WPS7326

Policy Research Working Paper 7326

Community Managed Forest Groups and Preferences for REDD+ Contract Attributes

A Choice Experiment Survey of Communities in Nepal

Sahan T. M. Dissanayake
Prakash Jha
Bhim Adhikari
Rajesh Bista
Randall Bluffstone
Harisharan Luintel
Peter Martinsson
Naya Sharma Paudel
E. Somanathan
Michael Toman

WORLD BANK GROUP
Development Research Group
Environment and Energy Team
June 2015

Abstract

A significant portion of the world's forests that are eligible for Reducing Emission from Deforestation and Forest Degradation, known as REDD+, payments are community managed forests. However, there is little knowledge about preferences of households living in community managed forests for REDD+ contracts, or the opportunity costs of accepting REDD+ contracts for these communities. This paper uses a choice experiment survey of rural communities in Nepal to understand respondents' preferences toward the institutional structure of REDD+ contracts. The sample is split across communities with community managed forests groups and those without community managed forest groups to see how prior involvement in community managed forest groups affects preferences. The results show that respondents care about how the payments are divided between households and communities, the severity of restrictions on firewood use, the restrictions on grazing, and the fairness of access to community managed forest resources as well as the level of payments. The preferences for REDD contracts are in general similar between community managed and non-community managed forest resource respondents, but there are differences, in particular with regard to how beliefs influence the likelihood of accepting the contracts. Finally, the paper finds that the opportunity cost of REDD+ payments, although cheaper than many other carbon dioxide abatement options, is higher than previously suggested in the literature.

This paper is a product of the Environment and Energy Team, Development Research Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at sdissan2@gmail.com.

Community Managed Forest Groups and Preferences for REDD+ Contract Attributes: A Choice Experiment Survey of Communities in Nepal

Sahan T. M. Dissanayake*, Prakash Jha, Bhim Adhikari, Rajesh Bista, Randall Bluffstone, Harisharan Luintel, Peter Martinsson, Naya Sharma Paudel, E. Somanathan, Michael Toman

Keywords: REDD+, Community Forestry, Nepal, Choice Experiment, Interaction Terms

JEL Codes: Q23, Q51, 013

*Corresponding author: Sahan T. M. Dissanayake, Department of Economics, Colby College, Diamond, 3rd floor 5230 Mayflower Hill Waterville, ME 04901-8852. sdissan2@gmail.com

Community Managed Forest Groups and Preferences for REDD+ Contract Attributes: A Choice Experiment Survey of Communities in Nepal[1]

1. Introduction

Over the past 150 years, deforestation has contributed an estimated 30% of the atmospheric build-up of CO_2 (WRI and IUCN, 1998). Curbing deforestation is a highly cost-effective way of sequestering carbon (Stavins and Richards, 2005) in that it also has potential implications for climate change adaptation (Stern, 2006). Many research findings demonstrate the potential for using forests as an efficient method for reducing atmospheric concentrations of carbon dioxide (McKenny et al., 2004; van Kooten et al., 1992; Cannel, 1999). Given the significant amount of forest currently under community management (18% of global forest and 25% of developing countries' forest) and its rapid increase[2] (World Bank 2009, Agrawal *et al.* 2011) it can be argued that the success of programs designed to reduce deforestation are closely linked to how community managed forests are incorporated into the program.

REDD+ (Reducing Emission from Deforestation and Forest Degradation) is a payment for ecosystem services (PES) program created under the United Nation's Framework Convention on Climate Change (UNFCCC) that tries to reduce deforestation and degradation in countries not subject to requirements under the convention (non-Annex 1 countries) and, therefore, release less

[1] Author Information: Sahan T. M. Dissanayake, Assistant Professor of Economics, Colby College, and Assistant Professor of Economics (by courtesy), Portland State University; Prakash Jha, Ph.D. student, University of Venice Ca Foscari, Italy, Bhim Adhikari, Senior Program Specialist, IDRC; Rajesh Bista, Research Officer, ForestAction; Randall Bluffstone, Professor of Economics, Portland State University; Harisharan Luintel, Portland State University and ForestAction; Peter Martinsson, Professor of Economics, University of Gothenburg; Naya Sharma Paudel, Environmental and Governance Specialist, ForestAction; E. Somanathan, Professor, Planning Unit, Indian Statistical Institute; Michael Toman, Lead Economist, Development Research Group, World Bank. Financial support for this research was provided by the World Bank through the Knowledge for Change Program. We would like to thank seminar participants at REDD workshops in Dhulikhel and Kathmandu, Economics Department Seminar Series at the University of New Hampshire Reed College for valuable feedback and suggestions on this work. The contents of the paper is the responsibility of the authors alone and should not be attributed to their institutions, the World Bank, or its member countries.

[2] The forest decentralization is rapidly increasing over time and therefore the area of community forests roughly doubled to 250 million hectares during the period 1997–2008 (World Bank 2009).

and sequester more carbon. The '+' in REDD+ stands for other co-benefits that have been added to the original REDD program (that was focused solely on carbon) to address potentially negative, unintended effects on non-carbon ecosystem services and to take account of effects on those who currently have claims to forests.

REDD+ is expected to create an opportunity to increase the investment in forest management that can bring a number of benefits, including achieving critical developmental goals, enhancing forest governance, bolstering global conservation efforts, reducing carbon emissions and deforestation, and contributing to poverty reduction particularly in the forest managing communities (Economist 2010a, Toni 2011, Wollenberg and Springate-Baginski 2010). From the community managed forestry perspective the effectiveness and the decision to adopt REDD+ contracts depend on incentives, benefit sharing arrangements, the opportunity costs of carbon sequestration, allocation of forest management decision making rights, and community interactions (McKinsey & Co, 2010; Gregorsen et al., 2011). At the same time there is limited evidence-based knowledge on the costs of carbon sequestration in developing countries, particularly in the context of community-managed forests and on community and household preferences for programs such as the REDD+ program.

In this paper we provide information to fill this knowledge gap by identifying the opportunity costs of carbon sequestration in communities with community managed forests. Specifically we use a choice experiment (CE) survey applied to rural Nepal communities to understand respondent's preferences towards the institutional structure of REDD+ contracts and to calculate the opportunity cost of these contracts. In particular we focus on calculating the opportunity costs of reductions in firewood collection and restrictions on grazing.

Results show that respondents care about how REDD+ programs are structured with

regard to the manner in which the payments are divided between the households and the communities, the restrictions on using grazing land, the restrictions on firewood collection and the level of payments received for the program. We find that respondents prefer that more of the REDD+ payments go to communities rather than households, which indicates trust in community level institutions. At the same time we find that that corruption and unequal access to CF resources decreases the likelihood of accepting the contracts.

We also find that preferences for REDD+ contract attributes depend on the levels of other attributes. One particularly interesting finding is that when REDD+ payment levels are high, the estimated additional REDD+ payment required to further tighten firewood collection restrictions or impose grazing closures is lower.

Finally we calculate the marginal willingness to pay for attributes and find that the opportunity costs of firewood reduction are higher in communities that are part of the Nepal Community Forestry Program (CF). Converted to CO_2 equivalents, we find that at our sample means, these estimated opportunity costs are equivalent to approximately $26.60 per ton of CO_2 for CFs and $18.62 for Non-CFs. These figures while being lower than costs for other abatement options are higher than other estimates for deforestation, which are typically below $10 per ton of CO_2. We find in addition that an average Non-CP community of 633 households would require $25 per household per year or a total of about $15,800 to agree to a grazing closure as part of a REDD+ program.

2. Community Managed Forestry, REDD+ and Carbon Sequestration

Worldwide, some 1 to 2 billion people depend primarily on forests for their livelihoods of which about half a billion are indigenous people (Chao, 2012). The loss of forest biomass

through deforestation and forest degradation accounts for 11–20 percent of annual greenhouse gas emissions (Saatchi *et al.* 2011; van der Werf *et al.* 2009; UNEP 2012) and the total carbon stored in forests is estimated at 638 gigatons CO_2 (UNFCCC 2011), with about 247 gigatons stored in Latin America, Sub-Saharan Africa and Southeast Asia. Community forestry management has generally been considered to be a successful means to not only to halt the deforestation and forest degradation but also craft institutional mechanisms for equitable benefit sharing in the communities. Therefore community managed forests will play an important role in the success of a REDD+ program since much of the forests in developing countries is actually owned or controlled to an important degree by the local communities (Agrawal *et al.* 2008). About 25% of developing country forests, or three times as much as is owned by the private sector, is under community ownership and/or administration and this percentage appears to be increasing over time. Decentralization reforms in developing countries in the past two decades have often promoted the community-based system of forest management (Agrawal et al, 2008). During the period 1997–2008, the area of collective ownership roughly doubled to 250 million hectares (World Bank 2009). Therefore it is difficult to envision a successful REDD+ initiative that does not incorporate community managed forests.

