



Large Differences in Livelihood Responses and Outcomes to Increased Conservation Enforcement in a Protected Area

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Accepted: 10 September 2021 / Published online: 7 October 2021

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Abstract

Despite the popularity of integrated conservation and development approaches to protected area management, adjacent communities increasingly face livelihood dilemmas. Yet understanding of how market processes and conservation enforcement interact to influence livelihood responses remains limited. Targeting eight villages in Nam Et-Phou Louey (NEPL) National Park in northern Lao PDR, we draw on survey data with 255 households, 93 semi-structured interviews, and meso-level data on village conditions to examine how residents navigate associated livelihood dilemmas. A cluster analysis reveals five livelihood types with divergent capacities to engage in market development and cope with enforcement pressures. We show how market linkages, historical conservation interventions, and local access conditions shape livelihoods and differences between villages. Our approach yields a nuanced picture of how global conservation efforts result in an uneven distribution of costs and benefits at local scales. Conservation measures must account for highly divergent capacities to cope with access loss and diversify livelihoods.

Keywords Protected Areas · Livelihoods · Mixed Methods · Integrated Conservation and development · Lao PDR

Introduction

Protected Areas (PAs) are essential tools in the global agenda for nature conservation (Lewis *et al.*, 2019). Today covering 15.4% of all terrestrial land (UNEP-WCMC *et al.*, 2021), an expansion of the global PA estate may be imminent with several experts calling for even higher levels of coverage in light of ongoing and rapid loss of species worldwide (Büscher *et al.*, 2017; Di Marco *et al.*, 2019; Ellis & Mehrabi, 2019).

However, decades of research on the social and environmental consequences of PAs paint a heterogeneous picture of their effectiveness at protecting nature and their impacts on local communities (Blom *et al.*, 2010; Oldekop *et al.*, 2016). PA conservation creates costs and benefits that are often unequally distributed across spatial scales, local contexts, and households, requiring trade-offs at multiple levels (Beauchamp *et al.*, 2018; Blom *et al.*, 2010; McShane *et al.*, 2011; Suich, 2010). Particularly in the Global South, PAs tend to imply substantial costs for local residents (Dawson *et al.*, 2017; Oldekop *et al.*, 2010; Roe *et al.*, 2015). Such costs are often associated with physical displacement including evictions, a loss of access to natural resources for customary and income-generating purposes, human rights abuses in the course of rule enforcement, and elite capture of benefits (Chechina *et al.*, 2018; Chomba *et al.*, 2015; McElwee, 2010; Oldekop *et al.*, 2016; Sheely, 2015). Interventions thus tend to exacerbate the social-ecological dilemmas facing local residents as livelihood improvement and biodiversity goals come into conflict (Southworth *et al.*, 2006).

Law enforcement has historically had a strong foundation in conservation and is a primary means for enhancing PAs (Ferraro & Hanauer, 2015; Gray *et al.*, 2018; Johnson

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et al., 2016). However, law enforcement alone is inadequate to ensure PA integrity and tends to be lax, especially in places where livelihoods rely on access to PA resources (McElwee, 2010; Phromma *et al.*, 2019). Moreover, while PA enforcement may have theoretical backing as a measure to change resource-use behaviours, a cohort of issues complicates its implementation in practice, including inadequate incentives for enforcement officers and competing interests between PA staff and local residents (Robinson *et al.*, 2010). In a PA in Bangladesh, for instance, Mukul *et al.* (2014) suggest that law enforcement was largely ineffective in halting illegal forest degradation practices, arguing that economic incentives for local residents are more effective.

The limitations and social consequences of strict law enforcement have made market-based instruments to create alternative income-generating activities for local residents increasingly popular (Holmes & Cavanagh, 2016). Ecotourism, certified commodity production, carbon credits, or other alternative livelihood interventions create new opportunities (Holmes & Cavanagh, 2016; Naidoo *et al.*, 2019). However, alternative livelihood interventions tend to be based on simplifications of agent behaviours that can have unintended outcomes for conservation (Wright *et al.*, 2016). These include assumptions that people will substitute current income sources with the new activities rather than complementing them; that local communities are homogeneous entities; and that individual activities are scalable across a population. Interventions must therefore be evaluated in light of the multidimensional nature of livelihoods, including tenure rights and prevailing market institutions, to account for the uneven distribution of social impacts of PAs (McElwee, 2010; Roe *et al.*, 2015; Wright *et al.*, 2016).

An equitable management of PAs can improve both the legitimacy and effectiveness of conservation (Schreckenber *et al.*, 2016; Woodhouse *et al.*, 2018). In a meta-analysis, Oldekop *et al.* (2016) find that positive socio-economic outcomes and fewer livelihood restrictions were associated with improved conservation outcomes. Moreover, local communities tend to oppose conservation policies and undermine PA rules when they perceive their livelihoods to be compromised (Kidegesho & Mtoni, 2008; Soliku & Schraml, 2018). Understanding how local residents navigate conservation-livelihood dilemmas is consequently a core policy and academic concern (Igoe, 2006; Schleicher *et al.*, 2019; Wunder *et al.*, 2014), particularly in contexts where market expansion for land-based commodities is shaping livelihoods at the frontiers of PAs (Roth & Dressler, 2012).

