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Binary Choices of Households about REDD Regime in Nepalese Forest

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Abstract

This study studies empirically whether REDD is a better alternative to community forest of Nepal. The data set of the study is primary nature in which the primary data sets were collected from household survey in the Kafle community forest of Lamatar-6, Lalitpur District, Nepal. The study has employed descriptive statistics and probit model to analyze the data sets. The study found 45 percent household depending on the community forest for livelihood materials (firewood, leaf litter, grass, water), along with Service and Agriculture income sources. As a result of binary choice, the study in mixed familiarity with REDD finds only 44 percent of households expect that REDD will be a better livelihood alternative to the poor. Further, 63 percent of households expect livelihood from REDD. Large household respondents don't believe that REDD will be a better alternative livelihood for the poor. Almost all households expect REDD for livelihood objectives. From estimation, household stakeholders who have good asset holdings (land and livestock) think that REDD will be not a better livelihood alternative to the poor. However, the household stakeholders who have literacy, different food sufficiency level, landholding (1>), different earning per day, Rsex, per day earning, and age thinks that REDD will be a better alternative. Thus, the poor households expect a livelihood role from REDD in Nepal. Therefore, REDD should be more beneficial to the poor household stakeholders and their livelihoods.

Keywords: REDD climate change, carbon, GHG emission, carbon credit, etc.

1. Introduction

The recent inclination of community forest user groups (CFUG) to transform the community forest management regime (CRMR) and leasehold forest management regime (LFMR) to Reduction of Emission from deforestation and degradation (REDD) in developing countries like Nepal is an emerging issue in the world for forest user groups, the community, policy makers, REDD advocators, climate change action groups, environmentalists, and researchers. In their inclination, carbon incentives from REDD is a major motivational factor to CFUG. In their uncertainty and indecision, heterogeneity in socio-economic characters of CFUG and their awareness level about REDD are key determinant factors. So, whether REDD is a better alternative to CFMR is a popular query.

In the emerging climate instability and threat challenge, REDD as an alternative carbon credit trading mechanism to minimize carbon emission from deforestation and degradation is a popular term for carbon incentive for sustainable forest management in the world. The idea of REDD is an environmental service trading market mechanism to trade carbon credit generated by the forest of the developing countries by reducing carbon emissions from forest degradation as business as action for reducing the carbon stock in the atmosphere (UNFCCC, 2009). This performance based payment system market approach was first tabled in the discussion during the Kyoto protocol negotiation in 1997 with a hopeful market solution of carbon emission from forest degradation (UNFCCC, 2009 and CIFOR, 2021). Despite a political and technical challenges, the Coalition for Rainforest Nations ensured REDD re-emerged as an issue at the 2005 Conference of the Parties (COP) to the UN Framework Convention on Climate Change, in Montreal (CIFOR, 2021). This idea was endorsed at the UNFCCC 13th conference of the parties (COP13) in Bali in 2007. Its justification was 18% carbon emission from forest degradation equivalent to 5.8 billion tons of CO2 per year. It is more than carbon emission from the global transportation system (CIFOR, 2021). Stern (2007) argues it as the single largest opportunity for cost effective and immediate reductions of carbon emissions. In this COP13, Nepal was a party to UNFCCC, the Kyoto Protocol and the Paris Agreement.

As a party of COP13, Nepal prepared REDD into two segments: concept and institutional development. In concept

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development, Nepal government initiated REDDS Readiness Plan Idea Note (R-PIN) to Forest Carbon Partnership Facility of the World Bank in 2008. Similarly, in the institutional development, the government of Nepal established REDD forestry and climate change cell (REDD implementation center) under Ministry of Forest and Soil Conservation in 2008.

As the follow up, the government of Nepal had to develop policy and activities for awareness, along with fund. In 2010, the government submitted the Readiness Preparation Proposal(R-PP) to FCPF and the FCPF endorsed it in June 2010. For the effective design and implementation of a National REDD plus strategy policy formulation, large number of strategic environmental and social assessment, drivers of deforestation and degradation, environmental and social management framework were conducted (DoF, 2018). In 2013, its mid-term report was submitted on R-PP progress to the FCPF. As activity, the government of Nepal executed 12 districts of Terai Arc Landscape (TAL) project in 2016. As a base, national forest reference level was submitted to UNFCCC in 2017 (DoF, 2018). Finally, a three layer institutional mechanism of REDD was endorsed as follows: a) REDD plus multi-sectorial and multi-stakeholder coordinating and monitoring committee (Apex Body), b), REDD Working Group, c) REDD implementation center. These institutional mechanisms were big jump to conduct REDD readiness and implementation process strengthening decentralization of community based resource management, non-carbon benefits and opportunities to access finance for REDD.