The prevention of deforestation and degradation may be an effective method used to reduce carbon in the atmosphere. For instance, Angelsen (2009) indicated REDD+ as a significant (can reduce 0.25 ^{0}C temperature increment at no extra cost), cheap (much of the deforestation and forest degradation is marginally profitable), and quick (policy and institutional change- can reduce the emissions) strategy to mitigate climate change. Similarly, McKinsey and Company (2010) suggest that forest carbon sequestration can effectively compete with other mitigation approaches as reduced deforestation and forest degradation could reduce carbon at

less than €10 per ton in addition to providing significant co-benefits. Similar results were also found by Kindermann et al. (2008) and Strassburg et al. (2009). The latter estimates that 80% of avoided deforestation costs less than US$5.00 per ton of carbon dioxide (CO2).

However, there is some controversy regarding whether all local opportunity costs of carbon sequestration were effectively included in the above studies (Dyer and Counsel 2010; Gregorsenet et al. 2011). Costs associated with community negotiations, meetings, monitoring, risk aversion and high discount rates (Yesuf and Bluffstone 2009; 2013) could turn out to be significant and potentially make communities unwilling to participate in REDD+ at prices carbon buyers would be willing to pay. For example, in their study of transaction cost of community forestry in Nepal, Adhikari and Lovett (2006) showed that transaction costs could be a major component of costs associated with community-based forest management and argued that these costs vary with attributes of the resource, nature of use rights and socio-economic circumstances of the local communities including the level of social capital in the village.

In summary, contingent upon different factors such as international support, national forestry environment, and condition of community forest, REDD+ seem to have significant ecological, economic and social implications in the community managed forest, but to-date opportunity costs in community forestry contexts have not been fully explored. We study the potential opportunity costs of REDD+ contracts by studying communities in Nepal, a country that has had an active community managed forestry programs for many decades.

We also would like to bring the reader's attention to the fact that recent discussions in the REDD+ literature have highlighted that incorporating the overall value of forest ecosystem services and biodiversity can increase the benefits (and therefore payments) for REDD+ programs but also that there are significant challenges to incorporating locally and/or globally

valuable ecosystem services and biodiversity into the REDD+ framework (Gardner et al. 2012). We do not consider the broad ecosystem and biodiversity values in this study, which focuses on calculating the opportunity cost of REDD+ contracts, but we strongly believe that biodiversity and ecosystem impacts and values need to be included in the cost-benefit calculations of REDD+ programs.

3. Community Forestry in Nepal: Past, Present and REDD+ Future

The History of CF in Nepal

In the mid-1970s the popular "theory of Himalayan degradation" predicted that all the forests in Nepalese hills will be deforested by the end of 20th century considering the rapid rate of deforestation (Ives and Messerli, 1989). The conclusion from this theory was that destruction of mountain forests in the Himalayan watershed would be one of the main sources of flooding and natural calamities in India and Bangladesh. This was the time when the Government of Nepal (GON) had nationalized all the forests through the private forest nationalization Act of 1957 and adopted a centralized bureaucratic approach to protect forest along with stringent regulatory provisions on accessing and managing forests (HMGN, 1956, HMGN, 1961, HMGN, 1967).

The Private Forest Nationalization Act of 1957 was instituted with the assertion that bringing the private and communally managed forests under state ownership would prevent the ongoing trend of deforestation. Chapagain et al. (1999) argue that the government intended to pursue three major objectives through implementation of this act: (1) to disempower the landed gentry by weakening their economic status, which was largely attributable to the vast lands they controlled; (2) to release vast areas of privately owned forests for raising forest revenue; and (3)

to open up the newly acquired forest lands to resettle land hungry migrants from the hills. However, after nationalization, local communities throughout the country reacted negatively, believing that their traditional right of access and use had been curtailed.

While the stated objectives of the nationalization were noble, and were designed to protect, manage and conserve the forest for the benefit of entire country, it became in fact, a highly disruptive factor in the overall wellbeing of the hill forests and related resources (Bajracharya, 1983). Scholars argue that forest nationalization resulted in massive deforestation soon after its inception, since the owners themselves entered into a spree of destroying the forests and converting them into agricultural land so that their ownership claims could be continued (Chapagain et al., 1999).

Though the actual rate of deforestation before nationalization is not available, many experts and international development aid agencies believe that nationalization hastened the process of deforestation as village people felt that their forest had been taken away by the government (Bajracharya, 1983; FAO/World Bank, 1979; Furer-Haimendorf, 1984). Gradually, the government realized the shortfalls of centralized, bureaucratic management in conserving forest and therefore sought for participatory and community based schemes to ensure conservation (Kanel, 2004a). Consequently, the government issued the Forestry Sector Plan in 1976. Participatory forest management policy was introduced in the form of Panchayat Forest (PF) and Panchayat Protected Forest (PPF) (HMGN, 1978).

The greatest barrier to community participation during early stages of PF and PPF was that local people were still not sure about the government's intention on the ownership over the forests. Moreover, there was widespread lack of public knowledge of the purpose of the new strategy (Arnold and Campbell, 1986). Though this newly instituted forest policy still lacked

many aspects of decentralization, this act, nonetheless, helped to revert ownership of forest resources from government back to the community. Amendments made in 1989 finally recognized local communities as the owner of local forests instead of the village Panchayat.

These PF and PPFs were later further devolved to the community forestry user groups on the basis of successful piloting in a few places. Community forestry became one of the priority programs of the government based on the Master Plan for Forestry Sector (MPFS) in 1989 (HMGN 1989). The main thrust of MPFS was handing over of all accessible hill forest to forest user groups (FUGs) to manage the local forest effectively, and to retrain the entire forestry staff to work as extension agents. However, MPFS restricted the scope of community forestry to meeting only basic needs, and by implication, it discouraged local communities from specializing and optimising in community forests through commercial operations (Chapagain *et al*., 1999). This was due to the fact that MPFS was still heavily influenced by the gloomy forecast of the "Himalayan Dilemma" which focused mainly on conserving Himalayan ecosystems and less on meeting livelihood needs of the local people.

A major political change occurred in 1990 that resulted in a multiparty parliamentary system in 1990. In this new political environment, the Forest Act of 1993 and the Forest Regulation Act of 1995 were promulgated as the main legal instruments to operationalize CF in Nepal. Thus CFs are patches of national forest area handed over to the local user group for management, conservation and utilization according to the Forest Act of 1993 and subsequent Forest Regulation Act of 1995 (HMGN, 1993, HMGN, 1995). The most distinct feature of this new legislation is that it explicitly mentions the FUGs as the formal organization to manage forests and it focuses on user groups as primary beneficiaries.

The community forest user group is registered as a corporate and autonomous body at the

District Forest Office (DFO) under its own charter. In fact, according to the act, a community forest user group is recognized as an "autonomous and self-governing institution" responsible not only for the management of community forests but also for undertaking other community level development activities (Varughese, 1999). The new institutional arrangements designed for promotion of community-based forest management are considered to be one of the unique examples of forest management in the world. The new policy emphasized handover of all accessible hill forests to local communities so that all government forests in the hills are managed as community forest and all of the benefits from such forests go to the community.

The major features of CFs according to the Forest Act of 1993 and Forest Regulation Act of 1995 are:

- Local user groups get 100% of benefits from the management and use.
- They can sell forest products independently according to the Community Forest Operational Plan (OP).
    - The OP is the contractual agreement between the local forest user group and the District Forest Office- the local level government agency responsible for the field level implementation of all the forest management programs.

The OP is the comprehensive documents covering forest inventory and forest management plan. The local forest user groups are independent, autonomous organizations and they have their own constitutions. They select/elect their executive committees through their general assembly, which serve as their government. They have their own bank accounts in which money from the membership fees, sale of forest products, fine and punishment and grants are deposited.

A dozen community forestry related projects are currently underway in different parts of the country. Following the enactment of the MPFS, the international, bilateral and multilateral donors has supported the government of Nepal both in terms of technical and financial assistance to implement the community forestry plan and policies. The current situation in Nepal is consequently one in which both legislative framework and the policy environment both favor the development of sustainable community-based forest management (Soussan *et al*., 1998). This combination of range of projects implementing CF models provides increasing legitimacy amongst the conventional forestry professionals and political will to end the centuries of centralized forestry bureaucracy in Nepal. As CF program has been implemented in Nepal for almost three decades, Nepal offers a relevant context to examine local people's preferences towards the institutional structure of REDD+ contracts and also the opportunity costs of accepting REDD+ contracts from a local perspective.

Current Status and Issues of CFs in Nepal

As of January 2014 there are 18,133 forest user groups, managing 1.7 million hectares of forest area (DOF, 2014). CFs in Nepal were initiated from few degraded forest patches and barren land and gradually covered the natural forest areas with good quality timber trees and other forest products having good market opportunities. The FUGs having CFs containing good quality timber and other marketable forest products lobbied to get rights for selling forest products outside the groups and generate income. For many years this issue was debated as some argued the scope of CF is just limited to fulfilling the basic forest product need of the local people and not for commercial sale. Others, however, argued that the Forest Act of 1993 has empowered user for 100% benefit independently. Later commercialization of forest products became common in CFs (Grosen, 2000).

