Community-Managed Forests and Household Welfare: Empirical Evidence from Nepal

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Community-Managed Forests and Household Welfare: Empirical Evidence from Nepal*

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Abstract

This paper evaluates the role of use of community-managed forests as a means of improving economic well-being of rural Nepalese households. I utilize a nationwide survey consisting of detailed questionnaires related to household welfare and employ instrumental variable (IV) approach to estimate the impact of using community-managed forest on monthly food consumption. Results show that households that use community-managed forests for firewood spend significantly more on food per capita than those dependent on government forests or private land. The study further finds that the effect is more pronounced among community-managed forest users belonging to low caste groups typically thought as possessing lower levels of social capital. Together, these results highlight the creation of community-managed forests as an effective means of addressing food insecurity that focuses the benefits on the most disadvantaged.

Keywords: Community-managed forests, Food spending, Household welfare
JEL Codes: Q18, Q23, Q57

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1 Introduction

Recent estimates show that more than one billion acres of tropical forests have disappeared in the last forty years, equivalent in size to more than half of the continental United States (Times, 2015). Amid serious concerns over high rates of deforestation and its consequences, forest management issues have been at the forefront of development policy discussions around the world (Edmonds, 2002). This has led the governments in more than fifty countries to carry out community forestry (CF) initiatives, aimed at providing local users with some control over natural resources (Agrawal, 2001). Recent figures from the World Bank suggest that 18% of the global forest and 25% of the forest cover in developing countries is owned by community and indigenous groups (Murty, 2009). Given that the area of community forests roughly doubled to 250 million hectares during the period 1997 - 2008 (Agrawal et al., 2011), CF has the potential to improve the welfare of about 450 million people in Asia (Parajuli et al., 2015). While proponents claim that CF program interventions lower ecological degradation and enhance the supply of basic forest products for subsistence needs, empirical evidence on equity and distributional benefits from CF management is rather mixed (Ostrom, 1990; Das, 2000; Kumar, 2002; Gautam et al., 2004; Ribot et al., 2006).

The emergent need to undertake an empirical study on socioeconomic repercussions of community-managed forestry is especially relevant in the context of Nepal's substantial shift in forest management policy over the years. In 1957, the Nepalese government nationalised all forests holdings of greater than three acres in the hilly and mountainous areas of the country (Bromley and Chapagain, 1984). This led to massive government revenues from timber exports and ultimately an increase in food production (Griffin et al., 1988). However, the government passed the Forest Act in 1993 to reduce deforestation and environmental degradation. The Act led to transfer accessible forestland from the national government to respective local communities through several forest user groups (Edmonds, 2002). Currently, forests cover almost forty percent of the country (Paudel et al., 2013), one-forth of which is comprised of community-managed forests.

Forest use in South Asia is directly linked with food and energy needs of rural inhabitants, particularly the poor (Shyamsundar and Ghate, 2014). While recent estimates show that over 80 percent of households in Nepal rely on firewood for cooking (Nepal et al., 2011), research on the evolution of community forestry programme in Nepal has focused mostly on improvement in environmental quality (Uddin et al., 2015). For instance, satellite imagery shows that community-based forest management in Nepal has resulted in more efficient use of forest resources, with a significant decline in the incidence of forest fires and the use of slash-and-burn agricultural practices (Niraula et al., 2013). In addition, community forestry user groups have contributed to a 14 percent decrease in household fuelwood extraction from forests (Edmonds, 2002). Unfortunately, Edmonds (2002) doesn't have a large sample with greater variation in the characteristics of communitites with forest groups and fails to address the mechanism through which user groups influence household extraction of wood for fuel. A number of other studies show more generally that transfer of forest areas to respective communities in Nepal has led to better forest protection (Tachibana et al., 2002; Malla et al., 2003; Nagendra, 2007).

Although the global conservation community is increasingly concerned about the social welfare implications of community-managed forestry, there remains a dearth of rigorous empirical evidence on the socioeconomic impacts of CF initiative in Nepal. While several qualitative studies (Timsina, 2002; Malla et al., 2003; Neupane, 2003) have found positive effects

of community-managed forests in the middle hills of the country, Thoms (2008) argues that community forestry in Nepal has been more successful in forest conservation than improving livelihoods. Conversely, Maskey et al. (2006) claim that community forest management has been effective in providing rural society's basic subsistence needs in Nepal, though Neupane (2003) reports that forest products available from community forests may not be equitably distributed among the forest user groups. Unfortunately, previous studies do not allow us to draw generalizable conclusions about impacts of community forestry on household welfare (Shyamsundar and Ghate, 2014). The purpose of this paper is, therefore, to evaluate the causal impact of using community-managed forest for firewood on economic well-being in rural Nepal.

One of the key problems identified in the literature is the highly non-random placement of community-managed as well as government forests (Shyamsundar and Ghate, 2014). Most of these areas in Nepal are sited on the basis of long-term conservation goals, such as habitat conservation, watershed management and recreation opportunities. Moreover, village-level characteristics such as social capital may explain both creation of community forestry institution and healthy forest outcomes (Baland et al., 2010). In addition, household's use of a community-managed forest in a given village for firewood is a matter of choice, giving rise to issues of endogeneity. Furthermore, Shyamsundar and Ghate (2014) claim that the expansion of local community rights can have heterogenous effects on rural livelihood and forest health.

This paper takes advantage of a rich nationwide household survey to measure the impact of using community-managed forests for firewood on household-level monthly food spending and home-produced food consumption.[1] As both placement and usage of community forests are potentially endogenous, I utilize a novel instrument for CF firewood sourcing. Specifically, I show that total time taken to collect firewood is both a relevant and valid instrumental variable (IV) for community forest usage. This helps me to credibly identify the role of community-managed forests in improving economic well-being of rural households in Nepal.

