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# Household Production, Time Allocation Behavior and Climate Change

## A case of Nepal

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### Abstract

*This study investigates empirically how forest resources production and time allocation behavior links with climate change issue by using household survey in mid hill village of Nepal. We use Cobb Douglas production function theory to develop household production function econometric model. We use two character households: unemployed and forest dependent population for observation of time allocation behavior for household production. In addition, we use poverty and illiteracy of household characters for understanding its effect on household decision behavior and production behavior. In outcomes of the study, household production behavior of rural people results higher dependency on forest biomass and its consequence-climate change cause issue.*

*Key words: household production, forest, time allocation, climate change etc.*

### 1. Introduction

The relationship between forest household production, time allocation behavior and decision and climate change issue is micro level query but has become an important issue in the context of climate policy perspective as well as academic perspective after establishing deforestation as major cause of climate change (UNFCCC, 2007) because deforestation alone contributes 18-25% carbon emission more than global transportation system (Stern, 2007) and damage cost of climate change will be huge in terms of deaths, scarcity, diseases, mal nutrition and GDP losses (Stern, 2007).

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<sup>3</sup> Tribhuvan University is a public university established by the Government of Nepal in 1959 A.D with an objective of higher education promotion and production of highly qualified human resources. The university is the oldest university in Nepal and the tenth largest in the world in terms of enrollment. Till 2018, it has 60 constituent campuses and 1084 affiliated colleges across the country (see its details in websites: [tribhuvan-university.edu.np](http://tribhuvan-university.edu.np)).

In forest household production, the relationship between poverty and forest resources is established by common hypothesis is that poorer households are more dependent on the forest (Godoy and Bawa 1993; Reddy and Chakravarty 1999). Amacher, *et al* (1996) considers subsistence households are a leading source of deforestation because of their fuel wood consumption. Adhikary (2003), Bista(2011a), Bista(2011b), Bista(2011c), Bista(2011d), Bista (2013), Bista (2018), Bista(2019a) & Bista(2019b) finds higher forest dependent population if they are rural poor. From these literatures, rural household depends more on forest resources for livelihood objectives for household welfare. However, its externality outcome (indirect relationship) establishes the relationship between forest household production and climate change issue.

In household production, economics methods are general in these literatures. Amachar, *et al.* (1999) and Edmunds (2001) have used household production model for analyzing household fuel wood demand and supply and welfare. Ahikary *et al.* (2003) has used econometric model to analyze household dependency on forest. Pattanayak, *et al.* (2003) has used C-D production function. However, the relationship is not traced out in Nepal because of different geographical variable and socio economic variable. In context of Nepal, still the relationship between forest household production, labor time allocation and climate change is a query. Thus, this paper investigates the relationship between forest household and labor time allocation in the period 2016 and what are variables behind forest household production in static condition. For this first investigation, C-D production function regression model will be applied.

## 2. Methodology and Data

To test the relationship between household production of forest ( $Q_f$ ) and time allocation for fuel wood biomass collection that is labor allocation for fuel wood biomass collection ( $L$ ), Cobb- Douglas production function can be expressed as

$$Q_f = f(L)^{\beta} \text{-----(1)}$$

There are other qualitative independent variable which are household character ( $h_c$ ) and household literacy ( $h_e$ ) influences household. Therefore, the Cobb-Douglas production function's econometric model is developed as follows.

$$\ln Q_f = \alpha + \beta \ln L + \beta_1 h_p + \beta_2 h_e + e \text{-----(2)}$$

Where,  $\alpha$ ,  $\beta$ ,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$  and  $\beta_5$  are parameters which are

$$\alpha > 1, 0 < \beta < 1, 0 < \beta_1 < 1, \text{ and } 0 < \beta_2 < 1$$

e= error term which is random variable.

## Household Survey Data

Data set which was used here was collected from household survey data conducted in Kalimati Village in 2016. The survey area, Kalimati Village was remote and rural areas of Lamjung District located in Mid Hill areas in altitude range from 300 ft to 6500 ft from the sea level and approximately 150 kilometers far west north of Kathmandu Centre. The village, one of Gouda Village Development Committee was selected for the household survey because of poverty and induction of contract forestry.

Table NO-2: Sample of Leasehold Forest

District	VDC	No of LF	HH	Sample No	Sample Village	Sample Ward	Sample HH
Lamjung	Gouda	6	476	1	Kalimati	3	42
Total		6	476	1			42

Source: Field Survey, 2016

Data set of the study was basically collected from household questionnaire survey in Kalimati Village. PRA method was used, along with case study method and interview method so that quantitative and qualitative data could be collected from 42 sample household. For supplementary, we collected secondary data sources such as minute book, procedure of decision making, structure and function of the Bhangeri Pakha Leasehold Forestry Program reports and also *Ninth Plan, Tenth Plan, Economic Survey, Web Browsing of Research report related to Leasehold Forestry in Midhill areas, reports of DEPROSC* etc

Household characters were homogeneity in terms of food sufficiency, literacy, social security and caste. Average household size was also like of national household size (approximately 5 household members). Primary income, employment and livelihood source of almost household was agriculture. In addition, fuel wood and other forest products were perceived as supplementary source of income, employment and livelihood. In simple, forest dependency was just like in other rural areas of Nepal was extremely higher because of leisure time, traditional social economic activities and absence of alternatives.

These characters influence fuel wood collection (fuel wood production) from the contract forest and other open access forest. These characters were defined as dummy because of qualitative information.