While livelihoods are grounded in the institutions and conditions of a particular place, they are increasingly shaped by distant economic and political processes, as demonstrated in research on telecoupling (Andriamihaja *et al.*, 2019; Baird & Fox, 2015; Eakin *et al.*, 2014; Friis

& Nielsen, 2019). Macro-level processes are mediated at the meso-level to then shape the conditions in which local livelihoods are embedded (Medina *et al.*, 2009; Newton *et al.*, 2016; Taylor, 2016). For rural residents in PAs, macro-level processes relate to the development of market institutions and government interventions. For instance, market linkages established at the village level can drive natural resource commodification and will result in diverse livelihood outcomes depending on context-specific factors tied to location, infrastructure, and market institutions (De Haan & Zoomers, 2005; Friis & Nielsen, 2017; Mahanty & Milne, 2016; Suich, 2010).

Similarly, the livelihood consequences of PA interventions are mediated by location-specific factors (Jansen *et al.*, 2006; Soltani *et al.*, 2012; Thapa Karki, 2013). Research highlights that PAs are often unevenly enacted across a given territory, affecting local livelihoods differently depending on conditions of the household and local context (Thapa Karki, 2013). For instance, Baird and Leslie (2013) show that being closer to a PA in Tanzania was associated with greater livelihood diversification. Clements *et al.* (2014) find that households closer to a PA in Cambodia were significantly better off, which could partly be explained by village-level characteristics such as distance to the city. In addition, access to conservation livelihoods such as ecotourism is determined largely by village context. Hoang *et al.* (2020) show that ability to derive benefits differed by village membership, while Ma *et al.* (2018) demonstrate how tourism benefits are associated with community assets and are spatially differentiated. Local attitudes towards PAs also tend to be a factor of village location and experiences with PA interventions (Badola *et al.*, 2012). For instance, Guerbois *et al.* (2013) show that residents closer to a PA in Zimbabwe, and experiencing more restrictions, view the PA more negatively. Perception of benefits from PAs is also shaped by location-specific factors (Amoah & Wiawe, 2012; Nyaupane & Poudel, 2011; Vodouhê *et al.*, 2010). However, studies either conduct in-depth analyses of only a few villages or are based on large-*n* multivariate analyses that do not adequately engage with differences between villages and the diverse types and levels of PA intervention found in a PA. For the latter, village-level characteristics are normally integrated as variables in multivariate models such as distance, market presence, or infrastructure (Guerbois *et al.*, 2013; Hoang *et al.*, 2020), without a critical engagement with how meso-level conditions shape local livelihood responses at the frontiers of PAs.

In this article, we present an alternative approach to nuancing livelihood impacts at PA frontiers that combines multivariate quantitative analyses and in-depth analysis of village contexts to understand how residents of local communities navigate dilemmas in the context of accel-

erating market-based livelihood development. In doing so we engage with the meso-scale to explain differences in livelihood outcomes resulting from PA engagements. We hypothesize that capacities to respond to PA pressures and opportunities are shaped by household capitals and context-specific conditions, in particular market linkages and the spatial features of people's livelihood activities. We use Nam Et-Phou Louey (NEPL) National Park in northern Lao PDR (Laos) as a case study.

Methods

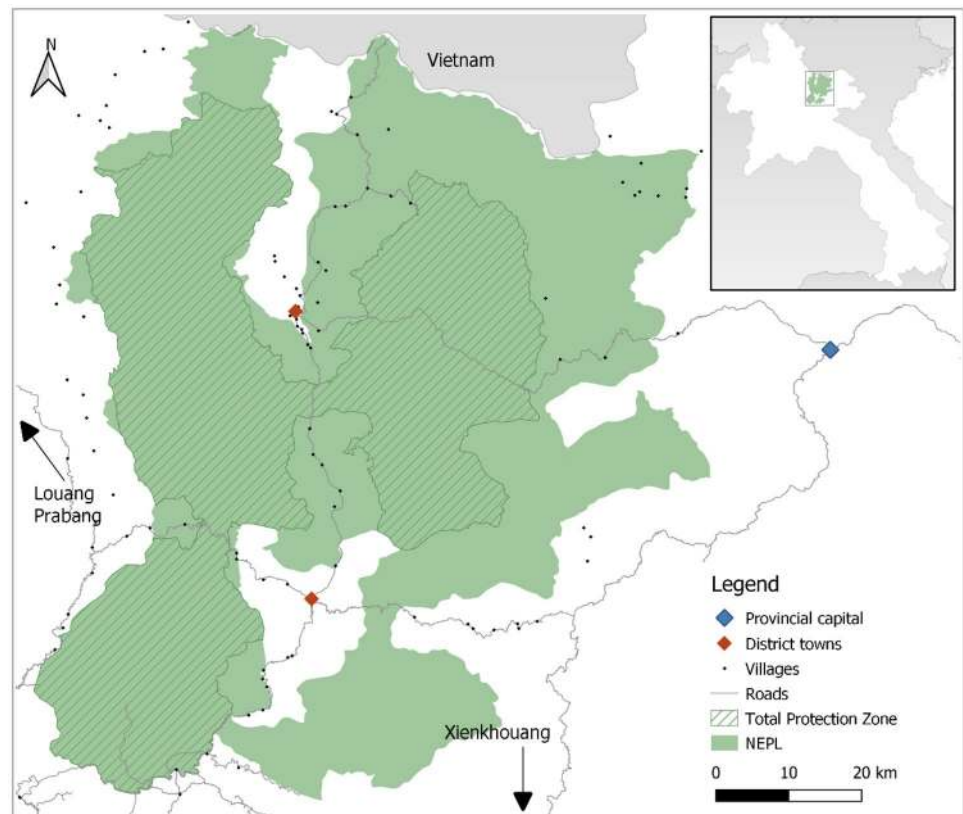
Study Area: Nam Et-Phou Louey National Park and Villages