In the initiation of REDD, Nepal has three major arguments. Firstly, Nepal presents herself for the successful community forest management with 22266 CFUGs managing 2.24 million hectares (35%) of total forests (44.74 % =6.61 million hectares) with 2.91 million households (33% of total households) (DFRS, 2015 and MoF, 2020). Secondly, Nepal argues for a huge deposit of carbon credit. DoF (2018) has projected 9 million ton carbon credit from the community forest having 15600 million NRs carbon income potentials. The projection covered 13 districts of the country. Let's imagine its potentiality if it covers 77 districts. Thirdly, Nepal expects sustainable forest management in future for miracle change in the livelihood and welfare of the CFUGs and global role to reduce carbon for stabilizing climate change. Therefore, Nepal has initiated the readiness program of REDD in the country since 2011 (DoF, 2018).

Despite a huge carbon benefits of CFM under REDD, the tendency of CFUG is still puzzle and indecision on REDD, whether it will be a better alternative to CFM, although the REDD readiness program all over the country across three layers: Federal, Provincial and Municipality through different REDD piloting projects to grab an opportunity of carbon finance under REDD since 2007. In the business as usual scenario in CFM, CFUG may lose an opportunity of potential carbon finance for sustainable forest conservation and management and livelihood and poverty reduction reducer to CFUG. As a result, CFM will face sustainability threat and a complexity of livelihood and poverty issues of massive forest dependent population all over the country. In future, it indicates a risk of deforestation and degradation and then higher scale of carbon emission. Therefore, indecision of CFUG about whether REDD will be a better alternative to the community forest is relevant issue.

In this context, the readiness program might be a valuable input to the Community Forest User's Group (CFUG) to build their perceptions whether REDD will be a better alternative to the community forest. However, lower rate of transformation from CFM to REDD regime has raised a query about coverage and effectiveness of REDD readiness program and decision of FUG to transform to REDD regime from CFM. In this regards, the accumulative large literatures are expected. Unfortunately, none of the past literatures have covered specifically this issue. This gap has made more relevant this study to fill such gap with new materials.

The broad objective of this paper is to examine whether REDD will be better alternative to the community forest for sustainable forest management and livelihood security. Its specific objectives are to examine whether REDD will be better alternative to the community forest and carbon trade and to explore its policy implication for sustainable forest management.

The organization of this paper is comprised as follows: Section 1: Background, section 2: Literature Review, section 3: Methodology, section4: Result and Discussion, section5: Conclusion.

2. Literature Review

2.1. Work Motivation

REDD is in simple a carbon credit trading mechanism under which carbon credit generated from reduction of carbon emission from degradation and deforestation through community forest management (CFM) of the CFUG. Kaimowitz,(2008) reviewed the prospects for REDD in Mesoamerica using PES and other instruments, with emphasis

on the effectiveness of REDD measures at reducing emissions, and their efficiency and fairness. The study concluded the growth of payment would be an important policy shift to REDD in the region in the coming years. However, the magnitude and impact of any payments must not be exaggerated and should be set in context of the overall trends resulting from broader social and economic dynamics.

In Nepal, literatures (Adhikari, 2009, and Staddon, 2009) on avoided deforestation in Nepal are review papers. Adhikari (2009) focuses on forest and climate change issues but Staddon (2009) deals on carbon financing and community forest. Adhikari (2009) argues multiple outcomes of forest commons in any international negotiations. The author emphasizes the evaluation of the contributions of forest commons not only forest products but also ecological services such as biodiversity conservation, climate change mitigation, and poverty alleviation. Staddon (2009) argues carbon offsetting as a solution to three issues: climate change, biodiversity conservation, and socio - economic development. The author argues the issues of equity, control, and power in community forests under REDD. In this regard, the REDD mechanism is considered a relevant measure in developing countries. Some developing countries (Brazil, Bolivia, Indonesia, etc.) have implemented it. Nepal is in readiness.

Bista (2021) conducted a study on REDD as the global role of Nepalese forest by gini coefficient method and probit model. The study found a result of huge potentiality of carbon credits and carbon income to the community forest and the CFUG. The study recommended strongly transforming non-market environmental services of CFM to carbon market of REDD mechanism for accessing unexpected huge carbon finance for market incentive to the CFUG.

Dhital, (2009) assessed the possibilities of REDD in Nepal through review method. The study argued benefits from the REDD mechanism including avoided rate of deforestation and forest degradation by identifying technical complexities in assessing the market, elite domination in contract negotiation and risk of ignoring the voices of forest - dwelling communities pose serious threats to the success of the plan.