The study improves upon the existing literature in a number of ways. First, it employs the IV approach that allows for the control of endogeneity of forest use, unlike previous studies (Timsina, 2002; Malla et al., 2003; Neupane, 2003). Second, it performs different sets of falsification tests to support the validity of the instrument used. These tests significantly strengthen the methodological rigor of the study and provide additional confidence in my main findings. Third, it delves into the heterogenous impact of CF initiatives across different household head characteristics, such as gender and caste categories. Furthermore, a number of potential mechanisms for the documented effect are discussed based on evidence from data. To the author's knowledge, this is the first empirical study that directly examines the relationship between the use of community-managed forests and rural household food consumption in the context of Nepal.

My empirical results indicate two major findings. The estimates show that households relying on community-managed forests expend 0.11 Rs. per capita a month more on log food items than their counterparts, and the result is robust to a broad set of specification and assumption checks. Additionally, I find that estimates on monthly food spending per capita are heterogenous across

[1]The Nepal Living Standards Survey 2010/11 (NLSS-III), conducted by Central Bureau of Statistics year round from February 2010 to February 2011 in Nepal among approximately 7,000 households, is a nationwide survey consisting of detailed questionnaires related to household welfare. Similarly, the Nepal Living Standards Survey 2003/04 (NLSS-II) was conducted year round from January 2003 to April 2004 among 3,912 households. The paper uses pooled cross-sectional data from both of these surveys for analysis. The number of observations used in the analysis is lower because forest-type use information isn't available for all the households in the survey.

different population sub-groups, with significantly larger effect observed among male household heads and non-high caste groups. While I don't find any significant difference in IV and OLS estimates for monthly food spending per capita, I further delve into investigating a plausible explanation for the observed effects. I provide evidence that outstanding debt, remittances, migration and differing levels of CF participation may explain observed heterogeneity in the effect of CF usage. Such channels are consistent with existent literature and I am able to empirically compare their importance allocating the benefits from a community-managed forest. This paper provides direct evidence that successfully implemented community-managed forestry initiatives can effectively address food insecurity among rural households in the developing world.

The remainder of the paper is structured as follows. Section 2 presents a detailed background on Nepal and a comprehensive overview of the forest management policy. Section 3 discusses the literature examining the relationship between community-managed forest and socioeconomic outcomes. Section 4 develops an empirical model followed by data description in section 5 and the main results of the study in section 6. Section 7 discusses implications of the empirical findings. Finally, Section 8 concludes and discusses areas for potential future research.

2 Background

Nepal is a land-locked country with a total area of 147,181 square kilometers surrounded by India on three sides and China to the north (See Figure 1). According to 2011 Population Census, the population of Nepal stands at 26.6 million (NDHS, 2012). Topographically, Nepal is divided into three distinct ecological zones: mountain, hill, and *terai* (or plains). For administrative purposes, Nepal is divided into five development regions: Eastern, Central, Western, Mid-western, and Far-western. Similarly, the country is divided into 14 zones and 75 administrative districts. Districts are further divided into smaller units, called village development committees (VDCs) and municipalities (NDHS, 2012).

Although indicators of modern development suggest Nepal is one of the poorest countries in the world, it is quite rich in socio-cultural diversity. According to 2011 Population Census, there are 125 ethnic groups, including Chhetris (16.6%) and Brahmins (12.2%) that constitute high caste groups. In addition, Magars, Tharus, Tamangs, Newars, Kamis, Muslims, Yadavs and Rais are some other ethnical groups classified as non-high caste groups in the study. Nepali is widely spoken and is the first language of 44.6% of the population. Maithili and Tharu are also in wide use, though some 120 other languages are also native to Nepal.[2] In addition, 81% of the people in Nepal practice Hinduism (NDHS, 2012).

2.1 Community Forestry in Nepal

Community forests in Nepal are areas of nationally owned forestland handed over to user groups for community-based protection and utilization. Kanel (2008) reports that there are currently more than fourteen thousand Community Forest User Groups (CFUGs) throughout Nepal, with some 159,876 members and covering a total area of 1.2 million hectares of forest land. Through

[2]Other languages in common use are Bhojpuri, Tamang, Newar, Bajjika, Magar, Doteli and Urdu.

community forestry, the government gives user groups rights of access, use, exclusion, and management but retains ownership. Neither the land nor the CF rights are permitted to be sold or transferred. Each user group develops its own constitution and forest operational plan when applying for community forest handover (Thoms, 2008). As originally conceived in Nepals Forest Sector Master Plan of 1988, community forests were aimed at meeting the bare subsistence needs of a community while protecting forestland at the same time.

According to Thoms (2008), the community forest formation process involves identification of users and the creation of a formal forest association known as a CFUG. According to government policy, all actual users of a given forest should be included in the user group. Under strict supervision of District Forest Officer, a newly formed CFUG is fully responsible for protecting the forest and is permitted to select or elect the membership of its executive committee, sell and set prices for forest products, and enforce use and access rules (Thoms, 2008). In addition, Thoms (2008) argues that creation of CFUGs may actually help reinforce existing local power disparities and prevalent elite domination.

While CFUGs have some discretion in their choice of management practices, each member household of a user group is allowed to harvest an equal amount of a given forest product regardless of household size or income. Those members who do not need the product often sell their surplus to other users or other people in nearby communities. Most CFUGs collect dues from their members and some sell minor forest products collectively. Although collective funds are kept in a bank account, Thoms (2008) reports that by law at least 25% of CFUG funds must be spent on forest management or community development activities.

3 Literature Review

Even though several studies have attempted to evaluate the impact of community forestry on household welfare in Nepal, there are a number of serious drawbacks. Shyamsundar and Ghate (2014) conclude that prior results cannot be generalized because they are based on case studies that do not look at large random groupings of villages. In addition, previous research has employed different quantity and value indicators of benefits, making it harder to estimate net benefits that are comparable across studies (Shyamsundar and Ghate, 2014). While prior research studies do not successfully identify whether decentralized forestry management has enhanced household welfare, they offer important insights into how community forests serve as an essential source of livelihood for both the poor and nonpoor.