Gradually CFs developed as an institution to not only implement forest management activities but also various community development activities including providing support for piped drinking water, roads, school support, health centers, and micro-credit at the community level. These CFs also became local institutions to contribute to the millennium development goals (MDGs). This is possible because CFs are endowed with valuable forest resources, have organized forest users and are legally empowered by Forest Act (Kanel, 2004b).

On the other hand with the growing commercialization of forest products and protection oriented nature of forest management elite domination and lack of equity in the benefits from forest management to the poor, forest dependent occupational groups and women and socially disadvantaged groups became a dominant issue (Adhikari et al, 2005, Pokharel and Nurse, 2004, Malla et al., 2003). Several studies documented that livestock herders, fuelwood sellers and blacksmith lost their livelihoods after they were not allowed to get forest products from CFs (Winrock International, 1998, Graner, 1997). Similarly CF added burden to women as their access to collect fuelwood from CF was restricted after the formation of CF.

Many community forestry projects in earlier days were designed to deal with energy supply and land degradation problems mentioned in the so called "Theory of Himalayan Degradation", rather than to solve the problem of meeting local needs for trees and tree products. As a result of tightening forest protection in CFs and without giving adequate options to the users, the pressure on nearby natural forest areas started to grow for getting fuelwood, grazing livestock, timber and other basic needed forest products. However, in subsequent years, community forestry has emerged as a strong revolution throughout the country and policy direction has slightly shifted towards meeting subsistence needs of local villagers. The Nepalese government's 9th plan even stated that poverty alleviation objectives could only be possible by

reconciling community forestry program within an overall system of community development. In the present scenario, community forestry opens new avenues for sustainable utilization of resources, exploitation of non-timber forest products and conservation of biodiversity and poverty alleviation in forest-based rural economies in the mid-hills of Nepal.

REDD in Nepal

Nepal became interested in REDD and submitted the Readiness Program Idea Note (RPIN) to Forest Carbon Partnership Facility (FCPF) of the World Bank for getting assistance in REDD related preparedness development (MFSC, 2008). Nepal's RPIN was accepted in 2008 and got financial assistance from FCPF to develop Readiness Preparation Proposal (RPP) (MFSC, 2010). At the center level, REDD structures (REDD Apex body, REDD working group and REDD cell) have been formed to support the readiness process which is implementing World Bank (FCPF) supported activities to implement the Readiness Preparation Proposal (RPP) since 2010. Similarly there are several non-state organizations working on diverse aspects of REDD readiness including general awareness, methodologies for biomass assessment, institutional arrangements for equitable benefit sharing, defending rights of local and indigenous communities, social and environmental safeguards and so on.

While the additional benefits from REDD is expected to get peoples' support in conservation, there might be additional costs which can potentially produce trade-offs with the expected benefits. Some of these costs include sacrifices to reduce the amount of fuelwood consumption, reduce the amount and frequency of grazing, additional forest protection activities. In this paper we analyze these costs and the preferences for REDD+ contracts using a choice experiment survey.

4. Methodology

Choice Experiment Surveys

Given that we are interested in identifying the opportunity cost of the REDD+ contracts and how the different characteristics of the REDD+ contracts influence the adoption of the contracts we use choice experiment (CE) surveys for this study. CE surveys are based on Lancaster's (1966) consumer theory and are used to elicit preferences for environmental goods and policies (Boxall et al. 1996, Louviere et al. 2000). Lancaster (1966) proposed that consumers obtain utility from the characteristics of goods rather than the good itself. Therefore, CEs can be considered the analog of hedonic analysis for stated preference valuation methods and they allow the researcher to gain a detailed understanding of the respondents' preferences for the policy or scenario being analyzed.[3] In a typical CE survey, the respondent repeatedly chooses the best bundle/choice from several hypothetical bundles/choices. The attribute values appearing in each bundle/choice are identified using experimental design techniques to ensure a balanced representation of values across choices. Alpizar et al. (2003) Hanley et al. (2001), Hensher et al. (2005), and Hoyos (2010) provide reviews of the choice experiment methodology.

Survey Instruments

The survey for this particular study presents respondents with opportunities to express preferences over hypothetical REDD+ contracts. The attributes of costs and benefits and their levels, presented in Table 1, were selected through the focus group discussions in nine CFs and nine non-CFs. These CFs were purposively represented in both the hill and Terai (plains) regions. In each region, these CFs were selected randomly from the random data set of the CF

[3] There are some concerns about hypothetical bias in values obtained from choice experiment surveys. See Carlsson, F. and P. Martinsson (2001) for a discussion of this.

impact study (MFSC, 2013). The surveys given out to communities that do not have CFs had four attributes; contract payment denominated per household, percentage of the payment going to the household (as opposed to the community), required reduction in fuelwood and the required reduction in grazing.

The surveys given out to communities that currently have CFs had three attributes; contract payment denominated per household, percentage of the payment going to the household (as opposed to the community), and required reduction in fuel wood. The grazing restriction attribute was not included in these surveys as communities that currently have CF's have grazing restrictions that are already in place. The exact list of attributes was refined after studying the REDD+ literature and analyzing results from focus groups in multiple communities.

Once an initial list of attributes was developed, we conducted focus groups with potential survey respondents. The final survey instrument contains background information about the REDD+ program, a description of the attributes and the levels, seven sets of binary choice question sets, and a small demographic questionnaire. Appendix A provides the actual background information document used for the surveys. These documents were pretested in the field before launching full implementation. For each of the choice sets the respondents choose between the two given alternatives and the status quo option. Figure 1 presents an example of the choice sets evaluated by respondents.

Experimental Design

We follow standard practice in the choice modeling literature (Adamowicz et al. 1997, Adamowicz et al. 1998, Louviere et al. 2000) and create an efficient experiment design that will allow both main effects and interaction effects to be estimated. The designs for the choice

experiments was generated following Kuhfeld (2010)[4]and achieve a 100% D-efficiency. The REDD+ survey design resulted in 84 unique choice profiles[5] (Kuhfeld 2010, Vermeulen et al. 2008). We created a block design where each of the surveys were separated into blocks of six choice profiles, giving fourteen unique REDD+ surveys with six questions each. Carlsson et al. (2010) test for learning and ordering effects in CE surveys and show that dropping the first choice question can decrease the error variance of estimates. Therefore, we add an additional choice question before the six choice questions and drop the first choice question when conducting the analyses to account for possible learning effects. In order to account for possible ordering effects we reversed the order of the questions in half the surveys and obtained 28 unique versions of the REDD+ survey.

Model and Estimation

The standard multinomial logit model, which has been the workhorse for analyzing discrete choice models for many years assumes that the respondents are homogeneous with regard to their preferences (the βs are identical for all respondents). This is a strong and often invalid assumption. Therefore, following the recent literature, we use a mixed multinomial logit model (MMNL)[6] that incorporates heterogeneity of preferences (Hensher and Greene 2003, Carlsson et al. 2003, Dissanayake 2013 *mimeo*). Assuming a linear utility, the utility gained by person *q* from alternative i in choice situation *t* is given by

[4] The experiment design was conducted using the SAS experiment design macro (Kuhfeld 2010).

[5]D-efficiency is the most common criterion for evaluating linear designs. D-efficiency minimizes the generalized variance of the parameter estimates given by D = det [V(X,β)1/k] where V(X, β) is the variance-covariance matrix and k is the number of parameters. Huber and Zwerina (1996) identify four criteria (orthogonality, level balance, minimum overlap, and utility balance) which are required for a D-efficient experiment design (see also e.g., Carlsson and Martinsson, 2003).

[6]This approach is also referred to as the mixed logit, hybrid logit, random parameter logit, and random coefficient logit model.

$$U_{qit} = \alpha_{qi} + \beta_q X_{qit} + \varepsilon_{qit} \qquad (1)$$

where X_{qit} is a vector of non-stochastic explanatory variables. The parameter α_{qi} represents an intrinsic preference for the alternative (also called the alternative specific constant). Following standard practice for logit models we assume that ε_{qit} is independently and identically distributed extreme value type I. We assume the density of β_q is given by $f(\beta \mid \Omega)$ where the true parameter of the distribution is given by Ω. The conditional choice probability of alternative *i* for individual *q* in choice situation *t* is logit[7] and given by

$$L_q(\beta_q) = \prod_t \frac{\exp(\alpha_{qi} + \beta_q X_{qitq})}{\sum_{j \in J} \exp(\alpha_{qj} + \beta_q X_{qjt})} . \qquad (2)$$

The unconditional choice probability for individual *q* is given by

$$P_q(\Omega) = \int L_q(\beta) f(\beta \mid \Omega) d\beta . \qquad (3)$$

The above form allows for the utility coefficients to vary among individuals while remaining constant among the choice situations for each individual (Hensher *et al*. 2005, Carlsson *et al*. 2003, Train 2003). There is no closed form for the above integral; therefore P_q needs to be simulated. The unconditional choice probability can be simulated by drawing R random drawings of β, β_r, from $f(\beta \mid \Omega)$[8] and then averaging the results to get

$$\tilde{P}_q(\Omega) = \frac{1}{R} \sum_{r \in R} L_q(\beta_r) . \qquad (4)$$

In the choice experiment questions, option A and option B are both restoration options that can be viewed as being closer substitutes with each other than with option C, the status quo

[7] The remaining error term is IID extreme value.

