



Research article

Decentralizing conservation and diversifying livelihoods within Kanchenjunga Conservation Area, Nepal



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ABSTRACT

To alleviate poverty and enhance conservation in resource dependent communities, managers must identify existing livelihood strategies and the associated factors that impede household access to livelihood assets. Researchers increasingly advocate reallocating management power from exclusionary central institutions to a decentralized system of management based on local and inclusive participation. However, it is yet to be shown if decentralizing conservation leads to diversified livelihoods within a protected area. The purpose of this study was to identify and assess factors affecting household livelihood diversification within Nepal's Kanchenjunga Conservation Area Project, the first protected area in Asia to decentralize conservation. We randomly surveyed 25% of Kanchenjunga households to assess household socioeconomic and demographic characteristics and access to livelihood assets. We used a cluster analysis with the ten most common income generating activities (both on- and off-farm) to group the strategies households use to diversify livelihoods, and a multinomial logistic regression to identify predictors of livelihood diversification. We found four distinct groups of household livelihood strategies with a range of diversification that directly corresponded to household income. The predictors of livelihood diversification were more related to pre-existing socioeconomic and demographic factors (e.g., more landholdings and livestock, fewer dependents, receiving remittances) than activities sponsored by decentralizing conservation (e.g., microcredit, training, education, interaction with project staff). Taken together, our findings indicate that without direct policies to target marginalized groups, decentralized conservation in Kanchenjunga will continue to exclude marginalized groups, limiting a household's ability to diversify their livelihood and perpetuating their dependence on natural resources.

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1. Introduction

The rural poor bear disproportionate costs of living within or near protected areas, including increased frequencies of crop raiding and livestock predation and decreased access to natural resources (Adams and Hutton, 2007). Since the early 1980s, increasing recognition of this imbalance has led many developing countries to shift their natural resource management approach from exclusive and centrally derived decision-making to one based on inclusive local participation and democratic representation (Agrawal and Ostrom, 2001; Baral and Heinen, 2007; Larson and Soto, 2008). Including local people is no longer seen as an

obstacle to effective management; instead, this approach can concurrently enhance environmental conservation and improve park-people relationships, particularly if it implements a system of sustainable access to natural resources (Gibson et al., 2000; Naughton-Treves et al., 2005). One such management approach, decentralized conservation, is based on locally empowered synergies that challenge traditional governance structures, demand institutional and political transformation, and redistribute political, administrative, and financial power to the local population (Hickey and Mohan, 2005; Larson et al., 2007).

Proponents of decentralized conservation argue it creates a more inclusive and legitimate decision-making system, strengthens accountability, minimizes organization costs, and provides the technical and financial assets necessary for local participants to diversify their livelihoods (Agrawal and Gupta, 2005; Larson and Soto, 2008; Ribot, 2002). However, thus far

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decentralized conservation has failed to accomplish these objectives, most often because central governments are reluctant to decentralize resources or power, and elite groups exclude marginalized local groups from decision-making (Klooster, 2000; Lane, 2003; Larson and Soto, 2008; Agrawal and Ostrom, 2001). Exclusion from meaningful participation limits the ability of marginalized local groups to access technical and financial resources, improve their quality of life, and decrease dependence on natural resources (Ellis, 2000; Larson et al., 2007; Parker and Thapa, 2011, 2012). As there is no panoptic institutional system to manage natural resources (Dietz et al., 2003), more research is needed to understand how decentralized conservation affects livelihood diversification among local residents who are dependent on natural resources (Brown et al., 2006; Larson et al., 2007; Persha et al., 2010).

Livelihood diversification is ‘the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living’ (Ellis, 2000, p. 15). Livelihoods are considered sustainable when their diversity maintains or enhances access to the five livelihood assets (natural, physical, human, financial, and social), yet does not diminish the natural resource base in the present or future, even in the event of stress of shocks (Chambers and Conway, 1992). Differing levels of livelihood diversification are often related to disproportionate access to assets based on pre-existing power structures. These power structures are linked to socioeconomic characteristics including household size and location, landholdings, livestock, farming experience, and access to off-farm employment, credit, and remittances (money received from friends or family living outside the area) (Barrett et al., 2006; Brown et al., 2006; Ellis and Freeman, 2004). Livelihood diversification is also affected by each household’s participation in strategies to manage natural resources, make community and natural resource access rules, and build capacity (Agarwal, 2001; Agrawal and Gupta, 2005; Bhandari and Grant, 2007; Rew and Rew, 2003). Less affluent households are unlikely to participate in resource management decision-making, have less diversified livelihoods, and be more dependent on natural resources (Adhikari et al., 2004; Barrett et al., 2001, 2006; Ellis, 2000; Parker and Thapa, 2011, 2012; Scoones, 1998). Resource dependent communities need policies that empower local people to collaboratively develop income generating activities, create resilient resource management institutions, and build knowledge, skills, and social capital (Acharya et al., 2007; Bhandari and Grant, 2007).