Muttaqin, Alviya, Lugina, & Hamdani, (2019) aims to examine communities' needs for forest products and services; analyze communities' interests towards REDD+ activities in reducing emission from deforestation and forest degradation activities; and analyze options to be developed into management plans for reducing emissions from deforestation and forest degradation. The paper studied in 9 communities in the provinces of Papua, Central Kalimantan, and Riau with a qualitative approach (stakeholder interviews, focus group discussions and field observations). The study found some constraints in managing forest ecosystem services to the community with their diverse interest but their capacity in planning and in systematic forest use including carbon conservation programs are relatively low. The study emphasizes on strengthening community-level organizational structures and developing robust plans for sustainable management of forest ecosystem services to support communities' participation in REDD.

Wong, Loft, Brockhaus, Yang, Pham, Assembe - Mvondo, & Luttrell, (2017) present a three-element assessment framework for evaluating the outcomes and performance of REDD+ benefit sharing mechanisms, using the criteria of effectiveness, efficiency and equity: (1) the structures (objective and policies) of a REDD+ benefit sharing mechanism; (2) the broader institutional and policy contexts underlying forest governance; (3) outcomes of REDD+ including emission reductions, ecosystem service provision and poverty alleviation.

2.2. REDD and Cost

Waluyo, Digdowiseiso, & Sugiyanto, (2019) examines the concept of reduction emission from deforestation and forest degradation (REDD) by using five costs (opportunity costs, transaction costs, implementation costs, stabilization costs, and administration costs). The paper argued REDD as an inexpensive option to reduce emissions in the energy sectors of industrialized countries and substantial benefits to the reduction of greenhouse gas emissions (GHG). In this regard, Levin, McDermott, & Cashore, (2008) argues that reduced emissions from deforestation and forest degradation (REDD) initiatives will yield significant impacts only if decision makers are committed to a results-based dual effectiveness test, addressing both forest degradation and global emissions reductions, and involving significant and measurable global-scale targets.

Gusti, Forsell, Havlik, Khabarov, Kraxner, & Obersteiner, (2019) examined the sensitivity of cost of REDD to variation of socio-economic drivers of deforestation, afforestation and forest management activities through the global forest model (GFM). In the study, three variables are considered: wood price, agricultural land price and corruption coefficient. The study found the MACCs as more sensitive to the corruption coefficient than to agricultural land price and wood price.

2.3. REDD, Forest and Climate Change

Bista (2021) reviewed the community forest management policy (CFMP) by using descriptive methods. The study found a success story of CFM in Nepal to avoid degradation and deforestation. The rate of deforestation was nearly zero with the growth forest conservation. Similarly, the study mentioned the growth of biomass capacity and carbon credits. However, the study noted its sustainability as major issue in the future in the constraint of finance.

Angelsen, Brown, and Loisel, (2013) assesses qualitatively several important considerations for a future reducing emissions from deforestation and forest degradation (REDD) mechanism. The paper emphasized to the effective implementation of REDD to capture its mitigation potential under the flexible, phased approach and to sustainable outcome for REDD under the global partnership by developing reference level based on employing the Kyoto Protocol definition of forest and the Intergovernmental Panel on Climate Change (IPCC) framework for greenhouse gas (GHG) inventories.

Köhl, Baldauf, Plugge, & Krug, (2009) assess climate change mitigation approach to REDD at five cross country level study in 2009 through carbon emission reduction framework. The study found low rate of deforestation countries not having REDD benefit.

Levin, McDermott, & Cashore, (2008) argues that reduced emissions from deforestation and forest degradation (REDD) initiatives will yield significant impacts only if decision makers are committed to a results-based dual effectiveness test, addressing both forest degradation and global emissions reductions, and involving significant and measurable global-scale targets.

Araya, & Hofstad, (2016) estimates REDD payments to compensate for the opportunity costs of stopping the conversion of montane forest and miombo woodlands into cropland in two agro-ecological zones in Morogoro Region in Tanzania through 250 household survey. As a result, the study found compensation to protect the current carbon stock in two vegetation types from 1tCO2e-1 for the montane forest to USD 39 tCO2e-1 for the degraded miombo woodlands of which upto 70% and 16% respectively. The finding suggest that given the possible factors that can potentially affect estimates of REDD plus payments, avoiding deforestation of the Montana forest would be feasible under REDD+ scheme.

3. Methods

3.1. Models: Binary Choices of Households whether REDD will be a better alternative

Let us assume “nth” households as respondent households of CFUG having “xi” heterogeneous socio-economic characters such as income level, awareness level, occupation, age, food sufficiency, literacy, and organization with assumptions that these socio-economic characters of households can determine their perception and responses on dichotomous choices whether REDD will be a better alternative or not. In this binary choice model (Probit Model), its dichotomous outputs will be relevant to REDD policy. Like the Sequential Model (Greene, 2005 and Maddala and Lahiri, 2009), the binary choice model will be logical for determining the probability of REDD for alternative livelihood for the members of CFUG in Nepal. Its regression model is as follows:

$$\text{Probit}(Y_i) = \beta x_i + u_i \quad (1)$$

where:

$$Y = \int_{0\ otherwise}^{1 = if\ Y* > 0}$$

B = vector of regression coefficient ($0<\beta<1$)

x_i = vector of predictor variables (e.g. avoided deforestation, livelihood, REDD etc)

u_i = vector of Random variable(error term)

π = probability of an outcome

In the probit model, the probability of better alternative livelihood of REDD is a dependent variable. This model depicts the relationship between a dependent variable and independent variables (income, landholding, education, caste, household size, occupation, area, organization, etc.).