Among recent empirical studies, Adhikari (2005) uses data among 330 households from 8 CFUGs in middle hills of Nepal to compare net benefits for poor, middle, wealthy and richer households. He finds that poorer households obtain less value from community forests than middle-income and rich, but forest dependence is higher among the poor. On the other hand, Adhikari et al. (2007) track forest use for 309 households before and after implementation of community forestry to determine the differences in quantity of fuelwood, leaf litter and fodder per household. Their conclusion is that community forestry is positively associated with people's livelihoods, and has led to a slight decrease in collection of firewood.

In addition, Khatri-Chhetri (2008) compares net annual benefits per household between one formal and one informal CFUGs from 100 households and shows negative correlation between formal CFUG and forest income. Specifically, Khatri-Chhetri (2008) shows that total value of

nontimber forest product (NTFP) collected by a formal CFUG is significantly lower than an informal CFUG, and reports that household dependence on forest decreases with an increase in income. Finally, Thoms (2008) evaluates fuelwood use among a sample of 2,871 households in seven hill districts across different asset categories and forest institutional arrangements (community-managed, government or private). The main finding is that mean fuelwood use of low caste groups is lower than high caste groups across all forest types, though poorer households are found to collect more wood from government forests, most of which is ultimately sold.

4 Identification Strategy

The OLS regressions estimate the following model of the linkage between use of community-managed forests and monthly food consumption per capita.

$$Y_{ijkl} = \beta_1.CF_{ijkl} + \beta_2.\mathbf{X}_{ijkl} + \beta_3.Dist_{kl} + \beta_4.Zone_l + \epsilon_{ijkl} \tag{1}$$

where Y_{ijkl} is a monthly food spending and home-produced food consumption per capita for household i living in a village j located at a district k in the region l. CF_{ijkl} is a dummy variable for use of community-managed forestry (1 if household uses community-managed forest to collect firewood, 0 if household uses government forest or private land to collect firewood). $\mathbf{X}_{ijkl}$ is a vector of household controls and household head characteristics. Household controls include rural location, area of housing plot, number of rooms in the house, sale value of the house, agricultural land or livestock ownership, outstanding loan, receipt of remmitance, and distance from the house to the market. Similarly, household head characteristics include age, gender, education status, caste status, religion and native language type. Furthermore, $Dist_{kl}$ are district-level dummies to account for geographical heterogeneity and unobserved fixed factors at the district level, such as political power and institutional strength.[3] Finally, $Zone_l$ is a vector of dummies for the three ecological zones used to control for cultural and soil fertility differences observed between the zones.

As noted earlier, an empirical challenge in identifying the causal effect of use of community-managed forest on household-level food consumption per capita is the endogeneity of community forest use. One, therefore, needs a variable (instrument) that is highly correlated with community forest dummy but does not directly explain the household-level spending per capita, i.e., the instrument should only affect food expenditure variables indirectly via use of community forests. The IV approach in the study instruments for household's use of community-managed forest with total time taken to collect firewood from the forest. The socioeconomic impact estimates are obtained using standard two stage least squares. The first stage is given by:

$$CF_{ijkl} = \gamma_1.Time_{ijkl} + \gamma_2.\mathbf{X}_{ijkl} + \gamma_3.Dist_{kl} + \gamma_4.Zone_l + u_{ijkl} \tag{2}$$

where CF_{ijkl} is use of community-managed forest for the household i and $Time_{ijk}$ is the total time taken to collect firewood from the forest of household's choice. The vector $\mathbf{X}_{ijkl}$ is the same vector of household controls, and $Dist_{kl}$ and $Zone_l$ remain the district and ecological zone dummies as above.

[3]For instance, Oli and Treueb (2015) explain that political instability in Nepal has expedited degradation of non-CFUG forests as the District Forest Offices appear unable to control illegal extraction of forest products.

To further strengthen the reliability of the instrumental variable, I conduct a falsification test among a smaller sample of households that don't rely on community-managed or government forests or private land to collect firewood. These households obtain firewood from protected forest, leasehold forest, religious forest or private forest. The falsification test specification entails OLS regression of monthly household food spending and home-produced food consumption per capita on the instrumental variable. If indeed the instrument directly causes change in food consumption, the coefficient estimate δ_1 would be statistically significant. The falsification test specification is given by:

$$Y_{ijkl} = \delta_1.Time_{ijkl} + \delta_2.\mathbf{X}_{ijkl} + \delta_3.Dist_{kl} + \delta_4.Zone_l + u_{ijkl} \tag{3}$$

where Y_{ijkl} is the monthly food spending or home-produced food consumption for the household i and $Time_{ijk}$ is the total time taken to collect firewood from the forest of household's choice.

Moreover, I perform additional OLS regressions to investigate any potential mechanism that may explain the significant difference in household's monthly food consumption between community-managed forest users and their counterparts. The specification is similar to (1), except that the outcome variable of interest will be different. This will be explained in Section 7.

5 Data

The core analysis of the paper is based on the Nepal Living Standards Survey 2010-11 (NLSS III) and 2003-04 (NLSS II) conducted by Central Bureau of Statistics.[4] Table 1 examines the characteristics of sampled households used in the study. The unit of analysis for this study is the household head. Consistent with Sims (2010), I am less interested in income, which is more susceptible to fluctuations and reporting inconsistencies, and instead use food spending and home-produced food consumption per capita as measures of socioeconomic outcome. On average, households in the study report to have log food spending of 6.36 Rs. per capita and log home-produced food consumption of 6.39 Rs. per capita a month respectively.[5] Figure 2 shows the kernel density plots of monthly food spending and home-produced food consumption per capita a month. Similarly, 43% of the households in the sample use community-managed forests to collect firewood.

