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Role of Community and User Attributes in Collective Action: Case Study of Community-Based Forest Management in Nepal

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Received: 16 November 2017; Accepted: 7 March 2018; Published: 13 March 2018

Abstract: A growing literature on collective action focuses on exploring the conditions that might help or hinder groups to work collectively. In this paper, we focus on community-based forest management in the inner Terai region of Nepal and explore the role of community and user attributes such as group size, social heterogeneities, forest user' perception on forests, and affiliation to the user group, in the collective action of managing community forests. Household surveys were carried out with 180 households across twelve community forest users' groups. We first measured ethnic diversity, income inequality, landholding inequality, and user perception towards the use and management of community forests to understand their effect on the participation of forest users in the management of community forests. Our results show that among the studied variables, group size (number of forest users affiliated to the community forests) and perception of the management of their community forests are strong predictors of forest user participation in community forest management. Income inequality and ethnic diversity were found to have no significant association. Land inequality, however, was found to decrease participation in the management and use of community forests. These community and user attributes play a crucial role in the success of collective action and may vary from community to community. Hence they need to be duly considered by the practitioners prior to any community-based project interventions for stimulating successful collective action.

Keywords: participation; community attributes; perception; social heterogeneity; ethnic diversity; collective action; community forest management; Nepal

1. Introduction

Community-based forest governance has emerged as an institutional apparatus to align the interests and responsibilities of local people with national governments in managing the local forests sustainably [1]. About 25% of developing countries' forests are community controlled [2] and community forestry is considered an important institutional vehicle for implementing emerging policy interventions related to forests and carbon (e.g., Reduced emission for deforestation and forest degradation—REDD+). The central proposition of this paradigm is that communities, who live in close proximity of the forests, can manage them effectively over the long term [3]. Community forestry

management (CFM) is considered as one of the successful models of community-based forest governance [4]; the success of which depends on many factors, such as socio-economic heterogeneity, institutional setting, leadership, property rights regimes, degree of decentralization, community characteristics, technology, and market influence etc. [5,6]. The premise of the CFM asserts that communities or groups of forest users collectively engage in the management of the forest. Hence, the involvement and participation of the forest users has been deemed integral for the functioning of CFM as collective action in forest management [7–10].

Over the years, many case studies have emerged in the literature, suggesting that some communities are more successful than others in achieving success in collective action [11–16]. This has sparked a notable debate among scholars on the diverse conditions and factors that may facilitate and/or hinder the collective action [17]. While there is consensus on the fact that a certain set of variables such as physical and socio-economic environment, local governance structures, social capital, community's willingness to participate, tenure rights etc. influence the likelihood of collective action [18], there is no consensus about the particular effect that these variables have. The communities managing the forests worldwide may differ in their capacity, interests, and perceptions regarding community forestry [19], eventually affecting the social and environmental outcomes of collective action. Hence, there is a need to explore the contextual factors that motivate resource users to participate in collective action [20]. This is of fundamental importance for practitioners who are aiming to improve forest governance by mobilizing cooperation and participation in the collective management of forests. Against this background, the purpose of this paper is to examine the role of community attributes and user attributes on forest user participation in the CFM in Nepal.

1.1. Community and Resource User Attributes Affecting Collective Action

The following section briefly discusses the characteristics of community and resource users in the context of collective action in forest management, which also form the basis of this study.

1.1.1. Social Heterogeneity

Collective action in forest management, particularly in Nepal, is considered to be a fairly successful form of forest governance [21,22]. This governance system is embedded in a society that is known to be heterogeneous [20]. The term heterogeneity may be used to describe inequality between people or communities among which interaction generates greater privileges for some than for others. This results not only in the asymmetrical distributions of wealth and power, but also different preferences and opportunity costs [23–25].

Inequality in income and ethnic diversity are the two most widely studied heterogeneities that play a significant role in explaining the socio-economic outcomes of collective action. Nagendra (2011) identifies common indicators of heterogeneity as being differences in wealth in terms of land, livestock, agricultural income, and non-farm income, and heterogeneities in social backgrounds such as caste and ethnic groups [26]. Ruttan (2002) distinguishes between various kinds of social differences that impede communication, such as caste, ethnicity, language, and religion [27]. All these heterogeneities can shape differences across forest-dependent communities in terms of trust, social capital, and world views on the importance of the forest, thus creating a differentiated need for sustainable collective management [28]. The literature on the role of heterogeneity in collective action is divergent, mainly because there is not one but many kinds of heterogeneities that vary in their nature, occurrence, and context. The existence of heterogeneities among the communities managing natural resources is seen as a challenge to overcome for successful collective action. Ethnic diversity, in particular, is viewed as unfavorable to collective action [29,30]. In their study, Alesina and Ferrara (2002) found that racial and income heterogeneity had a strong association with low trust among people within communities [31]. Some other studies also point in the same direction, where the heterogeneous composition of a group leads to a lower level of trust [32,33], posing endogenous challenges for successful collective action. The extent to which economic heterogeneities shape the capacity to

self-organize and sustain common property regimes is largely debated [34]. Disproportionate capacities of rich resource users in comparison to the poor resource users provide them with different benefits from a particular collective action [26]. There is lack of systematic clarity on the issue as some studies have lumped together the impacts of economic and socio-cultural heterogeneity on collective action outcomes [20]. Moreover, studies have shown all possible—neutral, negative, positive, U-shaped—in terms of the impact of economic heterogeneity on the success of collective action [35–37]. These mixed patterns may be the result of studying collective actions on different common-pool resources such as groundwater basins, irrigation systems, grazing lands, fisheries, and forests [34,38].

