0.34 ha in Hilly region as compared to 0.2 ha in Terai region for the surveyed households. The difference in landholdings across the community forest representing two regions i.e., Hilly and Terai region was statistically significant (Table 10).

Differences in livestock ownership, privately owned trees, and less fuelwood and fodder collected from the CFs suggests that households in the Hilly region are likely to be less reliant on CF for fodder and fuelwood. These households possessed fewer private trees and livestock.

2.6.2 Results and Discussion for the Regression Model

The conditional index value for all the explanatory variables was 13.38 implying no problem of collinearity in the use of these independent variables for regression analysis. Null hypothesis is rejected stating that the coefficients of the interaction terms between the regional dummy and independent variable is zero.

The F-statistic for the null hypothesis H_0: $\delta_0 = \delta_1 = 0$ was 3.48, with p-value of 0.00 (F-critical value = 3.26 at 0.001 level of significance with 8 numerator and 762 denominator degrees of freedom). Thus, regional differences were prevalent in terms of dependency on CFs. Independent variables i.e., socio-economic demographics had varying effects on the household dependency on CF across the two regions. The goodness of fit (R^2) value was 0.40 (Table 11).

The regression coefficient for TREES was negative, indicating that a greater number of private trees is correlated with less dependence on CF for fuelwood and fodder. For each additional privately-owned tree, household dependency decreased by 0.02. This finding is consistent with those of Cooke, (2016); Heltberg et al. (2000); and Van't vend et al. (2007).

An additional hectare of LAND is associated with a decrease in relative income from forest resource by 3.90, other factors held constant. Increased landholdings lead to increased workload for rural household in farm activities, which might lead to decreased forest activities. Similarly, an increase in landholdings leads to an increase in income from farm operations to a family ultimately leading to reduction in relative income generation from forest activities.

The regression coefficient for DIST was negative. As travel time to the nearest CF increases, the quantity of forest products collected decreases, similar to findings in Khanal Chhetri (2005) and Sapkota and Oden (2008).

INCOME was negative and statistically significant with a value of 12.85 implying that households with more income from agriculture and wages are more dependent on forest resources as compared to the households with more income from remittance, business and salary.

Lower caste households are found to be more dependent on forest resources. The variable CASTE was negative and significant with the value of 2.9. Adhikari et al. (2004) found higher caste people to be more dependent on forest resources as opposite of the findings. Lower caste people are resource poor, exert less influence in societal and CF management and decision making process. Similarly, poor people lack means to use alternative source of energy, which leave them no choice, but to be dependent on forest resources.

As expected, the more livestock a household possesses, the greater the dependence on CFs. For each additional head of livestock, dependency increases by 0.28, other factors held constant (Table 13). More fodder will be required for increased livestock. The fodder needed for livestock can either be collected from CF or from privately-owned trees. Adhikari et. al., (2004) found similar results where households were collecting more fodder for an increased number of livestock.

The coefficient for REGION was - 7.00 and statistically significant. The people in the surveyed districts representing the Terai region are less dependent on forests. Regional characteristics such as flat land leading to more productive agricultural land and other employment opportunities might explain this finding.

The interaction effect of the variables DIST and LIVESTOCK with REGION shows that regional differences in forest dependency prevails in terms of these independent variables. The variable DIST was decreasing forest dependence less in Terai region as compared to Hilly region. The flat land in Terai with proper road facilities provides justification of these findings.

On the contrary, the number of livestock reared by a household would increase forest dependency more in the Terai region than in the Hilly region. Private tree plantation can act as a substitute to CFs. Less private trees are planted in Terai region, which would lead to more dependence on forest resources for fodder in Terai region as LIVESTOCK number increases.

2.7 Conclusion

CF has been a source of fuelwood and fodder for rural households. Forest activities aligned with agricultural activities form the livelihood of rural households in Nepal. Households in the Terai region collect more fuel wood and spend less time for fuel wood collection than do households in the Hilly region of Nepal. Educational attainment was higher for respondents in the Hilly region compared to the Terai region. Animal husbandry in terms of number of livestock owned was higher for the Hilly region, as was the number of trees owned by households. Land holdings were greater in the Hilly region than in the Terai region. With the differences in socio-economic demographics and preferences for livestock and animal husbandry, regional difference in terms of fuel wood collection and fodder collection were observed in the study area. Forest dependence in terms of fuel wood and fodder can be minimized by promoting private tree plantation in both

these areas. Similarly, the promotion of alternate sources of energy in place of fuel wood can help to minimize the pressure on forest and afforestation can be promoted.

The regression analysis of the relative income from forest resources as the dependent variable and socio-economic demographics as independent variables showed that educational attainment, land holdings, travel time to the nearest community forest and number of privately-owned trees were negatively associated with household dependency on community forests. Thus, regional policy can focus on decreasing forest reliance/dependence or improving forest conservation by improving educational attainment and increasing private tree plantation in that region. The policy can focus on lower caste people regarding more working opportunities to them in order to decrease forest dependency. Small-scale cottage industries utilizing the local forest resources might help to reduce forest dependence. These activities might lead to better opportunity cost of labor use by these households and less reliance on forest for subsistence. Similarly, regional policy can focus on the use of alternative sources of energy leading to less reliance on forest resources.

