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Article

Balancing Conservation and Livelihoods: A Study of Forest-dependent Communities in the Philippines

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Abstract

Forest-dependent communities in the tropics typically rank lower in socioeconomic status than agricultural and urban communities, and improving livelihood choices while protecting forest resources can be a difficult task. Conflicts can arise where biodiversity conservation objectives restrict resource access to forest communities. In this study, we investigate how land cover, land use, and protected area management affects communities around a forest reserve in the Philippines. We conduct a socioeconomic analysis at two scales: a municipal-level analysis relating land use to socioeconomic status, and a community-level analysis contrasting villages that are close to and distant from a protected forest area. While forest-dependent communities generally had fewer amenities and infrastructure than agricultural and urban communities, community-level analysis showed that socioeconomic status was higher in areas close to protected areas. The study provides a counter-example to other findings by showing that access to resources improves socioeconomic status for local communities while maintaining environmental protections. We conclude that incorporating local livelihoods into forest conservation strategies, such as collection of non-timber forest product, results in a measure of sustainability, which in turn has a significant positive impact on the socioeconomic well-being of communities near the protected area.

Keywords: community based forest management, forest-dependent communities, poverty, protected areas management, rural communities, social forestry, subsistence agriculture, subsistence livelihoods

INTRODUCTION

Despite global increases in protected area coverage and the amount of community-managed forest lands (Zimmerer et al. 2004; Molnar et al. 2007), natural tropical forests are still declining worldwide (Hansen et al. 2013). Deforestation threatens animal and plant biodiversity, water and air quality, the livelihoods and food security of forest-dependent communities that are the poorest and most vulnerable (Kummer 1992; Kummer and Turner 1994; Saastamoinen 1996). Increasing natural forest protection and reforestation efforts are required to offset the effects of deforestation. However, most natural forests, even strictly protected, are inhabited by human communities (Nagendra et al. 2009). In the absence of other options for employment and income, these communities are often the poorest and the most depend on natural resources for their livelihoods (Adams et al. 2004; Levang et al. 2005).

Within these settings, some analysts argue for strict protection as the only way to save remaining forests (Shahabuddin and Rao 2010). But a strict approach towards protected areas can be detrimental to the socioeconomic well-being of forest-dependent communities (Cernea and Schmidt-Soltau 2006; McElwee 2010; Ferraro et al. 2011) while only marginally reducing deforestation (Andam et al. 2008; Naughton-Treves et al. 2011). Others suggest that community-led, locally implemented conservation that allows moderate use of buffer zones can lead to ecological and economic benefits (Wilshusen

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et al. 2002). Community-based forest programmes that defer deforestation from remaining natural patches promote socioeconomic development through planting of forest resources and livelihood development (Porter-Bolland et al. 2012).

Taking a middle ground, other research shows that circumstances can play a role in fulfilling socioeconomic and ecological goals of protected areas. For example, the protected areas that are undesirable for development but are accessible for small-scale eco-tourism activities and where rural livelihoods do not depend on heavy resource extraction found beneficial outcomes for people and biodiversity (Ferraro et al. 2011). However, too much access can lead to increased development and a transition from subsistence livelihoods to more intensive market-driven tourism that leads to increased land prices, resource extraction, and further socioeconomic inequality (Dressler 2014). As a result of the variable impact that protected area management and forest programmes have on the rural people, there is a need to understand socioeconomic, cultural and ecological conditions in these communities, targeting the dual mandate of livelihood development and forest conservation (Lele et al. 2010; Groom and Palmer 2012).

Given the diverse linkages between livelihoods and natural resources, there are numerous ways of incorporating ecological and socioeconomic goals at the community level (Levang et al. 2005). For example, if communities passively rely on forest resources such as clean water and soil qualities, then conservation in itself can be seen as beneficial with minimal attention given to livelihood development. But in communities that rely heavily on forest resources, such as logging or hunting, strict protection will increase poverty. In these settings, providing alternative livelihoods or pursuing other strategies of poverty reduction may also benefit conservation objectives (Adams et al. 2004). In many instances of very remote and poor places, providing basic healthcare, education facilities, and access to markets can deter communities from extracting natural forest for income (Levang et al. 2005). This approach also shows that well-being is not always measured by poverty rates. Rural households often lack earned income, but if they have land to farm, access to natural resources and basic amenities, their well-being would be defined by these factors rather than by income alone (Levang et al. 2005). As such, within subsistence economies, one cannot infer the level of well-being within a household based on income.

This study aims to quantify relationships between forest conservation and socioeconomic status in rural communities in the Philippines that depend on forest resources for their livelihoods. We focus our study on North Negros Natural Park (NNNP) in Negros Occidental Province. The region experienced a severe decline in forest cover as a result of commercial logging and land conversion to sugarcane plantations (Mulkins et al. 2000; Hamann 2002). The park is a biodiversity hotspot where many rare, endemic and endangered species find refuge, after forest cover of the province declined from 90% to 3% between 1946 and1996 (Hamann et al. 1999; Hamann 2002; Chechina and Hamann 2015). Tree poaching is successfully deterred by high fines and is uncommon in the forest. But charcoal making is currently the largest source of earned income using both legally-sourced and illegal logs (Cagalanan 2013). Other livelihood activities include rattan collection, gathering of non-timber products (fruits, seeds, bark and leaves) for food and medicine, and wildlife hunting (Hamann 2002). Illegal charcoal production poses a significant problem as it creates relatively little value but prevents regeneration of native forest trees. Additionally, large-scale sugarcane plantations that occupy most farmland create landlessness that forces many subsistence farmers to move into the uplands in search for land (Cagalanan 2013), substantially increasing stress on the remaining forest resources.