The forest landscapes of northern Laos typify livelihood dilemmas at the intersection of market development and nature conservation. Regional economic growth and consequent demand for land-based commodities have caused market linkages to increase drastically in recent years through cross-border trade with Vietnam and China, rising urban demand, and a government policy to commercialise smallholder agriculture (Vongvisouk *et al.*, 2014, 2016). This is accelerating transitions from shifting cultivation to

agricultural intensification and commodification (Hepp *et al.*, 2019; Kallio *et al.*, 2019; Ornetsmüller *et al.*, 2018). At the same time, forest conservation maintains a central importance in policymaking, including through strengthening the existing PA network (World Bank, 2020a, 2020b). Laos currently has 24 PAs covering approximately 18% of the country, three of which have recently been upgraded to national parks (MoNRE, 2016; World Bank, 2020a, 2020b). Despite having important impacts on local residents, including historical measures of eviction and overlaps with customary land, and although the inequitable distribution of livelihood consequences from commercialisation and conservation is of major importance (Castella *et al.*, 2013; Lagerqvist *et al.*, 2014; Newby *et al.*, 2014), only a few studies have explored the livelihood implications of Laos' agricultural transformation for people living in the vicinity of PAs (Ingalls & Dwyer, 2016; Martin *et al.*, 2018), most doing so indirectly when investigating land-use change (Castella *et al.*, 2013; Cole *et al.*, 2019).

Nam Et-Phou Louey (NEPL) National Park combines restrictive exclusionary measures with Integrated Conservation and Development (ICD) projects (Persson *et al.*, forthcoming). Officially delineated in 1993, NEPL remained a 'paper park' until it started receiving continuous management support in 2000 and law enforcement began in 2005

Fig. 1 Map of NEPL National Park (Source: author's own based on data from WCS)



(Corbett, 2008; Johnson *et al.*, 2012). Based on data from Wildlife Conservation Society (WCS), NEPL covers nearly 500,000 hectares of mountainous forestland, zoned into 198,000 hectares of Controlled Use Zone (CUZ), where limited subsistence activities are permitted, and 300,000 hectares Totally Protected Zone (TPZ), where access is strictly forbidden (Fig. 1). A critical biodiversity area in Southeast Asia, NEPL harbours several globally important and threatened animal species (Johnson *et al.*, 2009). The PA was originally framed around safeguarding a small tiger population that seems to have been extirpated (Rasphone *et al.*, 2019). Nevertheless, NEPL is a flagship for environmental policymaking in Laos. The PA is important for the country's Green Growth programme as a scalable PA management model and, in 2019, was upgraded to the country's first national park (World Bank, 2020a, 2020b).

The NEPL Management Unit (NEPLMU) is a government entity in charge of daily operations and receives technical and financial support from WCS. While NEPLMU staff members lead park-specific activities, district and provincial agencies are responsible for coordinating and implementing various projects and government programmes on forest governance and agricultural development (Broegaard *et al.*, 2017). The result is a bundle of measures to govern natural resource use, ranging from alternative livelihood support, ecotourism and social campaigns to land-use zoning, sanctioning and law enforcement. An estimated 91,500 people live in 283 villages within and adjacent to NEPL, with a smaller population of 23,000 living in the CUZ (Martin *et al.*, 2018). Local residents practice shifting cultivation for upland rice combined with foraging for Non-Timber Forest Products (NTFPs), cash crop agriculture, livestock herding and wildlife hunting. Increasingly, these practices are commercially oriented and opportunities for off-farm and non-farm income are growing.

[Fig. 1].

Data Collection & Analysis

Table 1 outlines the data collection procedures. Preliminary interviews were conducted in October–November 2018, while the mixed-method data collection at village sites was conducted in July–August 2019. We followed a concurrent triangulation design in which extensive and intensive methods were employed to generate separate datasets that were analysed in parallel, mainly for cross-validation and corroboration (Creswell, 2009). In order to capture the multi-dimensional ways that PA interventions interact with local land-use and livelihood practices in the context of rapid market expansion, it was necessary to establish the dominant livelihood trajectories and how these are shaped by market linkages at the village level. For this, we combined cluster and statistical analyses based on household survey data

with meso-level variables from key-informant interviews and secondary data. Eight villages were selected (renamed to pseudonyms based on the Lao word for village: Ban) to demonstrate a spread of socioeconomic and political contexts at the border of the TPZ and permit inter-village comparisons (Table 2). Since we were interested in the causal relationships between conservation interventions and livelihood adaptations, moreover, semi-structured interviews with households, coupled with a land-use mapping and discussion activity, provided qualitative data to interrogate household adaptations. Together, these methods provided a robust understanding of the major factors influencing capacities to respond to PA pressures and opportunities. Qualitative data was analysed using QSR NVivo 12, while statistical analyses were performed using IBM SPSS Statistics 27.

The household survey instrument was developed based on a literature review and in consultation with three national researchers. Revisions were made after two rounds of testing with 2–3 participants. Most survey respondents were conversant in Lao. For those that were not, one of the enumerators who spoke the ethnic language (Hmong) or a family member facilitated interpretation. Survey interviews lasted 45–70 min and were administered mostly at respondents' homes. The aim was to operationalise a number of variables to analyse the relationship between dominant livelihood practices, experiences with park interventions, and park attitudes.