[8] Typically $f(\beta \mid \Omega)$ is assumed to be either normal or log-normal but it needs to be noted that the results are sensitive to the choice of the distribution.

option (Haaijer, *et al.* 2001; Blaeij et al. 2007). One method to incorporate this difference in substitution between options is to use an econometric specification for the mixed multinomial logit model that contains an alternative specific constant (ASC) that differentiates between the status quo option and choices that represent deviations from the status quo. We do so by using a constant that is equal to one for alternative A or alternative B.

The coefficient estimates for the mixed multinomial logit model cannot be interpreted directly. Therefore, following the standard practice in the literature we calculate average marginal WTA for a change in each attribute *in* by dividing the coefficient estimate for each attribute with the coefficient estimate for the payment term, as given in (9).

$$MWTA_i = -\frac{\beta_i}{\beta_{cost}} \tag{9}$$

Econometric Specification

We analyzed the data using a main effects (no interactions) specification and specifications with attribute interaction terms and demographic interaction terms. The specifications are given in Equation 13 – Equation 15:

$$V_{ni} = \beta_{1n}ASC + \beta_{2n}X_{payment\_to\_community} + \beta_{3n}X_{duration} + \beta_{4n}X_{firewood} + \beta_{5n}X_{grazing} + \beta_{6n}X_{payment} + \varepsilon_{ni} \tag{13}$$

$$V_{ni} = (13) + \beta_{7n}X_{firewood} * X_{cost} + \beta_{8n}X_{grazing} * X_{cost} + \beta_{9n}X_{firewood} * X_{payment_{to_{community}}} + \beta_{8n}X_{grazing} * X_{payment_{to_{community}}} + \beta_{9n}X_{payment\_to\_community} * X_{cost} \tag{14}$$

$$V_{ni} = (13) + \beta_{sn}ASC * Z_s \tag{15}$$

where *Zs* denotes the socio-demographic variables. The data was analyzed using the clogit and mixlogit commands in STATA for the Conditional Logit and MMNL specifications.

5. Data

Data were collected in the summer of 2013 from 1,300 randomly selected households in both the hill areas and plains (Terai) in Nepal. Of the households 650 were from 65 communities that currently have CFs and 650 were from 65 communities that currently do not have CFs. The location of the sites are shown in Figure 2. The sampling design for CFs were adopted from the data set of the CF impact study (MFSC, 2013). For each CF, the matching communities not having CFs were selected based on criteria such as the socioeconomic characteristics, forest types and accessibility.

Household Characteristics

A summary of the household characteristics is provided in Table 2 for both CF and non-CF households. On average the CF and non-CF households were very similar. For CF households, 81.2% of the respondents were male, 38.9% of the households were categorized as "poor" and 52% of the households were categorized as "medium" with regards to social status. For non-CF households 86.3% of the respondents were male, 37.5% of the households were categorized as "poor" and 51.4% of the households were categorized as "medium" with regards to social status. Both groups were similar in educational achievements; for CF households 21.6% was illiterate, 33.8% had only a primary education, and 17.3% didn't finish secondary school and 11.4% finished secondary school. For CF households 20.4% was illiterate, 37.1% had only a primary education, and 16.2% didn't finish secondary school and 11.4% finished secondary school.

The CF and non-CF communities were also on average similar; the CF communities had a total of 3901 family members, with an average family size of 6.02 and an average age of 29.41.

The non-CF communities had a total of 3835 family members, with an average family size of 5.91 and an average age of 27.94.

Agriculture is main occupation in both CF (34.5%) and non-CF (30.8%) communities followed by foreign employment (7.38% in CF and 6.75% in non-CF) and household work (6.18% in CF and 7.48% in non-CF). Given that the CF and non-CF households and communities are similar allows meaningful comparisons to be made between them in terms of preferences for REDD+ contracts.

6. Results and Discussion

Given that the choice experiment surveys for the two respondent groups (CF and non-CF) have different attributes, we analyze the two groups separately and compare findings. We present four sets of results that correspond to specification (13) - (15). Tables 3 and 4 present results for the main effects specifications analyzed using a conditional logit model (column 1), the main effects specification analyzed using a MMNL model (column 2), the attribute interactions effects specification analyzed using a MMNL (column 3), and the beliefs and attitude interactions effects specification analyzed using a MMNL (column 4) for the non-CF and CF communities respectively. The significance of the standard deviation estimates for random coefficients from the MMNL is indicated with a "SD" next to the standard errors. As can be seen many of the variables exhibit individual heterogeneity and therefore it is necessary to account for this in the analysis by using a MMNL model.

The overall results from the four specifications indicate that the percentage of the payment going to the community, the required firewood reduction, the required grazing reduction (for non-CF households) and the payment amount are all significant variables in

determining the respondents' willingness to adopt REDD+ contracts. The significant coefficient results are robust across the econometric specifications and have expected signs. The significant results indicate the following:

1. As the required firewood reduction increases, respondents are less likely to choose that option.
2. For non-CF households as the required grazing reduction increases, respondents are less likely to choose that option.
3. As the percentage of the payment going to the community increases, respondents are more likely to choose that option.
4. As the payment values (amount) increases, respondents are more likely to choose that option.

Result (3), that respondents prefer more of the payment to be given to the community is somewhat surprising, but reflects the feedback from the focus groups. One possible explanation is that since households are currently not receiving any cash payments under the current CF management regime, the respondents did not believe higher amounts would be forthcoming under the REDD scheme in question. Adhikari et.al (2003) found similar results in their study around the buffer zone of Chitwan National Park in Nepal. In contrast, on-going work with a similar choice experiment survey in Ethiopia finds that respondents prefer more of the payment to go to the households.

By including attribute interaction terms (specification 14) we can better analyze the structure of the preferences for REDD contracts and relationship between attributes. Results for the specification 14 are shown in column 3 in Table 3 and Table 4. We find that for non-CF households (Table 3) the interaction terms between the *firewood reduction* variable and *payment*

amount variable, the *grazing restriction* variable and the *payment amount* variable, and the *payment % to community* variable and the *firewood reduction* variable are significant. This indicates that

5. The implicit opportunity cost of firewood reduction and grazing reduction is non-linear and is dependent on the payment amount.

    Since this variable is positive it indicates that the implicit cost of firewood reduction and the grazing reduction are positively dependent on the payment level; at higher payment levels the implicit opportunity cost is lower.

6. The preferences for the distribution of the payment between the households and the community are influenced by the required amount of firewood reduction.

    Since this variable is negative it indicates that when the required firewood reduction is high, respondents are less likely to support a larger portion of the payment going to the community.

7. For CF households we find that the interaction term for the *firewood reduction* variable and the *payment % to community* variable is significant.

    This indicates that as the payment level increases respondents would want more of the payment to go towards the households (as opposed to the community).

We finally analyze how the institutional arrangements, and beliefs about climate change and the benefits from the REDD program influence the REDD contract adoption decisions. For CF households to adopt REDD+ contracts we find that respondents that

8.a. believe they have equitable access to forest funds are willing accept smaller payments.

8.b. are migrants requires higher payments.

8.c. believe climate change is serious for Nepal require higher payments while respondents that believe climate change is serious for their community require smaller payments.

8.d. believe that the REDD program will benefit them personally require higher payments.

8.e. believe village authorities monitor forest use require higher payments.

8.f. believe that authorities support rule breakers require higher payments.

For non-CF households to adopt REDD+ contracts we find that respondents that

9.a. believe climate change is serious for Nepal require higher payments

9.b. believe rules of forest access are clear require smaller payments

9.c. believe village authorities monitor forest use require smaller payments

9.d. believe that authorities support rule breakers require higher payments.

We find that there are no significant differences in the payment amounts necessary to initiate REDD+ contracts between the CF and non-CF respondent groups but we find that respondent groups differ in their beliefs about REDD payments and the institutional arrangements. In general we find ensuring equitable access to forest resources, preventing corruption and ensuring proper monitoring of forest use can result in contracts being adopted for lower payments.

Across all of the specifications analyzed we find the respondents view firewood reductions and grazing reductions as costs and we calculate the Marginal WTA values to better

understand the opportunity costs. The Marginal WTA values are shown in Table 5a and Table 5b for the main effects specifications for both the conditional logit models and the MMNL model for both groups of respondents. We see from Table 5a and Table 5b that if the annual REDD+ payment per household increases by on average 29 Nepali Rupees (about $0.30) the proportion of payments to community can be decreased by 1%. We find that if households are required to reduce their firewood use by 1% from the status quo, they would require the payment amount to increase by on average 150 Nepali rupees (about $1.50). Comparing the values in table 5a and Table5b for the opportunity cost of reduction in firewood use we see that the opportunity cost is higher for communities that currently have community managed forests (on average 185 Rs vs 132 Rs for non-CF communities). This may be due to communities with community controlled forests already having restrictions on firewood use. For the non-CF communities the opportunity cost of grazing restrictions is on average 2325 Rs (about $23.00).