Negros forest offers a typical example of resource extraction coupled with poverty in rural communities. Rural people in Negros Occidental were historically employed as loggers or timber graders, or worked on the sugarcane plantations, with many relying on hunting as a source of income. But once the industries left in the late 1980s, many were left without an income (Mulkins et al. 2000). The government responded to this widespread problem with the implementation of Community-based Forestry Management (CBFM) programmes managed by the local Department of Environment and Natural Resources (DENR). These programmes were designed to reforest the land and give communities the opportunities for local livelihood development. Additionally, most natural forest patches gained protected area status, including the NNNP in 2005 (Cagalanan 2013) under the National Integrated Protected Areas System (NIPAS) act of 1992. These programmes work together to protect remaining natural forest (NIPAS) while incorporating livelihood development for rural communities through reforestation and crop planting activities on government land (CBFM). However, CBFM programmes in the Philippines received criticism for giving limited control of the land to the communities, imposing strict rules for land management and little help with implementation (Gauld 2000). Studies found that CBFM programmes did not distribute resources equally as land remained in the hands of local elites and wealthy land owners providing little local benefits (Pulhin and Dressler 2009). But success rates of CBFM vary, and other studies find that communities with strong local leadership, stakeholder involvement in management, and strong social capital can yield better distributed benefits to the entire community (Magno 2001).

In this study, we aim to understand the socioeconomic effects on communities located in protected areas versus the ones that are close to and far from a park boundary. We first investigate if strict protection of the resources within the park is enforced. To answer this question, we examine the land use plan in Negros Occidental and compare it to a satellite-derived land cover map of the province. Second, we ask whether satellite-derived land cover types are correlated to socioeconomic status of municipalities within Negros Occidental. We conduct a

municipal-level analysis to examine associations between satellite-derived land cover and socioeconomic status of communities inferred from census data. Third, we compare the socioeconomic status of rural communities that are located in or next to the protected area with rural communities, more distant from the protected area. Our working hypothesis is that strict protection may lead to inferior socioeconomic status of forest-dependent communities (considering normal population dynamics), whereas some access to forest resources could have a moderate benefit by striking a balance between unsustainable use and strict protection of biodiversity.

MATERIALS AND METHODS

Study area

The NNNP (Figure 1) covers 80,454 hectares and has been managed as a mix of strictly protected natural forest areas and multi-use zones for human settlement. The NNNP area contains 11% old growth forest, 22.5% residual forest and 30% secondary forest and the rest in mixed vegetation form. The protected area is divided into four different management zones (wildlife habitat, strictly protected, multi-use, and special-use) in order to allow livelihood activities for people that live within park boundaries. The strictly protected zone accounts for 30% of the area and includes all old growth forest in the park's center, where any resource use or settlement is prohibited. Enforcement of the strictly protected zone was largely effective, but not perfect. There were 283 settlers residing inside the strictly protected zone in 2011, which is 1.3% of the 21,500 people residing in 47 *barangays* (*barangays*=villages) located in or attached to the NNNP (San Jose 2011). Within the strictly protected zone, 13% of the area is designated as wildlife habitat zones that were identified to contain highly endangered and endemic wildlife (PEMO 2008). Protection of the wildlife habitat zones is enforced through the 400 volunteer forest guards who are elected by their community and endorsed by their respective municipality. The forest guards are provided with equipment, supplies, and receive a small stipend to conduct monthly foot patrol and report any illegal activity in the park (San Jose 2011). The rest of the park is divided into a multi-use zone (65%) that allows for settlements, crop farming, tree-planting for charcoal, firewood and fruit. Large-scale development activities are restricted to the few special-use zones that cover 5% of the park, for example allowing the development of mountain eco-tourism resorts (PEMO 2008).

Reforestation is encouraged through community and social forestry programmes and there were 30 Integrated Social Forestry (ISF) sites covering 11,266 hectares and three CBFM sites covering 541 hectares benefiting 3,705 members (17% of the NNNP population) and located within the multi-use zone in 2008 (PEMO 2008), covering 25% of the area. The community based programmes mandate reforestation with commercial