Cluster Analysis

Cluster analysis was employed to differentiate between different livelihood groups and identify dominant strategies. We largely followed the approach described in Köbrich *et al.* (2003) and Estevez-Moreno *et al.* (2019), performing agglomerative hierarchical clustering using Ward's method of minimum variance as the clustering method (see Appendix 1 for details). We performed the analysis on the normalised values of the variables of interest as well as on the factors from a factor analysis, and conducted a two-step non-hierarchical clustering to verify the initial groupings (see Appendix 2) (Parker *et al.*, 2015). Proportions of income from different sources were used as proxies for livelihood activities, and we triangulated the cluster results with qualitative survey responses on major income changes experienced at household level and secondary statistical data for the village level (Soltani *et al.*, 2012).

The variables used for the cluster analysis are described in Table 3, based on income from the past year. All income measures were converted from Lao Kip (LAK) to US Dollars (USD) based on the 2019 exchange rate (1 USD = 8,696 LAK). We divided livestock into "small" and "large" to account for their different husbandry practices. Final clusters were profiled by cross-tabulating livelihood variables

Table 1 Data collection and sources

Source	Description & topics covered	Participants & selection
<i>Grey literature & preliminary interviews</i>	Documents from conservation actors detailing conservation measures and park history; Interviews at multiple levels, covering forest conservation and development policies	Internet searches; Government officials at all levels; Representatives of conservation organisations; 40 in total
<i>Secondary statistical data</i>	Summary figures at the village level (including e.g. literacy rates, commercial crop orientation, population changes) to identify trends	Sources: WCS Laos; 2005 & 2015 Lao Population Census; 2011 Lao Agricultural Census
<i>Land-use mapping & group discussions</i>	Major land uses and market linkages for various commodities, including history of trader relationships and prices; Discussion of park impacts on village land and livelihoods. Field visits to one or more major production sites in each village	1 per village with 6–10 participants; Village authorities and members of various committees such as village headman, youth union, women's union, elder council, village guards, and village foresters
<i>Survey question-naire</i>	Household (HH) characteristics; livelihood activities and incomes in past 12 months; forest products; major income changes; shocks; participation in government extensions & park's activities; perception of park	30–45 HHs per village (large enough to compare between villages), 255 in total; Randomized selection at village level from list of all HHs maintained by village headman; selected HHs were approached to arrange a time
<i>Semi-structured interviews</i>	Questions involved (a) livelihood strategies, (b) constraints to livelihood diversification, and (c) interactions with and responses to park measures. When possible, interviews were recorded using a portable digital audio recorder, and detailed field notes were taken when declined or otherwise not possible to record	10–14 HHs per village, 93 in total; Selection based on variable experiences with the park and preliminary estimation of major livelihood activities based on questionnaire to access perspectives from a spread of livelihood types; 30–60 min per interview. Interviews were conducted by the first and third author in Lao mainly in participants' homes. For interviews in Ban1 and Ban2, these involved on-the-spot translations, while the rest of the interviews were conducted in Lao by the third author. Transcripts were later translated into English for analysis by the first author

Table 2 Village characteristics

	Ban1	Ban2	Ban3	Ban4	Ban5	Ban6	Ban7	Ban8
<i>Total no. HHs 2018*</i>	244	41	49	63	68	79	65	68
<i>No. HHs surveyed (inter-viewed)</i>	45 (14)	30 (13)	30 (10)	30 (11)	30 (11)	30 (11)	30 (12)	30 (11)
<i>Major income sources</i>	Livestock Gov't NTFPs	Livestock NTFPs	Livestock Fruit	Weaving Poultry	NTFPs	NTFPs	Livestock Maize	Livestock NTFPs
<i>Mean (median) income in USD**</i>	2,105 (983)	2,946 (2,715)	1,862 (856)	3,192 (2,275)	1,331 (1,092)	1,621 (798)	1,157 (397)	1,102 (756)
<i>% HHs selling crops**</i>	24.4	13.3	50.0	60.0	36.7	43.3	60.0	40.0
<i>% HHs with paddy land**</i>	2.2	93.3	16.7	73.3	16.7	10.0	10.0	76.7
<i>% HHs with a loan**</i>	13.3	66.7	26.7	53.3	23.3	46.7	46.7	46.7
<i>Distance to nearest town centre (km)</i>	60.4	18.2	20.3	28.1	34.3	37.4	21.4	6.3
<i>Distance to TPZ (km)</i>	3.5	3.8	2.7	1.6	2.9	0.0	2.5	2.9
<i>Distance to NEPLMU (km)</i>	225.2	18.2	20.3	28.1	79.8	82.8	21.4	43.0
<i>Presence of park***</i>	Low	Medium	Medium	High	Low	Low	High	Medium

*Based on WCS data

**Based on survey results

***Based on assessment of level of intervention

and cluster membership. We performed Kruskal–Wallis tests for significance and Mann–Whitney U post-hoc tests for continuous variables, adjusting the p-values based on Bonferroni–Holms, and chi-squared tests for dichotomous categorical variables. Lastly, we conducted a multinomial logistic regression analysis to assess which asset endowments explain differences between cluster groups, having removed variables with high multi-collinearity and those that did not exhibit significant relationships. We use the Sustainable Livelihood Framework to guide the analysis, breaking our indicators down into physical, natural, social, financial, and human capital (Amevenku *et al.*, 2019; Huy Phan *et al.*, 2019; Tiltonell *et al.*, 2010).