Table 1 presents detailed summary statistics of the relevant control variables employed in the empirical model of the study. Following previous studies (Lise, 2000; Dolisca et al., 2006; Torgler et al., 2011), I control for specific socioeconomic and demographic backgrounds, such as age,

[4]All households in the country were considered eligible for selection in the survey. The survey, however, excluded the households of diplomatic missions, and institutional households, such as people living in schools hostels, prisons, army camps and hospitals. The household members were determined on the basis of the usual place of their residence. Foreign nationals whose usual place of residence is within the country were included in the survey. For the NLSS III and NLSS II sample selection, seventy five districts were grouped into fourteen strata: mountains, urban areas of the Kathmandu valley, other urban areas in the hills, rural eastern hills, rural central hills, rural western hills, rural mid-western hills, rural far-western hills, urban Terai, rural eastern Terai, rural central Terai, rural western Terai, rural mid-western Terai, and rural far-western Terai.

[5]Food spending involves monthly purchase of bread, biscuit, noodles, rice, wheat, maize, beans, eggs, oil, vegetables, fruits, meat, sugar, sweets, tea, coffee, fruit juices, alcoholic drinks, cigarettes, tobacco and meals taken outside home. Similarly, home-produced food consumption entails monthly market value of food consumed that is produced at home and not purchased from the market.

gender, caste, religion affiliation and educational status of the household head, household size land tenure status. These controls are particularly important as others have found that older farmers are generally interested in collecting forest resources, while younger counterparts are more willing to participate in and contribute to decision-making that affect forestry programmes (Beach et al., 2005; Atmiş et al., 2007). Moreover, Oli and Treueb (2015) argue that age of the household head has a significant role in making decisions on household economic activities and men are more likely to participate in extra household activities in the patriarchal Nepalese society. Table 1 shows that the average age of the household head is approximately 46 years of age. Similarly, 76% of the sample reports having a male household heads and 35% of the household heads belong to high caste groups (namely, Brahmins and Chhetris). Majority of the household heads reside in rural areas (92%), practice Hinduism (83%) and speak Nepali as their native language (67%).

Consistent with prior literature (Owubah et al., 2001; Adhikari et al., 2004; Jumbe and Angelsen, 2007), I hypothesize that education is an important indicator of both social status and economic opportunities. As shown in Table 1, 42% of the household heads in the study have attended an educational institution in the past. Similarly, household size can significantly influence the socioeconomic status of the household (Naik, 1997). The average household size in the study consists of approximately 5 members. Table 1 shows that majority of the households in the sample study own agricultural land (92%) and livestock (94%). Further, the area of housing plot is roughly 1,755 sq. feet. with an average number of 4 rooms and an estimated sale value of 274,410 Rupees. Strikingly, 70% of the household heads have outstanding loan and 31% of the households have received remittance in the last twelve months. Finally, households in the study are moderately remote, with an average distance of 17 kms to the market respectively.

6 Results

6.1 Main Analysis

Table 2 evaluates the determinants of using community-managed forest to collect firewood, with total time taken to collect firewood from the forest as the proposed instrumental variable. Column 4 shows that log of each hour spent collecting firewood is associated with a 15.5 percentage point increase in the likelihood that a household uses a community-managed forest. The partial F-test from the first stage regression of the instrument and remaining covariates on using community-managed forests is 11.603, highlighting the relevance of the instrument in this setting (Bound et al., 1995).

The results of the OLS and IV estimation are given in Table 3. The first OLS specification shows that households using community-managed forests incur log food spending of 0.11 Rs. per capita a month more than those relying on government forest or private land. Accounting for the endogeneity bias, the IV specification reflects the same story, with households dependent on community-managed forests incurring log food spending of 0.318 Rs. per capita a month more than their counterparts. On the other hand, the estimates are slightly different in case of household's monthly home-produced food consumption. After accounting for the endogeneity of community-forest use, the IV estimation shows that households using community-managed forests to collect firewood consume significantly less amount of home-produced food.

It is worth noting that the socioeconomic impacts of community forestry on food spending

using IV are identical in signs compared to the OLS estimates even after accounting for district-level variation and geographical heterogeneity. Although the signs agree, the magnitudes of the IV estimates are more than twice as large as those found in the OLS regression. However, the Durbin-Wu-Hausman test for endogeneity suggests that the OLS and IV estimates are not significantly different.[6] Given that, one may prefer the results from the OLS estimation, since they are more conservative estimates of potential socioeconomic gains from use of community-managed forests.

6.2 Robustness Checks

6.2.1 Heterogenous impact of Community-managed forest use

Next, I perform a series of robustness checks. First, I estimate models that restrict the sample to male-headed households and female-headed households respectively. Oli and Treueb (2015) explain that men in rural Nepal are considered responsible for village development and governance, and women are disinclined to participate. Further, Agarwal (2000) argues that fear of losing standing in the community potentially inhibits women from participating in events held in publicly segregated spaces. These studies suggest that the gender of the household head is an important Socieconomic Effect modifier (SES) division across which inequality may be present.

Second, I estimate separate models for household heads belonging to high caste and non-high caste groups respectively, since previous studies have shown that lower caste households participate relatively less in the CFUG activities (Agrawal and Gupta, 2005; Maskey et al., 2006). In addition, according to Bhattarai and Ojha (2001), disadvantaged groups face comparatively higher opportunity costs of participating in community forestry, which will most likely cause them to have different food and frequent non-food expenditure outcomes relative to the households belonging to high caste categories.