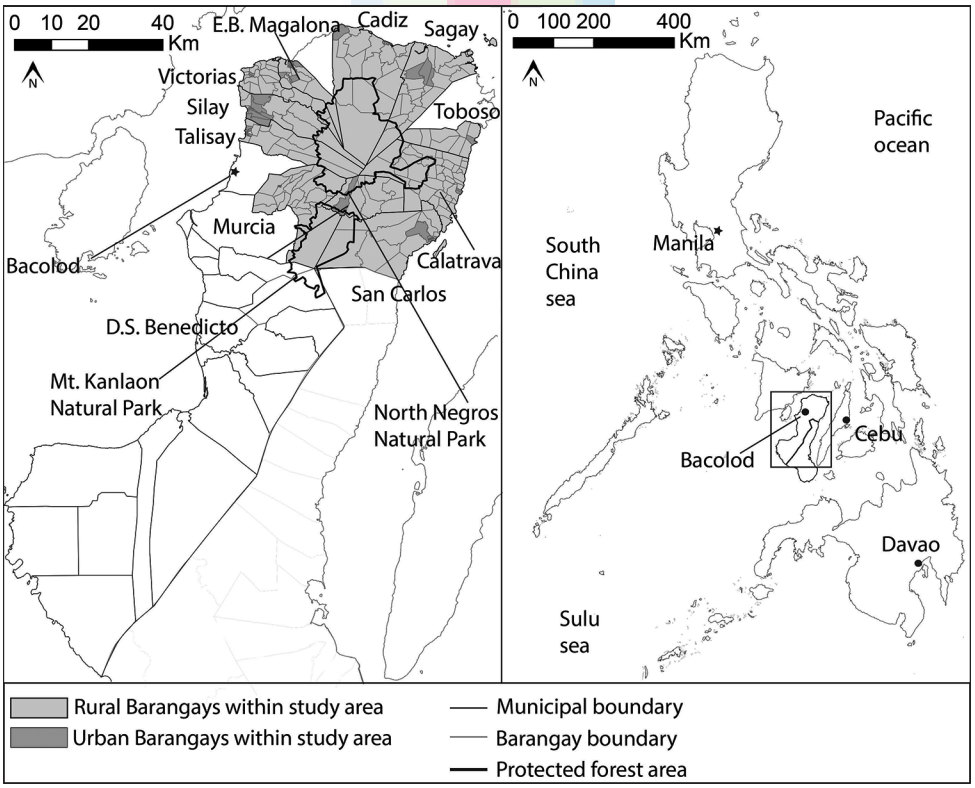

Figure 1

Municipalities and barangays (villages) selected for analysis in this study. Thirty-two municipalities of Negros Occidental, the northwestern part of Negros island are investigated (municipal boundaries are outlined in black). More detailed data is collected for 285 barangays of Northern Negros (shaded in medium and dark gray for rural and urban, respectively), that surround North Negros Natural Park and Mt. Kanlaon Natural Park

trees on 32% of the land and native trees on 8% of the land with 60% used for livelihoods development such as crop farming (PEMO 2008). However, the projects include mainly affluent members that are already landowners and exclude poorest and most remote households (Cagalanan 2013). Other reforestation projects include contract and local government programmes, nursery establishment and watershed conservation that hire local people (PEMO 2008). Our study area includes 32 municipalities of Negros Occidental province and 235 *barangays* that surround the protected areas, with 47 *barangays* located partially or fully inside the park boundary, shown shaded in medium (rural) and dark gray (urban) (Goslee and Urban 2007) in Figure 1.

Land use plan versus land cover data

Land cover data for this region indicates available natural resources and a potential for alternative livelihoods. We compared satellite derived actual land cover data to existing land use for Negros Occidental. Land use data (Figure 2, left panel) was extracted from the existing Negros Occidental Land Use Plan (PPDO 2011). Actual land cover (Figure 2, right panel), was derived from Envisat MERIS Fine Resolution (300 m) data collected in 2009 (Arino et al. 2012). Forest cover is composed of closed to open forest and mosaic forest or shrub land or grassland layers. Crop cover is composed of rain fed croplands and post-flooding or irrigated croplands layers, referring to large agricultural sugarcane plantations. Mosaic vegetation is composed of mosaic cropland and vegetation, mosaic vegetation and cropland, and closed to open shrub-land layers, representing subsistence farms and other vegetating scattered throughout the landscape. Mangrove is composed of closed to open broadleaved forest regularly flooded. Finally, artificial surface class includes buildings, roads and similar areas layer.

Land cover summary statistics were extracted for each municipality in Negros Occidental and for each of 285 *barangays* in the study area using zonal statistics in ArcGIS (ESRI 2011). The land use data was obtained as vector data, converted to a 30-meter resolution raster, and evaluated in the same way to obtain percent of land use for each municipality and *barangays*. Municipality and *barangay* boundaries were extracted from the Global Administrative Areas Database (Global Administrative Areas 2012). We calculated the per cent of actual land cover in each land use category (forest land, protected area, sugarcane production, agriculture and rice, fisheries and mangrove, and artificial surfaces) to analyse the degree to which the land use plan is being reflected by actual land cover.

Secondary socioeconomic data

We defined community well-being as an objective and measurable social or economic benefits that communities

