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Linking Attitudes, Policy, and Forest Cover Change in Buffer Zone Communities of Chitwan National Park, Nepal

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Abstract Deforestation in Nepal threatens the functioning of complex social–ecological systems, including rural populations that depend on forests for subsistence, as well as Nepal's biodiversity and other ecosystem services. Nepal's forests are particularly important to the nation's poorest inhabitants, as many depend upon them for daily survival. Two-thirds of Nepal's population relies on forests for sustenance, and these pressures are likely to increase in the future. This, coupled with high population densities and growth rates, highlights the importance of studying the relationship between human communities, forest cover trends through time, and forest management institutions. Here, we used surveys to explore how household attitudes associated with conservation-related behaviors in two rural communities—one that has experienced significant forest loss, and the other forest gain—compare with forest cover trends as indicated by satellite-derived forest-loss and -regeneration estimates between 2005 and 2013. Results found a significant difference in attitudes in the two areas, perhaps contributing to and reacting from current forest conditions. In both study sites, participation in community forestry strengthened support for conservation, forest conservation-related attitudes aligned with forest cover trends, and a negative relationship was found between economic status and having supportive forest conservation-related attitudes. In addition, on average, respondents were not satisfied with their district forest officers and did not feel that the current political climate in Nepal supported sustainable forestry. These findings are important as Nepal's Master Plan for the Forestry Sector has expired and the country is in the process of structuring a new Forestry Sector Strategy.

Keywords Attitudes · Community forestry · Conservation · Deforestation · Forest policy · Sustainable forest management

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Introduction

After decades of deforestation in the latter part of the twentieth century, Nepal is now regarded by some as one of the world's leading examples of successful community-based forest management (Gautam et al. 2004). Nepal was one of the earliest adopters of community forestry in Asia

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(Pandit and Bevilacqua 2011a citing Arnold 1992), and modern community-based forest management was formalized in the Master Plan for the Forestry Sector (MPFS) enacted in 1989, followed by related legislation in 1993 and 1995 (His Majesty's Government of Nepal, HMGN 1993, 1995; HMGN, ADB, and FINNIDA 1988). In combination, the core goal of these three pieces of legislation was to grant limited management rights and authority to established community user groups to foster the rehabilitation of degraded forest parcels and better meet the needs of local people.

Community Forest User Groups (CFUGs) and Buffer Zone CFUGs (BZCFUGs; hereafter, "CFUGs" will be used interchangeably) were granted limited authority to manage forests in their communities. Before this, in 1957, Nepal nationalized all forests in the country to ensure centralized control over timber markets (Agrawal and Ribot 1999; Jones 2007), but the Act undermined community-level management practices and significantly accelerated deforestation trends (Agrawal and Ostrom 2001). In addition, increased centralization and control over forest management created distrust between forest users and government forest-sector institutions—a condition that persists (Pandit and Bevilacqua 2011a, b; Shrestha and McManus 2007).

Today, there are 1.7 million hectares of community forest—about 29 % of all forests in Nepal. These forests support approximately 2.25 million households (Government of Nepal, GoN 2014). Although community forestry has been highly influential in Nepal, there have been varying levels of success among communities in the last 25 years in terms of reversing historic deforestation trends, granting representation to various sociodemographic and ethnic groups, providing local employment, and promoting efficient bureaucratic structures (GoN 2014).

A growing body of evidences—both empirical and anecdotal—suggests that modern forest-related policy changes have been effective in decentralizing management and reducing rates of forest loss (GoN 2014; Stapp et al. 2015), and some studies suggest that community-based forest management has been effective in combatting forest degradation in Nepal over the last 25 years (Gautam 2007; GoN 2014; Nagendra 2007; Nepal and Spiteri 2011; Spiteri and Nepal 2008; Stræde and Treue 2006).

Ostrom's (1990) seminal work examined how community-level self-governance of common pool resources (CPRs) can yield successful outcomes, especially as compared to centralized management institutions. In Nepal, as well as in many other parts of the world, her work also explored the complexities and fragility of management institutions, and what components of a CPR system are critical for it to function sustainably (e.g., Agrawal and Ostrom 2001, 2008; Andersson and Ostrom 2008; Ostrom et al. 1993; Shivakoti and Ostrom 2002).

Many studies have since examined the potential for successful self-governance of CPRs, particularly for forest resources in Nepal under varying social and biophysical conditions. These studies have reinforced the importance of Ostrom's design principles for managing CPRs (Ostrom 1990), as well as common property institutions, group size, heterogeneity, and the presence of collective action (see, e.g., Agrawal and Gupta 2005; Gautam 2007; Gautam and Shivakoti 2005; Chakraborty 2001; Gurung et al. 2013; Nagendra et al. 2005; Shrestha and McManus 2007). Still needed, however, is a better understanding of how household attitudes associated with forest conservation-related behaviors aggregate to community-level decision-making and, ultimately, landscape outcomes.