[Table 3].

Park Indices

We constructed one index to capture attitudes towards NEPL and a second on engagement in NEPL activities (see Appendix 3). Ten Likert Scale statements reflecting dif-

ferent dimensions including perceived impacts on income generation and food sufficiency (Ven, 2016) were chosen to construct the park *attitude* index by summing the scores. Inter-item correlation was below 0.397 (with a mean of 0.200), and a Cronbach's Alpha of 0.711 suggests robustness. The index was rescaled from 0 to 100 to improve interpretation. The park *engagement* index captures the multidimensional ways in which park conservation interact with people's daily lives. Therefore, we combined ten variables that reflect awareness, information access, and participation in activities. Higher weights were given to variables that, based on discussions with NEPL staff and key informants, reflect higher engagement. Inter-item correlation was below 0.478 for any pair of variables and showed a Cronbach's Alpha of 0.724, and the index was also rescaled from 0 to 100 to improve interpretation. We conducted a multivariate linear regression of the park engagement index to assess the extent to which livelihood grouping and village membership influence engagement (see Appendix 5). A wealth index was

Table 3 Variables used for clustering

Variable	Description
Proportion farm income	Sale of all crops
Proportion NTFP income	Sale of NTFPs from a pre-defined list of 10
Proportion public sector income	Government position, pension transfers, NEPL work, teacher
Proportion remittances	Income from remittances (cash transfers from outside the village)
Proportion private sector income	Construction work, owning a shop, farm labourer, trader
Proportion large livestock income	Sale of buffaloes and cattle
Proportion small livestock income	Sale of poultry, pigs, farmed fish, and goats

constructed based on a list of items to compare household wealth status (see Appendix 3).

Qualitative Analysis and Land-use Mapping

We analysed transcripts and notes from 93 household interviews to identify common themes in household responses to NEPL conservation measures and their spatial dimensions. An initial codebook, informed by theory and the research questions, was developed. The first author conducted the coding. This focused on household livelihood adaptation to park interventions, and reasons for (not) participating in park activities. Broad codes were subsequently refined into specific themes related to different livelihood practices (farming, NTFP collection, livestock grazing, participation in conservation activities) (Corbin & Strauss, 2008). We then compared coded responses with the household livelihood portfolio and village-level conditions. We sought to go beyond the presentation of codes by grounding the analysis in literature and background knowledge of PA conservation, shifting between different levels of abstraction to relate themes to theory, integrating notions of scale, and comparing across groups (Bazeley, 2009). The quotes selected were thus illustrative of broader patterns and logics (Cope, 2005). The land-use mapping activity provided important meso-level data to ground the qualitative assessments. Lasting between 1.5–2.5 h and involving 6–10 participants, this served as a catalyst for discussing the area-based impacts of park interventions and government land-use regulations, particularly along the village borders, and how resulting constraints affected the spatial dimensions of residents' livelihood activities.

Results

We differentiate livelihood clusters according to multiple livelihood dimensions, highlighting a striking inter-group inequality, continued reliance on land and natural resources for livelihoods, high, though unequal, levels of marketization of production, and limited remuneration from park activities. Combining these results with the qualitative data analysis, four dimensions of how park activities influence livelihood diversification options are analysed: access to land for farming, livestock grazing, NTFP collection, access to alternative livelihood options, and participation in park activities.

Dominant Livelihood Types

The cluster analysis reveals five major livelihood groups. Figure 2 and Table 4 characterise each cluster based on income and asset comparisons. The largest group, “NTFP Collectors”, consists of subsistence farmers with low income

levels and nearly 80% of cash income from NTFPs, mainly red mushroom (*Russula rosea* Pers., often called *Russula lepida* in Laos), but also other products such as bamboo shoots, broom grass, wild root crops and fruits. “Commercial Farmers” are households with income from crop sales and/ or small livestock. The “Workers & Migrants” group is composed of households with off-farm, nonfarm and private sector incomes and/ or receiving remittances, translating into a higher per capita income than Commercial Farmers. Nonfarm work includes work in the district town or the provincial capital, such as in construction or as a driver. “Herders” have high wealth, own the largest numbers of cattle and buffaloes and make high incomes from sale of large livestock. Having the highest proportion of paddy rice production and access to loans translate into a higher rice production than all other groups. Moreover, they have the highest NTFP income and very low farming income. The “Government Workers” group consists of households with very high income, mainly from public sector sources, who own 16 of 30 cars and trucks. They also hold large loans, are much more likely to have a household member on a village committee and to report having more than four people they can rely on in times of need.

NTFP Collectors score significantly lower than other groups on a number of indicators. Members do not commercialise their farm production and are the least diversified group in terms of income sources. Nearly all households that do not have a single income source greater than 58 USD yearly belong to this cluster ($n = 27/30$). NTFP Collectors are only slightly less likely to be indebted than other groups and own few physical assets and household products. They rarely cultivate paddy rice, i.e. wet rice cultivation, or participate in government extensions. Household members are also significantly less likely than other groups to be on a village committee. Commercial Farmers have a higher per capita income than NTFP Collectors and slightly higher wealth, according to the measures in our wealth index. This group also has more separate income sources and a higher proportion of paddy rice production than NTFP Collectors. The household heads of Workers & Migrants and Government Workers have a significantly higher education than those of NTFP Collectors, and Herders and Government Workers have more adults in the household.