2. A. Appendix

2. A. 1. Tables

Table 9 : Statistics of independent and dependent variables across the two regions along with the expected sign in regression model

Variables	Definition	Units	Mean	Max	Min	Expected Signs
RI	Imputed relative income from forest resources	Ratio	11.55	57.88	0.00	Dependent variable
FAMILY	Family members	Count	5.00	13.00	1.00	+/-
RHE	Relative household education	Ratio	6.00	21.00	0.00	-
CASTE	Caste dummy		0.48	1.00	0.00	-
INCOME	Income Dummy		0.39	1.00	0.00	-
TERAI	Regional dummy		0.50	1.00	0.00	+
DIST	Travel time to the nearest CF(minutes)	Count	27	120.00	2.00	-
LIVESTOCK	Livestock	Count	4.00	20.00	0.00	+
LAND	Land holdings (Hectare)	Count	0.27	2.50	0.02	-
TREES	Private tree plantations	Count	15.00	520	0.00	-
N	Total number of observations	Count	780			

Table 10 : Differences in mean values of demographic and resource variables across the Terai and Hilly regions of Nepal

Variables	Terai (Timber forest)	Hilly (Mixed forest)
Household income	269,650 (115,56)	295,906 (104,45)
Fuelwood collected (in headload)	36.64*** (20.84)	29.66*** (18.18)
Fuelwood collection time (minutes)	57.50*** (40.13)	66.07*** (44.95)
Fodder collected (in headload)	36.71 (52.03)	34.38 (41.67)
Fodder collection time (minutes)	70.54 (79.858)	62.68 (92.92)
Number of private trees	3.00*** (6.34)	27*** (42.29)
Number of livestock	3.00*** (2.76)	5.00*** (4.30)
Landholdings (hectare)	0.20*** (0.17)	0.34*** (0.28)
Number of observations	390	390

Notes:
*** = signifies statistical differences of mean values using two sample t-test
Standard errors in parenthesis

Table 11: Regression analysis of household dependency on forest resources

Dependent variable : Relative income earned from forest resources	
Independent Variables	
TREES	-0.0223** (0.00731)
LAND	-3.900*** (1.032)
LIVESTOCK	0.282** (0.102)
DIST	-0.100** (0.0317)
CASTE	-2.880*** (0.646)
RHE	-0.256 (0.158)
INCOME	-12.85*** (1.436)
FAMILY	-0.612*** (0.180)
TERAI	-7.001* (3.113)
Interaction terms	
FAMILY × TERAI	0.626 (0.334)
RHE × TERAI	0.206 (0.233)
CASTE × TERAI	2.272 (1.167)
INCOME × TERAI	-0.358 (2.118)
DIST × TERAI	0.0918** (0.0337)
LIVESTOCK × TERAI	0.768*** (0.211)
LAND × TERAI	-0.768 (2.482)

Table 11: Regression analysis of household dependency on forest resources (continued)

Dependent variable : Relative income earned from forest resources	
TREES x TERAI	-0.0951 (0.0707)
Constant	29.29*** (2.195)
Observations	780
R^2	0.402
F-statistic for the entire model	21.14
F-statistic for the restrictions ($H_0 : \delta_0 = \delta_1 = 0$)	3.48
(Critical F-value for the restrictions applied)	(3.26)

Notes:
Standard error in parenthesis
* = significant at 95 % level of significance
** = significant at 90 % level of significance
*** = significant at 99 % level of significance