7. Conclusions and Policy Implications

In this paper we present results from a choice experiment survey conducted in Nepal in 2013 as part of a collaborative effort to analyze the preference for REDD+ contracts in Nepal. In both CF and non-CF communities we find, for example, that households prefer higher REDD+ payments and would rather not take on REDD+ obligations without adequate compensation. For example, CF and non-CF respondents generally are not likely to choose options with high levels of firewood reductions and low REDD+ payments. Non-CF households also have the option to reduce grazing in exchange for payments. We find that those respondents are less likely to choose options with grazing restrictions than options without such restrictions. Such results are consistent with individuals making choices that are in their own interests.

A key REDD+ policy question is how to divide up REDD+ payments. Should they go to the community? To households? Part to households and part to communities? We find that respondents prefer that more of the payments go to communities rather than to households. This result indicates a high degree of trust in forest user group communities, because pure self-interest would likely have suggested a preference for payments to go to households where they can be fully controlled. This result mirrors our focus group findings.

We also find that preferences for REDD+ contract attributes depend on the levels of other attributes. One particularly interesting finding is that when REDD+ payment levels are high, the estimated additional REDD+ payment required to further tighten firewood collection restrictions or impose grazing closures is lower. Preferences for payments to be made to communities rather than households are found to be influenced by the required level of reduction in firewood collection. For example, when the required firewood reduction is high, respondents are less likely to support a larger portion of payments going to their communities. This finding suggests that as REDD+ contract requirements become very stringent, respondents would like to be sure their households get direct benefits in exchange for those sacrifices. Similarly, for CF households, at higher REDD+ payment levels respondents prefer that more of their payments go to households rather than communities, perhaps reflecting concerns with community level management of large sums.

We also find that respondent beliefs influence the payments required to accept REDD+ contracts. For example, CF households that believe they have equitable access to their CF community forest funds are more likely to accept REDD+ contracts. In a similar vein, all else equal, respondents are less likely to accept REDD+ contracts if respondents believe village authorities engage in more forest monitoring (as opposed to villagers) and also if they think those

authorities do not appropriately enforce CF rules and regulations. These results suggest that good governance, including ensuring equitable access to CF funds, preventing the misuse of funds and ensuring proper monitoring of forests can support REDD+ by reducing costs.

Finally we use the results to calculate the opportunity costs of the REDD+ contract obligations. We find that if households are required to reduce their firewood harvests by 10% from the status quo, non-CFs on average are willing to accept Rs. 1330 (about $14.00) per household per year. CF respondents, who generally already face restrictions on firewood collections, require Rs. 1850 (approximately $20) in exchange for a 10% reduction. We can calculate the cost per ton of abated CO_2 based on the average fuelwood use by households in Nepal. We estimate costs per ton at $26.60 for CF and $18.62 for Non-CF communities. We find in addition that an average Non-CP community of 633 households would require $25 per household per year, or $15,800, to agree to a grazing closure as part of a REDD+ program.

These findings agree with the current literature that the opportunity cost of carbon sequestration in community forests is low compared to other abatement options, but our estimates are higher than other estimates for the avoided costs of deforestation; Strassburg et al (2009), for example, estimate costs of avoided deforestation (not necessarily in community forests) at less than $5.00 per ton of CO2. This potentially important result indicates that in order to engage communities in a sustainable way, REDD+ deals may need to be more remunerative than previously envisioned.

References

Adamowicz, W., Boxall, P., Williams, M. and Louviere, J., 1998. Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. *American Journal of Agricultural Economics*. 80, 64-75.

Adamowicz, W., Swait, J., Boxall, P., Louviere, J. and Williams, M., 1997.Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation.*Journal of Environmental Economics and Management*. 32, 65-84.

Adhikari, B., S. Di Falco and J.C Lovett 2004. Household Characteristics and Forest Dependency: Evidence from Community-Based Forest Management in Nepal, *Ecological Economics*, Vol. 48 (2): 245-57

Agrawal, A. Chhatre, A. and Hardin, R. 2008. Changing Governance of the World's Forests. *Science*, 320: 1460-1462.

Agrawal, A, D. Nepstad and A. Chhatre. 2011.Reducing Emissions from Deforestation and Forest Degradation. *Annual Review of Environment and Resources*, 36: 373-396.

Alpizar, F., F. Carlsson and P. Martinsson. 2003. Using choice experiments for non-market valuation, *Economic Issues* 8, 83-110.

Angelsen A (Ed). 2008. Moving Ahead with REDD: Issues, Options and Implications. CIFOR, Bogor, Indonesia.

Angelsen, A, and M. Brockhaus. 2009. Realising REDD+ : National strategy and policy options. Bogor: Center for International Forestry Research.

Arnold, JE Michael, and J. Gabriel Campbell. Collective management of hill forests in Nepal: the community forestry development project. *Proceedings of the conference on common property resource management*. Vol. 425. 1986.

Bajracharya, D. 1983 Deforestation in the Food/Fuel Context: Historical and Political Perspective from Nepal. *Mountain Research and Development*, Vol. 3 (3) pp: 227-240

De Blaeij, Arianne T., Paulo ALD Nunes, and Jeroen CJM Van den Bergh. 'No-choice'options within a nested logit model: one model is insufficient. *Applied Economics* 39.10 (2007): 1245-1252.

Boxall, P.C., Adamowicz, W.L., Swait, J., Williams, M. and Louviere, J., 1996.A comparison of stated preference methods for environmental valuation. *Ecological Economics*. 18, 243-253.

Carlsson, F., Frykblom, P. and Liljenstolpe, C., 2003. Valuing wetland attributes: an application of choice experiments. *Ecological Economics*. 47, 95-103.

Carlsson, F., Mørkbak, R. and Olsen, B., 2010. The first time is the hardest: A test of ordering effects in choice experiments. rapport nr.: *Working Papers in Economics* 470.

Carlsson, F. Martinsson P. 2003 Design techniques for choice experiments in health economics, *Health Economics* 12, 281-94.

Carlsson, F. Martinsson P. 2001 Do hypothetical and actual marginal willingness to pay differ in choice experiments? - Application to the valuation of the environment, *Journal of Environmental Economics and Management* 41, 179-192.

Chapagain, D.P, K.R. Kanel and D.C. Regmi 1999 "Current Policy and Legal Context of the Forestry Sector with Reference to the Community Forestry Programme in Nepal. *A Working Review, Nepal-UK Community Forestry Project*, Kathmandu, Nepal.

Chao, S., 2012. Forest Peoples: Numbers across the world. Forest Peoples Programme, Moreton-in-Marsh, UK.

Dissanayake, Sahan T. M. 2014. Derivations of the Models to Estimate Discrete Choice Data. Mimeo. Available at http://sahan.org/files/working_papers/derivations_of_models_to_estimate_discrete_choice_data.pdf

Dyer, N. and Counsel, S.2010.McREDD: How McKinsey 'Cost Curves' are Distorting REDD," *Rainforest Foundation UK Climate and Forests Policy Brief*.November 2010.

DOF 2014. CF database. Babarmahal, Kathmandu: Community Forestry Division, Department of Forest.

Economist. 2010. Keeping it in the Community. *The Economist*, September 25, 2010.

Furer-Haimendorf, C. von. 1984. "The Sherpas Transformed. Social Change in a Buddhist Society of Nepal." 1984.

Gardner TA, Burgess ND, Aguilar-Amuchastegui N, Barlow J, Berenguer E, Clements T, Danielsen F, Ferreira J, Foden W, Kapos V, Khan SM, Leesm AC, Parry L, Roman-Cuesta RM, Schmitt CB, Strange N, Theilade I and Vieiram ICG. 2012. A Framework for Integrating Biodiversity Concerns into National REDD+ Programme. *Biological Conservation*. 154: 61–71.

Graner, E. 1997. Kami (blacksmiths) today: forests and livelihood security. *Contributions to Nepalese Studies*, 24, 217-231.

Gregorsen, H, Lakany, H., Karsenty, A. and White, A. 2011. Does the Opportunity Cost Approach Indicate the Real Cost of REDD+? Rights and Realities of Paying for REDD+ at Washington, DC: *Rights and Resources Initiative*.

Grosen, G. Year. 2000. Basic needs and commercialisation-Issue paper two. In: Community forestry in Nepal: *Proceeding of the workshop on community based forest resource management*, Godawari, Kathmandu. Ministry of Forest and Soil Conservation, Singhdurbar, Kathmandu, Nepal.

Hanley, N., Mourato, S. and Wright, R.E., 2001. Choice Modelling Approaches: A Superior Alternative for Environmental Valuatioin? *Journal of economic surveys*. 15, 435-462.

Hensher, D.A. and Greene, W.H., 2003. The mixed logit model: the state of practice. *Transportation*. 30, 133-176.

Hensher, D.A., Rose, J.M. and Greene, W.H., 2005. *Applied choice analysis: a primer*. Cambridge UnivPr, .