Earlier work has shown that household surveys focused on community-based resource management have been an effective method in making connections between household perceptions and empirical trends (see, e.g., Jones 2007; Mehta and Kellert 1998; Nepal and Spiteri 2011; Spiteri and Nepal 2008; Stræde and Treue 2006). Here, we describe the results of a household survey in two Village Development Committees (VDCs) located in the buffer zone of Chitwan National Park (CNP) in southern Nepal (Fig. 1). The VDCs were purposively selected based on a remote sensing analysis which identified buffer zone communities at two ends of a spectrum—one VDC experiencing high levels of forest loss between 2005 and 2013, the other VDC significant gains in forest cover (Stapp et al. 2015). Our first research objective sought to understand how household attitudes toward forest conservation-related behaviors correlated with empirical forest cover trends. Our second research objective explored which sociodemographic variables influenced supportive attitudes toward forest conservation-related behaviors.

Methods

Study Area

CNP, established in 1973, is a UNESCO-designated World Heritage Site. CNP is located close to the southern border of Nepal in the low-lying Terai region adjacent to India (Fig. 1). CNP is considered subtropical lowland and is located at the foot of the Himalayan Mountains, adjoining two rivers—the Narayani and the Rapti. The Park area extends over four administrative districts: Chitwan, Parsa, Nawalparasi, and Makwanpur. In addition to CNP, the Parsa Wildlife Reserve (PWR) is located to the east, and Beeshazar, and its associated lakes are located to the north of the Park (United Nations Educational Scientific and Cultural Organization, UNESCO 2013).

CNP and PWR together cover approximately 177,000 ha of mostly forested land. CNP has a long history of human

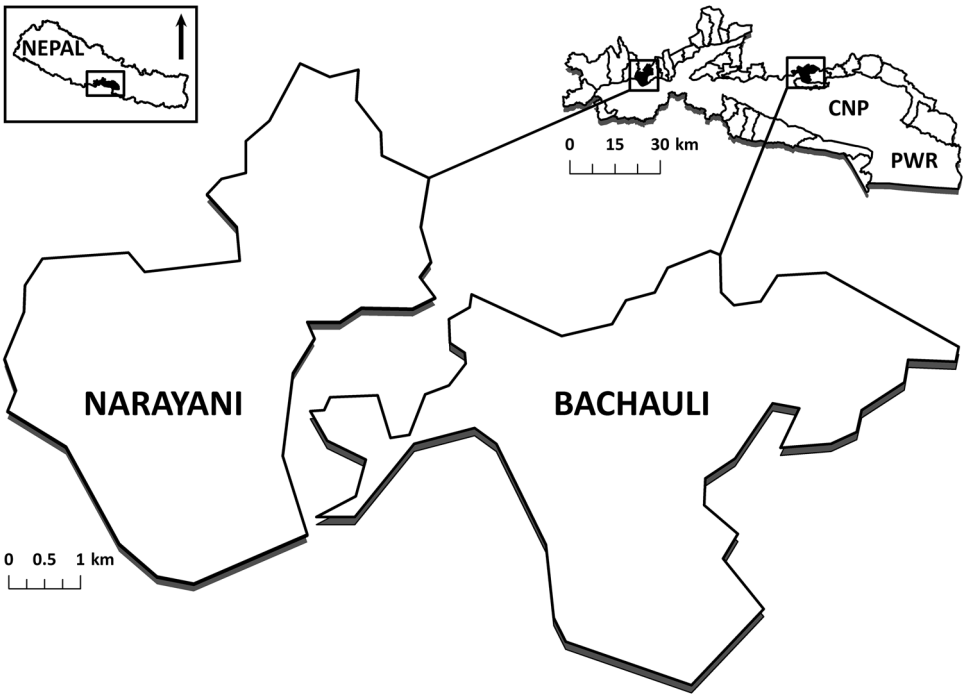

Fig. 1 Location of Chitwan National Park (CNP), Parsa Wildlife Reserve (PWR), and the VDCs of Bachauli and Narayani

influence. When first established, it was named Royal CNP, and was used by the royal family and other elites to hunt large animals such as Royal Bengal tigers (*Panthera tigris*), Asian one-horned rhinoceros (*Rhinoceros unicornis*) and Asian elephants (*Elephas maximus*). At the time, the Park and surrounding areas were fairly remote and inaccessible, and malaria was rampant. New roads were built in the 1950s and 1960s to improve access to the region, and forests were cleared to mitigate malaria and provide land for agricultural expansion and a growing population.

Today there are 36 VDCs adjacent to CNP. The total population of these administrative units increased from 292,000 in 2001 (HMGN 2001), to over 400,000 in 2011 (GoN 2011). Note that CNP's official buffer zone does not include the entirety of the surrounding VDCs (Stræde and Treue 2006). For this study, the entire area of VDCs adjacent to the Park is considered, which includes areas beyond the official buffer zone of CNP. The annual per capita income in the Central Terai region is $647 USD—slightly lower than the national per capita income of $718 USD (Sharma et al. 2014). The average household size is 7.1, with 48 % of people being of working age, and 41 % under the age of 15 (Stræde and Treue 2006, citing Banskota et al. 1996).