Table 4 performs a series of robustness checks outlined above. First, male household heads that use community-managed forests incur Rs. 0.105 per capita a month more on log food spending, significantly more than male-headed counterparts relying on government-managed forests or private land. Second, contrary to Thoms (2008), household heads belonging to non-high caste categories are prone to higher food spending as well. Specifically, non-high caste groups that use community-managed forests to collect firewood incur Rs. 0.105 per capita a month more on log food spending. In addition, the estimates on log home-produced food consumption are more pronounced among female-headed households and low-caste groups (see Table 4). Overall, the estimates in Table 4 suggest that the primary findings of the paper are robust across households of different observable characteristics, with significant positive impacts on monthly food spending observed among male-headed households and low-caste groups respectively.

6.2.2 Falsification Test

Although it is not possible to test the exogeneity of the instrumental variable directly, I conduct a falsification test among a subsample of households that don't use community-managed or government forests or private land to collect firewood (therefore excluded from my primary

[6]The test was run for each of the IV specifications in Table 3, paired with the OLS estimates for the sample. In all the cases, the test fails to reject the null hypothesis that the OLS estimates are equal to the IV estimates.

analysis).[7] To do so, I regress the monthly food spending per capita and monthly home-produced food consumption per capita variables on the instrument among this smaller sample of households from both NLSS III and NLSS II surveys. The implication is that if indeed the instrument directly causes an increase in food consumption, its coefficient estimate would be statistically significant. However, results from Table 5 indicate that the instrument is not a significant predictor of food spending as well as home-produced food consumption at any conventional level of significance. This provides strong evidence that the instrument employed in the study is plausibly exogenous.

6.2.3 Correlation with regressors

It is likely that the instrument could be correlated with some household-level unobserved condition that I cannot control for in the primary analysis. As mentioned above, it is not feasible to test whether the instrument is indeed correlated with unobserved determinants of monthly food spending and home-produced food consumption per capita. However, I can empirically examine the correlations between the instrument and other covariates. Consistent with Pless and Fell (2015), I perform this simple exercise to capture the underlying microeconomic fabric within which the households make financial decisions and could be correlated with similar unobservable characteristics. Table 6 presents the correlation matrix that shows that the instrument exhibits extremely low correlations (under 0.09) with all of the covariates. This gives me more confidence that my instrument is not correlated with unobserved determinants of monthly food spending and home-produced food consumption per capita.

7 Discussion

The regressions above suggest that the use of community-managed forest for firewood has had a positive economic impact on household food purchases. Previous studies have proposed potential channels that may explain positive benefits seen among non-high caste households that use community-managed forests to collect firewood. According to Maharjan et al. (2009), stronger focus on good governance has enabled the poor and socially excluded to raise their voices during discussions on forest management and community development. Maharjan et al. (2009) additionally report that community forestry activities have increased the ability of poorer households to generate a cash income, utilizing the resources offered by land provided in the community forests and soft loans from the Community Forestry User Group (CFUG) funds. In fact, among non-high caste households in the NLSS sample employed here, I find that community-managed forest users are more likely to receive loan by 4.8% than those relying on government forest or private land. This suggests that loan is one of the potential primary channels that may contribute to higher food spending per capita a month among non-high caste households.

One of the strands of the literature emphasizes that level of participation in community forestry activities plays an important role in determining household benefits. Oli and Treueb (2015), for instance, determine that the amount of forest product is a useful indicator of the household benefits derived from participating in community forestry activities. Furthermore, Maharjan et al. (2009) point out that while richer households have the capacity to utilize all types of forest products

[7] In the sample, 11.16% of the households rely on following forest types to collect firewood: protected forest, leasehold forest, or religious forest.

(including timber), the poor and ultra-poor have been hit hard by the reduction in forest products harvested from the community forest and continue to be disadvantaged on account of failure to make use of their allocations. In the context of this study, it is likely that poorer households (namely, non-high caste households) are spending more on food because they lack the amount of forest products received.

In addition, Lise (2000) claims that greater involvement of women in the community stimulates participation. One potential explanation is that female-headed households may be more participatory, and are able to extract comparatively higher number of forest products. Interestingly, among female-headed households, I find no statistically significant difference in the amount of firewood collected between community-managed forest users and their counterparts.[8] In addition, the story remains the same between non-high caste households dependent on community-managed forests and those not dependent on community-managed forests.[9] Assuming that amount of firewood collected from the forests is a reasonable proxy for levels of forest participation, findings from this study reject the null hypothesis that CMF users and non-CMF users belonging to non-high caste households are equally participatory.

The other posssibility is that households probably received substantial remittance allowing them to successfully spend more on food. However, data suggests otherwise. Among female-headed households and low caste households, I don't find any significant difference in likelihood of receiving remittance between community-managed forest users and their counterparts.[10] This test confirms that potential remittance received by households most likely doesn't contribute to higher monthly spending on food per capita among community-managed forest users and those dependent on government forest or private land.

While policy makers describe the community-managed forestry initiatives as pro-poor, Parajuli et al. (2015) conclude that tangible benefits from CF programs are disproportionately higher for rich and elite groups relative to poor or marginalized groups. Furthermore, Maharjan et al. (2009) claim that both poor and ultra-poor households using community-managed forests have seen an increase in physical assets, such as bicycles and radios. While I don't evaluate change in physical assets, I find that community-managed forest users in the lowest quartile of annual agricultural or livestock income distribution incur significantly less amount of monthly log home-produced food consumption (see Table 7). Consistent with anecdotal evidence, I find that poor households allocate more money towards food for survival. As reported in Table 7, among community-managed forest users, households belonging to the lowest 25th percentile of annual agricultural earning distribution spend 0.08 Rs. more per capita a month more on log food expenditure than those belonging to the topmost 25th percentile of the same distribution. Moreover, it is equally likely that the poor CFUGs are getting lower benefits in absolute terms than the rich and middle income households (Maharjan et al., 2009); however, results from Table 7 show that poorer households relying on community-managed forests incur significantly more expenditure on food spending and less consumption of home-produced food.