Among developing countries, Nepal is a leader in designing protected areas and initiating decentralization within human-inhabited lands (Baral and Heinen, 2007). Over 23% of Nepal’s land cover is federally protected (34,185 km²), 45% of which is inhabited by people and managed with varying decentralized approaches (IUCN categories IV–VI) (DNPWC, 2010). Nepal’s first initiative to partly decentralize conservation, the Annapurna Conservation Area Project, uses a co-management strategy that has had some success conserving biodiversity, enhancing economic development, and empowering local residents (Nyaupane and Thapa, 2006). However, marginalized Annapurna residents are excluded from participating in decision making, have limited access to livelihood assets, and are highly dependent on natural resources due to inconsistent regulatory and financial structures (Bajracharya et al., 2005, 2006; Baral et al., 2007; Heinen and Mehta, 1999; Nyaupane and Thapa, 2006). Similar situations occur throughout the developing world and have led to calls to completely decentralize conservation management in Zimbabwe (Conyers, 2003), Mexico (Klooster, 2000), Australia (Lane and Corbett, 2005), Bolivia and Guatemala (Andersson et al., 2006), and South Asia (Persha et al., 2010). Using lessons from Annapurna, in 2006 the Kanchenjunga

Conservation Area Project (hereafter referred to as Kanchenjunga) in eastern Nepal implemented a completely decentralized management approach. The twin aims of the approach were to concurrently conserve biodiversity and improve livelihoods of households living inside the project boundary. This would be achieved by developing economic initiatives and building the capacity for local decision making (Heinen and Mehta, 1999; Parker and Thapa, 2012).

Effective policies to alleviate poverty and reduce livelihood vulnerability requires identifying existing livelihoods (Brown et al., 2006) and understanding the human behaviors that promote livelihood diversification (Barrett et al., 2001). Existing research in the broader South Asian region has assessed how decentralizing forestry conservation can conserve biodiversity and benefit livelihoods in human-dominated landscapes (Persha et al., 2010). Here, we focus on diversifying livelihoods among resource-dependent households living within a protected area. In this paper, we evaluate whether decentralized conservation management in Kanchenjunga created incentives for local households to participate in decision making, and provided fair and equitable access to the technical and financial assets necessary for households to diversify their livelihoods. More specifically, the purposes of our study were to 1) assess the diversity of household livelihood strategies, and 2) identify the socioeconomic and demographic factors related to household livelihood diversification, within Kanchenjunga. Results of this research are instrumental to effective management of Kanchenjunga, adapting existing initiatives, and identifying and empowering marginalized groups and those households most in need of institutional assistance.

2. Methods

2.1. Study site

Located in the far northeastern corner of Nepal (Fig. 1), the mountainous Kanchenjunga Conservation Area Project has 12 peaks over 7000 m, including the third highest mountain in the world (Mt. Kanchenjunga 8856 m). The 2035 km² protected area is primarily composed of glaciers and rocks (65%) and forests (24%), with only a small amount of arable land (2%). It is sparsely populated by ethnic minorities in approximately 860 households of 4570 people, most of whom are Sherpa or Limbu, and others are Rai, Gurung, Magar, Thakali, Tamang, Tibetan, and Jirel (WWF, 2007). More than 90% of households are unable to produce sufficient quantities of food for dietary subsistence and are chronically undernourished (WWF, 2007). The combination of geographic isolation, agriculturally unproductive land, modest civil infrastructure, and inaccessible markets has made Kanchenjunga one of the poorest parts in Nepal. The vast majority of heads of households have not finished first grade, and only 6% of villagers over 30 years old have attended school (Parker and Thapa, 2011). Primary sources of income include subsistence agriculture and animal husbandry, supplemented by cottage industries, trade with Tibet, remittances, employment in the government or military, and a small amount of income from tourism (Müller-Böker and Kollmair, 2000). Kanchenjunga provides habitat for several endangered or vulnerable animals including the snow leopard (*Panthera uncia*), musk deer (*Moschus chrysogaster*), red panda (*Ailurus fulgens*), Himalayan black bear (*Selenarctos thibetanus*), and Himalayan Tahr (*Hemitragus jemlahicus*) (WWF, 2007). It is also a vital component for the eventual creation of the international Kanchenjunga mountain complex conservation area, which will connect Kanchenjunga to the Khangchendzonga Biosphere Reserve in the east in Sikkim, India and to the Qomolangma Nature Preserve in the north in Tibet, China (WWF, 2007).