Survey Design and Development

We used a purposive sampling approach (Mahat 2009; Tashakkori and Teddlie 1998) to better understand how household attitudes toward forest conservation-related behaviors correlate with empirical forest cover trends in areas that are on opposite ends of the spectrum with regards to forest loss and gain in recent years. Previous remote sensing work (Stapp et al. 2015) quantified the amount of forested land that had been deforested and regenerated within all 36 VDCs adjacent to CNP between the years 2005 and 2013. Two VDCs were purposively selected from this pool to meet these criteria: (1) Narayani, which had seen significant forest cover loss in recent years, and (2) Bachauli, which had seen significant forest regeneration (Fig. 1).

Similarities between Bachauli and Narayani such as size, geographic location, and population allowed for comparison (Mahat 2009). Narayani and Bachauli are approximately 17.7 and 19.5 km^2 in size, respectively. Bachauli's population rose approximately 23.5 % between 1991 and 2011, from 8338 to 10,905, whereas the population in Narayani rose approximately 20 %, from 7234 to 9047 (HMGN 1991; GoN 2011). One difference is that Narayani is characterized by an agriculture-based economy, while Bachauli's economy relies heavily on ecotourism from CNP. In fact, the north entrance to CNP is located in the Village of Sauraha, located within Bachauli.

To better understand how household attitudes toward forest conservation-related behaviors correlate with empirical forest cover trends, we define attitudes which support forest conservation by considering a household's (1) dependence on forests and perception of forest trends, (2) its willingness to support collective action and

community forestry, (3) its willingness to support non-governmental organizations (NGOs) that promote forest conservation, (4) its willingness to adopt energy-efficient technologies which decrease pressure on forests, and (5) its willingness to support existing forest-related institutions and policies.

Survey development was assisted by SeedTree[1] (ST), a US-based NGO that has been engaged in reforestation and environmental education outreach in Nepal for the last two decades with a special emphasis on the Chitwan region. ST has developed innovative approaches to reforestation that combine community forestry with native/indigenous species protection to conserve and restore native trees, shrubs, and grasses in 23 of Nepal's 75 districts. ST has also worked to install improved cooking stoves and home biogas systems in many areas of Nepal.

The household survey used a five-point Likert scale, where 1 denoted "strongly agree" and 5 denoted "strongly disagree" (De Vaus 2002), as well as sociodemographic and economic questions. In addition, two open-ended forest policy questions were included to provide information for further interpretation of the data (Oppenheim 1992). After development, the survey was approved by the University of Maine Institutional Review Board (Application #2014-02-14). It was then translated into Nepali and tested on a small group of residents in Bachauli to assure that the translation was accurate, and the questions were understandable.

Data Collection

A purposive survey sample was selected because of the absence of databases for households and household information such as addresses, telephone numbers, and household-level census data that would allow other types of sampling (Barber et al. 1997). We employed a two-stage approach to select survey participants. Individuals were selected in both VDCs using a network sampling approach (Sudman et al. 1988; Bernard 2002). First, with the assistance of World Wildlife Fund-Nepal and ST, village leaders in Bachauli and Narayani were contacted and asked to help in selecting individuals within their village who were willing and available to take the survey. These individuals then suggested others who would be willing to participate.

Additional respondents—as many as time and resources allowed—were selected using a random walk technique (Jones 2007; Lyon 2000). While not truly random, this is an efficient method for identifying individuals able and willing to participate in surveys in large, geographically remote areas (Jones 2007). In addition, some suggest that, although ideal, probability sampling methods are less suited to small surveys (Benoit et al. 2005; Kish 1965; Moser and Kalton 1971). Participation was not limited to any demographic, so long as the individual was an adult.

The survey was administered with the help of three translators, all fluent in Nepali as well as Tharu—a language endemic to the Terai region. Tharu is both the dominant ethnicity and language spoken in the area, making one-on-one translation essential for the completion of each survey. In total, 114 individuals were surveyed—60 in Bachauli and 54 in Narayani. Each survey took approximately 1 h to complete. The response rate was 100 %.

Statistical Analyses

Our first objective was to examine whether household attitudes toward forest conservation-related behaviors were consistent with empirical forest cover trends. Two analyses were performed to determine whether the overall survey results from Bachauli and Narayani were statistically different from one another—a critical step in determining whether the different forest cover trends in the two VDCs, as revealed through remote sensing in Stapp et al. (2015), were consistent with differences in local attitudes. All statistical tests were conducted using the 'Stats Package' in version 3.1.2 of the R Statistical Computing Software (R Core Team 2014).

First, the total responses for each Likert scale item for both samples were compared against one another using a Pearson's χ^2 test ($\alpha = 0.05$). There is considerable debate over whether Likert scale data should be analyzed as ordinal or interval. This is due to the fact that on a discrete 1-to-5 scale, a respondent is not allowed to respond with, for example, 1.5 or 2.7. For this reason, we used both parametric and nonparametric tests to examine whether there was a significant difference for each question between the two study areas. Both a Welch two-sample *t* test and a Mann–Whitney–Wilcoxon tests for distribution were used to compare the difference in each response ($\alpha = 0.05$). However, only the means and results of the *t*-tests are presented here because, although there is statistical value in checking for congruency between parametric and nonparametric tests, treating the data as interval allows for more powerful and sophisticated statistical analysis (Nepal and Spiteri 2011, citing De Vaus 2002).