2. A. 2 Figures

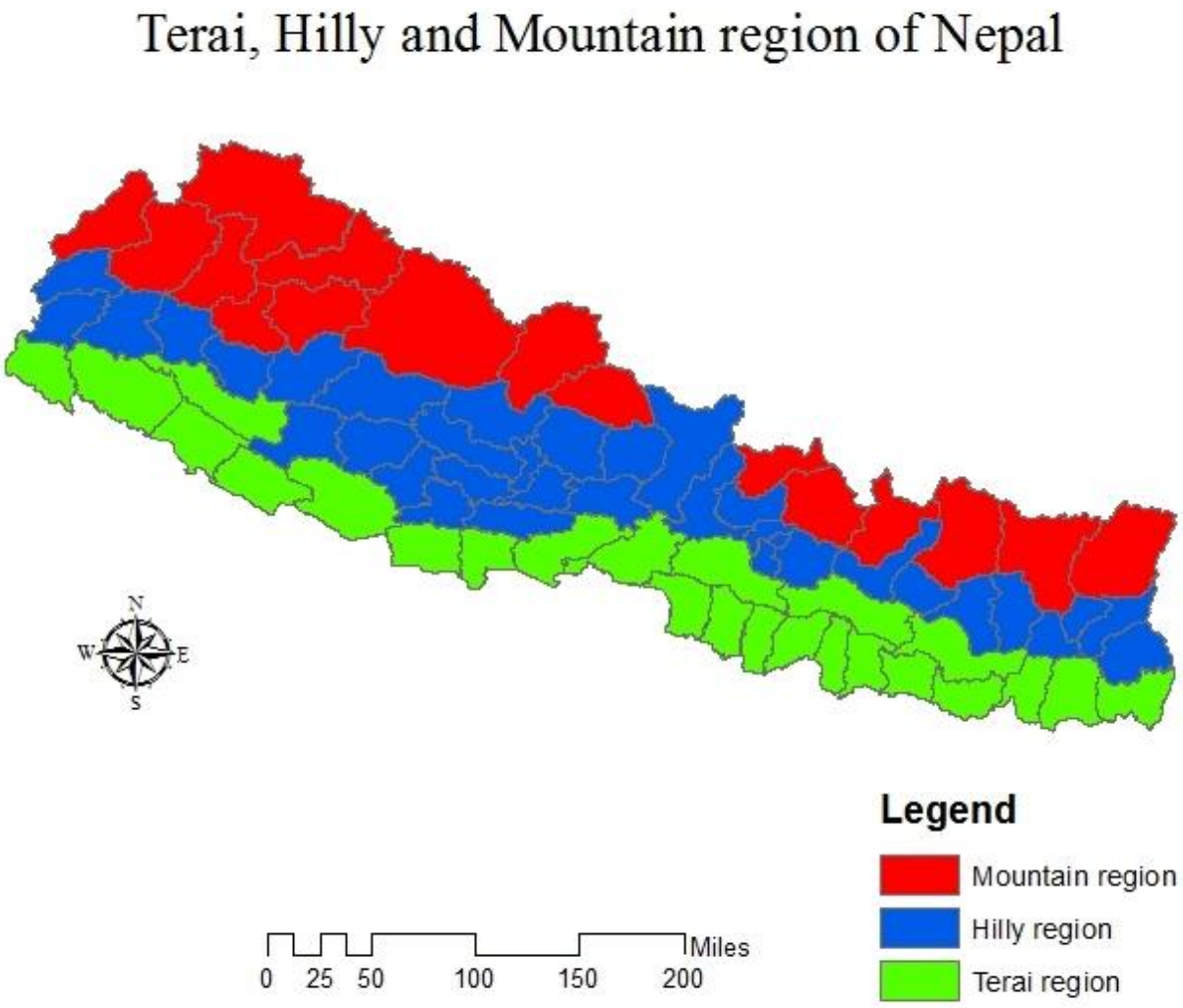

Figure 1: Map of Nepal showing three different regions

Chapter III: Role of Women in Community Forest User Groups in Nepal: A Perception Analysis using Ordered Logit Analysis

Chapter III: Abstract

Women play an important role in household and resource collection activities. Out-migration of the male population for work opens up the door for women in management and decision making roles in society. An ordered logit regression analysis of Likert scale responses regarding the role of women in CFUG management and decision-making activities were analyzed in the present study. Regional and caste differences are prevalent and women are still not regarded capable for management and decision making abilities. Extension activities and policies focusing on importance of women in resource management can foster positive attitude towards women in Nepalese societies.

3.1 Introduction and Study Rationale

Women play a significant role in the domestic household activities due to their involvement in household activities. Women are also involved in the collection of fuelwood, firewood and forest products needed for day to day household activities. Due to their active role as resource collector, women play an important role in natural resource policies in the developing world like Nepal.

The prevalence of Nepal's caste system along with the sex and age of individuals predefine a set of roles for an individual to perform in the society. Traditionally, women have predefined manners and behaviors to follow in households belonging to high caste Hindu (Bennett 1983, Gray 1990, Kondos 1990). Similarly, men are given higher status and importance in Nepalese society (Shrestha 1999). Women typically manage household, rear children, farm and collect and use forest products (Thacker 1993, Bhatt et. al. 1997). Thus, caste and gender play a significant role in defining the role women play at the household level in Nepalese society.

Nepal's community forest program has been a catalyst for social inclusion in Nepal i.e., means to empower women. Community forestry has contributed positive impacts on gender equality, empowerment, poverty reduction and forest resource management. In the early stages of the community forest program, women's participation was completely ignored in the planning cycle. However, women's participation was significant in the implementation of forest related activities. Mere participation of women in the implementation of activities does not necessarily ensure effective participation in decision-making. Effective participation requires recognition of women's views and accountancy of those views during decision-making process (Agrawal & Ostrom 2001). In Nepal, women often just participate physically in various community forest

activities and lack influential decision-making roles. Unless and until women can play a vital role in every decision-making process in all stages of community forest, it cannot be accounted as increment of women's meaningful participation or women empowerment in an authentic way (Kanel & Kanel 2006).

Studies regarding women's participation have shown that husbands and other male members discourage women because they have preconception of women being illiterate, incapable, and not able to express their views and opinions in the decision making process (Upadhyay 1995, Thapa 1999, Nepal 2007). Women supported by NGOs used to take part in the meetings on a regular basis, but they also have bitter experience of non-participation in the decision making process (Koirala, Giri & Pokhrel 2008). After three decades of community forest program, studies have increasingly focused on the extent to which CFUGs implement democratic practices, improve livelihood options and restore ecological benefits (Dhital, 2009). Banjade et. al. (2004) has outlined social exclusion prevalent in community forestry of Nepal in the forms and intensity of membership, representation in decision-making forums, benefit sharing and access to information.