Fig. 1. Map of Kanchenjunga Conservation Area identifying management offices.

Established in 1998, Kanchenjunga became Asia's first completely decentralized conservation area in 2006 when the Government of Nepal officially handed over management to a democratically elected system of three levels of local management (Gurung, 2006). The lowest level of representation is made up of 44 "user groups" and 32 "mother groups" with between 20 and 80 members (Locher and Muller-Boker, 2007). User groups are a common method to organize grassroots level management in community forests and protected area buffer zones by empowering and mobilizing the local community. User group membership is open to any member of the local community, but is often dominated by men. Mother groups, on the other hand, are exclusively for female residents to encourage and build the capacity of women to represent the community and make management decision (Locher and Muller-Boker, 2007). The middle level of representation consists of seven "user committees", each with nine members elected from user and mother group executive members. The highest level of representation is the "supervisory council" with 12 members elected from user committee executive committees (Parker and Thapa, 2012). In theory, all Kanchenjunga households have an equal opportunity to participate in each level of management.

Assisted by the World Wildlife Fund, this decentralized system of management is also meant to mobilize local empowerment, participation, and capacity building programs. Kanchenjunga has initiated several programs to help local households diversify their livelihoods, including savings and credit groups, a non-timber forest product fund, and a livestock insurance program to compensate wildlife depredation (Parker and Thapa, 2011). Although Kanchenjunga residents are positive about capacity building programs

(Müller-Böker and Kollmair, 2000), only 22% of households participated in the abovementioned programs or had any interaction with management staff in the past year (Parker and Thapa, 2011). Residents' expectations are heavily dominated by aspirations for large infrastructure developments such as roads and bridges (WWF, 2007). Residents are also concerned about the reliability and transparency of project management, inequitable access to training programs caused by ethnic social stratification, and the distance from households to project offices (Ikeda, 2004; Müller-Böker and Kollmair, 2000; Parker and Thapa, 2011).

Households in Kanchenjunga are heavily dependent on access to natural resources, including wood for cooking, timber for construction, and non-timber forest products for food and medicine. The average household generates 64% of its livelihood from natural resources (Parker and Thapa, 2012). Several challenges limit the sustainability of livelihoods within Kanchenjunga: increasingly unproductive agricultural lands, lack of land ownership and unclear land tenure rights, socially inequitable labor habits, lack of food security, and the absence of established links to markets (Parker and Thapa, 2012; WWF, 2007). Increased international demand for traditional medicine and human-wildlife conflicts have contributed to increased poaching and retaliatory killing of livestock predators (Ikeda, 2004; WWF, 2007). Residents believe wildlife conservation has increased wildlife crop raiding and led to a livestock predation rate of over two yaks per year from snow leopards (Ikeda, 2004; Müller-Böker and Kollmair, 2000). The frequency of human-leopard conflict will inevitably increase: the Ghunsa Valley is not only the most populated and popular route for tourist trekking, but also contains 40% of available snow leopard habitat in Kanchenjunga.

2.2. Data collection

We studied household livelihood diversification in Kanchenjunga from October to December 2008. We adapted quantitative and qualitative methodologies from the Livelihoods and Diversification Directions Explored by Research (LADDER) project: a literature review, participatory rural appraisal wealth ranking, and a household survey (see Ellis and Freeman, 2004). We searched published and gray literature for academic, government, and non-governmental organization documents addressing past and current projects, policies, or programs related to community development and management of Kanchenjunga. Wealth ranking exercises help researchers assimilate into study site communities and collect more robust data when used alongside interview surveys (Ellis and Freeman, 2004). We surveyed a random sample of adult (≥ 18 years of age) head of households in all the villages within Kanchenjunga (25% of all 860 households, $N = 215$ (Bartlett et al., 2001)). If the head of household was unavailable, we interviewed the next most knowledgeable adult in that household (see Nyaupane and Thapa, 2006). Our survey assessed household characteristics, livelihood assets, and levels of access to those assets. Wherever possible, we avoided technical jargon and used local words in the surveys and interviews. Due to the high level of illiteracy and lack of familiarity with survey procedures, the interviewer asked questions verbally and recorded responses. A professor at Tribhuvan University in Kathmandu assessed survey translation accuracy from English to Nepali and vice versa. Although the first author previously lived in Nepal working with communities in protected areas and speaks fluent Nepali, we hired and trained two local research assistants from the Kanchenjunga region to help administer the survey. Hiring local assistants also helped to build local rapport and minimize cross-cultural bias and non-sampling error (Walpole and Goodwin, 2001). We pilot tested the survey among project and government agency staff in the

district headquarters of Taplejung, and slightly modified it based on those results.