In order to check for internal consistency of responses, Cronbach's coefficient alpha was computed for all responses for Bachauli and Narayani (De Vaus 2002). The scores were 0.69 and 0.71, respectively, which both surpassed the minimum threshold requirement which must be met in order to confirm significant consistency (i.e., >0.65) (DeVellis 1991; Nepal and Spiteri 2011). The raw scores

[1] For more information about SeedTree, visit: http://www.seedtree.org/.

for each respondent for all questions were converted into an attitude index score by summing response values for all questions and then dividing by the number of questions (De Vaus 2002). For Bachauli, the mean score was 1.90 (on a 1-to-5 scale, where 1 denotes "strongly agree," and 5 denotes "strongly disagree"). For Narayani, the mean score was 2.48.

Our second objective was to examine which demographic and economic variables influence supportive attitudes toward forest conservation-related behaviors. Here, logistic regression using economic and sociodemographic variables was used to examine which variables explained the variation in attitudes. In order to use the attitude index scores as the dependent variable in the logistic regression models, they were first converted to a dichotomous dummy variable by separating the "supportive" scores from the "unsupportive" scores at the mean value (on 1-to-5 scale where 1 equals "strongly agree," indicating support for the questions asked). For Bachauli, scores below the mean were recoded as "1" (supportive), with all other values as "0." The opposite was done for Narayani, recoding the values above the mean index score as "1" (unsupportive), with all other values as "0." This was done to examine which independent variables explained the variation in positive attitudes in Bachauli and negative attitudes in Narayani—a key question, given the significant difference between the two areas in terms of both forest cover change over the last decade and overall survey responses (Stapp et al. 2015).

In addition to the intercept coefficient, we also computed standard error, *P*-value, Wald statistic, and goodness-of-fit values for each explanatory variable in the models to test the variable's individual and relative significance. The Wald statistic was calculated by dividing the intercept coefficient by the standard error coefficient and squaring the result. Hierarchical partitioning, using R^2 as goodness-of-fit, was used to sum each variable's independent and joint contributions in explaining the variance of the response variable (Chevan and Sutherland 1991). This method is well suited for applications in conservation and ecology because it takes into account all of the relationships between predictor variables and mitigates multicollinearity issues commonly encountered in multivariate regression analyses (Mac Nally 2002).

Results

Sociodemographic Characteristics of Respondents

In Bachauli, 13.3 % of respondents were male, and 86.7 % were female, while in Narayani, 31.5 % of respondents were male, and 68.5 % were female. The mean household size was 7 persons in Bachauli and 6.3 in Narayani. The age of respondents ranged from 18 to 80 years, with an average age of 40. Ages were classified into three categories: younger (16–35), middle-aged (36–55), and older (56+) (Mehta and Heinen 2001). For Bachauli and Narayani, respectively, 38.3 and 46.3 % were younger, 45 and 44.4 % were middle-aged, and 16.7 and 9.3 % were older. In total, 67.4 % of respondents reported being a member of a CFUG in their community, with 53.3 % in Bachauli and 81.5 % in Narayani. Respondents were asked to state whether or not they were able to support their household's livelihood on a daily basis. This served as a proxy for "wealthy" or "poor" (Mehta and Heinen 2001; Spiteri and Nepal 2008). In Bachauli and Narayani, 25 and 66.7 %, respectively, were categorized as wealthy, with 75 and 33.3 % categorized as poor.

Because the average annual income is so low in this region of Nepal, two additional economic variables were collected—the amount of land and livestock each respondent owned. Nepali standards of area measurement were used in the field and later converted to hectares with the help of local translators. The average amount of land owned in Bachauli and Narayani was 8.6 and 9.1 ha, respectively. The survey asked each person to include head counts for each type of livestock they owned. This number was re-scaled using the Tropical Livestock Unit (TLU) measurement system developed by the Food and Agricultural Organization of the United Nations to create a continuous, rather than categorical, variable (FAO 2003). The TLU system administers a score for each type of livestock based on each country's continent, with Asian values ranging from 0.01 for a chicken, to 0.50 for a cow or buffalo. TLU scores were summed and ranged from 0 to 6.5 in Bachauli and from 0 to 5 in Narayani. Households in Bachauli reported owning more livestock compared to Narayani, i.e., a livestock score of 1.12 compared to 0.72.

The use of both fuel-efficient stoves and household biogas has been influential drivers in the reduction of forest loss in Nepal, and the adoption of both has consistently risen over the last 25 years. In Bachauli and Narayani, 25 and 51.9 % of respondents indicated that they use fuel-efficient stoves, while 46.7 and 20.4 % use home biogas energy systems, respectively. Finally, level of education was collected for each respondent with the choices of "none," "primary," "lower secondary," "secondary," and "university." 18 % of respondents in Narayani and 31.7 % of those in Bachauli had no education, while close to half of respondents (40.7 and 46.7 %, respectively) had a primary education, 11.1 and 0 % had a lower secondary education, 24.1 and 3.3 % had a secondary education, and 5.6 and 16.7 % had attended a university.