There are some commonalities across clusters. All groups place a priority on household rice sufficiency as even wealthy households with nonfarm income produce rice for household consumption. Only 2% of households in the sample did not produce any rice and only 9% sold rice in the past year. Members of all clusters make an income from and consume NTFPs. In addition, there are no significant differences in the way households across clusters deal with shocks such as loss of income. Likewise, there are no significant differences between income changes across groups,

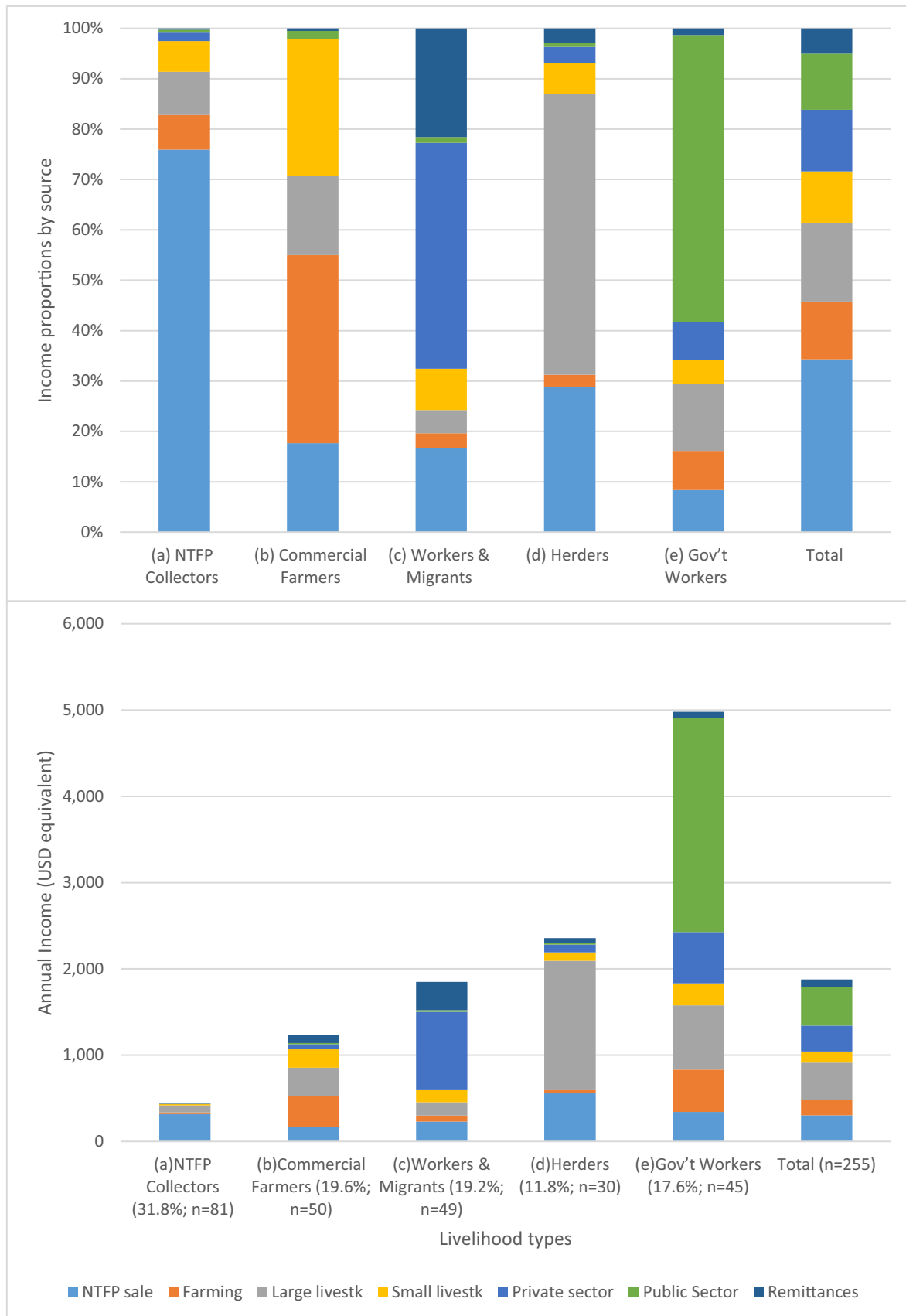


Fig. 2 Average income proportions (%) and annual incomes (USD) by cluster

Table 4 Comparison of proxy variables for asset endowments between cluster groups