2.3. Data analysis

We identified livelihoods using a multi-step cluster analysis based on livelihood assets and the ten most prevalent income activities (similar to Brown et al., 2006). The ten income-generating activities were: farming corn, cardamom, millet, potato, cereals (barley, wheat, and rice), the medicinal plants *charaito* (*Swertia chirayita*) and *galaichi* (*Plumeria acuminate*), keeping large livestock (yaks, cows, buffalo, and oxen) or small livestock (pigs and goats), receiving remittances, and having additional sources of off-farm income (e.g., cottage industries, wage labor, salary, pension). To control for subsistence agricultural and bartering effects, we measured crops as reported yield in kilograms instead of cash value. We treated the multiple sources of off-farm income as a single combined variable during analysis. Income from remittances was treated separately from off-farm income due to the high frequency and magnitude of remittances among households in Kanchenjunga. We conducted a z-score transformation among the independent variables (livelihood activities) before including them in the cluster analysis (Hair et al., 2005). During the multi-step cluster analysis, we first used a hierarchical cluster analysis to identify preliminary clusters of households by examining the agglomeration coefficient. We then used a k-means cluster analysis to identify the final clusters. This second, non-hierarchical step confirmed the initial cluster groupings (Hair et al., 2005).

After identifying clusters of livelihoods, we conducted a multinomial logistic regression analysis to evaluate factors associated with different livelihood strategies. Within the multinomial logistic regression we used seven pre-existing socio-demographic variables and four variables related to decentralized conservation that could affect a household's ability to adopt varying livelihood strategies (Table 1).

3. Results

3.1. Household profiles

The majority of heads of household in Kanchenjunga were male (86%), of Sherpa (53%) or Limbu (41%) ethnicity, and about 51 years

old with no formal education. The average household had 5.9 members, of which 2.2 were under 18 years old. Infrastructure development in the area is scarce: the closest road can be between one and four days' walk away. Less than 2% of the households had indoor toilets, less than 7% had access to electricity (from micro-hydro projects), and drinking water is primarily provided by makeshift spring-fed polyvinyl chloride pipes. Most (76%) of the houses were at located in lower elevations (1380–2249 m) while 24% of the houses were in higher elevations (2250–3600 m) (Table 2). Households were dramatically different based on their elevation; for example, higher elevation houses are built with wood and rocks, while lower elevation houses are built with mud and thatched roofs. Lower elevation households, on average, owned three times more land, grew more corn, cardamom, and millet, and owned more pigs and goats, while higher elevation households grew more potatoes and medicinal plants, and owned more yaks and cows. More importantly, lower elevation households received over nine times the annual amount of remittances compared to higher elevation households.

3.2. Research question 1: What are the levels of household livelihood diversification?

Our cluster analysis identified four distinct levels of household livelihood diversification among the 10 most prevalent income activities in Kanchenjunga. Households with greater levels of household diversification also had greater per capita income. Table 3 shows the mean values per household of the twelve livelihood activities for each cluster, as well as the overall percent of households in the cluster, the total number of households in the cluster, and the per capita income within each cluster.

The first livelihood cluster we identified (*Least diversity*) accounted for just over one quarter of the households (27%). These households have the lowest annual per capita income (\$131), and produce the least among six of the ten livelihood activities (corn, cardamom, millet, cereals, small livestock, and remittances). These households were mostly located in high elevations (70%) that limit the livelihood activities (especially on-farm); therefore members of these households tend to seek off-farm employment (e.g. trade and tourism). The second livelihood cluster (*Less diversity*) was the most frequently identified livelihood strategy, exhibited by 41% of the households and mostly by those in low elevations (94%). Despite

Table 1
Operationalization of variables associated with household livelihoods.