Ethnicity was broken down into three categories: (1) Tharu, the dominant ethnicity, (2) Hindu higher castes such as Brahmin and Chhetri, and (3) others, including castes such

as Magar, Newar, Kumal, and Kurmi (Sah and Heinen 2001 citing Bista 1987). Overall, one-third of all respondents belonged to "other" castes: 63.2 % were Tharu, and very few—only 3.5 %—belonged to a higher class.

Distribution and Difference in Attitudes between Bachauli and Narayani

For all Likert questions, there was a significant difference between the two VDCs ($P < 0.001$; Table 1). For both parametric and nonparametric tests, a significant difference ($P = <0.05$) was found between the two VDCs for every question except for Question 4, "I am satisfied with the current condition of forests in my community" (see Table 2). In addition, the mean responses for all but two questions were more supportive of behaviors that support forest conservation in Bachauli than Narayani (i.e., values closer to 1 on a 1-to-5 scale). The two questions that were less supportive in Bachauli than Narayani were Questions 5 and 8 (see Table 2): "I am actively involved in the operation and effectiveness of the CFUG in my area," and "It is important that all community members receive benefits from the way that forests are managed in my community." In Table 2, the survey questions and results are categorized into five separate classes, representing the five concepts which were used to define attitudes hypothesized to support forest conservation.

Informal interviews with respondents, combined with responses provided on the optional open-ended survey questions, contribute additional insight. For example, in Narayani, community forests reportedly provide habitat for CNP wildlife such as the one-horned rhinoceros, which lives and breeds in forests along the Narayani River. Without forests, rhinos and other CNP wildlife may feed and take refuge in croplands. The people of Narayani hope to attract more ecotourists in the future, and projects are underway to expand tourism infrastructure such as picnic areas and lodging facilities. In Bachauli, revenue from some community forests was being used for development projects such as constructing a new women's center, which was to offer free literacy classes. In Bachauli, CFUGs were almost entirely composed of poorer women, and were viewed as a positive opportunity to incorporate women in community responsibilities and decision making. However, of the two CFUGs we met with in Narayani, one was composed of a large group of mostly women, while the second—which oversees and manages considerably more forested land in the area—was composed entirely of a small group of men.

Logistic Regression Analysis

Logistic regression was used to determine which sociodemographic variables influenced supportive attitudes toward forest conservation-related behavior. The results for Bachauli and Narayani are shown in Tables 3 and 4, respectively. In Bachauli, having supportive attitudes toward forest conservation was positively correlated with participating in a CFUG ($P = 0.01$), and household size ($P = 0.03$). Supportive attitudes were negatively correlated with being wealthy ($P = 0.03$). A second economic indicator, the amount of livestock owned, was also found to have a negative correlation with supportive attitudes toward forest conservation (i.e., more livestock, less supportive of conservation). In Narayani, being wealthy was also found to be negatively correlated with supportive attitudes toward forest conservation ($P = 0.02$), while the other two economic indicators—hectares of land owned and amount of livestock owned—were positively correlated ($P = 0.04$ and 0.02, respectively).

Discussion

Community-based forest management has been influential in reducing forest degradation rates and conserving local biodiversity in many regions of the globe. Despite this general finding, household characteristics, attitudes, and sociodemographic variables of stakeholders involved have not been closely examined in community forestry systems in Nepal (Acharya et al. 2004; Adhikari et al. 2004). Because community forestry has been established in Nepal for a relatively longer time than most countries, it provides an ideal location to study household perceptions (Adhikari et al. 2004). Our research sought to explore how household attitudes toward forest conservation-related behaviors

Table 1 Distribution of responses to all survey questions in Bachauli and Narayani

	Likert scale responses on 1-to-5 scale					Total observations
	(1) Strongly agree	(2) Agree	(3) Neutral	(4) Disagree	(5) Strongly disagree	
Bachauli	396 (44.0 %)	321 (35.7 %)	109 (12.1 %)	35 (3.9 %)	39 (4.3 %)	900
Narayani	188 (23.2 %)	321 (39.6 %)	114 (14.1 %)	95 (11.7 %)	92 (11.4 %)	810
Total observations	584	642	223	130	131	1710