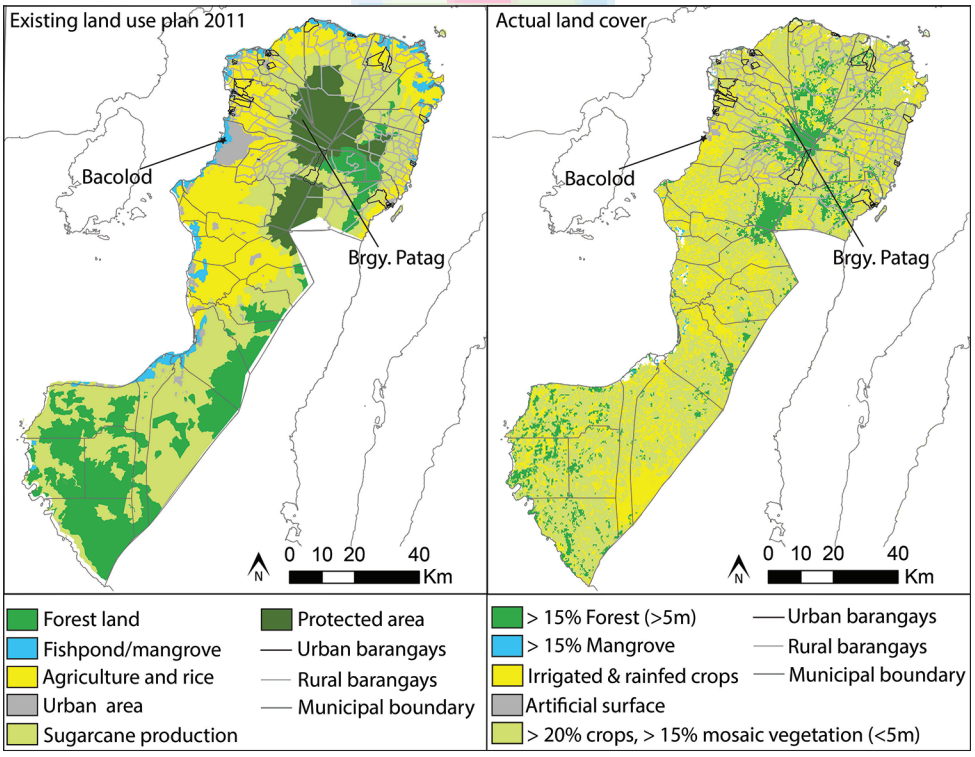

Figure 2

Land use (left) versus actual land cover (right) for the province of Negros Occidental, Philippines. The land use plan is according to the Negros Occidental Social and Economic Trends Report 2011 (PPDO 2011) and land cover is determined from 300m resolution Envisat MERIS remote sensing data (Arino et al. 2012)

gain through local economic activity (Stedman et al. 2011) instead of the subjective well-being such as self-reported measure of life satisfaction and happiness (Rojas 2008). We examined municipality level socioeconomic indicators from 32 municipalities in Negros Occidental (Figure 1, municipal boundaries). Municipal level data on poverty rate, crime, home amenities (electricity, sanitation, potable water), infrastructure and services (heath centers and elementary schools), malnutrition, elementary school enrollment, population density, and total area was derived from the Negros Occidental Social and Economic Trends Report 2009 and is based on a 5% population sample (PPDO 2011). Pearson's correlation analysis of land cover classes with socioeconomic indicators was used to evaluate community well-being, where all 32 municipalities of Negros Occidental serve as sampling units. Consistent with Carnus et al. (2006) correlation values and significance (*P-values*) are given for this analysis. The significance values were adjusted for multiple inferences using the Holm method (Holm 1979) within each land class group.

Second analysis focuses on 11 municipalities around the NNNP containing 285 *barangays* (Figure 1, *barangay* boundaries). Due to lack of available data, the *barangay* level socioeconomic indicators are different from those at the municipal level. For example, poverty rates and household amenities data are not collected at the *barangay* level. For comparison, we collected indicators that are similar to the indicators at the municipality level (malnutrition, elementary school enrollment, population density, and total area) and add others (number of all precincts, markets, daycare) to be used as proxies for socioeconomic well-being. Data on population density and facilities (number of all markets, health stations, daycare centers, and elementary schools) show government investment in the area and were derived from the municipal planning department office reports. *Barangay* data on crime against women and children were derived from the women's desk from the Philippines National Police office report. Data on child malnutrition, registered and actual voters, and elementary school enrollment were gathered at each municipal Health Centers, municipal Commission on Election office and the Department of Education, respectively.

We grouped the *barangays* into three groups as follows: 47 rural *barangays* in or close to the protected areas, 135 rural *barangays* outside of protected areas that are mostly agricultural, and 53 urban *barangays*. Rural *barangays* near or further from the park are socioeconomically similar best described as subsistence agricultural economies (Reyes 2001). We do, however, include urban areas in the analysis for contrast purposes and expect the results for urban center to be substantially different. We summarised land cover classes for the three *barangay* groups (mean and standard deviation). Violation of the assumptions of normality and homogeneity of variances were assessed via visual assessments of residual plots. Since approximate normality could not be achieved via transformation, we used a close non-parametric equivalent to analysis of variance. Using the same groupings of *barangays* (urban, rural in proximity to protected areas, rural but outside of protected areas), we used a permutational analysis of variance of socioeconomic indicators (Anderson and Braak 2003) with the *aovp* function in *lmPerm* package in the R programming environment (R Development Core Team 2014). Subsequent pairwise comparisons were performed with the Wilcoxon signed-rank test (Wilcoxon 1950) adjusting the results for multiple inferences using the Holm's method.

Primary socioeconomic data

We conducted 15 interviews with residents of forest-dependent households in *barangay* Patag to assess the perception of community well-being in the fall of 2012 (Table 1). *Barangay* Patag has 50% forest cover and is entirely located inside the boundary of the natural park. This group consisted of nine male and six female participants between the ages of 18 and 74 with average age of 42. Participants were chosen using the respondent-driven sampling method (Salganik and Heckathorn 2004) of the families living closest to the forest and dependent on forest resources to gain knowledge from community members dependent on forests and most knowledgeable about the forest resources. Interviews were also conducted with 36 residents of Patag that live farther from the forest and are part of the ISF project supported by the Japanese International Cooperation Agency (JICA) and provide the community with crop and tree planting materials and technical support. This group represented individuals that are knowledgeable about

Table 1
Summary of survey questions and responses of Patag community members and Patag People's organisation members

Survey question topics	Patag community members (n=15)	People organization members (n=36)
Average participant age (range)	41 (18-74)	45 (21-74)
Female/male participants	6 female/9 male	22 female/14 male
Average no. people/household (range)	6.5 (3-9)	4.86 (4-11)
Monthly income above $ 240	2	0
CBFM Concession holder	8	36
Primary source of Livelihood	15 farming, 5 forest guards, 1 resort caretaker, 1 sugarcane seasonal worker, 1 bodega owner	34 farming, 6 bodega owners, 7 sugarcane worker or laborer, 4 work for NGO, 3 supported by family, 1 souvenirs, 1 chicken farm
Better/worse with forest reserve	14 better, 1 worse	36 better
Perception of forest cover change in past decade	8 incease, 7 no difference	36 increase
Forest uses by the community	Firewood, charcoal, fruits, food, water, medicine	Fruits, timber, forest land for planting coffee, firewood
Distribution of resources	Not equal	Not equal

the community forestry and their impacts on livelihoods. This group consisted of 22 female and 14 male participants between the ages of 21 and 75 with an average age of 45.