In this study, we assess ethnic diversity, income inequality, and land inequality across the study site and use them as the explanatory variables to examine their effect on forest user participation in CFM.

1.1.2. Group Size

Group size refers to the number of resource users affiliated to the resource management group. It affects the collective action in the management of natural resources in several ways [20,39,40]. In this study, group size refers to the number of forest users affiliated to the Community forest user group (CFUG) in Nepal. CFUG is a local-level institution for forest management where the local people make decisions regarding forest management, utilization, and the distribution of benefits from the forests. Some studies (see [41–43]) on group size and collective action highlight that a larger group size leads to an increased provision of collective goods and increased effectiveness of the group. Whereas, in studies especially within the context of community-based natural resource management, smaller groups tend to be more successful in comparison to larger groups [37–39]. Such findings conform to the Olsonian thesis, which claims that large groups fail and small groups succeed in collective action due to an increase in the transaction costs of decision-making and monitoring with the increasing size of the group [36]. However, there are also studies that suggest a rather curvilinear pattern of group size affecting collective action outcome [44,45].

Given its varying role found in collective action literature, we include group size as one of the explanatory variables in our study.

1.1.3. Perception

Resource users' perceptions are known to affect not only the conception of collective action, but also its implementation and overall management [46]. Lubell suggests that community participation, which is one of the main determinants of successful collective action, is in fact a function of resource users' perceived success of the collective action [47]. Perception of resource users is an interesting variable to explore because communities are diverse entities [48], and heterogeneities prevalent within the groups may lead to diverse preferences, interests, and motivation towards collective action [49]. Generally, in collective action studies, perception is often used as a variable that explains the subjective way in which people experience and understand their environment and related processes [46]. For the purpose of this study, we follow the same understanding of perception. In relevance to the main line of inquiry, the perception of forest users in this study focuses on their experiences related to CFUG leadership and management, as well as their use and knowledge of forests. The operationalization and measurement of the perception variable is discussed in the next section.

1.1.4. Forest User Participation in Collective Action

Collective action, by definition, refers to action taken by a group of people in pursuit of their perceived shared interest [50], and calls for people to participate in a joint action and decisions to achieve an outcome which involves their common interest [51,52]. Hence, in this study, we consider forest users' participation as a proxy indicator of collective action in forest management. Participation is a broad concept that varies across the spectrum of disciplines relevant to development studies [53]. In collective action literature, participation, especially in the decision-making process and rule-making,

is attributed to be one of the drivers for successful collective action [54–59]. In this study, participation refers to the involvement of forest user households in CFM activities, and the details of its operationalization are mentioned in the method section.

2. Materials and Methods

2.1. Study Area

Nepal provides an excellent test case for our study, given its extensive history of more than 35 years in CFM establishment across ~18,000 community forest user groups [60,61]. The study site is situated in the inner Terai Chure region of Nepal, in the Kayar Khola watershed (Figure 1). The study covered twelve community forestry users' groups (CFUGs) (see Table 1) across three village development councils (VDCs), namely: Shaktikhor, Pithuwa, and Korak in the Chitwan district, Nepal, which is located at 27°35′ N and 84°30′ E.