Haaijer, Rinus, Wagner Kamakura, and Michel Wedel. 200. "The 'no-choice'alternative in conjoint choice experiments." *International Journal of Market Research* 43.1: 93-106.

HMGN 1956. Private Forest Nationalization Act (2013). Kathmandu: Ministry of Law and Justice, His Majesty's Government of Nepal.

HMGN 1961. Forest Act 2018. Kathmandu: Ministry of Law and Justice, His Majesty's Government of Nepal.

HMGN 1967. Forest Protection Act 2024. Kathmandu: Ministry of Law and Justice, His Majesty's Government of Nepal.

HMGN 1978. Panchayat Forest and Panchayat Protected Forest Rules (2035). Kathmandu: Ministry of Law and Justice, His Majesty's Government of Nepal.

HMGN 1989. Master Plan for the Forestry Sector, Forest Sector Policy. Kathmandu: Ministry of Forests and Soil Conservation and Law and Justice, His Majesty's Government of Nepal.

HMGN 1993. Forest Act. Kathmandu: His Majesty's Government of Nepal, Law Books Management Board/HMGN.

HMGN 1995a. Collection of forestry related legislation of Nepal. Kathmandu: Ministry of Forest and Soil Conservation.

HMGN 1995b. Forest Regulation. Kathmandu, Nepal: Law Books Management Board, His Majesty's Government of Nepal, Ministry of Forest and Soil Conservation.

Hoyos, D., 2010. The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*,. 69, 1595-1603.

Ives, J. & Messerli, B. 1989. The Himalayan Dilemma, London, Routelodge.

Kindermann, G, Obersteiner, M., Sohngen, B., Sathaye, J., Andrasko, K., Rametsteiner, E., Schlamadinger, B., Wunder, S. and Beach, R. 2008. Global Cost Estimates of Reducing Carbon Emissions through Avoided Deforestation. *Proceedings of the National Academy of Science*, 105: 10302–10307

Kuhfeld, W.F., 2010. Marketing research methods in SAS experimental design, choice, conjoint, and graphical techniques.

Kanel, K. 2004a. Current Status of Community Forestry in Nepal. Regional Community Forestry Training Center for Asia and the Pacific (RECOFTC) Bangkok, Thailand

Kanel, K. R. Year. Twenty Five Years of Community Forestry: Contribution to Millennium Development Goals. In: Kanel, K. R., Mathema, P., Kandel, B. R., Niraula, D. R., Sharma, A. R. & Gautam, M., eds. Fourth Natinoal Community Forestry Workshop, 2004b Kathmandu Community Forestry Division, Department of Forest, Government of Nepal.

Lancaster, K.J., 1966. A new approach to consumer theory.*The Journal of Political Economy*. 74, 132-157.

Louviere, J.J., Hensher, D.A. and Swait, J.D., 2000.Stated choice methods: analysis and applications. Cambridge University Press.

Malla, Y. B., Nuepane, H. R. & Branney, P. 2003. Why aren't Poor People Benefiting More from

Community Forestry? *Journal of Forest and Livelihood*, 3, 78-93.

McKenny, D.W., D. Yemshanov, G. Fox, E. Ramal (2004) Cost Estimates for Carbon Sequestration from Fast Growing Poplar Plantations in Canada. *Forest Policy and Economics*, 6: 345-358.

McKinsey and Company.2010. Impact of the Financial Crisis on Carbon Economics: Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve.(http://www.mckinsey.com/clientservice/sustainability/pdf/Impact_Financial_Crisis_Carbon_Economics_GHGcostcurveV2.1.pdfaccessed on January 8, 2011).

MFSC 2008. Forest Carbon Partnership Facility Readiness Programme Idea Note (R-PIN) for Reducing Emissions from Deforestation and Forest Degradation (REDD). Kathmandu, Nepal: Ministry of Forest and Soil Conservation, Government of Nepal.

MFSC 2010. Nepal's Readiness Preparation Proposal REDD 2010-2013. Kathmandu, Nepal: Ministry of Forest and Soil Conservation.

MFSC 2013. Persistence and change: Review of 30 years of community forestry in Nepal. Kathmandu: Ministry of

Pokhrel, B. & Nurse, M. 2004. Benefiting the Poor from Community Forestry. *Journal of Forest and Livelihood*, 4, 19-29.

Saatchi, S, Harris, M., Brown, S., Lefsky, M., Mitchard, E., Salas, W., Zutta, B., Buermann, W., Lewis, S., Hagen, S., Petrova, S., White, L., Silman, M. and Morel, A. 2011. Benchmark Map of Carbon Forest Carbon Stocks in Tropical Regions across Three Continents. *Proceedings of the National Academy of Sciences*, 108(24): 9899-9904.

Soussan, J. Research Team 1998 Community Forestry in Nepal: Progress Report on a DFID-Funded Research Project. Nepal-UK Community Forestry Programme, Kathmandu, Nepal.

Stavins, R.N. and K.R. Richards 2005 The Cost of US Forest-Based Carbon Sequestration. *Working Paper of the Pew Center on Global Climate Change*, Arlington, Virginia, USA.

Stern, N. 2006 The Economics of Climate Change: The Stern Review. Cambridge University Press, UK.

Strassburg, B., Turner, R. K., Fisher, B., Schaeffer, R. and Lovett, A. 2009. Reducing Emissions from Deforestation – The "Combined Incentives" Mechanism and Empirical Simulations. *Global Environmental Change*, 19: 265-278.

Toni F. 2011. Decentralization and REDD+ in Brazil. *Forests*. 2: 66-85.

Train, K.E., 2003.Discrete choice methods with simulation. Cambridge university press, .

Saatchi, S, Harris, M., Brown, S., Lefsky, M., Mitchard, E., Salas, W., Zutta, B., Buermann, W., Lewis, S., Hagen, S., Petrova, S., White, L., Silman, M. and Morel, A. 2011. Benchmark Map of Carbon Forest Carbon Stocks in Tropical Regions across Three Continents. *Proceedings of the National Academy of Sciences*, 108(24): 9899-9904.

UNEP. 2012. "The Emissions Gap Report 2012: A UNEP Synthesis Report," Available at http://www.unep.org/pdf/2012gapreport.pdf

UNFCCC. 2011.Fact Sheet: Reducing Emissions from Deforestation in Developing Countries. Available at (http://unfccc.int/files/press/backgrounders/application/pdf/fact_sheet_reducing_emissions_from_deforestation.pdf Accessed on 25 July 2013)

van der Werf, G.R., Morton, D.C., DeFries, R.S., Olivier, J.G.J., Kasibhatla, P.S., Jackson, R.B., Collatz, G.J. and Randerson, J.T. 2009. CO2 Emissions from Forest Loss. *Nature Geoscience*, 2: 737 – 738.

Van Kooten, G.C., L.M. Arthur, W.R. Wilson (1992) Potential to Sequester Carbon in Canadian Forests: Some Economic Consideration. *Canadian Public Policy*, 18:127-138.

Vermeulen, B., Goos, P. and Vandebroek, M., 2008.Models and optimal designs for conjoint choice experiments including a no-choice option.International Journal of Research in Marketing. 25, 94-103.

Varughese, J. 1999 "Villagers, Bureaucrats, and Forests in Nepal: Designing Governance for Complex Resource". Unpublished PhD Dissertation, Indiana University, USA.

Winrock Interrnational 1998. Policy analysis of Nepal community forestry programme. Kathmandu: Winrock International.

Wollenberg E and Springate-Baginski O (Eds). 2010. REDD, Forest Governance and Rural Livelihoods: The Emerging Agenda. Bogor: CIFOR, Bogor, Indonesia.

World Bank. 2009. Forests Sourcebook: Practical Guidance for Sustaining Forests in International Cooperation. Washington D.C.: The World Bank

WRI and IUCN (1998) Climate, Biodiversity, and Forests: Issues and Opportunities Emerging from the Kyoto Protocol. Washington DC, USA.

Yesuf, M. and Bluffstone, R. 2013.Time Preference, Risk Aversion and Market Failures in Low Income Countries: Experimental Evidence from Rural Ethiopia. Under Review.