The questionnaires were conducted with help of a local interpreter. The interpreter had higher education level than the average participant in the study, but came from a *barangay* that has similar conditions as Patag. The interpreter was a male, 36-year-old, with some college education. He was from Bago, Don Salvador Benedicto, a rural mountain *barangay* that is located inside the boundary of the protected forest and contains 10% forest cover. While the interpreter had higher education level than most respondents, he came from a similar rural forest community, which was taken into consideration for choosing him for this study (MacKenzie 2016). Close-ended questions focused on the source of income and livelihood, livelihood supplements, perception of well-being, main trees and crops, perception about the protected forest (Table 1). The involvement in the questionnaire was voluntary and the uses of these data were explained to the respondents before administering the questionnaire. Ethics approval was obtained through the Human Research Ethics Review process at the University of Alberta Ethics Board on February 28, 2012 with one year validity. Additionally, information was gathered through personal communications with government officials, informal community group discussions, government project plans and year-end programme assessments.

RESULTS

Land use planning versus land cover data

In Table 2, we report how the actual land cover corresponds to the existing land use shown in Figure 2. Mosaic vegetation is the most prevalent land cover type and composes the majority of all land use classes. Areas designated for forest land and protected areas are composed primarily of mosaic vegetation and forest. Actual land cover shows that much of the forest has been removed and the land converted to mixed subsistence farms (mosaic vegetation) and agricultural use (crops). Much of the cropland is found in the areas designated for sugarcane production and agriculture. Although sugarcane is designated to be planted in upland regions (Figure 2), most of it is planted in lowlands designated for agricultural production. Industrial agriculture is represented by large sugarcane plantations.

While the protected area covers 9% of the total land area in the province, less than 40% of it is forested. That brings the total natural forest cover in the province to just fewer than 3.5% of total land cover. The rest of the forest cover (under 10% of land area) comes from plantation forests located outside of the protected areas. A study conducted in 1996 estimated that the natural forest comprised 3% of land cover in Negros Occidental (Hamann 2002). Therefore, the analysis concludes that, even though the total natural forest area is small, it did not decline and potentially increased marginally in the province since 1996. The study by Hamann (2002) estimated that 14% of the park was old growth forest with another 10% secondary forest, and residual forest comprising the rest. By 2008, a local government assessment estimated old growth forest to make up 11% of the protected area and 22% secondary forest (PPDO 2011), potentially implying that old growth forest area decreased while degraded forest area increased. Finally, a study that tracked vegetation biodiversity, tree basal area, and density of the natural forest inside the park, showed that biodiversity, basal area, and density either increased or stayed the same, depending on the age of the plot, from 1995 to 2012, suggesting that forest health is not being threatened at the NNNP (Chechina and Hamann 2015).

Municipal-level socioeconomic analysis

The relationship between major land cover types (forest, crops, mosaic vegetation, mangrove, and artificial surfaces) and socioeconomic indicators of 32 municipalities in Negros Occidental is visualised in Figure 3 (significant correlations are reported in Table 3). Positive correlations in Figure 3 between land use and socioeconomic indicators are shown with points on outer meridians while strong negative correlations are shown on the inside meridians with points of no association laying on the center meridian. The analysis reveals that municipalities that have large-scale agriculture (crops) have lower poverty rates and more amenities represented by more homes with electricity and sanitation. Agricultural municipalities have more health stations. Agricultural land is located closer to urban centers, providing more opportunities for earned income to surrounding communities. Sugarcane plantations that are located in cropland areas also provide additional potential for seasonal earned income.

Table 2

Land use versus actual land cover for Negros Occidental. Refer to Figure 2 for planned land use and actual land cover in Negros Occidental. Planned land use is derived from the Negros Occidental Social and Economic Trends 2009 report (PPDO 2011). Actual land cover classes are derived from 300 meter resolution Envisat MERIS remotely sensed data (Arino et al. 2012). See the methods section on land cover extraction and modifications

	Actual land cover %				
Planned land use	**Forest (13.2%)**	**Crops (27.8%)**	**Mosaic vegetation (57.7%)**	**Mangrove (0.2%)**	**Artificial surfaces (0.1%)**
Forest land (30%)	21.1	20.5	58.5	0	0
Protected area (9%)	38.8	15.6	45.6	0	0
Sugarcane production (36%)	7.5	29.9	62.5	0.09	0
Agriculture and rice (21%)	1.86	36.2	61.7	0.19	0
Fishpond/mangrove (2%)	10.8	44	37.9	4	3.42
Urban area (2%)	0.37	47.9	48.3	0.43	2.98

Areas that have mostly mosaic vegetation (scattered farmland and mixed vegetation) or forest cover are highly correlated with poverty and negatively with house amenities, such as electricity and sanitation. These areas are rural, where people rely on subsistence farming and lack opportunities for earned income. This analysis also shows that rural places dominated by subsistence agriculture, whether in forest or agriculture dominated setting, are socioeconomically similar. Generally, in places where subsistence farming is the main livelihood, families with little to no earned income cannot afford to pay for school supplies and uniform required to attend schools (despite free universal elementary education) instead children usually help on the family farm. However in our study, these municipalities have somewhat higher rates of enrollment in elementary schools (not significant) than agricultural areas.