Social relationships and interactions within community have changed as compared with the past but the poor, women and lower caste groups' access and control to the institution are still minimal (Timsina, 2002). CF policy and programs further marginalize the weaker section of the society, specifically, the poor women and the oppressed and the policy and program vest the rights and responsibilities only to a few key individuals in the community (Timsina, 2002).

Regarding the community forest program in Nepal, social inclusion of women has received a lot of attention and women's participation has been encouraging. Physical inclusion of women in CF decision making and implementation activities does not go well with the notion

of gender equity/equality. Gender equality means that women and men have equal conditions for realizing their full human rights and for contributing to, and benefiting from, economic, social, cultural and political development (UNESCO, 2003). Gender equality is therefore the equal valuing by society of the similarities and the differences of men and women, and the roles they play. It is based on women and men being full partners in their home, their community and their society (UNESCO, 2003). The meaningful presence of women in the decision making body i.e., executive committee and rights to use their voices in the decision making process, will only ensure that women are not neglected anymore in the decision making process. The empowerment of women in individual household level can only ensure that women are empowered in community and in the societal level.

How would the presence of women in community institutions of forest governance improve resource conservation and regeneration? Agarwal (2009) found that groups in India and Nepal with a high proportion of women in their executive committee (EC) i.e., the decision making body, showed greater improvements in forest conditions. Moreover, groups with all women ECs in Nepal sample were having better forest regeneration and canopy growth despite the fact of receiving much smaller and more degraded forests. Women's contribution to forest conservation and rule compliance was having significant impact on conservation outcomes. The huge knowledge base of plant species and the methods of product extraction coupled with the greater cooperation among women were the contributing factors for resource conservation.

Women play a pivotal role in both household and resource conservation activities. How the individual members and the society view women's roles forms the fundamental question of the realization of the importance of women's participation and active involvement in resource conservation activities. The present study analyzes the perception of surveyed household

members regarding the role of women in CF activities i.e., both at the decision making and implementation phases. Are women involved more than men regarding household and forest work? Are the voices of women being heard at CFUG member meetings? Do women play a role of communication within the society for the flow of important decisions and message of CFUGs agendas? In the present study, these questions will be answered in the form of perceptive analysis of the respondents using a Likert scale measuring the perceptive behavior of the responedets; which will be further analyzed using ordered logit regression.

3.2 Survey Data and Data Collection Methods

Survey design and Data Collection methods is the same as mentioned above in Chapter 1 in section 1.3.

3.3 Background Information for Study

An estimated 2 million people were absent among the 26 million population in Nepal for the year 2011. Looking back at the data of 1960's and 1970's when the percentage of absent population used to be around 3-4%, it has significantly increased to 7.3% in 2011(Table 12). As of the report from Ministry of labor, the number of male labor migrants was around 492726 for the year 2013/14 as compared to 211371 of the year 2008/09(Table 12). The outmigration has increased by 133.1% in the year 2013/14 as compared to the base year of 2008/09(Table 12). Thus, outmigration among the male population is in surge. Similarly, women workers are also leaving the country in search of work but the relative number of female labor migrant is lesser as compared to males. The number of female migrant labor was 29152 as compared to 492726 male migrants in the year 2013/14 (Table 12).

High population growth rate (1.84% annually, 2014) coupled with the civil war (Maoist war) has propelled outmigration of the working class people in Nepal. The political instability in

the country leading to lack of job opportunities has impinged the Nepali youth for outmigration. As of the data of 2013/14, remittance generated by outmigration accounts for around 29.1% of the total GDP of Nepal (Table 14). Remittance as a prominent sector to contribute to the total GDP of Nepal shows the exodus of Nepali youth propelled to leave the country for employment.

Outmigration of Nepali youth/ working class especially male population has opened the door for more involvement of women in the management aspects of CFUGs. High outmigration of male population has brought a changed socio-economic condition to the society. The absenteeism of the so called working class opens the door for women participation and involvement in the management issues pertaining to common pool resource management in Nepalese condition. 2848 CFUGs out of 18690 CFUGs in Nepal which accounts for 15.01% of the total CFUGs have either been run by women groups or have more than 50% women involvement in the working committee (MOF, August, 2015). With increased role of women and increase in the number of CFUGs lead by women, more obligations along with the opportunities are present to women in Nepalese society.

Gender equity cannot be achieved without equal participation of women in each sector of the society. Looking at the secondary data, we see there is still a gender gap of 17.1% as of 2011 regarding the literacy status of women and men in Nepal. 75.1 percent male population are literate as compared to 57.4 percent female population of age of 5 years and more in the year 2011 (Table 15). This shows the difference in the reality of Nepalese society regarding girl's education. In one side, out-migration opens up the door for women participation in CF activities. Contrary, in the hind side, literacy status of women in Nepalese condition act as obstacle for women's involvement in CF management activities.