Yesuf, M. and Bluffstone, R. 2009. Poverty, Risk Aversion and Path Dependence in Low Income Countries: Experimental Evidence from Ethiopia. *American Journal of Agricultural Economics*, 91(4): 1022-1037

Table 1: Attributes and levels for the REDD+ Survey Instrument

Attributes	Description	Levels
REDD + payments (Rs. per household per year)	Annual total REDD+ payment to your community.	1000 2000 3000 4000 5000
Portion of the REDD+ payment going to the household.	The portion of REDD+ payments that go to communities for community projects and /or equally divided between households in your group.	100% community 50% community and 50% household 100% household
Reduction in amount of fuel wood collected	Required fuelwood reduction measured as a portion of your current use.	25% 50% 75% 100%
Grazing restrictions (only for non CF households)	Required reduction of grazing measured as a portion of your current use.	Yes No

Table 2: Household Characteristics in CFs and Non-CFs

SN	Variable	CF HH %	Non-CF HH %	p-value
A	**Gender**			
1	Women headed households (WHH)	18.77	13.69	0.01306
2	WHH due to temporary migration of men	4.15	3.69	0.6682
3	WHH due to men's death	6.77	4.92	0.156
B	**Wellbeing class**			
1	Rich	9.08	11.08	0.231
2	Medium	52	51.38	0.8243
3	Poor	38.92	37.54	0.6075
C	**Caste groups**			
1	Dalit	14.46	17.69	0.1128
2	Janajati	43.69	39.38	0.1151
3	BC	39.54	41.08	0.5718
4	Others	2.31	1.85	0.5596
D	**Age of HH head (in years)**	52.46	48.77	4.297e-06
E	**Total population**	50.58	49.72	0.2879
	Men	51.91	52.80	0.4315
	Married	54.24	52.20	0.07231
	Immigrated	15.08	35.85	2.20E-16
F	**Main occupation**			
1	Agriculture	34.48	30.80	0.0005527
2	Skilled worker	1.26	1.69	0.1093
3	Services in GO, NGO, private sector	3.69	3.34	0.3984
4	Services in foreign country	7.38	6.75	0.2804
5	Household chores	6.18	7.48	0.02278
G	**Land holding and food security**			
1	Land holding by family	95.85	0.92	0.003704
2	Food sufficiency from own land	26.46	35.69	0.000324
H	**Income fluctuation in last ten years due to agriculture and livestock**			
	Increased	24.31	24.00	0.8969
	No change	57.08	60.15	0.2601
	Decreased	18.62	15.85	0.1862
I	**Income fluctuation in last ten years due to off-farm activities**			
1	Increased	37.69	37.08	0.8186
2	No change	53.69	54.00	0.9114
3	Decreased	8.62	8.92	0.8445

Table 3: Regression Results for the REDD+ CE Survey for Non-CF Communities

	(1) CL Main Effects	(2) MMNL Main Effects	(3) MMNL Attribute Interactions	(4) MMNL Demographic Interactions
ASC	2.776*** (0.102)	7.512*** (0.526), SD	9.173*** (0.779), SD	9.407*** (1.688), SD
Payment % to Community	0.0329*** (0.00507)	0.0733*** (0.0153), SD	0.101* (0.0567), SD	0.0989*** (0.0210), SD
Firewood Reduction	-0.171*** (0.00815)	-0.380*** (0.0235), SD	-0.516*** (0.0629), SD	-0.299*** (0.0266), SD
Grazing Restriction	-0.299*** (0.0360)	-0.668*** (0.101), SD	-1.481*** (0.368), SD	0.255** (0.122), SD
Payment	0.141*** (0.0159)	0.263*** (0.0273)	-0.0660 (0.122)	-0.296*** (0.0357)
Community X Payment			0.0136 (0.0103), SD	
Firewood X Payment			0.0389** (0.0155)	
Grazing X Payment			0.195** (0.0855), SD	
Firewood X Community			-0.00963* (0.00565), SD	
Grazing X Community			0.0165 (0.0369)	
ASC X Equitable access to forest fund				-0.919 (0.863)
ASC X Respondent migrated				0.764 (0.866)
ASC X CC serious for Nepal				2.865** (1.144)
ASC X CC serious for community				-1.040 (1.030)
ASC X CC serious personally				-0.840 (1.012)
ASC X REDD likely to benefit community				0.988 (0.980)
ASC X REDD likely to benefit personally				-0.215 (1.014)
ASC X Community members trustworthy				0.129 (1.096)
ASC X Community members follow rules				-0.271 (0.821)
ASC X Rules of access and forest use are clear				-3.717*** (1.364)
ASC X Forest access decisions are fair				1.377 (1.081)
ASC X Village authorities monitor forest use				-1.389* (0.831)
ASC X Villages monitor forest use				1.162 (0.886)
ASC X Authorities support rule breakers				1.537* (0.849)
Observations	11694	11694	11694	7122
Log likelihood	-3027.4	-2473.3	-2446.7	-1454.8
Chi-squared	2510.0	1108.1	1149.0	581.6

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Regression Results for the REDD+ CE Survey for CF Communities

	(1) CL Main Effects	(3) MMNL Main Effects	(5) MMNL Attribute Interactions	(X) MMNL Demographic Interactions
ASC	3.322*** (0.108)	7.647*** (0.479), SD	6.978*** (0.563), SD	7.179*** (0.899), SD
Payment % to Community	0.0416*** (0.00542)	0.0640*** (0.0118), SD	0.182*** (0.0308), SD	0.0590*** (0.0121), SD
Firewood Reduction	-0.260*** (0.00913)	-0.454*** (0.0239), SD	-0.431*** (0.0438), SD	-0.462*** (0.0253), SD
Payment	0.135*** (0.0170)	0.255*** (0.0250)	0.594*** (0.0909)	0.250*** (0.0260)
Firewood X Payment			-0.0191 (0.0117)	
Community X Payment			-0.0397*** (0.00762), SD	
Firewood X Community			0.00118 (0.00367)	
ASC X Equitable access to forest fund				-1.031* (0.579)
ASC X Respondent migrated				3.029** (1.430)
ASC X CC serious for Nepal				1.647** (0.800)
ASC X CC serious for community				-2.117** (0.824)
ASC X CC serious personally				-0.634 (0.654)
ASC X REDD likely to benefit community				0.349 (0.631)
ASC X REDD likely to benefit personally				2.095*** (0.681)
ASC X Community members trustworthy				-0.463 (0.798)
ASC X Community members follow rules				-0.591 (0.675)
ASC X Rules of access and forest use are clear				-1.191 (0.816)
ASC X Forest access decisions are fair				1.038 (0.663)
ASC X Village authorities monitor forest use				1.592*** (0.545)
ASC X Villages monitor forest use				0.516 (0.537)
ASC X Authorities support rule breakers				1.814** (0.713)
Observations	11697	11697	11697	10851
Log likelihood	-2702.3	-2316.4	-2298.4	-2140.5
Chi-squared	3162.3	771.9	783.5	632.7

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

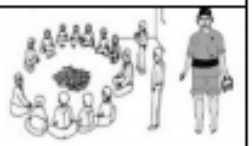
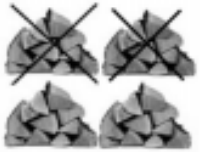
Table 5a: Marginal Willingness to Accept for REDD+ Attributes for non-CF

MWTA - Main Effects		
Attribute	**Conditional Logit**	**MMNL**
Payment to Community (Rs per 1%)	32.89	27.84
Reduction in Firewood (Rs per 1%)	-120.80	-144.45
Reduction in Grazing (Rs for restriction)	-2114.90	-2536.28

Table 5b: Marginal Willingness to Accept for REDD+ Attributes for CF

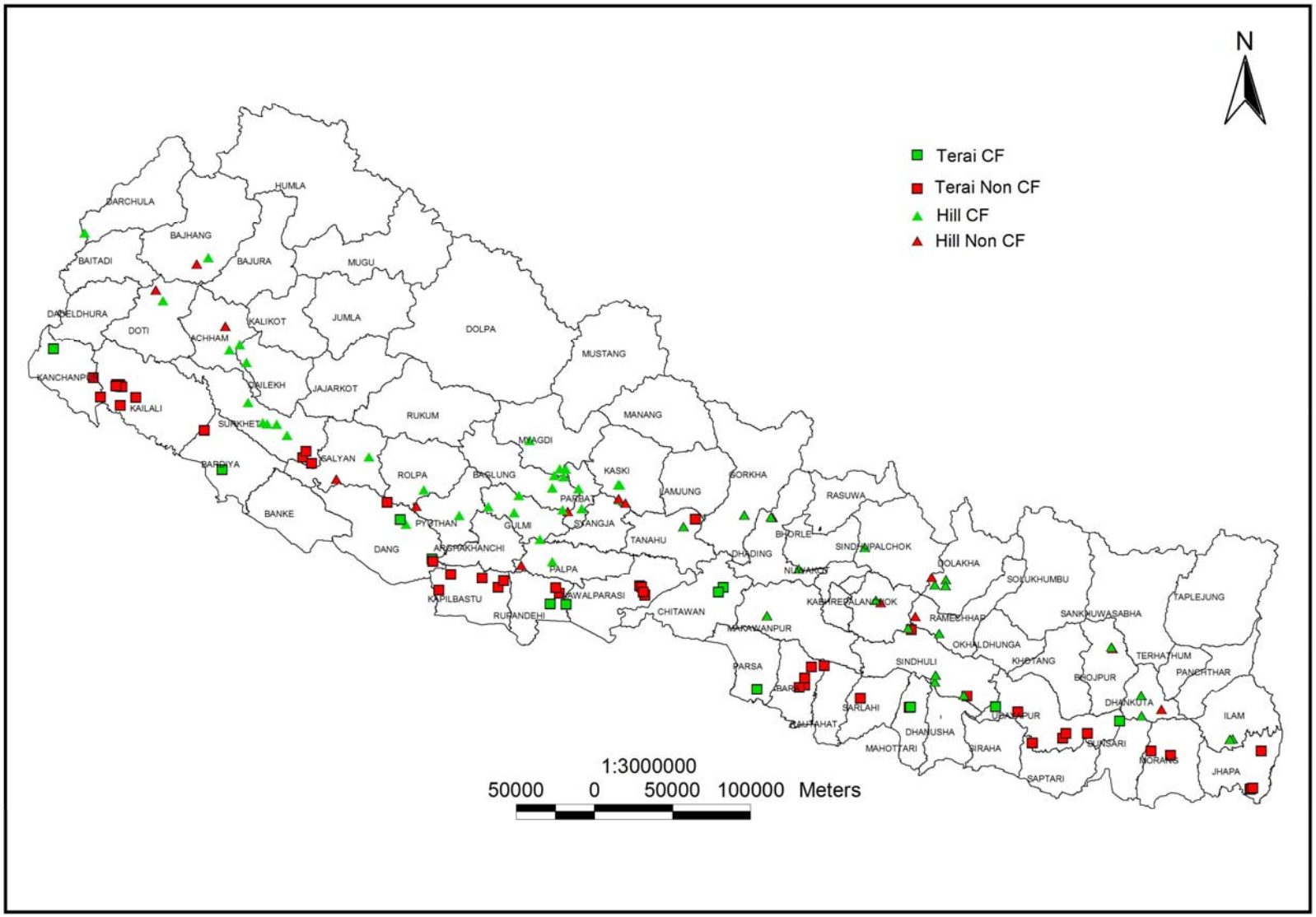
MWTA - Main Effects		
Attribute	**Conditional Logit**	**MMNL**
Payment to Community (Rs per 1%)	30.85	25.09
Reduction in Firewood (Rs per 1%)	-193.13	-178.28