Barangay-level socioeconomic analysis

Barangays in protected areas have the lowest population density, are located further from the municipal center, have most of the forest land, larger total area and the least cropland compared to the *barangays* farther from the protected areas and urban *barangays* (Table 4). Although it is worth noting that for the *barangays* that are fully or partially located in a protected area, access to land resources may be limited by as much as 30% due to strict forest protection status. Other rural areas have most cropland and mosaic vegetation. Urban *barangays* have the highest population density, lowest total area, most of the mangrove areas, and large amount of cropland. As expected, urban *barangays* benefit from their proximity to markets, schools, health centers, and employment opportunities. Rural *barangays* benefit from having larger area per capita for household farms, more natural and forest resources.

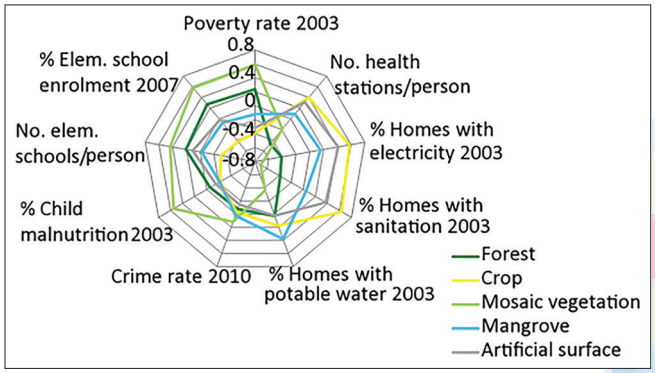

Figure 3

Spearman rank correlation between socioeconomic indicators and land cover (percent) of municipalities (n=32) in Negros Occidental. Positive Spearman rank correlation coefficients are shown towards the outside of the radar graph and indicate positive associations between land cover and socioeconomic indicators, negative correlations are shown towards the inside of the radar graph indicating negative associations between socioeconomic indicators and land cover. No association between indicators and land cover are located near the zero meridian of the radar graph

Protected area *barangays* have higher rates of elementary school enrollment than other rural *barangays* (Table 5). There are also more elementary schools per capita in protected area *barangays,* likely because schools are zoned based on total area rather than per capita basis. There are fewer teachers in protected areas possibly due to remoteness. This finding is consistent with studies showing that remote places have trouble staffing their schools (Levang et al. 2005). Even though there are fewer schools per capita in urban centers, they are larger and have higher enrollment rates. The schools are more accessible in urban areas because of shorter distances and smaller total area. Other rural *barangays* in the lowlands, that are closer to urban centers, have access to urban elementary schools, which could explain high enrollment rates in urban centers as they attract students from neighbouring rural places. Malnutrition and crime rates are not significantly different between the two rural groups. Urban *barangays* have low child malnutrition rate but higher crime rates (not significant). *Barangays* in protected areas have lowest voter registration rates than other rural and urban communities likely due to fewer registration precincts.

Assessment of dependence on forest resources

Interviews with forest-dependent community in Patag revealed that members perceive themselves as relatively poor. Most

Table 3

Correlation analysis between socioeconomic indicators and actual land cover in Negros Occidental. Spearman rank correlation coefficient and P value are given for the actual land cover (Figure 2, right) for each municipality (n=32) in Negros Occidental and socioeconomic indicators (see Figure 3 for visualization of correlations). The significance of the correlation is adjusted for multiple inferences using the Holm method within land cover groups

	Actual land cover (%)				
Socioeconomic indicators	**Forest**	**Crop**	**Mosaic vegetation**	**Mangrove**	**Artificial surface**
Poverty rate 2003	0.16	-0.45~	0.57*	-0.12	-0.31
Homes with electricity 2003	-0.32	0.61**	-0.67***	0.16	0.41
Homes with sanitation 2003	-0.23	0.61**	-0.66***	0.05	0.37
Homes with potable water 2003	0.02	0.11	-0.31	0.38	0.02
Child malnutrition 2003	-0.08	-0.21	0.43~	-0.21	-0.15
Crime rate 2010	-0.16	0.01	-0.1	0.02	-0.15
Number of health stations/person	-0.46~	0.45~	-0.29	0.09	0.31
Number of elementary schools/person	0.1	-0.34	0.37	-0.03	0.11
Elementary school enrollment 2007	0.12	-0.47~	0.56*	-0.07	-0.02

~$P<0.1$, *$P<0.05$, **$P<0.01$, ***$P<0.001$

Table 4

Comparison of actual land use in barangays located in the North Negros Natural Park and the ones outside the protected forest area. The mean and standard error (se) are given for rural barangays that are partially or fully located within a protected forest area (protected area, Figure 2), all other rural barangays outside of protected area (other rural) and urban barangays

	Land use		
Actual land cover	**Protected area mean (sd) (*n*=47)**	**Other rural mean (sd) (*n*=135)**	**Urban mean (sd) (*n*=53)**
Population density (people/sq. km)	2.45 (2.84)	22.0 (90.0)	111.5 (141.6)
Distance from municipal center (km)	20.6 (9.74)	8.39 (7.25)	1.75 (3.49)
Forest cover (%)	15.1 (14.8)	5.03 (8.86)	5.3 (12.77)
Crops cover (%)	0.25 (0.81)	33.4 (38.1)	31.2 (44.2)
Mosaic vegetation cover (%)	57.9 (15.9)	58.2 (25.4)	31.3 (31.2)
Mangrove cover (%)	0.00 (0.00)	4.84 (13.9)	58.3 (56.7)
Artificial surface cover (%)	0.06 (0.19)	1.13 (1.89)	7.12 (9.62)
Total area (100 HA)	28.5 (21.6)	11.3 (12.0)	2.86 (4.99)