3.4 Empirical Model

A Likert scale is a psychometric scale developed by psychologist Rensis Likert (Likert, 1932). Five level Likert item is used in the present study to record the surveyed respondent's perception about the various roles of women in CF management and decision making. The respondent's response will be categorized into five categories i.e., strongly disagree, disagree, undecided, agree and strongly agree. Score from 1 to 5 in ascending order is used for these categories respectively. The Likert scores than will be analyzed using ordered logit regression (Long and Freese,2014). The dependent variable will be the ordered response of the respondents regarding the role of women in CF management and decision making process. Women possess more knowledge than male regarding forest management; women's involvement in decision making helps better implementation of rules and regulations formulated; women's view and opinion should be properly addressed during CFUG committee formation and decision making; presence of women in CFUG working committee helps to reduce conflict within the working committee; and importance is given to opinions and ideas of women during implementation and decision making process in CFUG are the ordered dependent variable in the present study. Similarly, logit regression (Long and Freese, 2014) was used to analyze the dependent variable with binary response. The dependent variable for the logistic regression model was: more time is spent by female members as compared to male members in forest activities.

The structural model defining the dependent variable y^* as a latent variable is as follows:

$y^* = x\beta + e$,

where the error term 'e 'follows standard logistic distribution.

The latent variable y^* is divided into J ordinal categories. The linear model is estimated using ordered logit regression (Long and Freese, 2014). For the logit model, the latent variable y^* is a binary outcome and is estimated using logit regression (Long and Freese,2014).

3.5 Explanatory Variables

Education is used as a means of information which leads to change in attitude. Education of individuals and the educational attainment of family members will act as a source of information for disposing perception/attitude towards role of women. Positive relationship between Educational attainment and positive perception towards the role of women is expected.

Similarly, caste differences are supposed to determine the affect i.e., feelings and emotions associated with women. Higher caste people are expected to have negative perceptions towards role of women in CF management and decision making process. Gender differences will also signify the affect i.e., feelings and emotions associated with women. Males are expected to have negative relation with the perceptive behavior of women as management and decision makers.

Income variable is constructed as 1 for those households whose income from salary, business and remittance sources are greater than those households with income from agriculture and daily wages. Families with relatively more income from agricultural sources; i.e., agriculture and daily wages are to have negative attitude towards the role of women. Families with non-agrarian activities are to be more educated and well informed which in turn will help to develop positive attitude towards role of women in CFUG management. Community forestry program started from the Hilly regions of Nepal. The implementation of CFUG in Terai region occurred later than in Hilly regions of Nepal. People in Hilly region are to have positive attitude towards the role of women as compared to Terai region.

Age of a respondent can shape both positive/negative attitude towards the role of women in management and decision making role in CFs. More aged respondents are expected to have positive attitude if they have been educated or informed during the course of time. On the contrary, uneducated person's attitude will remain negative regarding the role of women in CFUG management activities.

3.6 Results and Discussion

Majority of the respondents (560) agreed with the fact that women spend more time in forest related activities than man do, while the rest of households disagreed with the fact (Table 16). Females are less likely to agree with the fact that they spend more time in forest related activities than males. Individuals in hilly region are less likely to agree to fact that women spent less time than male in forest related activities (Table 16). Households with more relative education are more likely to agree with the fact that women spend more time in forest related activities than male do.

Higher caste individuals were likely to disagree with the fact that women possess more knowledge about forest management. Contrary, the people in Hilly region are more likely to agree with the idea that female possess more knowledge (Table 17). The families with higher relative education however, are likely to disagree with the fact that women possess more knowledge than male. Income dummy variable is positively related with the perceptive behavior of individuals. The respondent belonging to higher caste causes 0.003 increase in probability to strongly disagree and causes 0.04 increase in probability to disagree with the fact that women possess better forest management knowledge (Table 18). Similarly, respondent belonging to mixed type forest in the Hilly regions leads to 0.03 increment of probability to agree and 0.08 increase in probability to strongly agree with the fact that women have better forest management

knowledge. Households reporting a relatively higher level of education were more 0.05 likely to disagree with the statement. Similarly, families belonging to income category with income source greater from jobs, remittance and business will lead to increase in probability to agree by 0.04 and strongly agree by 0.06 that women possess more knowledge.

The respondents in the Hilly region are more likely to agree with the statement that women's involvement in decision making helps better implementation of rules and regulations formulated (Table 19). The respondents with income from non-agrarian sources are also more likely to agree with the fact. However, the respondents with higher relative education will disagree with the same fact. The marginal effects show that respondents belonging to mixed type forest in Hilly regions will lead to increment in probability to strongly agree by 0.15 with the same fact that women's involvement in decision-making process in CFUG helps for better implementation of rules and regulations formulated in the group (Table 20). Similarly, households with more relative household education will lead to increase in probability to disagree by 0.05. The probability of strong agreement increases by 0.04 with a household belonging to income category with income greater from non- agrarian income sources with the above-mentioned perceptive statement (Table 20).

The people in Hilly region are likely to agree with the fact that women's view and opinion should be properly addressed during CFUG formation and decision making process (Table 21). Similarly, the likeliness to agree with fact is higher for the households with more non-agrarian income sources. On the contrary, more aged respondents and respondents with higher relative education are more likely to disagree. Looking at the marginal effect, the probability to strongly agree with the statement increases by 0.27 for respondents in the Hilly region (Table 22). For the respondents representing households with greater income from non-

agrarian sources, the probability will increase by 0.07 to strongly agree with the same above-mentioned fact.