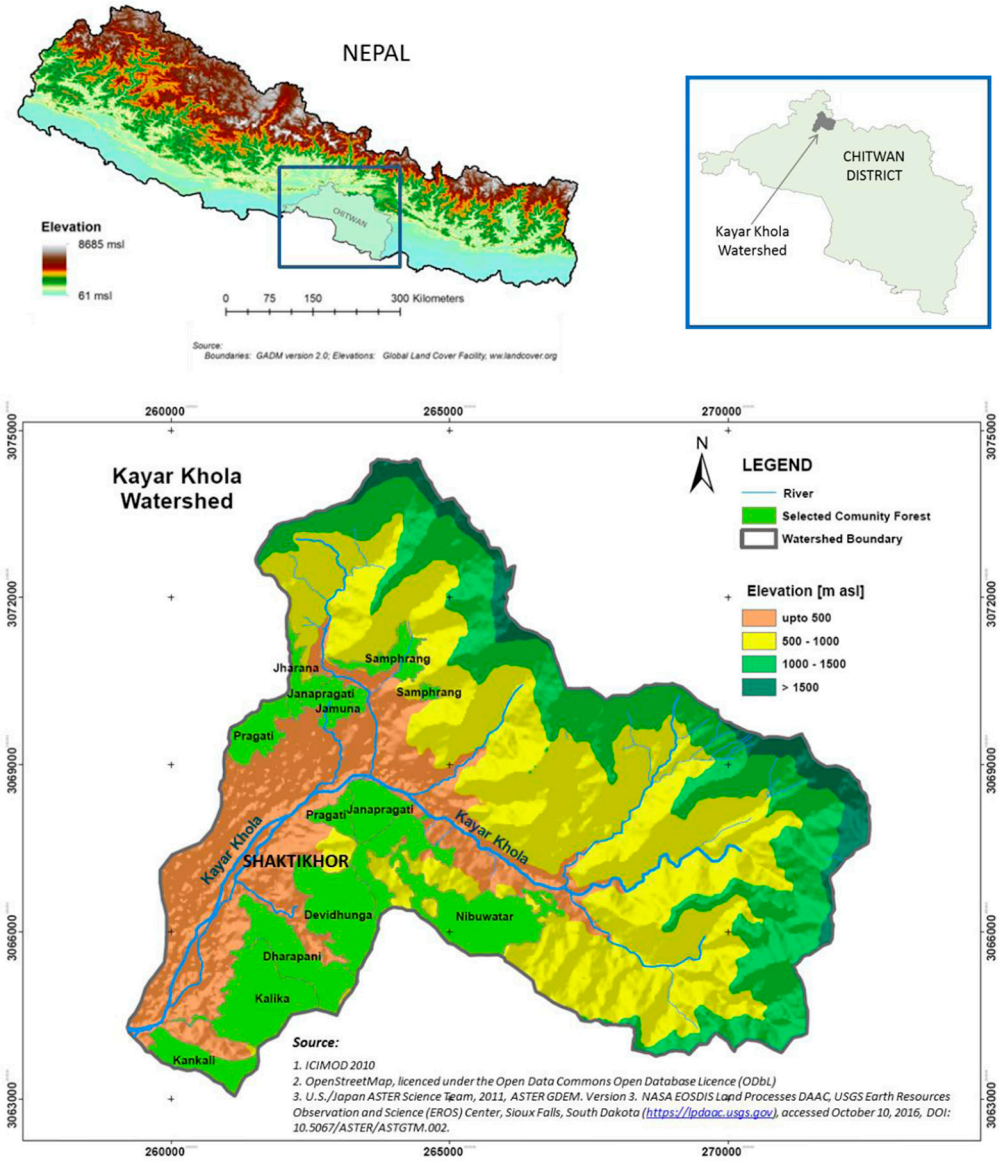

Figure 1. Location and geographic context of the study site in Nepal.

Table 1. Characteristics of the community forest user groups (CFUGs) in the studied community forests (CF).

CFUG	Household Size (HH)	No. of Castes	CF Area (ha)	CF Area /HH
Amlachuli	235	5	208.1	0.88
Amritdhara Pani	501	6	1088	2.17
Devidhunga	162	6	179.8	1.10
Dudhkoshi	881	15	495	0.56
Jamuna	35	3	30.7	0.87
JanPragati	180	8	136.8	0.76
Kameripani	146	2	315.5	2.16
Satyadevi	124	10	491.6	3.96
Satkanya	367	6	74.3	0.19
Samphrang	80	5	71.5	0.89
Pragati	187	6	136.8	0.73
Mangladevi	91	6	71.6	0.78

Source: District Forest Office, Chitwan, 2015.

The CFUGs are the grassroots level entity to which power is devolved by the Nepalese government for using and managing the patch of forest handed over to the communities.

The natural vegetation in this area is dominated by Sal forest (*Shorea robusta* Gaertn. F.), which is commercially a high-value timber species. The agricultural system is characterized by traditional subsistence farming, together with cultivating cash crops and cereals. The population consists of multiple ethnicities such as Brahmin, Chhetri, Newar, Gurung, Magars, Tamang, and Chepang.

2.2. Data Collection

The household survey questionnaire was administered in 180 households from villages comprised of forest users affiliated to twelve CFUGs sampled for the study area. The CFUGs were selected based on the following conditions: (1) selected CFUGs are officially handed over to the community at least three years before this study; (2) have extensive ethnicity/caste representation; (3) and the CFUGs represent different income groups. The final sample included 56.1% females and 43.9% males.

We developed a structured questionnaire with closed-ended questions. Questionnaire design was pretested and adjusted in a pilot phase. All the interviews were conducted with a translator fluent in both English and Nepalese, with previous training and discussion of questions between the researcher and the field assistant to frame the questionnaire identically. The questionnaire was comprised of the following three sections:

(1) *Perception Data:* The first part included questions on forest users' perception of their village and community forests to be measured on a five-point Likert scale. We asked respondents about their agreement on statements which aimed to assess their knowledge about forest rules and penalties, indicating their satisfaction level on the distribution of forest resources. Data was also collected on the forest users' perception about the group leadership and on management of the forest. We rated their perception with a five-point scale (from strongly agree to strongly disagree) (see Tables 2 and 3).

(2) *Participation Data:* The second section of the questionnaire gathered information on the participation of forest users in management of the community forest as a member of the CFUG. The number of days spent annually by the forest user household were noted down in the following activities. The five core CFM activities were: (1) forest conservation mainly involving activities like forest fire control and monitoring and plantation, if any; (2) forest use and utilization; collecting fodder, grass, firewood etc.; (3) decision-making, which relates to the collective decision-making as part of the community forestry users group regarding anything related to forests, village, projects etc. that involves forest users and CFUG funds; (4) Developmental activities, which pertains to any social and developmental activity carried

out by the CFUG members collectively, in which they have contributed in terms of money, time, or labor. The activities could range from providing housing for very poor people in the community, school construction, providing irrigation facility, drinking water pumps, road construction etc., and lastly, (5) days spent in trainings, which pertains to any vocational training provided through or in collaboration with the CFUG that was attended by the forests' users. The questionnaire also gathered data on (6) the number of meetings attended in a year; (7) last general assembly meeting attended or not; and (8) number of trainings received so far. The question was also asked to get participants to self-report and evaluate their own participation in these five activities as high, medium, low, or not at all.

(3) *Socio-economic and Demographic Data:* The last section included demographic and socioeconomic questions such as the respondent's age, education, caste, gender, farm and non-farm household income, household size, and land ownership. To double check the information on farm and off-farm income, we also relied on information given by a local resident, who knew everyone well enough in his village in cases where we thought respondents were understating their income in comparison to the assets they had (cemented double-storey house and size of poultry farm for example). Community proximity to the community forests was also noted.

Table 2. Coding and statements/questions related to perception items in the household survey.

Code	Statement
ForAll	There is enough forest resources available for all the community forest users.
ForU	There is enough forest resources for your household.
ForCFUG	How is the forest resource availability in comparison to other CFUGs?
For10	How is the forest resource availability in comparison to 10 years ago?
ForDiRe	The forest resource availability is reliable in your community forest
CFForFair	CFUG committee distributes forest resource fairly
CFHon	CFUG leaders keep your CFUG honest
CFMSat	You are satisfied with community forest management's fairness.
FRuFair	How fair are forest use rules?
PenFair	How fair are penalties for breaking those rules?
FRuAw	Do you have knowledge on the forest rules related to your community forests?