Finally, migration is often raised as an alternate possible mechanism (Sims, 2010). If poorer households selectively moved out of villages in response to failure to acquire CFUG membership,

[8]Female-headed households relying on community-managed forests collect 7.8 kgs of firewood more than those that rely on government forests or private land. This difference is statistically insignificant at the 10% level.

[9]Among non-high caste households, CMF users collect 2.64 kgs of firewood less than non-CMF users, although the estimate is statistically insignificant.

[10]Results are availabe upon request.

average wealth would increase.[11] If this mechanism held, one should then see significantly lower population density for villages with community-managed forests across different time periods. Instead, I find that population density in 2011 in villages with community-managed forests (334.20) is not significantly different from that in 2006 (341.78) and in 2001 (299.27) respectively.[12] In addition, villages with community-managed forests used in the study have witnessed an increase in population growth rate of 7% between 2001 and 2011. Furthermore, number of individuals who have lived outside of their permanent residence for two months or more between 2005 and 2010 is not statistically different between villages with and without community-managed forests. These summary statistics, therefore, suggest that migration is least likely to drive the primary results of the study.

8 Conclusion

The study examines the relationship between community-managed forest use for firewood and the overall economic well-being of households. Accounting for potential self-selection bias, the paper demonstrates total time taken to collect firewood from the forest as a reliable instrument. Contrary to previous research (Chhetri et al., 2013; Adhikari et al., 2014), this study based on the IV and OLS estimates suggest that households using community-managed forests spend significantly more on food, and the effect is more pronounced among non-high caste households that are at a social, cultural or economic disadvantage. The most likely explanation is that CMF users, belonging to non-high caste households, most likely received loans that allowed them to spend more on food.

The findings of the paper are important as they provide evidence that community-managed forestry in a developing country leads to improved economic outcomes, especially for otherwise disadvantaged households. However, one should be cautious when extrapolating from Nepal's experience to other developing countries. While it is hard to draw overly positive conclusions about community-managed forests in general, there is increasing evidence from numerous regions that forests products are particularly important to more vulnerable members of a community (Arnold et al., 2011). Notably, Vinceti et al. (2008) report that "people at risk of food insecurity, or hunger or malnutrition", generally have the highest degree of reliance on forest products for income and food. Consistent with Arnold et al. (2011), this study shows that community-managed forests can contribute to improved food security, particularly for non-high caste groups.

Although the paper fills a critical gap in the existing literature with the introduction of a valid instrument, it is important to acknowledge the limitations of the current study. First, the possiblility of unobserved heterogeneity between households and local communities limits the reliability of existing predictions on how a given household's collection behavior will be modified as its income and assets change over time. According to Baland et al. (2013), a household whose members are more hardworking and upwardly mobile will exert more effort to collect more firewood and achieve higher incomes and consumption. The same household may not, however, collect more

[11] Paudyal et al. (2009) report that poor migrants from the Middle Hills and internally displaced people are sometimes unable to afford the CFUG membership fees, allocated by the committees to reflect the amount of work existing members have put into developing the CFUG. Although still able to access CFUG products, non-members are potentially disadvantaged by having to pay higher prices.

[12] Village-level population density data for years 2001 and 2011 are obtained from Nepal Population Statistics Census. Note that population estimates for year 2006 are projected estimates only.

firewood as its income increases over time. Given that this study relies on cross-sectional data, it is difficult to eliminate the potential bias emanating from change in characteristics over time.

Finally, it would be valuable to understand how community-managed forests in developing countries have affected a broader set of socioeconomic outcomes, such as biodiversity, water quality and health. The existing limitations of cross-sectional data to shed light on these wide range of outcomes underscore the need for substantial long-term monitoring process to evaluate the impact of community-managed forests on different indicators of economic development.

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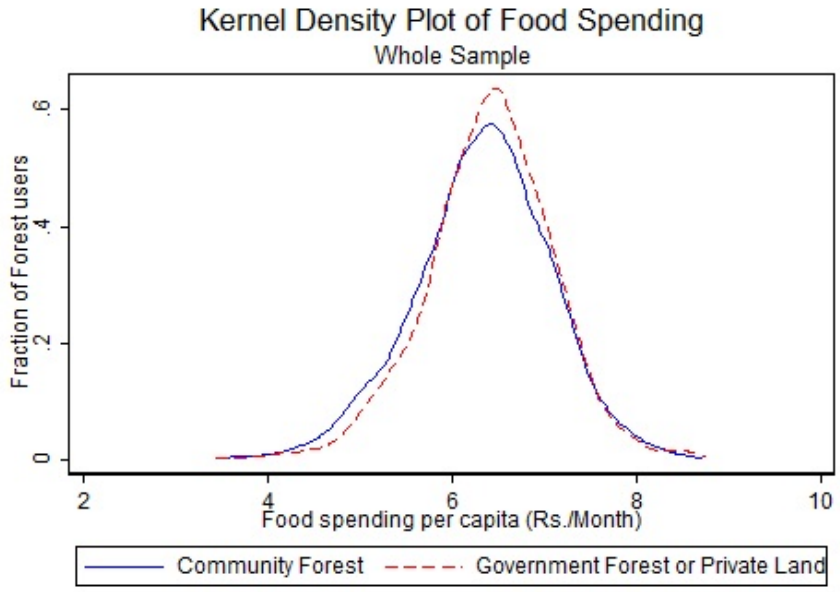
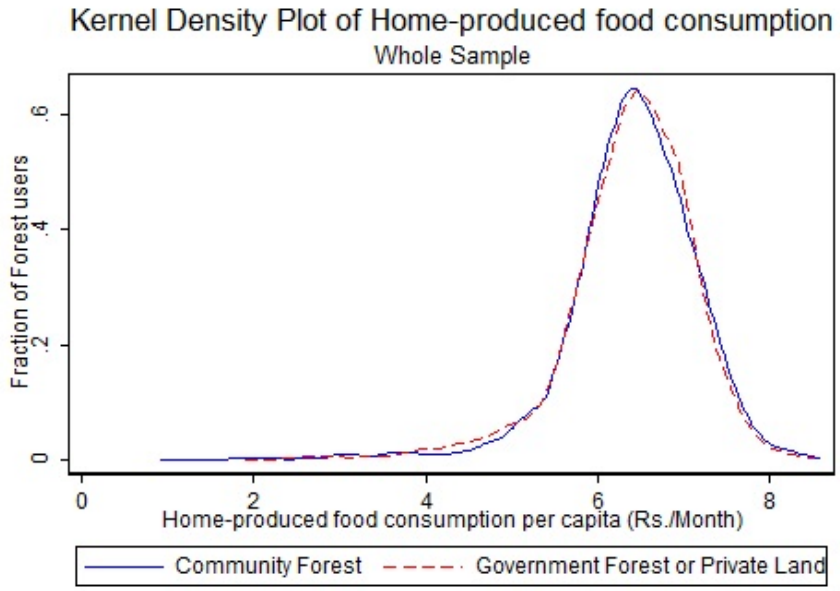
Figure 1: Map of Nepal