The respondents representing the mixed forest in the Hilly region of Nepal seems to have positive concern about the women empowerment and involvement in management and decision making process. The Hilly region people are more likely to agree with the fact that women in CFUG working committee helps to reduce conflict within the working committee (Table 23). Similarly, households with more non-agrarian income are more likely to agree with the fact. Looking at the marginal effect, increment in probability by 0.05 to agree and 0.1 to strongly agree will occur for the respondent being of Hilly region with the fact that presence of women in CFUG working committee will help to reduce conflict within the group (Table 24). Similarly, households belonging to income category with more non-agrarian household income will increase the probability by 0.04 to strongly agree with the above-mentioned statement regarding the role of women (Table 24).

Higher caste people are more likely to disagree with the fact that women's ideas are given importance during implementation and decision making process in CFUG (Table 25). On the other side, the respondents representing mixed forest in Hilly region had agreement with the fact that women's ideas are given importance during implementation and decision making process. The probability to strongly disagree increases by 0.005 and disagree by 0.02 with the fact that women's ideas and opinion are given importance during implementation and decision making process for the respondent belonging to higher caste (Table 26). Contrary, the probability increases by 0.06 to agree and 0.11 to strongly agree for the respondents representing the mixed forest with the similar statement.

3.7 Conclusion

Limited land resources for crop cultivation, high population growth rate and lack of job opportunities in the country has led to exodus of Nepali youth for foreign employment. Thus, out-migration of the working class i.e., active male population in search of employment is in surge in Nepalese condition as remittance has become an important sector of household earnings. While the women are less educated than men in Nepalese condition who are the care-taker of the family affairs in the absence of male population. These changing socio-economic conditions have provided both opportunities and challenges to women in Nepalese condition. Realization of importance of women's involvement in implementation and decision-making process in community forest forms a challenge in rural socio-economic situation.

Women are the primary actors involved in forest and household activities. Based on the findings of the study area, caste and regional differences were seen regarding the role of women in implementation and decision making activities in CF. Relative household education was positively related with perceptive behavior of respondents. Non-agrarian households were positive towards the role of women. Government policy need to focus on programs and activities to promote women education in Nepal for the agrarian households.

3. A. Appendix

3. A. 1 Table

Table 12 : Statistics on outmigration from Nepal based on absent population

Year of census	Total population	Absent population	% of total population
1961	9741466	328470	3.4
1971	NA	NA	NA
1981	15425816	402977	2.6
1991	19499115	658290	3.4
2001	23499115	762181	3.2
2011	26494504	1921494	7.3

Source: Kansakar (2003) and CBS (2011)

Table 13: Statistics on labor permits issued to male and female labor migrants in Nepal

Year	Total labor migrants	Female labor migrants	Male labor migrants
2008/09	219965	8594 (3.9%)	211371
2009/10	294094	10056 (3.4%)	284038
2010/11	354716	10416 (2.9%)	344300
2011/12	384665	22958 (6.0%)	361680
2012/13	450834	27742 (6.2%)	423092
2013/14	521878	29152 (5.6%)	492726

Source: Department of Foreign Employment, Ministry of Labor and Employment (2014).

Table 14 : Percentage contribution of remittance to GDP

Year	% contribution of remittance to GDP
2008/09	21.2
2009/10	19.4
2010/11	18.5
2011/12	23.5
2012/13	25.7
2013/14	29.1

Source: Economic survey (2014)

Table 15: Statistics on literacy status of Nepal by age 5+

Census year	Total	Female	Male	Gender gap
1952/54	5.3	0.7	9.5	8.8
1961	8.9	1.8	16.3	14.5
1971	13.9	3.9	23.6	19.7
1981	23.3	12.0	34.0	22.0
1991	39.6	25.0	54.5	29.5
2001	54.1	42.8	65.5	22.7
2011	65.9	57.4	75.1	17.7

Source: CBS (2011)

Table 16: Logistic regression for the perception analysis of more time spent by female members as compared to male members

Variable	Coefficient
Gender(female = 1)	-0.601***(0.16)
Caste(higher caste = 1)	.06(0.18)
Education	0.008(0.017)
Forest type (mixed =1)	-1.14***(0.17)
Relative education	0.13***(0.03)
Income dummy variable	-0.18 (0.22)
Age of respondents (years)	0.005(0.005)
Observations	780
Pseudo R Square	0.076
Log likelihood	-428.12

Notes: Standard error in parenthesis

*p<0.10, **p<0.05), ***p<0.01

Table 17: Ordered logit regression for the perception analysis of females possessing more knowledge regarding forest management

Variable	Coefficient
Gender(female = 1)	-0.13(0.15)
Caste(higher caste = 1)	-0.52***(0.16)
Education	0.02(0.017)
Forest type (mixed =1)	0.64***(0.15)
Relative education	-0.06**(0.03)
Income dummy variable	0.55**(0.19)
Age of respondents (years)	-0.002(0.002)
Cut 1	-4.88(0.48)
Cut 2	-2.24(0.27)
Cut 3	-1.16(0.26)
Cut 4	1.84(0.27)
Observations	780
Pseudo R Square	0.03
Log likelihood	-853.43