Variable	Operationalization
Pre-existing socio-demographic variables	
Highest education level	Highest level of education attained by any adult (≥ 18 years old) within the household
Number of dependents	The number of dependents (< 18 years old) within the household
Caste/ethnicity	Household ethnicity measured as Brahmin, Chettri, Sherpa, Limbu, or Rai. Recoded as 1 = Sherpa and 0 = other due to low frequency
Remittance	Yes or no, based on whether the household received remittance
Landholdings	Total household land ownership (hectares)
Total livestock units ^b	Collected in absolute value and converted to livestock units (1 livestock unit = 1.2 yaks, 1.2 cows, 1.2 buffalo, 5 sheep, 4 goats, 2 calves, 5 pigs)
Household elevation	Low elevation households are 1380–2249 m (e.g. Lelep, Hellok, and Yamphudin villages) and high elevation households are 2250–3600 m (e.g. Ghunsa and Olachan Gola villages)
Decentralized conservation variables	
Management participation ^a	Type of participation role that a household can take in Kanchenjunga management groups: 0 = non-attendee/member, 1 = attendee, 2 = suggestion maker, 3 = discussion leader, and 4 = decision maker. Recoded as 0 = no participation, 1 = general participation, and 2 = leader participation due to low frequency
Household visits by Kanchenjunga staff (n/y)	No or yes, whether or not Kanchenjunga staff visited the household within the past year
Household member visit to a Kanchenjunga office (n/y)	No or yes, whether or not someone from the household visited a Kanchenjunga office within the past year
Training participation (n/y)	No or yes, based on whether or not someone from the household participated in Kanchenjunga training courses within the past year

^a Adapted from Maskey et al. (2006).

^b Adapted from Agrawal and Gupta (2005).

Table 2

Household livelihood activities by elevation.

Activities	Household mean values				Percent of households		
	Low ^g elevation	High ^h elevation	T-score	Sample (N = 205)	Low elevation (N = 156)	High elevation (N = 49)	Chi ⁱ – value
Corn (kg)	223.4	50.3	37.6 ^j	182.1	87	14	93.9 ^j
Cardamom (kg)	131.4	38.7	11.7 ^j	109.5	67	12	44.4 ^j
Millet (kg)	186.5	7.4	58.5 ^j	143.7	83	10	86.5 ^j
Potato (kg)	90.1	204.4	4.0 ⁱ	103.9	46	65	5.8 ^j
Cereals ^a (kg)	26.8	23.5	0.0	26.1	13	14	0.0
Medicinal plants ^b (kg)	18.6	67.0	11.0 ^j	30.2	12	31	10.0 ^j
Large livestock (LU) ^c	4.41	10.33	13.7 ^j	5.51	87	88	0.0
Small livestock (LU) ^d	3.49	1.45	13.0 ^j	3.00	83	21	66.2 ^j
Remittances ^e (US \$)	\$631.00	\$70.70	14.5 ^j	\$497.10	38	8	15.4 ^j
Off-farm income ^f (US \$)	\$253.90	\$235.40	0.0	\$249.50	78	84	0.6

^a Households engaged in 'cereals' activity produce at least some wheat, barley, rice, and/or buckwheat.^b Medicinal plants include charaito (*Swertia chirayita*) and galaichi (*Plumeria acuminata*).^c Large livestock include cows, yak, buffalo, and ox (livestock units).^d Small livestock include pigs and goats (livestock units).^e Remittances include any household receiving consistent money from family members not living in the house.^f Off-farm income includes wage labor, salary, pensions, and non-farm business profits (not remittances).^g Low elevation households are 1380–2249 m (Lelep, Hellok, and Yamphudin villages).^h High elevation households are 2250–3600 m (Ghunsa and Olachan Gola villages).ⁱ =significant at 5%.^j =significant at 1%.**Table 3**

Cluster analysis of activities within each livelihood strategy.

Clustering variables	#1: Least diversity and income	#2: Less diversity and income	#3: More diversity and income	#4: Most diversity and income	Sample means ^a
Corn (kg)	11.9	156.8	385.7	191.7	182.1
Cardamom (kg)	16.8	186.8	122.1	62.9	109.5
Millet (kg)	11.9	95.4	373.8	42.8	143.7
Potato (kg)	89.7	35.4	96.8	644.5	103.9
Cereals ^a (kg)	4.8	38.0	13.4	25.7	26.1
Medicinal plants ^b (kg)	65.2	17.0	0.0	80.0	30.2
Large livestock (LU) ^c	7.41	3.2	4.85	14.96	5.51
Small livestock (LU) ^d	0.92	3.9	3.49	4.08	3.00
Remittance (US \$)	\$123	\$294	\$1120	\$841	\$497
Off-farm income (US \$)	\$380	\$225	\$221	\$425	\$249
<i>Additional values</i>					
% of households	27%	41%	26%	6%	100%
No. of households	56	83	53	13	205
Per capita income (US \$)	\$131	\$149	\$268	\$305	\$192

^a Households engaged in 'cereals' activity produce at least some wheat, barley, rice, and/or buckwheat.^b Medicinal plants include charaito (*Swertia chirayita*) and galaichi (*Plumeria acuminata*).^c Large livestock include cows, yak, buffalo, and ox (livestock units).^d Small livestock include pigs and goats (livestock units).