P (better alternative livelihood of REDD=1) = β0+β1 income+β2 landholding+β3education+β4 caste+β5 household size+β6 occupation+β7 area +β8organization + ε

where:

β0= intercept,

β1,β2 ,β3,β4,β5 ,β6 ,β7 ,β8 = regressors, 0<β0,β1,β2 ,β3,β4,β5 ,β6 ,β7 ,β8<1

ε = error term

3.2. Data Sources

This paper used primary data set collected from the survey to 48 households as stakeholders of Kalimati Community Forest (KCF) in Lamatar village in 2018 (April-May-June) follow up the survey 2010. In the sample selection, the study team employed two stage samples. In the first level, the sample was selected. Its rationales are as follows: firstly, the profile of KCF was of 10 years long history of a community forest management and involvement in carbon inventory and activities with NGOs and INGO. Secondly, KCF was selected because of REDD's piloting and carbon inventory. Thirdly, heterogeneous socio-economic characteristics of household were aware about REDD and their perception. Fourthly, the study site was 8 km far from Kathmandu. Thus, KCF was finally selected for the conducting household stakeholder survey and carbon inventory survey.

As a follow up in the second level, 48 sample households were selected from 63 total households in KCF as forest users groups (FUG) after the required pre-information was collected from the Village Forest Range Post and the Executive Committee of KCFUG to conduct a household stakeholder survey. It covers approximately 70 percent of the population households.

Data collection method followed to above sampling selection process. In the data collection method, survey tool was used with the help of a KCF executive member. In the survey, household questionnaire tool was employed. The survey was conducted by coding household stakeholders during three months (April-May-June). The questionnaire which was used in the household survey is divided into three sections: section 1: basic information about household socio-economic, and section 2: household's participation and dependency in KCF and section 3: expectations of household stakeholders about REDD.

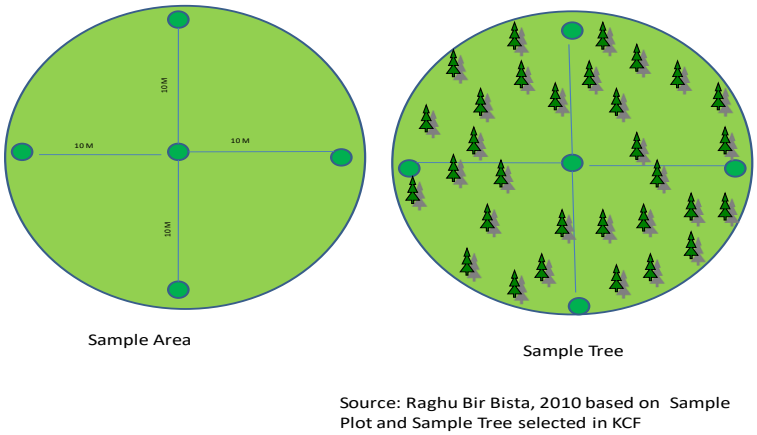

Figure 1. Sample Plots of KCF

3.3. Characteristics of Study Area

3.3.1. Characteristics of Kafle Community Forest (KCF)

Kafle Community Forest (KCF) at Lamatar Ward No 6 in Lalitpur District, Kathmandu (Map-1 and 2) is the study area of this study. The distance to KCF from Patan Bus Station, Lalitpur Metropolitian City Center, Kathmandu is of 8 km.

KCF is selected as the study area because of the following rationales: a) ICIMOD and the government of Nepal piloted KCF for REDD program, b) KCF has a long history of forestation, deforestation and reforestation, c) the members of CFUG of KCF are socio-economically heterogeneous, d) the members of CFUG are highly dependent on KCF for their livelihood, e) the CFUG has maintained documentation of plant species, activities of carbon inventory and f) KCF is not so far to access during the study.