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Table 18: Marginal effects of socio-economic demographics on the perception of female possessing more knowledge regarding forest management

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Gender	0.0009	0.01	0.012	-0.005	-0.017
(female =1)	(0.001)	(0.10)	(0.013)	(0.006)	(0.019)
Caste	0.003**	0.04***	0.05***	-0.03**	-0.07***
(higher caste = 1)	(0.002)	(0.01)	(0.02)	(0.013)	(0.02)
Education	-0.0001	-0.001	-0.002	0.0009	0.002
	(0.0001)	(0.001)	(0.002)	(0.0008)	(0.002)
Forest type	-0.004**	-0.05***	-0.06***	0.03**	0.081***
(mixed =1)	(0.002)	(0.011)	(0.014)	(0.002)	(0.02)
Relative education	0.0004	0.005**	0.005*	-0.002**	-0.008**
	(0.0002)	(0.002)	(0.003)	(0.002)	(0.005)
Income dummy variable	-0.004*	-0.05*	-0.05***	0.04**	0.06***
	(0.002)	(0.02)	(0.02)	(0.02))	(0.02)
Age of respondents	0.00002	0.0002	0.0002	-0.0002	-0.0003
	(0.00002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)

Notes: Standard error in parenthesis,

*p<0.10, **p<0.05, ***p<0.01

Table 19: Ordered logit regression on the perception of women's involvement in decision making

Variable	Coefficient
Gender(female = 1)	-0.11(0.16)
Caste(higher caste = 1)	0.11(0.16)
Education	0.03(0.016)
Forest type (mixed =1)	1.34***(0.18)
Relative education	-0.13***(0.04)
Income dummy variable	0.42**(0.21)
Age of respondents (years)	-0.002(0.001)
Cut 1	-5.89(0.75)
Cut 2	-2.83(0.31)
Cut 3	-1.44(0.27)
Cut 4	2.23(0.29)
Observations	780
Pseudo R Square	0.05
Log likelihood	-707.41

Notes: Standard error in parenthesis

*p<0.10, **p<0.50, ***p<0.01

Table 20: Marginal effects of socio-economic demographic variable on the perception of women's involvement in decision-making

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Gender	0.0002	0.004	0.009	-0.001	-0.011
(female =1)	(0.0003)	(0.006)	(0.013)	(0.003)	(0.017)
Caste	-0.0002	-0.004	-0.01	0.001	-0.012
(higher caste = 1)	(0.0003)	(0.006)	(0.02)	(0.003)	(0.019)
Education	-0.0001	-0.002	-0.0003	0.0005	0.003
	(0.00)	(0.001)	(0.001)	(0.0005)	(0.001)
Forest type	-0.002	-0.053***	-0.12***	0.023	0.15***
(mixed =1)	(0.009)	(0.01)	(0.02)	(0.017)	(0.02)
Relative education	0.0002	0.005***	0.011***	-0.002	-0.013***
	(0.0002)	(0.001)	(0.004)	(0.001)	(0.003)
Income dummy variable	-0.001	-0.02**	-0.04*	0.02	0.041**
	(0.001)	(0.01)	(0.02)	(0.01)	(0.02)
Age of respondents(yrs)	0.0001***	0.00	0.00	-0.00002***	-0.0001***
	(0.000)	(0.00)	(0.00)	(0.00004)	(0.0002)

Notes: Standard error in parenthesis; *p<0.10, **p<0.05, ***p<0.01

Table 21: Ordered logit regression of the perception of women's views and opinions

Variable	Coefficient
Gender(female = 1)	0.05(0.15)
Caste(higher caste = 1)	-0.16(0.16)
Education	0.02(0.02)
Forest type (mixed =1)	1.80***(0.18)
Relative education	-0.13***(0.03)
Income dummy variable	0.52***(0.20)
Age of respondents (years)	-0.004***(0.002)
Cut 1	-5.17(0.55)
Cut 2	-3.69(0.35)
Cut 3	-2.07(0.28)
Cut 4	1.89(0.29)
Observations	780
Pseudo R Square	0.09
Log likelihood	-642.37

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Table 22: Marginal effect of socio-economic demographic variables on perception of women's view and opinion

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Gender	-0.0002	-0.001	-0.003	-0.004	0.008
(female =1)	(0.001)	(0.002)	(0.009)	(0.01)	(0.02)
Caste	0.001	0.002	0.01	0.01	-0.02
(higher caste = 1)	(0.001)	(0.002)	(0.01)	(0.01)	(0.02)
Education	-0.0001	-0.002	-0.001	-0.001	0.003
	(0.0001)	(0.002)	(0.001)	(0.001)	(0.002)
Forest type	-0.01**	-0.025***	-0.11***	-0.13***	0.27***
(mixed =1)	(0.004)	(0.01)	(0.02)	(0.02)	(0.03)
Relative education	0.001*	0.002***	0.01***	0.01***	-0.02***
	(0.0002)	(0.001)	(0.002)	(0.003)	(0.01)
Income dummy	-0.002	-0.01**	-0.033**	-0.03***	0.07***
variable	(0.001)	(0.004)	(0.02)	(0.005)	(0.02)
Age of respondent	0.00002***	0.00006***	0.0002***	0.0003**	-0.0007***
(years)	(0.00001)	(0.00003)	(0.0001)	(0.0002)	(0.0002)