producing the most cardamom and cereals among all clusters, and being more diversified and having more income than those in the first cluster, second livelihood cluster households have below average levels of diversification and per capita income (\$149). These households produce the least amount of potatoes, own the fewest large livestock, and grow below average levels of corn and medicinal plants, and earn below average amounts remittances and off-farm income. The third livelihood cluster (*More diversity*) was practiced by a quarter of the households (26%), all were located in lower elevation villages. These households have the second most diversified livelihood strategy and second highest per capita annual income (\$268) by producing the most corn and millet, and receiving the most annual remittances (\$1120). The fourth livelihood cluster (*Most diversity*) was only found among 6% of households, equally distributed among high and low elevation villages. These households grow six times the mean value of potatoes, the most medicinal plants, own the most livestock (both large and small), earn the highest off-farm income, and receive the second most annual amount of remittances (\$841).

3.3. Research question 2: What factors are related to livelihood diversification?

Our first research question identified four distinct levels of household livelihood diversification; our second research question asked what socio-demographic factors and decentralized conservation initiatives are related to each livelihood strategy. First, we conducted a series of ANOVAs among the pre-existing socio-demographic and decentralized conservation management variables to assess differences between general household groups for each variable (Table 4). Households significantly varied among each pre-existing socio-demographic variable except education level. Among decentralized conservation management variables, households only varied in the roles of management participation. For all households in the past year, only 15% had visited a Kanchenjunga field office, only 21% had been visited by a Kanchenjunga field officer, and only 16% of had attended livelihood trainings.

Second, we applied a multinomial logistic regression to identify what household factors are associated with the most common

Table 4

Comparing factors of livelihood diversification to the most common strategy (Cluster 2).

Diversification factors	#1: Least diversity	#2: Less diversity	#3: More diversity	#4: Most diversity	Sample means ^a
Pre-existing variables					
Number of dependents	2.09	2.51	1.85*	2.54	2.22*
Landholdings (ha)	0.41**	1.21	1.86	1.24	1.17**
Total livestock units	5.69**	2.80	3.98**	12.62**	4.52**
Highest education level (years)	5.71	5.63	6.42	6.38	6.04
Remittance (no/yes)	0.11	0.22	0.64**	0.38*	0.31**
Sherpa (no/yes)	0.89**	0.29	0.43	0.92*	0.53**
% from low elevation (1380–2249 m)	30%**	94%	100%	54%*	76%**
Decentralized conservation variables					
Lead participation role (no/yes)	0.13	0.14	0.09	0.00**	0.12
General participation role (no/yes)	0.68	0.53	0.83**	0.62	0.65**
No participation (no/yes)	0.19	0.33	0.08*	0.38	0.23**
Training participation (no/yes)	0.21	0.18	0.08	0.08	0.16
Kanchenjunga staff visit to household (no/yes)	0.20	0.19	0.30	0.08	0.21
Household visits to a Kanchenjunga office (no/yes)	0.18	0.12	0.17	0.15	0.15

Multinomial logistic regression predicted 68.7% correctly, (pseudo R-squared = 0.703, log-likelihood value = 298.561).

Statistical significance is represented by *5%, and **1%.

^a Sample means of variance significance measured by ANOVA.

livelihood strategy (Cluster 2) compared to the least diversified livelihoods (Cluster 1), the above average diversified livelihoods (Cluster 3), and the most diversified livelihoods (Cluster 4). Significant differences are shown in Table 4. Although all but one pre-existing socio-demographic variable significantly varied among the clusters, no clear relationships emerged. For instance, although *More diversity* (Cluster 3) had the fewest dependents, *Most diversity* (Cluster 4) had the most household dependents. And while the *Least diversity* (Cluster 1) held less than a third of the land under ownership, the other three clusters owned similar quantities of land. *Most diversity* (Cluster 4) owned the most livestock at over three times the average, but *Least diversity* (Cluster 1) owned the second most livestock. When assessing for ethnicity differences among livelihood clusters, the most diverse and least diverse livelihood clusters were predominantly Sherpa, while the middle clusters were predominantly Limbu. Similarly, the most and least diverse livelihood clusters (Clusters 1 and 4) were predominately Sherpa, while the middle level clusters were mostly Limbu. The clearest relationship with diversity was exhibited among prevalence of remittances; the more diverse livelihoods (Clusters 3 and 4) were by far (six times) more likely to receive remittances.