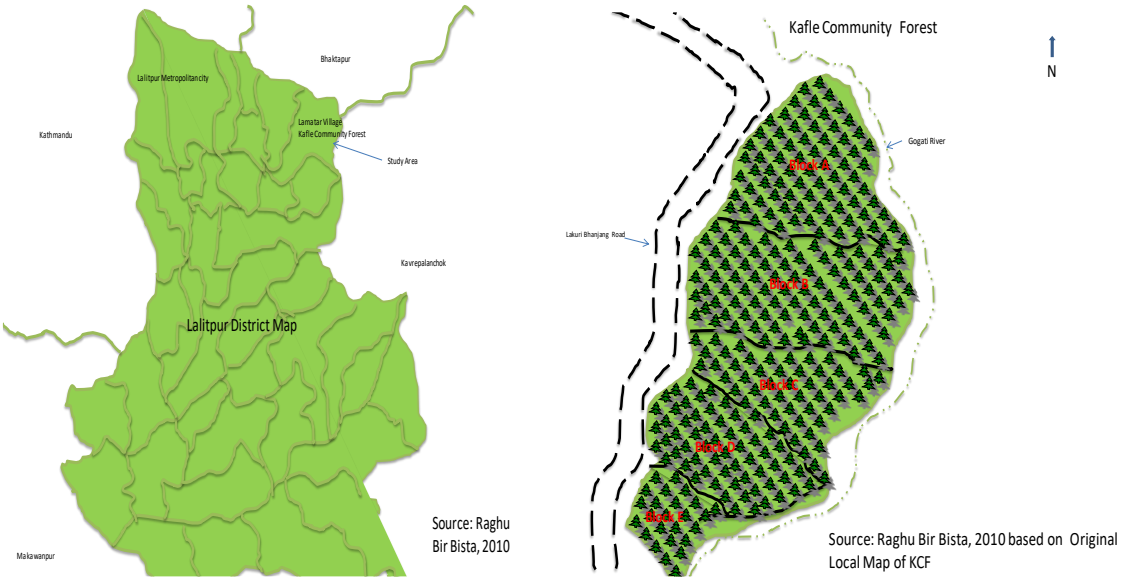

Figure 2. Lalitpur District and KCF Map

This study district is Lalitpur district, a small district of 77 districts of Nepal (Map 1). It lies in Kathmandu Valley, the Central Development Region. In the district, forest covered 15, 253 ha in 2006. Out of total forest area, about 65 percent (9,923ha) was community forest managed by 162 CFUGs (FD, 2006). Out of 162 CFUGs, KCF is one of total CFUGs of the district. In KCF, its forest area was of 96 ha owned and managed by 63 households of the VDC located in Mathilo Khoriya Dada in the east, Gumati Khola in the north, Chisapani Peepal Tree to way to Bhihawar in the South, and the main road to Khatri Bhajho in the west (Map-2). It lies in the altitude from 1540 meters to 1970 meters. The forest lies at an elevation of between 1830 and 1930 meters and is dominated by lower temperate broad-leaved species, particularly Schima-Castanopsis (katus-chilaune). KCF was clustered into five blocks as A, B, C, D, and E with the area of 20, 31,27,6, and 10 hectares respectively for its sustainable management and utilization. The forest is dominated mixed type regenerated trees (DFO, 2002).

3.3.2. Household characteristics of Stakeholders

This section offers socio-economic characteristics of KCFUG households as table 1.

Table 1. Household Resource Endowments

Land Holding	Mean	Standard deviation	Minimum	Maximum
Irrigated land	2.7	2.0	0.1	10.0
Marginal land	2.3	1.6	0.1	8.0
Livestock				
Cow/buffalo	1.57	0.5	1	2
Goat/Sheep	2.73	1.5	1	6

Source: Field Survey, 2018

Household Resource Endowments: In KCFUG household, the study found "2Ls" resource endowments out of three traditional resource endowments such as land, labor, and livestock (Table 1). In the perception of KCFUG households, there were land and livestock as major assets. Their assumption was that more assets mean more wealth. In table -1, almost all households own land assets in which on average per household owns 2.7 ropani (0.2 hectares) irrigated land

and 2.3 ropani (0.17 hectare) marginal land. As per national land categorization, all households are small farmers having such average landholdings below 0.5 hectare. Besides, all households farm livestock for meeting livelihood goods and services and generating non-farm income. On average, every household farms 1.57 units of cow/buffalo and 2.73 units of goat/sheep. In these traditional livelihood farm and off-farm activities, household resource endowments indicate the characteristics of poor household.

HH size and Composition is endogenous variable having wider effect on household livelihood and income. Table 2: household composition and demography provides on average 4.85 members family size. Its heterogeneity is from 2 member's family size as minima to 9 member's family size as maxima. Relatively, this family size is smaller than national household size (5.4) (CBS, 2011). In the different income groups, family size of the rich household is smaller than of the medium and poor household. In KCF, a larger household of the poor and medium-income group is a major source of labor endowments in the forest management and conservation. Thus, the correlation between HH size and labor endowments in the forest is observed in different kinds of literature. In sex composition, household has of 50% male and 50% female. This sex composition is different with national 49 % male and 51 % female. There is not so much difference. Mean Male size is 2.48 and mean female size is 2.46.