Table 3. Rating code for perception items in the household survey.

Perception Items	Rating Codes
FRuFair; PenFAir	1 = Very Fair; 2 = Fair; 3 = Unsure; 4 = Unfair; 5 = Very unfair
FruAW	1 = Very Fair; 2 = Fair; 3 = Unsure; 4 = Unfair; 5 = Very unfair
CFHon; CFForFair;	1 = Very Good; 2 = Good; 3 = Fair; 4 = Poor; 5 = Very Poor
ForDiRe;ForU; ForAll	1 = Strongly Agree; 2 = agree; 3 = Neither Agree nor disagree; 4 = Disagree; 5 = Strongly Disagree
ForCFUG; For10	1 = Better; 2 = Same; 3 = less; 4 = not sure

2.2.1. Measurement of Ethnic Diversity, Income and Land Inequality

To measure the ethnic diversity for our study, we used the ethnic fractionalization index following Varughese and Ostrom [34], which is in line with most of the literature on sociocultural diversity. The index is computed using:

$$A = 1 - \sum_{i=1}^{n} (P_i)^2 \quad (1)$$

where P_i is the proportion of total population in the ith ethnic type. A varies from 0 to 1, with values close to 1 indicating an ethnically highly diverse user group and values close to zero indicating a highly homogenous user group.

The ethnic fractionalization index measures the probability of two randomly selected individuals from one user group belonging to a different ethnic type.

Caste has historically been the predominant basis for the organization of society in Nepal, which conveys an inherent hierarchy. Although ethnicity is a social construction of cultural identity by defining the boundaries between different groups, they are found to be used side by side (Caste/Ethnicity) in the National Census of Nepal [62]. For this reason, we will not delve into the socio-logic differentiation between caste and ethnicity and simply follow the Nepal Census.

For measuring the economic heterogeneity of forest users affiliated to 12 CFUGs in the Chitwan district, Nepal, we used the standard method of computing the Gini coefficient [63–65]. The formula for this is:

$$G = \sum X_i Y_{i+1} - \sum X_{i+1} Y_i \quad (2)$$

where X_i denotes the cumulative proportion of the population in the ith class interval, and Y_i denotes the cumulative proportion of the income received by the income receiving unit in the ith class interval. The Gini coefficient ranges from 0 to 1, with values close to one indicating high economic inequality in the user group and values close to zero indicating low economic inequality in the user group. For the purpose of this study, we incorporate self-reported data on farm and non-farm income for measuring the income inequality.

In the agrarian economy, landholding and livestock holding also account for the household income [23,66] and have been used as proxies for studies related to economic interest in the forest or benefits derived from the forest [33]. To counter the potential income measurement bias, we include landholding inequality as additional evidence for economic heterogeneity and use it as one of the predictor variables alongside income inequality and ethnic diversity to understand the effects of social heterogeneity on the effectiveness of collective action.

2.2.2. Operationalization and Measurement of Variables

Dependent Variable

Community participation is a common measure to assess the effectiveness of collective action [49]. In our study, we use forest users' participation as a proxy indicator of the functioning of collective action. This is our dependent variable for measuring the collective action in forest management.

In this study, participation is defined as the involvement of forest user households in various CFM activities.

The participation variable is composed of eight items that assess the household participation in CFM. Five out of eight items are associated with days spent annually in five distinct forest use and management activities within the community forestry users group, namely: (1) forest conservation; (2) forest resource collection and utilization; (3) decision-making; (4) developmental activities; and (5) trainings. The other three items relate to (6) the number of meetings attended in a year; (7) last general assembly meeting attended or not; and (8) trainings received so far. Combining items with a different number of response options can introduce bias into the results and in our case, the responses for the items were mixed—binary and count. Hence, all eight items were standardized and averaged to make a composite variable (scale) of participation for each household.

A Cronbach's alpha score of 0.74 indicated strong internal consistency of the items in the participation scale.

Independent Variables

To facilitate the research objective, we first determined the different kinds of heterogeneities to incorporate in the study. Based on theoretical knowledge, economic inequality and ethnic diversity were included as independent variables along with group size, which is comprised of the number of households affiliated to the respective CFUG and forest user perception on community forests.

We measured ethnic fragmentation through the ethnic diversity index, and income inequality through the income inequality index and land inequality index. The ethnic diversity indices for the CFUGs were calculated using the ethnic fragmentation formula (see Equation (1)), whereas income

and land inequality indices for the CFUGs were calculated using the Gini coefficient formula (see Equation (2)).

In our study, the variable-perception of forest users' is composed of seven items mainly covering perception on CFUG committee leadership (for codes and variable items see Table 2); perception of the relative importance of CFUG activities; perception on the status of their own community forest in comparison to the neighboring CF and in comparison to 10 years ago. The codes for the required items were reverse coded and all seven items were standardized and averaged to make a composite variable (scale) of perception. The internal reliability of this measure is relatively low (Cronbach's alpha score for this composite scale is 0.62). Deleting some items does not result in a better internal reliability. An explanation for this relatively low reliability could be the diversity in underlying variables and the low number of items (7). The perception variables are diverse as they are intended to measure the perception of forest users on diverse aspects of community forestry management from leadership to status of the community forests.

Control Variables

In the multivariate analysis, we controlled the effect of a number of socio-demographics, such as gender, age, household size, household income, landholding, and users' affiliation age, which refers to the number of years a particular household has been an affiliated member of the respective CFUG.