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Table 23: Ordered logit regression on the perception of the presence of women in CFUG working committees

Variable	Coefficient
Gender(female = 1)	-0.10(0.15)
Caste(higher caste = 1)	-0.12(0.16)
Education	-0.006(0.02)
Forest type (mixed =1)	0.83***(0.15)
Relative education	-0.05*(0.03)
Income dummy variable	0.37**(0.2)
Age of respondents (years)	0.002(0.002)
Cut 1	-6.33(1.03)
Cut 2	-2.00(0.28)
Cut 3	-0.88(0.26)
Cut 4	2.34(0.28)
Observations	780
Pseudo R Square	0.022
Log likelihood	-799.83

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Table 24: Marginal effect of the socio-economic demographic variables on the perception of presence of women in CFUG working committee

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Gender	0.0001	0.01	0.01	-0.001	-0.011
(female =1)	(0.0002)	(0.01)	(0.01)	(0.00)	(0.017)
Caste	0.0001	0.01	0.01	-0.008	-0.014
(higher caste = 1)	(0.0002)	(0.01)	(0.01)	(0.009)	(0.016)
Education	-0.00	-0.0004	-0.0006	0.00	0.0007
	(0.00)	(0.00)	(0.001)	(0.00)	(0.001)
Forest type	-0.00	-0.06***	-0.07***	0.05***	0.1***
(mixed =1)	(0.00)	(0.02)	(0.02)	(0.01)	(0.02)
Relative	0.0001	0.004*	0.005*	-0.003	-0.01*
education	(0.0001)	(0.002)	(0.003)	(0.001)	(0.003)
Income dummy	-0.0004	-0.03*	-0.04**	0.03	0.04**
variable	(0.0005)	(0.002)	(0.02)	(0.02)	(0.02)
Age of	-0.00	-0.00	-0.00	0.00	0.00
respondents	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Table 25: Ordered logit regression for the perception of the importance given to opinions and ideas of women

Variable	Coefficient
Gender(female = 1)	-0.083(0.16)
Caste(higher caste = 1)	-0.38**(0.17)
Education	-0.03(0.016)
Forest type (mixed =1)	1.21***(0.18)
Relative education	0.01(0.04)
Income dummy variable	0.20(0.20)
Age of respondents	-0.002(0.002)
Cut 1	-3.86(0.4)
Cut 2	-2.12(0.3)
Cut 3	-1.24(0.3)
Cut 4	2.69(0.3)
Observations	780
Pseudo R Square	0.043
Log likelihood	-712.86

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Table 26: Marginal effect of socio-economic demographic variables on perception of the importance given to opinions and ideas of women

Variable	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Gender	0.00	0.004	0.005	-0.003	-0.01
(female =1)	(0.00)	(0.008)	(0.01)	(0.008)	(0.01)
Caste	0.005*	0.02**	0.03**	-0.02*	-0.03**
(higher caste = 1)	(0.002)	(0.01)	(0.02)	(0.01)	(0.01)
Education	0.00	0.001	0.001	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.001)
Forest type	-0.017***	-0.07***	-0.08***	0.06***	0.11***
(mixed =1)	(0.002)	(0.02)	(0.02)	(0.02)	(0.02)
Relative	-0.0002	-0.0006	-0.001	0.001	0.00
education	(0.0004)	(0.002)	(0.003)	(0.00)	(0.00)
Income dummy	-0.002	-0.01	-0.013	0.01	0.02
variable	(0.003)	(0.01)	(0.01)	(0.01)	(0.02)
Age of the	0.00	0.00	0.00	-0.00	-0.00
respondents	(0.00)	(0.00)	(0.00)	(0.00)	()0.00

Notes: Standard error in parenthesis

*p<0.10, **p<0.05, ***p<0.01

Conclusion

This research is aligned with finding labor productivity of rural households involved in fuelwood and fodder collection. The difference in market price of fuelwood and fodder per headload and the difference in amount of fuelwood and fodder collected might be the sole reason for the seasonal variation in revenue generation. Marginal revenue product of labor also differed across seasons and locations.

Socio-economic demographics of rural household were found to exert relationship with the collection of fuelwood, fodder and other forest resources. Rearing of livestock by rural household was positively associated with forest dependency while the number of private trees, distance to the nearest CF, family members, land holdings and income dummy variable were negatively related with forest dependency. Lower caste people in Terai region of Nepal were found to be more dependent on forest resources for forest resources. The rural households perceive women's role more of resource collector and household worker rather than management and decision making. Women still are not believed to possess management and leadership skill in rural Nepalese conditions. Government policy focusing on extension activities targeted towards women empowerment and education can help rural communities realize the importance of role of women in CF management and decision making process.

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