Notes: This figure shows map of Nepal that can be obtained from Nepal Demographic and Health Surveys (NDHS) 2011 report. See NDHS (2012) for more details.

Figure 2: Kernel density plot of monthly household log food spending per capita and home-produced log food consumption per capita (Rs.)



(a) Monthly log food spending per capita



(b) Monthly home-produced log food consumption per capita

Notes: This figure shows kernel density plots of monthly household log food spending and home-produced log food consumption per capita (Rs.)

Table 1: Summary Statistics - NLSS Sample

Characteristics	N	Mean	St. Dev.	Min	Max
Outcomes (Rs. per capita):					
Log Monthly food spending	5,151	6.36	0.73	3.44	8.76
Log Monthly home-produced food consumption	5,075	6.39	0.77	0.92	8.60
Independent Variable:					
Use CMF to collect firewood	5,151	0.44	0.50	0	1
Control Variables:					
Time to collect firewood (Hr)	5,151	1.20	0.62	-4.09	3.30
Age of household head (Years)	5,151	46.34	14.14	11	95
Household head is male	5,151	0.76	0.43	0	1
Household head belongs to high caste	5,151	0.35	0.48	0	1
Household head has attended educational institution in the past	5,151	0.42	0.49	0	1
Household head is Hindu	5,151	0.84	0.37	0	1
Household head's native language is Nepali	5,151	0.68	0.47	0	1
Household head resides in rural area	5,151	0.92	0.26	0	1
Size of household	5,151	5.29	2.49	1	32
Area of housing plot (Sq. Feet)	5,151	1,755	3,533	86	165,991
Number of rooms in the house	5,151	4.25	2.23	1	20
Sale value of the house (Rs.)	5,151	274,410	644,106	2	15,000,000
Household head owns agricultural land	5,151	0.93	0.26	0	1
Household head owns livestock	5,151	0.95	0.23	0	1
Household head has outstanding loan	5,151	0.71	0.46	0	1
Household head has received remittance	5,151	0.32	0.46	0	1
Distance to the market (km)	5,151	17.21	29.32	0	500

Notes: This table reports summary statistics only for a sample of households that report the forest type used to collect firewood and are used in the main analysis. High caste group comprises of the household heads who are either Brahmins or Chhetris. Food spending involves monthly purchase of bread, biscuit, noodles, rice, wheat, maize, beans, eggs, oil, vegetables, fruits, meat, sugar, sweets, tea, coffee, fruit juices, alcoholic drinks, cigarettes, tobacco and meals taken outside home. Food spending and consumption per capita are expressed in 2003 Rupees throughout the main analysis.

Table 2: First stage regression: Determinants of using Community-Managed Forest

	Dependent Variable: Use community-managed forest to collect firewood			
	(1)	(2)	(3)	(4)
Time to collect firewood from the forest (Hr)	0.152***	0.149***	0.154***	0.155***
	(0.017)	(0.016)	(0.016)	(0.015)
Control variables	No	Yes	Yes	Yes
Zone dummies	No	No	Yes	Yes
District dummies	No	No	No	Yes
Observations	5,151	5,151	5,151	5,151
R^2	0.036	0.061	0.064	0.224
F Statistic	83.602***	12.170 ***	11.393***	11.603***

Notes: This table reports estimates from four separate regressions that specify household's use of community-managed forests to collect firewood as the dependent variable and total time taken to collect firewood from the forest as the primary variable of interest. The control variables used in the last three regressions include household head characteristics, such as age, gender, high caste, educational status, religion affiliation, native language type, rural location, household size, housing plot area, house sale value, ownership of agricultural land and livestocks, outstanding loan, remittance provision, distance to paved road and market. Two ecological zone dummies are included in the last two regressions to account for cultural heterogeneity and soil fertility. Seventy district dummies are included in the last regression specification to address geographical heterogeneity and unobserved fixed factors at the district level. Standard errors, in parentheses, are clustered at the village level. *** indicates significance at the 1% level.

Table 3: Impact of using community-managed forest on household's monthly log food spending per capita and home-produced log food consumption per capita (Rs.)

	Dependent Variable (Rs. per capita a month):			
	Log Food Spending		Home-produced Log Food Consumption	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Community-Managed Forest	0.110***	0.318***	-0.020	-0.302***
	(0.026)	(0.123)	(0.025)	(0.106)
Observations	5,151	5,151	5,151	5,151
R^2	0.241	0.225	0.342	0.315

Notes: This table reports estimates from four separate regressions that specify household's monthly log food spending per capita and monthly home-produced log food consumption per capita as the dependent variable and use of community-managed forest to collect firewood as the primary variable of interest. The control variables used in the regressions include household head characteristics, such as age, gender, high caste, educational status, religion affiliation, native language type, rural location, housing plot area, house sale value, ownership of agricultural land and livestocks, outstanding loan, remittance provision, distance to paved road. In addition, two ecological zone dummies are included to account for cultural heterogeneity and soil fertility and seventy-four district dummies are included to address geographical heterogeneity and unobserved fixed factors at the district level. Standard errors, in parentheses, are clustered at the village level. *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significant at the 10% level.