$\chi^2 = 118.922$, $n = 1710$, df $= 4$, $\alpha = 0.05$, $P < 0.001$

Table 2 Mean survey responses and *t*-test results for Bachauli and Narayani

Questions on 1-to-5 scale (1 = strongly agree)[a]	Bachauli			Narayani			
	$\bar{x}$	SE	$G\ \bar{x}$	$\bar{x}$	SE	$G\ \bar{x}$	WT *P*
Household need for forests and perception of forest trends			1.82			2.9	
(1) My household relies on local forests for fuelwood	1.86	0.89		3.31	1.12		<0.001
(2) My household relies on local forests for fodder for livestock	1.91	0.92		4.13	1.28		<0.001
(3) Forests in my community have improved in recent years	1.53	0.87		2.00	0.75		0.002
(4) I am satisfied with the current condition of forests in my community	1.96	0.41		2.16	0.79		0.24
Willingness to support collective action and community forestry			1.65			1.73	
(5) I am actively involved in the operation and effectiveness of the Community Forest User Group (CFUG) in my area	1.75	0.89		1.20	0.45		<0.001
(6) Efforts by our CFUG have improved the condition of forests in my community	1.61	0.76		2.48	0.81		<0.001
(7) Forest condition in my community has improved because of community-wide cooperation	1.66	0.89		1.96	0.67		0.046
(8) It is important that all community members receive benefits from the way that forests are managed in my community	1.56	0.69		1.27	0.68		0.027
Willingness to work with NGOs that promote forest conservation			1.54			2.24	
(9) Non-governmental organizations (NGOs) that promote reforestation efforts have improved forests in my community	1.63	0.93		2.55	0.94		<0.001
(10) I am willing to work with and receive help from NGOs to improve forest conditions in my community	1.45	0.74		1.92	0.77		0.001
Supportive of forest-related institutions and policies in place			2.81			3.52	
(11) I am satisfied with current forest policies in Nepal	2.08	0.92		3.11	1.23		<0.001
(12) I am satisfied with my district forest officers	3.05	1.12		3.57	0.98		0.009
(13) Nepal's political climate today supports sustainable forest management	3.31	1.26		3.88	1.36		0.022
Supportive of the use of energy-efficient technologies			1.46			1.83	
(14) Fuel-efficient stoves are important in sustaining forests in my community	1.46	0.65		1.77	0.63		0.011
(15) Household biogas is important in sustaining forests in my community	1.45	0.64		1.88	0.81		0.002

$\bar{x}$ mean, *SE* standard error, $G\ \bar{x}$ mean for question group, *WT P* significance of Welch two sample *t*-test for means ($\alpha = 0.05$)

[a] $n = 60$ in Bachauli, 54 in Narayani

Table 3 Logistic regression examining correlation between sociodemographic variables and positive attitudes toward forest conservation-related behavior in Bachauli

Variables	*B*	SE	Wald	*P*	*R*
Age	0.05	0.03	2.78	0.13	<0.001
Gender (female)	2.53	1.44	3.09	0.07	0.09
CFUG member (yes)	2.62	1.06	6.11	0.01	0.21
Economic status (wealthy)	−1.96	0.95	4.26	0.03	0.11
Number of persons in household	0.42	0.20	4.39	0.03	0.06
Hectares of land owned	0.006	0.01	1.44	0.26	0.1
Livestock owned	−1.16	0.51	5.17	0.02	0.005
Education	0.41	0.39	1.11	0.30	0.001
Caste (Tharu)	1.33	0.90	2.18	0.14	0.05

n 60, *B* logistic regression coefficient, *SE* standard error, *Wald* Wald statistic, *P* significance, *R* R^2 statistic (the sum of the variable's independent and joint contribution in explaining the variance of the dependent variable)

correlated with empirical forest cover trends. We also sought to better understand the sociodemographic variables that influence supportive attitudes toward forest conservation-related behaviors in our two study locations.

Supportive attitudes included having a need for forests in their community, being cognizant of current forest conditions, supporting their local CFUG, being willing to work with NGOs that promote sustainable forest practices,

Table 4 Logistic regression examining correlation between sociodemographic variables and negative attitudes toward forest conservation-related behavior in Narayani

Variables	*B*	SE	Wald	*P*	*R*
Age	−0.008	0.03	0.07	0.81	0.01
Gender (female)	0.45	1.07	0.18	0.67	0.06
CFUG member (yes)	−1.57	1.10	2.04	0.15	0.01
Economic status (wealthy)	2.26	1.01	5.01	0.02	0.08
Number of persons in household	0.13	0.15	0.75	0.37	0.001
Hectares of land owned	−0.005	0.002	6.25	0.04	0.05
Livestock owned	−0.94	0.40	5.52	0.02	0.05
Education	0.66	0.46	2.06	0.15	0.01
Caste (Tharu)	1.23	0.77	2.55	0.11	0.01

n 54, *B* logistic regression coefficient, *SE* standard error, *Wald* Wald statistic, *P* significance, *R* R^2 statistic (the sum of the variable's independent and joint contribution in explaining the variance of the dependent variable)

supporting forest-related policies and management institutions in Nepal, and recognizing the importance of energy-efficient technologies such as fuel-efficient stoves and biogas in reducing forest degradation.

Of the 36 VDCs adjacent to CNP, Bachauli and Narayani are on opposite ends of the spectrum in terms of reversing forest trends between 2005 and 2013. Bachauli has not just ceased the rapid rate of forest loss that it experienced prior to 2005, but in the last decade it has reversed it to a rate of significant regrowth (Stapp et al. 2015). The opposite is true for Narayani. The relative success of other communities in Nepal in terms of forest conservation and community forestry varies as well (see, e.g., Gautam and Shivakoti 2005). A clear difference was found between the overall attitudes of respondents toward forest conservation in Bachauli and Narayani, and it appears that attitudes between the areas of interest reflect forest cover trends—i.e., they are distinctly different, with attitudes in Bachauli being more supportive of forest conservation.