2.3. Data Analysis

Statistical Analysis

In our study, we used both household and CFUG level data to provide a nuanced picture of factors that may influence collective action. This makes our dataset nested in structure (the sampled 180 households are nested within 12 CFUGs). Hence, we carried out the multilevel analysis of the survey data to explore how community and user attributes affected forest users' participation in collective action of forest management. Multilevel models are appropriate for the data structure where units are nested within groups, allowing researchers to model the group structure of the data. For this, we used a mixed linear model [67] in R statistical software [68]. After optimizing the fixed-effects of the model, a random effect was inserted to see if the nested structure of the data would affect the model. The Akaike information criterion (AIC) comparison of the two models indicated that random effect (CFUG) was not significant, hence after variable selection, we used the most robust fixed effect model to interpret the result outcomes.

Forest users' participation in the management of community forest was used as a proxy indicator of collective action. For this, the data was collected at the household level.

Our dependent variable (participation) is a continuous variable. We standardized it by subtracting each participation score from its mean and dividing it by the standard deviation, again transforming the data by adding a 1 as a constant to make our values strictly positive. This allowed us to take the log of the dependent variable-participation, which then gave us a normally distributed set of data (normality was assessed using a Shapiro Wilk test). Out of six explanatory variables in the final model, the perception of forest users and affiliation age were considered at the user level. The remaining four variables, namely the ethnic diversity index, income inequality index, land inequality index, and group size (number of households affiliated to the community forest), were considered at the group level and were repeated for each household belonging to the respective CFUG. Normality of our model was assessed using scatter and quantile-quantile (Q-Q) plots of the models' residuals as compared to the fitted values. We used variable selection to generate the robust model and also checked for over-dispersion.

All analysis was done in R 3.3.1 [68] and we used a significance level of $\alpha = 0.05$ for all testing.

3. Results

3.1. Perception of Forest Users on Their Community Forests

In our study, forest users' perception on community forests was found to be largely positive. We found that 7.7% of forest users had an extremely positive perception, 76.6% of forest users had a moderately positive perception. 14.4% of the forest users had a mildly positive perception, and only 1.1% of forest users had a negative perception about their community forests and their management by the user group committee. To summarize the perception data at the CFUG level, individual level data on perception was averaged. Figure 2 and Table 4 show the averaged standardized score (ranging from 0 to 1) for the perception of forest users within each CFUG. Although the majority of perception fell within the moderately positive range, the analysis of variance (ANOVA) on the standardized scores yielded significant variation in perception among forest users across user groups, $F(11, 168) = 6.647$, $p < 0.0000$. Post hoc pair-wise comparisons using the Tukey's honest significance difference test (HSD). The result is shown in Table 5.

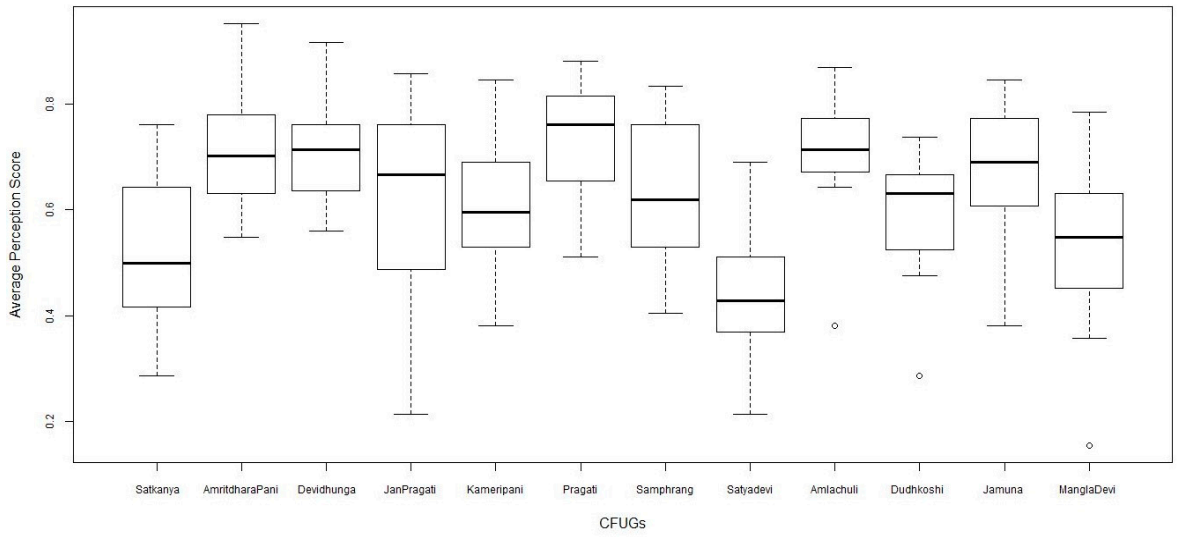

Figure 2. Boxplot for averaged perception score across twelve CFUGs.

Table 4. Average standardized score of overall perception of forest users across 12 Users' groups.

User Group (Name)	Overall Perception Score (Ranging from 0 to 1)
Satkanya	0.52
AmritdharaPani	0.70
Devidhunga	0.70
JanPragati	0.60
Kameripani	0.61
Pragati	0.73
Samphrang	0.63
Satyadevi	0.43
Amlachuli	0.71
Dudhkoshi	0.60
Jamuna	0.68
ManglaDevi	0.53

Table 5. Results of a Tukey HSD post-hoc comparison.