Variable	(a) NTFP Collectors	(b) Commercial Farmers	(c) Workers & Migrants	(d) Herders	(e) Gov't Workers	Total
Physical Capital						
<i>Wealth index</i>	22.36 ^{b,d,e} (1.08)	26.94 ^{a,d,e} (1.29)	27.78 ^{d,e} (2.38)	35.56 ^{a,b,c} (2.55)	40.25 ^{a,b,c} (3.07)	29.01 (.96)
<i>Does not own motorbike**</i>	++ (n=12)	0 (n=2)	+(n=6)	0 (n=2)	-(n=0)	N/A
<i>Owns car or truck**</i>	-(n=1)	-(n=2)	0 (n=7)	0 (n=4)	++ (n=14)	N/A
<i>Owns hand tractor***</i>	-(n=9)	+(n=15)	-(n=9)	++ (n=19)	0 (n=12)	N/A
<i>Owns fridge***</i>	-(n=10)	-(n=8)	0 (n=10)	0 (n=10)	+++ (n=27)	N/A
Natural Capital						
<i>% rice from paddy</i>	5.5 ^{b,c,d,e} (2.1)	31.0 ^{a,c} (5.3)	20.82 ^{a,b,d} (5.0)	58.3 ^{a,b,c} (6.5)	34.6 ^a (6.7)	24.7 (2.3)
<i>Access to paddy land***</i>	-(n=8)	++	0	++	0	N/A
<i>Rice production/capita (kg)</i>	288.8 ^d (16.6)	326.2 ^e (24.2)	256.2 ^d (23.6)	396.9 ^{a,c} (27.1)	248.5 ^b (24.5)	295.5 (10.3)
<i>% of rice sold</i>	0.37 ^b	6.08 ^a	3.02	4.03	3.18	2.93
<i># NTFP types consumed (no diff)</i>	6.3 (2.0)	6.9 (2.8)	6.8 (2.1)	7.0 (2.0)	6.7 (2.4)	6.7 (2.2)
<i># shocks (no diff)</i>	1.5 (.1)	1.7 (.2)	1.5 (1.1)	1.3 (1.0)	1.4 (.1)	1.5 (.1)
<i># crops for sale (no diff)</i>	1.0 (.1)	1.1 (.1)	1.0 (.2)	0.7 (.8)	1.2 (.2)	1.0 (.1)
Social Capital						
<i>HH on village committee ***</i>	-	0	0	+	++	N/A
<i>Can rely on > 4 people**</i>	-	0	-	0	++	N/A
Financial Capital						
<i>Income/capita (USD)</i>	65.10 ^{b,c,d,e} (9.19)	169.52 ^{a,c,d,e} (20.99)	320.12 ^{a,b,e} (47.65)	305.73 ^{a,b,e} (42.61)	745.34 ^{a,b,c,d} (95.41)	282.93 (25.01)
<i>Herd size (# large livestock)</i>	2.0 ^{d,e} (.3)	2.4 ^{d,e} (.4)	3.7 ^d (.7)	17.5 ^{a,b,c,e} (1.9)	7.4 ^{a,b,d} (1.4)	5.2 (.4)
<i># income sources</i>	2.2 ^{b,c,d,e} (.2)	4.1 (.2)	4.0 (.3)	4.1 (.3)	4.9 (.4)	3.6 (.1)
<i>No income source > 58 USD***</i>	++++ (n=27/30)	-	-	-	-	N/A
<i>Total loan (USD)</i>	552 ^d (117)	634 ^d (158)	859 (188)	1878 ^{a,b} (416)	1232 (259)	903 (93)
<i>Loan***</i>	-	-	0	++	0	N/A
<i>Own large livestock***</i>	-	0	-	++	+	N/A
Human Capital						
<i>HH size</i>	7.0 ^d (.3)	7.1 ^d (.4)	7.1 ^d (.5)	8.8 ^{a,b,c} (.7)	8.1 (.5)	7.4 (.2)
<i>Education of HHH (years)</i>	3.9 ^{c,e} (.4)	4.4 ^e (.4)	5.6 ^{a,e} (.5)	5.0 ^e (.6)	8.6 ^{a,b,c,d} (.6)	5.3 (.2)
<i># adults in HH (> 15 years)</i>	3.8 ^{d,e} (.2)	4.1 (.2)	4.4 (.4)	5.3 ^a (.4)	5.1 ^a (.4)	4.4 (.2)
<i>Participated in livestock extension***</i>	-	+	0	+	+	N/A
<i>Age of HHH (years) (no diff)</i>	38.6 (1.3)	41.8 (1.8)	40.2 (2.0)	42.8 (2.1)	41.0 (1.5)	40.5 (.8)

Table 4 (continued)

Variable	(a) NTFP Collectors	(b) Commercial Farmers	(c) Workers & Migrants	(d) Herders	(e) Gov't Workers	Total
NEPL Park Variables						
<i>Park engagement index</i>	27.8 ^{b,c,d,e} (1.9)	38.2 (3.6)	38.4 (3.2)	40.6 (3.3)	44.4 (3.5)	36.3 (1.4)
<i>NEPL income past year (USD)</i>	0.6 ^{b,e} (0.4)	16.0 ^a (5.3)	5.8 ^b (3.6)	1.4 (0.9)	13.3 ^a (7.5)	6.9 (1.8)
<i>NEPL income past 5 years (USD)</i>	4.7 ^{b,d,e} (2.1)	43.1 (17.9)	24.9 (9.5)	10.0 (5.5)	49.5 (17.7)	24.6 (5.2)
<i>Participation rates patrolling/monitoring</i>	17.3%	18%	22.4%	40%	31.1%	23.5%
<i>Park attitude index (no diff)</i>	49.0 (2.8)	42.4 (2.9)	45.6 (2.7)	41.8 (4.0)	48.8 (3.5)	46.2 (1.3)

Letter indicates significant difference between the two groups using $p < .05$ significance level. The number in brackets shows the standard error. For dichotomous categorical variables, (-), 0, and (+) indicates less, neither, and more likely, respectively, with *** $p < .01$, ** $p < .05$, and * $p < .10$. "no diff" indicates no significant differences between groups

meaning groups with fewer income sources experienced an equal amount of significant income fluctuations.