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Table 2. Household Composition and Demography

HH		Mean	Standard deviation	Minimum	Maximum
HH size		4.85	1.42	2	9
	Male	2.48	0.88	1	6
	Female	2.46	1.009	1	5
Education					
	Literate	4.45	1.54	1	9
	Illiterate	1.04	0.21	1	2

Source: Field Survey, 2018

Table 3. Poverty Scenario

Poverty	Relative poor	Absolute Poor
Mean	5.06	14.17
Standard Error	0.419	1.31
Standard Deviation	1.6	4.18
Population	76	157
%	32.62	67.38

Source: Field Survey, 2018

Household's poverty and economic condition: Table 3 offers poverty scenario and food sufficiency across income groups, education, and sex. In the per day earning poverty line of the World Bank (1.9USD), out of total members of CFUGs, there are 32.6 percent relative poor and 67.38 absolute poor households, despite higher literacy level. Cross checking above result of this poverty measure by 12 months food sufficiency, about 66.6 percent members of CFUGs are below food sufficiency line that is food insufficiency (table 4). These absolute poor families mean resource endowments constraint with a struggle for survival having extreme food deficits out of 12 months. They have not livelihood alternatives to reduce their extreme food deficits, except for community forest, KCF.

Table 4. Household Socio economic condition

HH categories	No of HH	Average Size of HH	Average Food Sufficiency	
			12 month	less than 12 month
Economic				
Poor	12	4.9	4	8
Medium	25	4.9	8	16
Rich	11	4.58	4	8
Education				
Literate	45	4.35	15	29
Illiterate	3	0.5		3
Sex				
Male	45	2.37	12	26
Female	3	2.45	3	6

Source: Field Survey, 2018

Household Participation: Table 5 shows household participation in KCF in percentage. Measure of this participation in KCF is four participations: none, lower, medium and higher out or which higher and medium participation indicates effective participation meanwhile lower and none participation indicates ineffective participation. In table 5, household participations are 85.3 percent in forest protection, followed by forest management at 84 percent, development activities at 82 percent, resource utilization at 76.6 percent, decision making at 73.0 percent, and training at 55.99. Thus, these measure values indicate effective participation of households in terms of labor endowment, contribution and attendance.

Table 5. Household Participation in percentage

Participation	Higher	Medium	Lower	None
Decision Making	29.5	43.2	25	2.2
Development Activities	28.8	53.3	17.7	
Forest management	27.2	56.8	15.9	
Forest Protection	29.2	56.1	14.6	
Resource Utilization	16.2	60.46	16.29	6.9
Training	15.9	40.09	34.09	9.09

Source: Field Survey, 2018

Household Livelihood Dependency: As per the policy realization and fact, National Planning Commission (NPC) (1997) mentions community forest in Nepal is perceived as alternative livelihood local resources for the poor (NPC, 1997). As about 66.6 percent households of KCFUG are absolute poor, members of KCFUG depend excessively KCF for meeting their livelihood demands including fodder, leaf litters, fruits, grass, fuel wood, construction materials, clean drinking water, etc. in table 6.

In table 6, member of KCFUG extracts on average weekly 16.4 bhari (656 kg) firewood, 4.4 bhari (176 kg) grass, and 7.6 bhari(304 kg) leaf litter. In the extraction of forest resources, there is a maxima of 100 bhari(4000kg) firewood followed by 40 bhari(1600kg) grass and 50 bhari(2000kg) leaf litters. In the exceptional case of forest resource demand and extraction, member should pay nominal charge per bhari. The household of KCFUG depends on firewood is greater than on other NTFP (leaf litter and grass) because households have traditional energy sources and consumption for heating in winter and cooking in all over a year. On KCF, the perception of households of KCFUG was positive because of increasing availability of firewood and decreasing their time allocation for access, extraction and collection of firewood. Besides, since firewood was a popular source of energy to all members of KCFUG, instead of clean energy (natural gas), their energy bill was 70 percent less than natural gas. Similarly, since KCF has generated a positive externality of increasing water sources and availability after forest's regeneration and rehabilitation, households of KCFUG has increasing invisible non market external benefit as a free cost of unlimited clean drinking water at the same opportunity cost of their labor endowment for KCF's management and protection. Thus, these free public goods have supplemented their livelihoods to some extents to meet their socio-economic level.