User Group Pair	Mean Difference	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound
AmritdharaPani–Satkanya	0.186	0.013	0.020	0.352
Devidhunga–Satkanya	0.188	0.012	0.022	0.353
Pragati–Satkanya	0.217	0.001	0.051	0.383
Amlachuli–Satkanya	0.194	0.028	0.007	0.360
Satyadevi–AmritdharaPani	−0.265	0.000	−0.431	−0.100
ManglaDevi–AmritdharaPani	−0.167	0.045	−0.001	−0.333
Satyadevi–Devidhunga	−0.267	0.000	−0.433	−0.101
ManglaDevi–Devidhunga	−0.169	0.041	−0.334	−0.003
Satyadevi–Kameripani	−0.176	0.025	−0.342	−0.011
Satyadevi–Pragati	−0.296	0.000	−0.462	−0.131
ManglaDevi–Pragati	−0.198	0.005	−0.364	−0.032
Satyadevi–Samphrang	−0.191	0.009	−0.357	−0.025
Amlachuli–Satyadevi	0.273	0.000	0.108	0.439
Jamuna–Satyadevi	0.240	0.000	0.074	0.406
ManglaDevi–Amlachuli	−0.175	0.027	−0.341	−0.009

Sig.: significance.

3.2. Social Heterogeneity

Table 6 shows the values of ethnic diversity indices (FRAC), income inequality (Income Gini), and land inequality (Land Gini) indices for each of the studied user groups. The index of ethnic diversity ranges from 0.3 to 0.8, averaging 0.66 ± 0.151 SD. Due to the nonavailability of caste distribution data for three CFUGs, namely Amritdhara Pani, Satyadevi, and Mangaladevi, we used the mean value of the ethnic diversity index for filling in the missing data for regression analysis.

Table 6. Gini coefficients for income and land inequality and index of ethnic diversity (FRAC) for the study sites in Nepal.

Name of CFUG	Income Gini	Land Gini	FRAC
Amlachuli	0.38	0.33	0.67
Amritdhara Pani	0.40	0.37	0.66
Devidhunga	0.35	0.23	0.72
Dudhkoshi	0.41	0.30	0.78
Jamuna	0.36	0.24	0.40
JanPragati	0.44	0.50	0.79
Kameripani	0.39	0.43	0.38
Satyadevi	0.38	0.37	0.66
Satkanya	0.31	0.42	0.66
Samphrang	0.54	0.19	0.73
Pragati	0.39	0.32	0.80
Mangladevi	0.44	0.36	0.66

The index of income inequality ranges from 0.31 to 0.54, averaging 0.39 ± 0.05 SD, whereas the land inequality index ranges from 0.19 to 0.5, averaging 0.33 ± 0.38 SD.

3.3. Multivariate Analysis

Table 7 summarizes the descriptive statistics of the independent variables used in the regression models. The results of the multiple regression analysis of participation in CFM are shown in Table 8.

Table 7. Summary statistics of the variables included in the regression analysis (N = 180).

Variable	Description	Mean	Std. Dev.	Min	Max
	Dependent Variable N = 180				
Participation	Number of days engaging in CFUG activities	1.580	0.63	0	3.53
	Independent Variables				
Landholding inequality	Land Inequality Index	0.33	0.08	0.19	0.50
Income inequality	Income inquality Index	0.39	0.05	0.31	0.54
Ethnic diversity	Ethnic diversity Index	0.65	0.16	0.38	0.8
Age	Age of the respondent	40.25	13.44	18	79
Household Size	Household size	5.2	2.01	2	18
Groupsize	Number of user households affiliated to the CFUG	249.1	227.7	35	881
Perception	Composite measure of forest users' perception scaled from 0 to 1 (1 meaning extremely positive perception)	0.62	0.15	0.15	0.95
Forest area per HH	Forest area per household (ha)	1.22	0.86	0.19	3.96
Affiliation age	No. of years since user household is a member of CFUG	12.3	5.2	1	37
Income	Household income: combined farm and non-farm income in NPR (Nepalese Rupee)	379,244.4	1,021,774.7	9000	12,187,000
Gender	Gender of the respondent: 56.1% Female; 43.9% Male	-	-	-	-

Table 8. GLS estimates for factors that influence participation in collective management of community forests.

Predictor	Coef	SE Coef	T	*p*-Value
Constant	1.140	0.460	2.477	$<2 \times 10^{-16}$ ***
Income inequality	0.150	0.079	1.889	0.060.
Land inequality	−0.129	0.050	−2.550	0.011 *
Ethnic diversity	−0.638	0.359	−1.777	0.077.
Group size	−0.767	0.202	−3.797	0.000 ***
Perception	0.987	0.266	3.710	0.002 **
Affiliation age	0.246	0.088	2.795	0.003 **
Additional controls [a]	-	-	-	Not significant

N = 180, Adj R^2 = 0.25, Signif. codes: *** = 0; ** = 0.001; * = 0.05; . = 0.1; [a] Additional controls include age, gender, household size, household income, and landholding.

The variable selection method gave us the final model, which was found to be the most robust after AIC comparison. Land inequality had significant negative regression weights, indicating that the participation of forest users in CFM is high when there is less land inequality in the group. The other two variables of heterogeneity: ethnic diversity and income inequality, do not show any significant effect on the participation of forest users.

Perception, a behavioral attribute of the forest users, accounts for a very strong and positive relationship with participation. Whereas, with the increasing size of the group, forest user participation tends to decrease. The coefficients from the model also indicate that participation in the management of community forests increases by 24% with the unit increase in the affiliation age.

4. Discussion

4.1. Limitations of the Study

Before discussing the implications of our findings, a few limitations of this study must be noted.

Based on the literature and key interviews in the field, we identified eight kinds of engagement in which forest users in Nepal become involved in managing their community forests. This may vary from country to country and further research in this direction may help to develop more reliable and exhaustive proxies to operationalize participation for community-based forest management studies.