Three out of the four decentralized conservation variables did not explain which households fell into each livelihood cluster. The only significant variable was household roles in management groups, where *More diversified* households (Cluster 3) were more engaged in management groups and interacted more with Kanchenjunga staff. The *Most diversified* households (Cluster 4), however, participated and interacted the least with Kanchenjunga staff and management groups. Interestingly, no households in the most diverse livelihood cluster held a leadership position within a management group.

4. Discussion

We identified four distinct livelihood strategies with varying levels of diversification that have directly corresponding levels of income. Our results demonstrate that levels of household livelihood diversification in Kanchenjunga are more affected by pre-existing socio-demographic variables than any decentralized conservation related variables. This indicates that complete decentralized conservation at Kanchenjunga has yet to improve local livelihoods and enhance economic development. The various levels of livelihood diversification within Kanchenjunga households were more related to pre-existing conditions (such as dependents,

landholdings, livestock, ethnicity, household elevation, and presence of remittances) than to project trainings or participating in management decision making. Households with more diversified and higher income generating livelihood strategies were characterized by having greater access to livelihood assets: more human capital (fewer dependents), more natural capital (owned more land), more financial capital (receive more remittances and owned more livestock), and more social capital (more often Sherpa, received more remittances and participated more in Kanchenjunga management groups).

Effective biodiversity conservation depends on implementing management appropriate to each situation and location, especially in regions inhabited by people (Persha et al., 2010). Although there is no commonly agreed upon approach to conservation management (Dietz et al., 2003), researchers and practitioners increasingly point to democratic decentralization to reduce park-people conflicts and the costs borne by resource dependent communities living within or near protected areas (Adams and Hutton, 2007; Agrawal and Ostrom, 2001; Baral and Heinen, 2007; Larson and Soto, 2008). Decentralized conservation purports to provide incentives for resource dependent households to participate in management decision making processes and equitably distribute the costs and benefits of environmental conservation, including access to livelihood assets (Agrawal and Gupta, 2005; Larson and Soto, 2008; Ribot, 2002). However, policies with a primary objective of alleviating poverty by improving local livelihoods need to first be able to identify existing household livelihood strategies and then identify the factors or barriers faced by more marginalized households (Barrett et al., 2001). Our research adds to the discourse of assessing the effectiveness of decentralized conservation by evaluating the diversity of household livelihood strategies in Kanchenjunga and identifying the factors that affect livelihood diversification (Brown et al., 2006). Results are also useful for environmental conservationists, sustainable tourism practitioner, and protected area managers by providing an enhanced system to identify local residents most in need of poverty alleviation initiatives and improved access to natural resources.

Our results contradict the belief that decentralized conservation necessarily improves access to technical and financial assets, and thereby improves and diversifies livelihoods (Barrett et al., 2001; Bhandari and Grant, 2007; Ellis and Freeman, 2004). Effective interventions to alleviate poverty and improve livelihoods depend on mobilizing, empowering, and increasing awareness and education of local people (Barrett et al., 2006; Ellis and Freeman, 2004).

Poverty alleviation initiatives and mobilization strategies have been taking place in Kanchenjunga since 1996. Our findings indicate social connections with Kanchenjunga staff, and access to saving and credit programs or sponsored capacity building training all failed to predict livelihood strategies of Kanchenjunga households. These findings could be related to the overall minimal level of interactions between Kanchenjunga staff and local households. In the past year, only a fifth of Kanchenjunga households had any interaction with project staff or had ever participated in project-sponsored training programs. It is common in Nepal for residents to not fully understand the purpose of projects or the intended beneficiaries. [Khadka and Nepal \(2010\)](#) found 95% of local residents felt Annapurna was primarily for the benefit of foreigners. However, an overall lack of education throughout Kanchenjunga could also be affecting project awareness. The lack of statistically significant association of education levels with livelihood diversification is likely due to the chronic lack of education within the region. [Parker and Thapa \(2011\)](#) found the average level of education in Kanchenjunga among head of households was less than one year, and only 6% of all household members >30 years old had ever attended school.

Kanchenjunga's inability to effectively mobilize and diversify livelihoods could also be a result of our static view on exclusionary processes, instead of assessing household abilities to widen their own rates of active participation over time through an open process of social change ([Giri and Darnhofer, 2010](#)). Evidence of local effective group management could also just need more time to allow for institutional strengthening that will create a more balanced and long term focus, similar to management groups in Annapurna ([Baral et al., 2007](#)). [Baral et al. \(2007\)](#) found that local groups in Annapurna transitioned focus from primarily economic concerns in the initial years to capacity building and then to a more conservation and development balanced focus after a 10 year time period. [Baral et al. \(2007\)](#) argues that integrated project failures reported within the literature might be premature. However, tourism arrivals in Annapurna during the same time periods increased to over 100,000 annually which is a stark contrast to Kanchenjunga's 300 yearly tourists. Local groups in Kanchenjunga do not have access to livelihood alternatives as found in Annapurna.