Table 6. Statistical Descriptive summary of NTFP extraction

Forest Product	Minimum	Maximum	Mean	Standard Deviation
Firewood	0	100	16.4	18.0
Grass	0	40	4.4	5.6
Leaf litter	0	50	7.6	12.9

Source: Field Survey, 2018

Besides, KCF generates monetary benefits (Table 7). On average, KCF makes Rs 182,797.9 per annum from selling forest products (fuel wood, timber, grass, leaf litter, etc.). The KCF benefit amount income is higher than their mean income from service and agriculture sectors (table 7). Since directly and indirectly, such KCF benefits are divided as forest dividend to members of KCFUG, such income is a supplementary income to them for increasing investment on energy substitution, chemical fertilizer substitution, and clean drinking water supply and facility. This benefit is a strong motivation factor behind the household's participation in KCF. There is claimed equal participation and distribution.

Table 7. Annual Income of Sample Households from different sources (Rs)

Income Source	Min	Max	Mean	Standard Deviation
Service	0	726000	179958.3	133483.1
Agriculture	-1000	268800	41122.55	46675.5
CF	73000	328500	182797.9	52003.4
Total	72000	1323300	403878.8	232161.9

Source: Field Survey, 2018

4. Result and Discussions

UNFCCC and other independent studies have argued huge REDD potentials in developing countries. CIFOR estimates US$17-33 billion per annum in the future. There is still room for query in developing countries like Nepal about its potentials and implications.

4.1. Biomass and Carbon Service

As the context of REDD, KCF is a module of avoided deforestation and degradation. Its philosophical logic was property right to the community for afforestation and forest management and governance for avoiding deforestation. KCF has increased biomass of tree as carbon sequestration and stock. Table 8 provides biomass and carbon stock, which were estimated by the allometric method. In carbon benefit, KCF could generate carbon income (Rs 24549.55 thousand) from forest products of KCF. On average, the carbon income potential of KCF is Rs. 39, 81,196. If carbon potential is included in KCF income, average income will increase at Rs. 1013711.33. It means 41 times more carbon income than income from NTFP. Thus, carbon income may be a game changer to sustainable forest management and poverty reduction, although opportunity cost of REDD is a huge.

Table 8. Statistical character of Biomass and carbon service

Indicators	Min	Max	Mean	Standard Deviation
Biomass/ha	45.23	90.46	95.95	5.26
C ton /ha	52.22	104.44	47.91	2.67

Source: Field Survey, 2018

4.2. Estimation and Analysis of Expectations about REDD

The binary discrete choice questionnaire about REDD was set up level-1: if yes, the better alternative of REDD to KCF. In the household survey, members of KCFUG had shown a major concern on awareness level, opinion, and expectation of stakeholders about REDD. Their capacity and understanding might set a future of REDD in Nepal in community forest management.

4.2.1. Descriptive Statistics of independent variables for REDD

In the discrete choice of households on REDD, assumption is that heterogeneous socio-economic factors of household influence their responses on the discrete choices. In the socio-economic variables, there are seven independent variables such as a) literacy, b) poverty level, c) food sufficiency level, d) sex, e) landholding, f) family size, and g) income level in the model. In table 9, their statistical result of the model 1 is presented. In summary, HH size within the age group is measured in terms of the number of the unit. The food sufficiency of households is measured in months. The landholding of HH is in the local unit that is ropani(0.07 hectare). In earning per day, there is used per person per day in terms of the dollar. Earning is considered as an exogenous variable. Livestock of HH is in number unit.

Table 9. Descriptive Statistics Model-1(if yes, better alternative of CF)

Variable	Mean	Std. Dev	Min	Max
HH size	5.125	1.39	2	9
Food Sufficiency				
12 >	0.33	0.48	0	1
9>	0.25	0.44	0	1
6>	0.29	0.46	0	1
3>	0.12	0.33	0	1
Land Holding				
10>	0.208	0.41	0	1
5>	0.208	0.41	0	1
1>	0.58	0.503	0	1
Earning per day				
1>	0.208	0.41	0	1
2>	0.54	0.51	0	1
>2	0.25	0.44	0	1
Rsex	0.916	0.28	0	1
Rlivestock	1.86	1.57	0	1
Literacy				
>SLC	0.5	0.51	0	1
SLC>	0.25	0.44	0	1
Literacy	0.25	0.44	0.4	5.2
Per day earning	1.8	1.11	0.33	2.5
Age	44.62	15.24	19	73
Source of information				
Seminar	0.58	0.5	0	1
Training	0.25	0.44	0	1
Newspaper	0.125	0.337	0	1

Source: Field Survey, 2018

Model-1: Better Alternative of REDD to CF

In Model-1: better alternative of REDD to CF, there were binary choices: “Yes” and “No”, if the household respondent of KCFUG responded “yes” in better alternative of REDD to CF. In model-1: a better alternative of REDD to CF, there were similar independent variables but there were only 25 household respondents of the total sample of 48 household respondents. Statistical characters of these independents are estimated and presented in table 9.