Secondly, the data for this study is limited to the inner Terai region of Nepal. It must be noted that the CFM in the middle hills region of Nepal is considered to be very successful [69,70] compared to that in the Terai region [71,72], particularly in outcomes related to benefit equity and ceding of technocratic control of the government over forests [73–75].

Owing to the difference in forest dependency, the experience of CFM and forest health between the Terai and Mid-hills of Nepal, comparative data from the mid-hills would have been desirable. However, given the destruction of research sites in the Gorkha district due to the earthquake in 2015, which is when the data for this study was collected, caution is required to generalize the outcomes of this study for the mid-hill region of Nepal. Having said that, our study can be well replicated in terms of methodology and concept to any forest user community to understand and emphasize the role of behavioral, as well as socio-economic, factors in collective action.

Lastly, natural resource management falls under the Social-Ecological Systems (SES) framework, which is comprised of an extensive set of variables that have proven to be helpful in explaining sustainable outcomes in the collective management of natural resources such as forestry, fishery, and water resources [76–78]. These variables are often linked to each other through reinforcing feedback loops. This may also suggest that variables, for example, perception of the forest users in the management of forests, may be as much as an indicator of the successful collective action as a pre-condition for such success. Although exploring the causal relationship between participation and the studied variables would be useful, the scope of this paper limits us to only examining the (associative) effect of these variables on forest users' participation in CFM activities. Thus, the relationships observed in the regression model of this study should not be construed as causal in nature [79].

4.2. Community and Resource User Attributes Affecting Collective Action

In the following section, we discuss the findings on how various attributes of the community and resource users affect the likelihood of CFM.

4.2.1. Effect of Social Heterogeneity

In our study, social heterogeneity comprises three distinct types—Ethnic diversity, Income inequality, and Landholding inequality.

Our results indicate that income inequality did not have any significant effect on the participation of the forest users. This runs contrary to the theoretical predictions, which assert a significant (negative or positive) relationship between income heterogeneity and cooperation [80–85]. This may be attributed to the unreliability of income data collected from the field. In the studies based on forest commons, data on household income may suffer from measurement error such as under-estimation and under-reporting [86]. In our study, we used a second proxy for wealth, i.e., land holding, and we strongly support the use of a single wealth asset such as landholding to measure economic heterogeneity either on its own or in supplement with the income data [33,81].

In our regression model, the land inequality index shows a significant negative effect on participation. With the increase in land inequality, participation tends to decrease. Baland and Platteau (1999) explain that the cost incurred by forest users participating in CFM activities is not constant across households, and it may depend on the wealth and opportunity cost of time [38]. Poor households may be discouraged to participate in if the incentive to participate in collective action is very low as compared to the cost of participating. With the increase in wealth inequality, such differences may also increase, thus inhibiting the likelihood of participation. The involvement of communities in collective action calls for shared objective and economic interests. The high levels of

wealth inequality may lead to a decrease in the shared economic interests, which may further lead to a decrease in participation, making the collective action ineffective [33].

However, some empirical studies suggest that wealth inequality may increase the incentive to participate in collective action [87–89]. It generally holds true to resource management that is highly technology-driven and is costly to operate such as irrigation and fisheries [33]. In such cases, high inequality may create a condition under which "wealthier members take on a disproportionate economic responsibility in order to ensure the success of collective action" ([90] p. 692).

As the literature is ambiguous in linking economic heterogeneity with collective action, there is an ever increasing need for context specific case studies to add to the current knowledge. Case-oriented studies can help build a comparative database to eventually undertake statistical–analytical work and detect broad but significant patterns in the meta data [91].

The third type of social heterogeneity studied in this research is ethnic diversity. Studies that have examined the role of ethnic diversity in collective action broadly suggest that it may pose a challenge to the successful outcome [25,30]. Naidu (2009), in her study, found that the ethnic diversity follows a rather U-shaped relationship with cooperation. She argues that very high ethnic diversity allows for increased interaction across households belonging to different castes, thus building mutual trust as the ability of any one group to capture power or dominate other caste groups is potentially decreased [33]. This is in contrast to several studies such as [87,92–94], which have claimed ethnic diversity as a challenge for collective action due to a lower level of mutual trust across groups and a decreased ability to impose social sanctions, which often leads to failure outcome [29,38,93,95–97].

In our study, however, we do not find evidence that ethnic diversity has any significant effect on the participation of forest users in CFM. This result is reinforced by anecdotal evidence taken from informal focus group discussions among forest users in the field. We found that the forest users across different user groups share a strong sense of belonging towards their CF. Moreover, the CFUGs in Nepal are known to be cohesive in nature [98–100], which suggests low conflict and more trust among the CFUG members.

As our model shows no significant link between ethnic diversity and participation, this finding concurs with studies like Adhikari and Lovett (2006) and Sapkota et al. (2015), who provide empirical evidence that in Nepal other user attribute variables are in fact more influential to explain collective action than ethnic and wealth heterogeneities [23,101]. Heterogeneity was not found to be a strong predictor of community management outcomes in Nepal in Varughese and Ostrom's (2001) study [34]. The reason for this could be a rather diluted culture in a conglomerated settlement that, whilst being ethnically diverse, lacks a distinct hierarchy or power structure [102].

Waring and Bell (2013) point out that power and status differences between ethnic groups play an important role in determining the collective action outcomes [103]. They propose considering the measure of ethnic dominance instead of ethnic diversity to understand how ethnicity affects cooperation in collective action. We believe that ethnic dominance can be an important variable to explore in CFM studies conducted in areas with strong hierarchical ethnic divisions with a distinct power gradient running across ethnicities.