Table 4: Heterogenous impact (OLS estimates) of using community-managed forest on household's monthly log food spending and home-produced log food consumption per capita (Rs.)

	Dependent Variable: Log Food Spending (Rs. per capita a month)			
	Household characteristics:			
	Males	Females	High Caste	Non-high Caste
	(1)	(2)	(3)	(4)
Community-Managed Forest	0.105***	0.050	0.062*	0.105***
	(0.025)	(0.037)	(0.034)	(0.028)
Observations	3,897	1,254	1,810	3,341
R^2	0.357	0.441	0.401	0.389
	Dependent Variable: Log Home-produced Food Consumption (Rs. per capita a month)			
	Household characteristics:			
	Males	Females	High Caste	Non-high Caste
	(1)	(2)	(3)	(4)
Community-Managed Forest	-0.015	-0.086**	0.013	-0.059*
	(0.026)	(0.039)	(0.030)	(0.031)
Observations	3,838	1,237	1,803	3,272
R^2	0.391	0.442	0.387	0.376

Notes: This table reports OLS estimates from eight separate regressions that specify household's monthly log food spending per capita (the top four) and home-produced log food consumption per capita (the bottom four) as the dependent variable and use of community-managed forest to collect firewood as the primary variable of interest across following four subgroups: male household heads, female household heads, household heads belonging to high caste group and household heads belonging to non-high caste group. The control variables used in the regressions include household head characteristics, such as age, gender, high caste, educational status, religion affiliation, native language type, rural location, housing plot area, house sale value, ownership of agricultural land and livestocks, outstanding loan, remittance provision, distance to paved road and market. Two ecological zone dummies are included to account for cultural heterogeneity and soil fertility. Seventy-four district dummies are included to address geographical heterogeneity and unobserved fixed factors at the district level. Standard errors, in parentheses, are clustered at the village level. *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significant at the 10% level.

Table 5: Falsification test: Evaluating the reliability of the instrumental variable (IV)

	Dependent Variable (Rs. per capita): Monthly Log Food Spending		
	(1)	(2)	(3)
Time to collect firewood (Hr)	0.041	0.068	0.068
	(0.046)	(0.050)	(0.050)
P-value	0.371	0.176	0.173
Additional Controls	No	Yes	Yes
Zone dummies	No	No	Yes
Observations	681	603	603
R^2	0.002	0.095	0.101

	Dependent Variable (Rs. per capita): Monthly Log Home-produced Food Consumption		
	(1)	(2)	(3)
Time to collect firewood (Hr)	0.093	0.026	0.023
	(0.093)	(0.067)	(0.066)
P-value	0.318	0.693	0.726
Additional Controls	No	Yes	Yes
Zone dummies	No	No	Yes
Observations	577	524	524
R^2	0.002	0.441	0.445

Notes: This table reports estimates from six separate regressions among a small sample of households excluded from the primary analysis of the study. This sample consists of households that rely on protected forest, leasehold forest and religious forest to collect firewood, and comprises about 11.16% of the total number of households surveyed in both NLSS III (Year 2010-11) and NLSS II (Year 2003-04) respectively. Standard errors, in parentheses, are clustered at the village level.

Table 6: Correlations between instrument (total time taken to collect firewood from forest) and control variables employed in the study

Characteristics:	Log time to collect firewood (Hr)
Age of household head (Years)	-0.0408
Household head is male	-0.0200
Household head belongs to high caste	-0.0918
Household head has attended educational institution in the past	-0.0583
Household head is Hindu	0.0007
Household head's native language Nepali	-0.0577
Household head resides in rural area	0.0360
Area of housing plot (Sq. Feet)	-0.0081
Number of rooms in the house	-0.0746
Sale value of the house (Rs.)	-0.0422
Distance to the market (km)	-0.0541
Household head owns agricultural land	-0.0944
Household head owns livestock	-0.0098
Household head has outstanding loan	0.0178
Household head has received remittance	-0.0184

Table 7: Differences in household's monthly food spending per capita and home-produced food consumption per capita (Rs.) between community-managed forest users belonging to the lowest 25th percentile and the highest 25th percentile of the income distribution

	Dependent Variable (Rs. per capita):	
	Monthly Log Food Spending	Monthly Log Home-produced Food Consumption
	(1)	(2)
	Panel A: Yearly agricultural earning distribution	
Lowest 25th percentile	0.083*	-0.273***
	(0.049)	(0.052)
R^2	0.35	0.35
Observations	680	680
	Panel B: Yearly livestock earning distribution	
Lowest 25th percentile	0.048	-0.280***
	(0.044)	(0.044)
R^2	0.36	0.40
Observations	696	691
Additional Controls	Yes	Yes
Zone dummies	Yes	Yes
District dummies	Yes	Yes

Notes: Information for agriculture and livestock earnings is not available for year 2003/04, and this table uses data from 2010/11 only. The lowest quartile dummy is generated by using annual agricultural earnings and annual livestock income respectively. The control variables used in the regressions include household head characteristics, such as age, gender, high caste, educational status, religion affiliation, native language type, rural location, housing plot area, house sale value, ownership of agricultural land and livestocks, outstanding loan, remittance provision, and distance to the market. The two ecological zone dummies are included in the last two regressions to account for cultural heterogeneity and soil fertility. Seventy four district dummies are included in the last regression specification to address geographical heterogeneity and unobserved fixed factors at the district level. Standard errors, in parentheses, are clustered at the village level. *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significant at the 10% level.