4.2.2. Estimation and Result of Probit Model

In the study, a probit model was used for the estimation of parameters (table -10). The estimation was level: better alternative of REDD to CF.

In the result of table 10, the higher LRχ2 (13) test of better alternative of REDD to CF displays that the model has good explanatory power. In the model, the estimated parameters show that landholding (10>) and Rlivestock are significant determinants with a negative sign in 95 percent confidence level. It implies that the probability of a better alternative of REDD to CF decreases if households have a large size of landholding and of livestock. Similarly, the positive value of parameters shows that food sufficiency, landholding (1>), different earning per day, Rsex, literacy, per day earning, and age are significant determinants with a positive sign in 95 percent confidence level. It implies that the probability of a better alternative of REDD to CF increases if households have higher literacy, higher age, per day earning, higher and less than 2 dollars earning per day. In Rsex, it implies the probability of a better alternative of REDD to CF for more male participation in the household respondent. Concerning less than 1 Ropani land holding, it implies a positive better alternative of REDD to CF.

Table 10. Model-1 (Alternative of REDD to CF)

Variable		Probit Coeff	St.Err
constant		-93.15	56473.7
HH size		5.02	6022.2
Food Sufficiency			
	12 >	39.14	3962.4
	9>	55.37	
	6>		
	3>		
Land Holding			
	10>	-12	12590.6
	5>		
	1>	37.75	
Earning per day			
	1>		
	2>	6.57	14456.9
	>2	1.57	
Rsex		13.53	13186.9
Rlivestock		-11.8	2513.01
Literacy			
	>SLC		
	SLC>	10.51	6980.3
	Literacy	10.98	7580.8
	Per day earning	14.06	8875.52
	Age	0.13	211.07
	Psedo R2	1	
	LR(x2)(13)	20.02	
	Prob>x2	0.09	
	No of observation	20	

Source: based on Field Survey, 2018

5. Conclusions

REDD is a UN flagship approach. Its basic idea is environmental service market trade mechanism under which carbon service trade is one of its mechanisms to capture potential carbon credits from avoiding deforestation and degradation of developing countries like Nepal at their own interest and concern for local resource conservation, management for livelihood security and poverty reduction. In Nepal, the community forest management is the successful story of avoided deforestation and degradation. Despite its non-market environmental benefits, higher opportunity cost to avoid deforestation and degradation has raised a query about its continuity in future, although its global role of carbon sequestration is to reduce the stock of GHG emission in the atmosphere. In this regards, REDD may be a powerful market tool to Nepal for integrating carbon market and incentives for motivating financially business as action to avoid deforestation and degradation and providing financial incentives to improve livelihood of members of CFUG and their socio-economic transformation. In this context, REDD may be a big game changer in CFM and households of CFUG. This transformation is possible when their perception about REDD is positive with their knowledge. Therefore, the study aims to examine the better alternative of REDD to CF through the binary choice method. The study found that the poor households are more dependent on the community forest for NTFP. The share of forest products is approximately 45 percent. They contribute more labor endowments in forest management and conservation. Estimation of biomass and carbon per hectare provides REDD potentials if KCF enters in REDD. In the case of KCF, it has earned Rs 24, 549.55 but potential income is Rs. 39, 81,196 if KCF enters in REDD. It shows 41 times more carbon incentive benefit potentials, despite the higher cost of avoided deforestation. Thus, KCF shows a huge carbon benefit potentiality of community forest (2.24 million hectares (35%) of total forests (44.74 % =6.61 million hectares) (DFRS, 2015 & MoF, 2020). As evidence, DoF (2018) has projected 9 million ton carbon credit from the community forest having 15600 million NRs carbon income potentials. The projection covered 13 districts of the country.

In the result of the model, 52 percent of household stakeholders have a familiarity with REDD but 48 percent do not have familiarity with REDD. Out of 25 household stakeholders, 44 percent of household stakeholders who are familiar with REDD expect that REDD is a better alternative livelihood to the poor. Further, 63 percent of households expect livelihood from REDD. Thus, the result is mixed between familiarity and no familiarity about REDD. Large household respondents don't believe that REDD will be a better alternative livelihood for the poor. Almost all households expect REDD for livelihood objectives. Thus, the result is mixed between familiarity and no familiarity about REDD. Almost all households expect REDD for livelihood objectives.

In conclusion, household stakeholders who have good asset holdings (land and Rlivestock) think that REDD will not be a better livelihood alternative to the poor. However, the household stakeholders who have literacy, different food sufficiency level, landholding (1>), different earning per day, Rsex, per day earning, and age think that REDD will be a better alternative. In other words, rich household characteristics by asset holding don't support that REDD will be a better alternative. However, poor household characteristics by asset holding support that REDD will be a better alternative.

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