4.2.2. Effect of Group Size

In our analysis, we found that group size, i.e., the number of households affiliated to the CFUG, is a strong predictor for participation in collective action. Group size is negatively correlated ($r = -0.34$, $p < 0.0000$) with the participation of forest users in community forest management, indicating that larger groups tend to have a lower participation of forest users in CFM. This result is in alignment with the previous literature, which states that co-operation becomes difficult as the group size increases [36–38]. This is because the monitoring expenses become higher and sanctions become ineffective and difficult as the group increases in size [39]. Our participation variable is comprised of forest users' involvement in various activities, with forest protection being one of them. Forest user households work in rotation in terms of monitoring and forest protection activities in their community

forests. Hence, it is likely that each household participates less in a larger user group compared to the user group with a smaller number of households. Similarly, forest users' participation in decision-making, trainings, and developmental activities may also be affected by the number of affiliated forest users in respective CFUG.

Our findings are consistent with the commonly held view that collective action becomes difficult as group size increases. There are studies (see [39,44]) that suggest that there is an optimum group size for the success of collective action. However, there is no consensus on what that optimum size is [17,34].

Our model indicates the trend of decreasing forest users' participation with the increase in group size. This can be seen in contrast to the study by Agrawal and Goyal (2001), which indicates that smaller groups are less successful in collective action because it may be too difficult to create viable institutions for undertaking collective action, given the limited resources [39]. Similarly, Boyce (1994) argues that with group size, the negotiating power of the community vis-a'-vis the forest department over management and forest use also increases, making a larger group better off [104]. We argue that collective action comprises two main components—the emergence and an outcome. The findings similar to Agrawal (1996) and Boyce (1994) etc., [39,104] are specific for studies looking at the emergence of collective action and may not hold true for studies that are focusing on the outcome of collective action through forest users' participation. Hence, it is very important to look into context-specific details prior to interpreting the results from studies on group size and collective action.

4.2.3. Effect of Forest User Perception and Affiliation Age

In this paper, we argue that common interest and shared perceptions across groups of forest users may play a bigger role in generating a successful collective outcome, particularly in CFM in Nepal.

Sullivan et al., (2017) argue that individual level perception of collective action problems can alter the participation behavior of an individual to solve an issue [73]. Our findings provide evidence that forest users' perceptions, which are based on the (subjective) way the users' experience, think about, and understand the context of community forests [105], have a significant effect on the forest user participation. In the literature, a few case studies which took individual perception into consideration found that indeed the perception of risk, success, or failure of a particular collective action, strongly influences the intention and willingness of individuals to participate in particular efforts [106–109].

Our result shows that having a positive perception of the management of community forests and CFUG leadership is one of the strongest incentives for forest users to participate in the CFM. It may appear as a fairly straightforward result; however, this finding implies that these perceptions are important predictors of collective action, which must be linked with the underlying socio-economic and environmental variables to facilitate an understanding of the gaps and failures in the CFM initiatives.

Consistent with Ostrom (2009), the duration of membership of the forest management group shows a positive correlation with the forest users' participation in CFM [78]. This finding implies that the experience and affiliation of the forest user with the use and management of their community forests is linked with the cooperative outcome of the CFM.

5. Conclusions

In this article, we test some of the commonly held ideas on the effects of community attributes on the functioning of collective action. Our empirical research relies on case study evidence, to assess how the common community and user attributes such as economic and ethnic heterogeneities, group size, and user perception affect the participation of forest users in the CFM initiatives.

Overall, we found that land inequality negatively affects the participation, which seems to support the claim that economic heterogeneities hinder the functioning of collective action, and suggests that single asset measurement will be a more accurate descriptor than income to quantify this heterogeneity. We found that ethnic diversity is not as significant a factor as often reported in the collective action literature.

One of our key findings is that the forest users' perception is a strong predictor for assessing the community participation in CFM. Understanding local perceptions requires consultations and regular feedbacks of those groups along with a flexible project design. The perception of local people on the forests can change overtime and therefore their willingness to partake in collective action might also change. Hence, policy makers and community project developers need to develop a better understanding of the forest user's behavior and perceptions prior to implementing any intervention relying on collective action.

Failures to overcome collective-action problems contribute to the degradation or loss of natural resources around the world [20]. Exploring and measuring heterogeneities across communities, prior to implementing any policy intervention, remains a priority and sufficient efforts must be made to find out how those heterogeneities are linked with the resource users' definition of a "common interest" in the collective action. An applied understanding of the varying effects of socio-economic, physical, and behavioral factors on the functioning of collective action has significant policy implications.

Our findings also imply the need for a more diagnostic approach in analyzing the role of context-relevant variables in diverse CFM arrangements. To examine the causative effects of community characteristics on the participation outcome of collective management of forests, a quasi-experimental research design may be more useful [110]. Comparison of the same group of forest users which are also involved in other forms of collective action such as the REDD+ project or any payment for ecosystem services (PES) project, can help to control for potential biases associated with cross-community comparisons and identify a stronger causality of community and user attributes to their participation behavior in collective action.

Acknowledgments: The study was supported by research grant "Research Fellow Partnership Programme (RFPP)", financed by ETH Global. We would like to thank Ujjwal Devkota for assistance with field data collection. We are thankful to ICIMOD, Kathmandu for providing desk space and field support to S.N. We also thank Jaboury Ghazoul, who gave his valuable inputs in the initial draft of the manuscript. Last but not the least, we are thankful to the anonymous reviewers for giving their constructive feedback, which helped to improve the paper immensely.

Author Contributions: S.N. conceived the study, collected and analyzed the data; T.T.P., B.K., C.G., and S.N. contributed in writing and finalizing the manuscript.

Conflicts of Interest: The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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