Project managers throughout Nepal need to re-evaluate means of integrating poverty alleviation and environmental conservation. Research in Nepal has often shown that a distribution of benefits does improve local resident attitudes and behaviors ([Nepal and Spiteri, 2011](#)) and an increased devolution of project control helps empower locals and alleviate poverty within a more equitable system of benefits distribution ([Baral and Heinen, 2007; McDougall et al., 2013](#)). Although the conservation literature has called for a focused attention on participation from the traditional marginalized groups ([Agrawal and Gupta, 2005](#)), research in Nepal continues to identify mere tokenism participation in projects intended to just fulfill quotas requirements of marginalized membership ([Dahal et al. 2014](#)). How can project management improve participation levels of marginalized groups in places like Kanchenjunga that lack a developed tourism industry or even road access to alternative markets? Creating a more equitable distribution of benefits that leads to poverty alleviation and empowered participation in Nepal requires an assessment of marginalized peoples throughout Nepal and not just within one protected area at a time. Previous scholars have also highlighted the imbalance of benefits between famous protected areas (eg. Chitwan and Annapurna) and non-famous ones (e.g. Kanchenjunga and Makalu-Barun) ([Budhathoki, 2004](#)). For example, Chitwan National Park has reinvested over 247 million rupees while non-famous Suklaphanta Wildlife Reserve has only reinvested 2 million ([DNPWC, 2009](#)).

This research calls attention to the stark difficulties involved in

successfully alleviating poverty while concurrently protecting biodiversity, especially within human inhabited protected areas. Protected area managers need to find a means to effectively assuage pre-existing barriers to livelihood capitals. Successfully integrating conservation and development is dependent on local access to a diversity of markets and financial capital to diversify and sustain livelihoods ([Barrett et al., 2001, 2006; Bhandari and Grant, 2007; Ellis and Freeman, 2004](#)). Faced with little economic choices, residents are unable to diversify their livelihoods no matter how well mobilized and organized management initiatives might be. Generally, people in Kanchenjunga are very poor with little infrastructure, minimal access to external markets, and negligible community development. Over three quarters of households earn less than \$1 US per day. However, remittances are a significant determinant of livelihood diversification and the ability to cope with financial stress at Kanchenjunga. Remittances, received by 31% of the households, were worth twice the annual value of off-farm income (\$497). Annual remittance values among livelihood strategies varied widely, from \$123 to \$1120 (whereas off-farm income varied from \$221 to \$425). The maximum remittance value received by a household was twice that of the maximum value household off-farm income (\$6600 compared to \$3300). These findings are similar to those in other parts of Nepal ([Bhandari and Grant, 2007](#)) and throughout developing countries around the globe. In 2010, the global value of remittances was US \$440 billion, of which US \$325 billion was sent to developing countries ([World Bank, 2011b](#)). In 2009, remittances in Nepal were valued at almost US \$3 billion and comprised more than 22% of Nepal's national GDP ([World Bank, 2010, 2011a](#)). Using livelihood diversification as a metric to evaluate sustainable livelihoods assumes a preference for a diversity of economic activities in an absence of barriers and neglects the historical and cultural preferences.

Successful management of Kanchenjunga is not only a priority for Nepal, but also for the international conservation community. Kanchenjunga is an integral component for the eventual international transboundary Kanchenjunga mountain complex conservation area created between Nepal, India, and China ([Oli et al., 2013](#)). Not only is Kanchenjunga the first completely decentralized conservation area in Asia, but it also has a rather homogenous population compared to those identified within the literature as ineffective collective management strategies ([Adams and Hutton, 2007; Adhikari and Lovett, 2006; Agrawal and Gupta, 2005; Ribot, 2002](#)). If decentralized conservation proves to be ineffective in Kanchenjunga, where else could it work? Our findings point to the need for a robust operational definition of diversified livelihoods, by using a cluster analysis to identify different livelihood strategies the factors or barriers related to adopting more diversified strategies ([Brown et al., 2006](#)). Our results will assist Kanchenjunga managers to identify household characteristics strongly associated with those who lack access to livelihood assets (financial, social, physical, natural, and human) necessary to adopt improved livelihood strategies. For example, functional literacy programs and group savings and credit programs help illiterate rural women start small scale economic activities ([Acharya et al., 2007](#)). Our results could be used to target households with the greatest need for community capacity building programs and strategies, for instance households identified within the two least diversified and lowest income generating livelihood strategies.

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