Although the overall differences between the two VDCs, and between almost every question, were significantly different, many interesting connections can be drawn between Bachauli and Narayani. Both populations reported being unsatisfied with their district forest officers (DFOs), and both expressed that Nepal's current political climate does not support sustainable forest management. Iversen et al. (2006) conducted a study about the high-value Sal (*Shorea robusta*) forests and institutions in place regarding CFUGs in the Terai region and found that "Terai user groups face serious challenges in terms of monitoring the actions of office-holders," and that "the local leverage of the DFO is strong and may create problems" (p. 104).

Interestingly, the only question on the survey which did not show a significant difference between the two communities was "I am satisfied with the current condition of forests in my community" (Question 4 in Table 2). Although Narayani has seen significant loss in total forest cover between 2005 and 2013 (Stapp et al. 2015), respondents did not view these trends as negative. After all, Narayani's economy is agriculture-based, and hence land use may be prioritized for crops—not community forests. However, positive this might be for the people of Narayani, it raises a challenge for future forest conservation efforts in Nepal. Indeed, as population rises, there will likely be increased pressure to convert forests to agricultural uses.

In addition, there was a large difference in mean responses between Narayani and Bachauli for Question 11: "I am satisfied with current forest policies in Nepal" (see Table 2). Respondents from Bachauli were somewhat satisfied, while those in Narayani were somewhat dissatisfied. The questions grouped under "Household need for forests and perception of forest trends" had overall large differences between Bachauli and Narayani, with Bachauli having strongly more supportive responses than Narayani for Questions 1–3 (see Table 2). Three conclusions can be inferred from these data. First, the perception of forest improvement in recent years reinforces the results of previous remote sensing results (Stapp et al. 2015). That is, Bachauli has seen dramatic improvement in terms of forest cover in recent years, and Narayani has seen much loss, both of which are accurately reflected in responses to Question 3: "Forests in my community have improved in recent years." Second, households in Bachauli are significantly more reliant on forests for fuelwood in their community. Third, households in Bachauli are significantly more reliant on forests for livestock fodder in their community (Table 2). These results can perhaps be explained in part by the percentage of respondents in both Bachauli and Narayani who use energy-efficient technologies. For example, respondents in Bachauli owned significantly more livestock and used home biogas systems more often than those in Narayani, which reinforces Bachauli's reported reliance on community forests for fodder.

Households with livestock, such as in Bachauli, would logically use biogas more, because they have a more readily available supply of animal waste that can be used to fuel the units and generate energy.

In Bachauli, the strongest positive correlation in the logistic regression analysis was found between being a member of a CFUG and having supportive attitudes toward forest conservation (Table 3). Although intuitive, this finding supports the hypothesis that community forestry in Nepal has had a positive influence in reversing forest loss over time. Being wealthy and owning more livestock was shown to negatively affect attitudes in Bachauli, and poorer households were more supportive of forest conservation. In Narayani, the same was true for wealth—i.e., being wealthy was correlated with less-supportive attitudes toward forest conservation. However, the amount of land and livestock a Narayani household owns was positively correlated with having supportive attitudes.

It is difficult to interpret this difference between the two communities in this regard, although it is perhaps influenced by Narayani's primarily agricultural economy. Adhikari et al. (2004) examined a pattern linking household resources such as land and livestock to dependence on community forests and found that farming households required substantially more tree and grass fodder—noted as an important product of community forests by Thoms (2008)—for their livestock than those without land or livestock. Also, those with farms and livestock in Narayani are the working class of the area, and although most people are farmers, one-third of respondents reported not being able to support their family's livelihood on a daily basis (Table 4). For comparison, 75 % of Bachauli respondents also reported not being able to support their family on a daily basis. Although farming households rely on community forests more than nonfarmers, the poorest households are unable to afford sufficient land and livestock and therefore require less fodder and other forest products (Adhikari et al. 2004). These results suggest that households with more livestock in Bachauli, and households with agricultural lands in Narayani, are both reliant on forests in their community to support their livelihoods.

Informal interviews with respondents, combined with responses provided on the optional open-ended survey questions, describe a desire for forests in both communities to provide habitat for CNP animals in order to mitigate crop destruction by wildlife. Perhaps for this reason, farming households that own land and livestock might value forest conservation more than households that do not. Karanth and Nepal (2012) found that all survey respondents supported tourism in CNP, and 97 % expressed a supportive attitude of the Park. There is also a consensus in both Bachauli and Narayani that forests support ecotourism. Forests provide habitat for CNP's endangered wildlife, which is primarily what attracts tourists to the area, as well as aesthetics and shade for lodging facilities and picnic areas.