Table 5

Comparison of socioeconomic indicators of barangays in the North Negros Natural Park and outside the protected forest. The mean and standard error (se) are given for rural barangays that are partially or fully located in a protected forest (see Figure 2), all other rural barangays outside of protected area (other rural) and urban barangays. Permutational analysis of variance is performed for the three groups of barangays and followed up with pair-wise Wilcoxon rank sum tests to identify significant differences between socioeconomic indicators (marked with different letters). The significance of the tests is adjusted for multiple inferences using the Holm method

	Land use			***P* (perm. Anova)**
Socioeconomic indicators	**Protected area mean (se) (*n*=47)**	**Other rural mean (se) (*n*=135)**	**Urban mean (se) (*n*=53)**	
% Child malnutrition	8.54 (0.89)[a]	7.83 (0.52)[a]	5.95 (0.83)[a]	0.1776
% Crime against women & children	0.09 (0.02)[a]	0.12 (0.02)[a]	0.28 (0.05)[b]	<0.0001
% Registered voters	51.2 (1.20)[a]	56.5 (1.11)[b]	62.4 (1.66)[c]	<0.0001
Number of precincts/person *1000	2.90 (0.13)[a]	3.31 (0.11)[a]	3.87 (0.17)[b]	<0.0001
Number of daycare/person*1000	1.00 (0.07)[a]	0.84 (0.06)[b]	0.42 (0.04)[c]	<0.0001
Number of markets/person *1000	0.08 (0.02)[a]	0.05 (0.01)[a]	0.06 (0.02)[a]	0.815
Number of health stations/ person*1000	0.37 (0.04)[a]	0.35 (0.02)[a]	0.31 (0.04)[a]	0.815
Number of elementary schools/ person *1000	0.59 (0.04)[a]	0.44 (0.03)[b]	0.25 (0.08)[c]	<0.0001
Student teacher ratio (elem. sch.)	37.3 (1.58)[a]	29.6 (1.48)[b]	15.7 (2.29)[c]	<0.0001
% Elementary school enrollment	18.7 (0.96)[a]	15.0 (1.55)[b]	21.3 (7.19)[c]	0.0489

households averaging five people have average earnings of 5,000 Philippine pesos per month (USD 120) confirming high poverty rates in rural forest areas. There is no major tourism infrastructure, industry or trade and the community relies on local livelihoods. All respondents said that people in the community rely on farming for subsistence, confirming quantitative analysis. Half of the respondents (seven of 15) noted farming as their only livelihood. Additionally, few people own small local stores, cater to local tourists, are employed by the municipal government as forest guards or social forestry participants. Forest guards were former hunters that were recruited by the municipal government for their knowledge and ability to work in the forest and to divert local livelihoods away from hunting in the protected area. They perform foot patrol of illegal activities, aid in biological surveys and collect seedlings for nurseries. Forest guards reported illegal charcoal from six of 11 municipalities suggesting it as the biggest threat to the protected area.

Positions of power are held by the *barangay* elites who are the descendants of sugarcane plantation owners in Negros and have substantial wealth, landholdings, and political connections (Cagalanan 2013). Respondents noted that vast majority of the community members do not benefit from social forestry or have decision making power, confirming unequal distribution of assets. Social forestry programmes covered 14% of *barangay* area but officially included only 4% of people in Patag as concession holders based on the 1996 assessment report, confirming interview data. By 2010, most concession holders were either terminated or had cancellation notices (72%) from the municipality for failure to develop or illegally selling their land due to lack of funds. This analysis shows that social forestry programmes benefit a select few and implementation is difficult due to funding constraints.

Interviews with social forestry community members revealed that they have slightly higher income and more diversified livelihood options than the forest community respondents. Higher incomes are due to livelihood diversification programmes, which includes animal husbandry and vegetable farming, funded by a foreign aid agency. The livelihood diversification programme was a result of consultation with the group and is part of their local livelihood. More than half of the respondents were involved in supplemental livelihood

activities such as caretakers, food sellers, sugarcane workers, store owners, and craft making. Only three participants worked seasonally on sugarcane plantations. The success of the social forestry programme can be attributed to modest programme funding and regular monitoring by the aid agency. These small-scale efforts can be problematic, however, by enhancing social and economic differentiation within the region instead of increased benefits for the community as a whole.

Most respondents from both groups said that the protected forest positively affected their well-being (Table 1). All of the respondents from the ISF programme credit protected forest as a source of additional livelihood because of funding they receive from foreign aid agency. Nine members of the ISF programme and three Patag community members mentioned ecological benefits of the forest, such as favourable weather for farming as the forest cover brings plenty of rain and contributes to abundance of clean water. Only one person in the Patag interview group said that the forest reserve increased poverty in the community. Unlike communities of Bagong Silang and Bago of Don Salvadore Benedicto (Cagalanan 2013), members in Patag are aware of the ecological benefits of the protected forest area.