Figure 1 Example of One Choice Set Evaluated by CF Respondents

बिशेषताहरू	बिकल्प १	बिकल्प २	बिकल्प ३
रेडबाट प्राप्त हुने रकम (रु. प्रति बर्ष)	 ४०००	 १०००	
रेडको रकम समुहबाट खर्च गर्ने कि प्रत्येक घरधुरीलाई बराबरी बाँड्ने ?	 सबै रकम समुहमा	 आधा रकम समुहमा आधा रकम घर घरमा	रेड चाहिदैन
अहिलेको भन्दा घटाउनु पर्ने दाउराको मात्रा (*वन बाट ल्याउने दाउरा मात्र*)	 दाउरा पुरै बन्द	 दाउरामा आधा कमी	
म बिकल्प छान्छु	❒	❒	❒

१

Figure 2


N
Terai CF
Terai Non CF
Hill CF
Hill Non CF
DARCHULA
HUMLA
BAJHANG
BAITADI
BAJURA
MUGU
DADELDHURA
DOTI
KALIKOT
JUMLA
DOLPA
ACHHAM
MUSTANG
KANCHANPUR
DAILEKH
JAJARKOT
KAILALI
RUKUM
MANANG
SURKHET
MYAGDI
BARDIYA
SALYAN
KASKI
ROLPA
BAGLUNG
GORKHA
LAMJUNG
RASUWA
PARBAT
BANKE
PYUTHAN
GULMI
SYANGJA
TANAHU
BHOJPUR
DANG
ARGHAKHANCHI
DHADING
SINDHUPALCHOK
DOLAKHA
PALPA
NUWAKOT
SOLUKHUMBU
KAPILBASTU
BAWALPARASI
KABHREPALANCHOK
TAPLEJUNG
RUPANDEHI
CHITAWAN
RAMECHHAP
SANKHUWASABHA
MAKAWANPUR
OKHALDHUNGA
TERHATHUM
KHOTANG
SINDHULI
PANCHTHAR
PARSA
BARA
BOJOJPUR
SARLAHI
DHANKUTA
RAUTAHAT
UDAYAPUR
ILAM
DHANUSHA
MAHOTTARI
SIRAHA
SUNSARI
MORANG
SAPTARI
JHAPA
1:3000000
50000 0 50000 100000 Meters

Appendix A: Background Information for Choice Experiments Presented to Respondents and Follow-Up Questions

Introduction to Climate Change and REDD+

I would like to ask you to participate in a brief survey to understand what you like and dislike about a possible agreement between your community and international organizations. This agreement would focus on your community forest [*mention the name of the Community Forest User Group (CFUGO or non-CFUG here*]. As you might know, the climate is changing. The climate of the earth on average is becoming warmer and weather patterns are changing. This climate change is caused by carbon pollution into the atmosphere from factories and vehicles mainly in the richer countries like Japan, United States of America and Europe [*show and discuss the RECOFTC graphic on climate change*].As a result of international agreements that were first made about 20 years ago, these rich countries and others are responsible to reduce their carbon emissions. These countries are finding it difficult to reduce their emissions and the world climate has therefore continued to change. This climate change is considered a serious problem.

To help with, or in addition to, the efforts to reduce the amount of carbon that the rich countries are emitting, an international program was created to use the abilities of forests to store carbon to help reduce climate change. As you may know, trees grow by combining solar energy, water and carbon from the atmosphere. Healthy forests therefore actually remove carbon from the atmosphere, which helps the climate *[show and discuss RECOFTC graphic on carbon sequestration]*.

Money has been collected from richer countries for the purpose of reducing deforestation and forest degradation in low income countries like Nepal. Using these funds it is expected that international organizations will pay money to governments, individuals and communities like yours to reduce deforestation, improve forest quality and capture carbon. This program is called REDD+ *[show and discuss RECOFTC graphics on REDD+]*. The program is voluntary and no communities or individuals in Nepal will be forced to participate.

Do you have any questions about what I've just said? Do you agree to participate? *[Proceed if respondent agrees*]

Experiment Background

There has been no decision to implement REDD+ in your area and to my knowledge there is no plan to do so. It may, however, come to Nepal and it is therefore very important to understand what you and others in your community who use and protect forests would like to see in such agreements. That is why we want to ask you for your views. The choice of whether to participate will be made by you and your fellow forest users. Though you and your neighbors may decide to participate in REDD+, there will be no coercion.

If REDD+ were to come to Nepal, there will be an opportunity for Nepali communities to be paid money to capture carbon from the atmosphere in their forests. There would also be an opportunity for communities to enjoy other benefits from higher quality forests, such as more animals and plants, non-timber forest products and simply the chance to help and protect the forest environment.

REDD+ agreements would be between international organizations interested in stopping climate change and the Government of Nepal. The Government would then make an agreement with your community, with active involvement of and some oversight by international organizations. The agreement will specify the responsibilities your community takes on, such as reductions in fuelwood collections and open grazing elimination (if appropriate). All these steps can improve forest quality and increase carbon sequestration. Progress will need to be monitored and verified every year. You may also need to make work and money contributions to your forest user group community in addition to what you are currently doing.

The agreement will also specify the payment in rupees that will be made each year and will detail how those resources can be used. For example, resources coming to the community may be used for community development projects like children's education, health and community recreation. They might also be used to fund household or individual projects administered by the community like support for income generation activities, installation of biogas digesters, purchase of tractors or use of improved seeds and fertilizers.

Alternatively, resources (or some part) could be divided equally among households in your group. Each household might therefore receive an equal share of the annual REDD+ payment and those funds could be used as each household prefers.

If you are part of a community forest user group (CFUG), this REDD+ agreement would be with the CFUG. If you have not established a CFUG, to participate in REDD+ and receive payments for increasing carbon in your forest you will need to establish a CFUG.

As of now, there are no specific activities related to forest management that focus on REDD+. To participate in REDD+, your CFUG would need to develop or revise its forest management plan to increase carbon sequestration. Monitoring and verification would also need to be included in such plans and as I mentioned, a formal agreement would be developed. The government, probably through the District Forestry Office, with financial resources from international organizations, would provide training and financial support to help you develop these plans. Because international organizations are providing the REDD+ funds, there will be good and open record-keeping, which will help control any potential mismanagement of community funds. The participation of such international organizations will also contribute to more equitable distributions of benefits among community members.

We emphasize that the main responsibility for organizing the CFUG and its members to meet REDD+ requirements and distribute rewards will be with you and your neighbors. If you and your community would like to participate in REDD+, any conflicts or controversies within your community that block the making and implementation of a REDD+ agreement will need to be resolved. If you and your neighbors would like additional support, depending on the capacity, availability and goodwill in the District Forestry Office, help may be available with organizing your CFUG (if needed) or to improve its operation.

We will now ask you to make 6 choices among possible REDD+ contracts. Each choice will

have three options, one of which is the current situation with no REDD+. These options are described by the following attributes:

Annual total REDD+ payment to your community. *These amounts are presented as rupees per household (to calculate the total payment, multiply the per household amount by the number of households in your community)*
The portion of REDD+ payments that go to communities for community projects and /or equally divided between households in your group *The word after the word "community" is the portion going to communities and the word after the word "households" is the portion to households like yours.*
REDD+ required fuelwood reduction measured as a portion of your current use
Open grazing is prohibited or not*(for non-CFUGs only)*

Do you have any questions?