### 3. Estimation of C-DHPF

Data set of C-DHPF includes four variables: weekly quantity of forest fuel wood collection and production ( $q_f$ ), weekly time allocation for household forest production ( $L_f$ ) and qualitative household character variables such as poverty ( $h_p$ ) and illiteracy ( $h_e$ ). When we conducted household survey, there was curiosity on relationship between household and forest in open access resource regime because household fuel wood production requires household time allocation as input of production. We had to explore the relationship to understand further household production and time allocation. In PRA survey we got unanimously positive response, they responded with statement, “We use forest resources for our livelihood, income and micro enterprises”. In order to test household fuel wood production and labor time allocation of household, we focused on two questions for quantitative and qualitative information such as.

- How much time allocation of household per week from their leisure for weekly fuel wood collection production?
- What is effect on poverty and illiteracy level of individual on household time allocation decision and household fuel wood production behavior?

We interpreted answers of first question such as quantitative information of household fuel wood production ( $q_f$ ) and labor time allocation of household ( $L_f$ ). Quantitative information of household fuel wood production ( $q_f$ ) was measured in terms of *Doko* (50 kg weight unit) per week, meanwhile labor time allocation of household from leisure time was measured in terms of hours unit. In open access regime forest management, labor time allocation of household was only household fuel wood production but there was household characters variables such as poverty and illiteracy. They influenced labor time allocation decision and household production behavior but which level of influence, we could get it from qualitative information of poverty and illiteracy.

#### **4. Results of C-DHPF**

Table-1 provides mean and standard deviation of key variables in C-DHPM estimation samples. In column 1, there are key variables such as Quantity of fuel wood production (dependent variable) and Labor time allocation per week ( $L_f$ ) (independent variable). In addition, there are two dummy variables (poverty level and literacy). Standard deviation gives no more deviation character of household data from mean. Thus, mean of key variables represents properly household data of key variables collected from household survey.

In addition, more mean household labor time allocation per week on household fuel wood collection production indicates more leisure time, no information, physical inaccessibility and lack of alternative economic activities in rural areas because of poor development delivery. This household decision and behavior is made rational by evidence of poverty level and illiteracy. Thus, household production in rural areas has labor input only.

Table No-2:-Mean and Standard Deviations: C-DHPF estimation Sample

Variables	Household sample
Quantity of fuel wood production	0.72(0.140)
Labor time allocation	1.22(0.133)
Poverty level	0.10(0.297)
illiteracy	0.38(0.492)

Table-2 presents the results of regression of dependent variable, Quantity of fuel wood production ( $Q_f$ ) on one independent variable, weekly household labor time allocation ( $L_f$ ) and dummy variables such as household poverty level and household illiteracy. There are three coefficients such as  $\beta$ ,  $\beta_1$  and  $\beta_2$ . In the results of regression, coefficient of weekly household labor time allocation( $\beta$ ) indicates how much weekly labor time allocation as input of fuel wood collection production, so much fuel wood collection output will come if there is open access regime and forest stock of fuel biomass is available. The input output relationship between household fuel wood production and weekly labor time allocation has positive relationship. Dummy variables such as poverty and illiteracy also provide evidence of explanation.

Table No-3: Results of Regressions of Quantity of fuel wood production on weekly household labor time allocation, household poverty level and household illiteracy

Dependent variable: Average Quantity of fuel wood collection & production			
Repressor	1	2	3
Weekly Household Labor Time allocation ( $L_f$ )	1.058(0.005)		
Poverty level ( $h_p$ )		0.003(0.002)	
Illiteracy ( $h_e$ )			0.001(0.001)
Intercept( $\alpha$ )	-0.574 (0.007)		

## 5. Discussion, conclusion and policy implication

Considering above results of C-D HPM, they provide sufficient and necessary evidence on the relationship between household fuel wood collection and household labor time allocation. Labor time allocation on household production behavior in rural areas is only in fuel wood production if there is lack of alternative and capital but leisure. It provides sufficient evidence that large family means large labor source and large time allocation on fuel wood collection in the study areas.  $R^2$  value is 0.99. It means fuel wood collection production is explained by independent variable by 99%, along with dummies.

Poverty level – below the poverty line defined as minimum subsistence level or less than \$ 2 per day earning is massively rural incident in accordance with National Planning Commission's Tenth Five Year Plan report. In household, if there is low income, this is low opportunity to meet basic needs. It makes needy to the people for utilizing open access resources such as forest. If you have leisure, no alternative and livelihood needy, its motivation will be on fuel wood collection for livelihood objective maximization, although it is destroying forest resources of the country. From survival point of view, it is rational. In addition, the poor people are illiterate-not able to write, read and understand. There is not understanding of forest resources and its importance, except intuition decision. These two households character lead to higher dependency and consumption of fuel wood.

Average Labor productivity in household fuel wood production is lower. It is evidence of declining forest stock and more distance forest location from household in the mid hill Nepal. Due to higher dependency on forest leading deforestation, forest stock and forest location are shifting. This will be a serious issue, if policy initiation is not considered.

We conclude that rural household leisure time, poverty and illiteracy, along with lack of alternatives explain their household fuel wood collection and production, although agricultural productivity is lower. This production function indicates higher dependency of rural household on forest resources for livelihood objective. When Household maximizes utility of forest resources, it will deepen more deforestation issue and its consequent threat-climate change issue. From this outcome, poverty and illiteracy explains household time allocation behavior and decision process in forest household production of rural areas without thinking what will be effects of deforestation on their household livelihood behavior and decision. Optimization behavior of forest household production and time allocation behavior results higher deforestation rate, generation of distance between forest and household, declining marginal labor forest productivity and declining forest biomass stock. IPCC (2001) provides sufficient evidence of carbon emission from deforestation. Thus, forest household behavior and time allocation behavior of rural areas of developing countries leads deforestation and then climate change issue, despite its lower contribution. Therefore, policy alternatives on efficiency of fuel consumption, institutional development and development of labor market are required for addressing such household production behavior and labor time allocation pattern for reducing deforestation and GHG emission.

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