In Bachauli, CFUGs were almost entirely composed of poorer women, and were viewed as a positive opportunity to incorporate women in community responsibilities and decision making. This is a progressive exception to the norm, as a recent REDD study by Khadka et al. (2014) found that women only represent about 15 % of leadership positions in CFUGs studied in Nepal. While positive, barriers still exist in the decision-making processes of CFUGs for marginalized groups such as women (Adhikari et al. 2004). Although women participate in most forest management tasks, they are typically not included in decision-making processes (Khadka 2010; Poudel et al. 2014).

Community forestry in Nepal has the potential to contribute to social capital in many forms such as new schools, academic scholarships for children from marginalized groups, and new roads (Gautam 2009; Pokharel et al. 2012). In Bachauli, revenue from some community forests was being used for development projects such as constructing a new women's center, which was to offer free literacy classes. One of the two CFUGs that were visited in Narayani, however, was composed of a handful of wealthier men and appeared to poorly represent the overall demographics of the area—a problem viewed by some studies as widespread in Nepal (see, e.g., Chhetri et al. 2012; Lund et al. 2014; Malla et al. 2003).

Conclusion

Although this study was conducted in a small area of Nepal, it examined communities experiencing some of the highest and lowest rates of forest degradation in the area. Our comparison provides insight into the current status of decentralized, community-based forest management in the country, and offers specific policy recommendations. These findings are especially important as Nepal's MPFS expired in 2011, and the country is in the process of developing a new Forestry Sector Strategy. In addition to our findings, the Review Summary Report (MFSC) of the MPFS, released in April 2014, discusses many areas where the MPFS has struggled, many of which—such as a lack of marginalized population inclusion and inefficient government forestry sector institutions—reinforce our findings.

Our results suggest several forest policy recommendations. First, we found significant differences in attitudes in the two communities we studied, perhaps contributing and responding to their respective current forest conditions and trends. Attitudes toward forest conservation parallel empirical forest cover trends in both Narayani and Bachauli, with generally supportive attitudes toward forest

conservation reported from Bachauli, and less-supportive attitudes from Narayani. This gives insight into how to best target populations who might be supportive of efforts to improve forest conditions by better understanding how attitudes correspond with empirical forest cover trends.

We found that attitudes which support forest conservation are correlated with wealth, with poorer households in both study sites being more supportive of forest conservation. Although the MFSC report states the MPFS has "enhanced the livelihoods of the rural people who have been involved while giving special focus to the needs of poor and disadvantaged households," it also cautions that the policy has "failed to have significant impacts on rural employment and the local economy," noting that "a clear policy for the allocation of national forest to the various community-based forest management regimes is lacking – especially for the Terai" region which is the area of our study (GoN 2014, p. 2).

Decentralized, community-based forest management conceptually allows traditionally underrepresented populations to participate in the responsibility, social benefits, and revenue that come with managing forests. However, underrepresented populations are often marginalized within community-based forest management in Nepal (McDougall et al. 2013). The MFSC report sheds further light on the lack of progress toward social inclusion and poverty alleviation, stating that stakeholders

> such as women, poor people, and disadvantaged groups (including marginalized indigenous communities), although usually nominally represented in various decision-making forums, have little genuine power and voice, and there is still a tendency toward unilateral decisions and lack of transparency on the part of government and more powerful civil society actors (GoN 2014 p. 20).

Indeed, Pandit and Bevilacqua (2011b) found that the wealthy group in their study (i.e., elite castes) generally perceived user participation in CFUG activities to be more balanced and evenly distributed than women and other marginalized groups. Birendra et al. (2014) found that in recent years, community forestry in Nepal has shifted from providing forest products for community use to maximizing revenues, which is happening through elite dominance and marginalization of poorer community members and castes. Furthermore, when marginalized people are included in community forestry tasks, they are typically attending meetings and doing volunteer jobs—which become costly to the individual—such as patrolling the forest (Pokharel et al. 2012).

It is of concern that even in Bachauli—where forest conditions have improved and the consensus among respondents is generally supportive of forest conservation—there is dissatisfaction with DFOs, and a general belief that Nepal's political climate today does not support sustainable forest management. These views were shared in Narayani. Informal interviews and discussions revealed a general distrust toward national-level governmental institutions regulating community forestry. The MFSC report reinforces this perception by stating that, "The legal autonomy of forestry groups has been eroded by a series of administrative orders, circulars and other decisions that have increased the transaction costs of better forest utilization and has hindered the growth of forest based enterprises" (GoN 2014, p. 2).

Here, we suggest two areas of need to be considered as Nepal develops its new Forestry Sector Strategy. The first is to ensure increased distribution of rights, responsibilities, and revenue for poorer, underrepresented populations. Participatory forest management has proven to be effective in reducing forest loss in Nepal, and it is imperative that women, the poor, and other disadvantaged groups share in these responsibilities and benefits. The second is for government institutions and representatives to become more transparent, consistent, and considerate in their management practices and relationships with communities and CFUGs. In Nepal, "government forestry sector institutions are viewed as archaic and largely ineffective in meeting the needs of a changing society" (GoN 2014, p. 7). Although equal participation alone is not a panacea (Birendra et al. 2014 citing Cohen and Uphoff 1980), the state of forests in Nepal can only improve if better relationships are built between all stakeholders.

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