DISCUSSION

The provincial land use is poorly enforced

Our first objective was to understand the enforcement status of land use in NNNP to analyse the impact of enforcement on livelihoods. We found that there is significant amount of land that is designated for forest use (30% forest land and 9% protected area, Table 2) in the provincial land use plans, however, most forest land is being used for large-scale or subsistence agriculture. It is always challenging to convert agricultural land back to forest, especially in places that have a large human population, like Negros Occidental. Forceful land conversion from agricultural use to forest may mean confiscation of farmland, relocation of communities and restricting resource-use. Such restrictions and enforcements can exacerbate poverty in rural areas by limiting or altering livelihood choices (Groom and Palmer 2012). The protected area in Negros Occidental is avoiding this issue by allowing the rural communities to occupy and practice subsistence activities (including forestry) inside the park boundary in the multi-use zone outside of the remaining primary forest. The moderate restrictions in the peripheral multi-use management zones of the reserve are, at least in part, a historical failure to enforce original protected area policies. Nevertheless, the park analysed in this case study still contains a generally well protected area of old growth forest and has strictly enforced protections for a core wildlife habitat zone. In practice, access to forest resources becomes gradually less restrictive towards the park periphery. Given the observed socioeconomic benefits of this partial access to forest resources, combined with an increasingly stronger enforcement of biodiversity protection towards the core wildlife habitat, we think that these settings strike the right balance between biodiversity protection and poverty alleviation. The approach could be emulated elsewhere through policies that create multiple buffer zones with increasing levels of formal protection and enforcement around core areas of high conservation value.

Furthermore, studies show slow forest transition can occur when economic development creates non-agricultural jobs that incentivise significant amount of farmers to leave their lands or when forest resources become so scarce that farmers start planting trees on their land, often with incentives from the government (Rudel et al. 2005). We perceived a strong drive to bring back the forest cover by the provincial government, non-governmental organisations, and local communities through policy and social forestry projects on the ground. But while the government policies exist for reforestation, the funding is limited for proper implementation, management and evaluation of these projects (Pulhin and Inoue 2008), which results in lack of activity and cancelation of forest concessions. As a result, forest land is not likely to increase inside the protected area because of lack of community reforestation activities. While the national CBFM programme incorporates livelihood development into reforestation, the cancellation of forest concession is evidence that these strategies are not being assimilated by the communities around the NNNP. Lack of consultation with the local communities about livelihood strategies, lack of funding for materials, lack of technical training is causing many CBFM projects to fail in the Philippines (Dressler et al. 2010). Evidence from interviews of community forest group supported by JICA in Patag serve as an example that consultation with community members and technical support can increase the uptake of reforestation efforts and provide socioeconomic well-being to communities.

Protected areas may not exacerbate poverty

Our results show that rural communities near protected areas do not have lower levels of socioeconomic well-being, a finding that is contrary to expectations for remote areas (Levang et al. 2005), but consistent with a study by Ferraro et al. (2011). Additionally, International Union of Forest Research Organisations report highlights the pivotal role that the forest resources play in providing alternative food sources and ecosystem services (IUFRO 2015) and we suspect that these factors play a role in Negros Occidental, although long-term socioeconomic data would need to be analysed to make this causal link between well-being and protected areas (Andam et al. 2010). Protected area management in the NNNP does involve communities and created alternative livelihoods by employing former hunters and loggers as forest guards. However, the forest guard positions are primarily volunteer efforts that involve less than 2% of the NNNP population and are compensated by small stipends not comparable to hunting- and logging-based livelihoods. The design of the park management allows people to settle, farm and collect non-timber forest products in the multi-use zone. This strategy appears to minimise forest destruction and results in

a positive valuation of forest resources by local communities. Even though we did not formally evaluate how this affects the culture and traditions of the community, the knowledge of local plants and animals is being maintained by the forest guards. Furthermore, subsistence agriculture remains the main source of livelihood without the presence of large agriculture, mining, or tourism industries. We infer that rural livelihoods and social structures did not change dramatically in the NNNP as a result of the protected area establishment.

A study in forest reserves in Thailand and Costa Rica (Andam et al. 2010) showed less poverty in rural places close to protected areas compared to the ones further away. Andam et al. (2010) found that protected areas witnessed decreased forest loss, while they did not exacerbate poverty of many communities, where diversification of livelihoods, government funding, and tourism played a large role in poverty alleviation, and we suspect that the situation could be similar in NNNP. A study on marine protected areas in Indonesia showed that poverty alleviation tends to peak during implementation stages of government and internationally-funded protected areas programmes and short-term investment fail to provide long-term benefits to communities (Gurney et al. 2014). In order to understand the impact that protected area status had on rural people in Negros Occidental, there is a need to analyse temporal socioeconomic trends, population trends and cultural changes for NNNP from the time of its establishment in 2005. But our study provides a broad overview of the socioeconomic structure and impacts of communities in protected area in Negros Occidental.

CONCLUSIONS

The results of this study offer insights about protected areas management and poverty alleviation. Both, conservation and socioeconomic, goals can be achieved through protected area management when the livelihoods of people currently residing in them are incorporated into planning via multi-use zones and community-based resource management strategies. In this case study, conservation of old growth forest and core wildlife habitat relies on community-based forest guards patrolling the areas of highest conservation value. Acceptance of such conservation efforts is enhanced if beneficiary communities gain a degree of access to these forest resources. Access to forest resources increases toward the periphery of the park, where sustainable use of the forest is permitted in designated multi-use zones. Here, we observed socioeconomic benefits of partial access to forest resources, while the objective of conservation is met through increasing enforcement of biodiversity protection involving core wildlife habitat. Results suggest that an approach that creates multiple buffer zones with increasing levels of formal protection and enforcement around core areas of high conservation value, while allowing increasing access to forest resources in the periphery may strike an effective balance between conservation objectives and poverty alleviation that is supported and can be managed by local communities.

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