Results from the multinomial logistic regression show which asset endowments influence the likelihood of not belonging to the NTFP Collectors cluster (see Appendix 4). It includes all variables that were shown to have significant relationships after checking for multi-collinearity. Market links for different livelihood activities at the household level account for differences, in addition to a few other variables reflecting asset endowments such as household size, owning a production or luxury good, and household head education level (Table 5).

Examining how the clusters are spread across the villages indicates a strong influence of village-level characteristics ($p < 0.0005$; Cramer's $V = 0.354$). NTFP Collectors dominate in a number of villages, including Ban3, Ban5, Ban6, and Ban7, while Commercial Farmers are prominent in Ban4 and slightly in Ban7 and Ban8 (Fig. 3). Over half of the Herders are in Ban2, only one in neighbouring Ban3, and none in Ban4. Government Workers are dominant in Ban1, and are quite evenly spread across the other villages, while

Workers & Migrants account for less than 10% in Ban5, Ban6, and Ban7.

Table 4 indicates some structural differences between livelihood groups regarding their interactions with NEPL. A bivariate regression analysis of the park attitude index shows that there are no significant differences between livelihoods groups, meaning all groups on average have a similar attitude towards NEPL. Looking more closely at some of the statements, however, reveals that Commercial Farmers are more likely to claim that NEPL has affected their family's ability to obtain sufficient food (chi-sq $p = 0.036$) and that they would likely make more income if there was no PA (chi-sq $p = 0.010$). A multivariate linear regression model of the park attitude index shows that, when accounting for park engagement and village membership, cluster membership does indeed add some predictive power to the model, explaining 15.5% of the variance instead of 11.4%, though overall this is quite small (see Appendix 5 for details). This is not surprising since, for instance, Commercial Farmers are located in villages experiencing strong land constraints, such as Ban4.

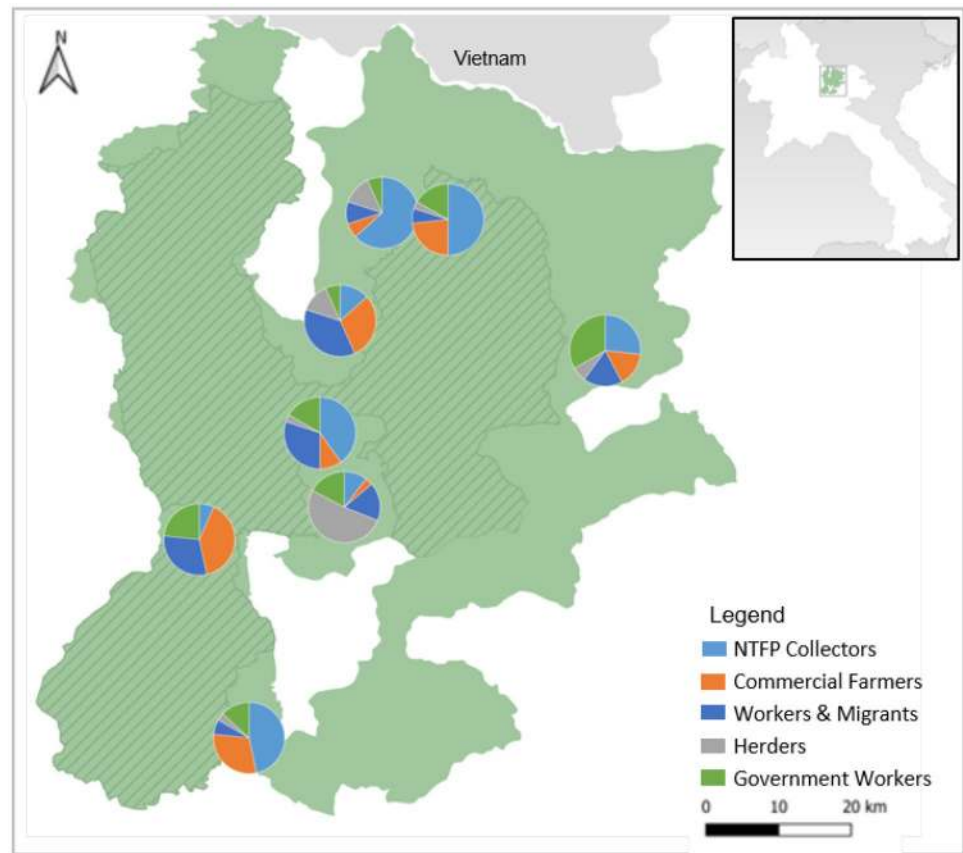
Table 5 Main variables influencing cluster membership, ranked by importance

	Commercial Farmer	Worker & Migrant	Herder	Government Worker
1st	Earn farm income***	Earn nonfarm income***	Herd size***	Earn nonfarm income ***
2nd	Earn income from small live-stock***	Earn income from small live-stock***	Number of income sources***	Education of HHH (years)***
3rd	Proportion of rice production from paddy*	Household size**	Earn farm income**	
4th		Rice production/ capita**	Earn NTFP income**	
5th		Owning a car or truck*	Owning a TV*	
6th		Herd size*		

NB NTFP Collectors is the reference group

*** $p < .01$ ** $p < .05$ * $p < .10$

Fig. 3 Distribution of livelihoods across village sites



The park engagement index shows that NTFP Collectors are significantly less engaged in NEPL when we account for multiple dimensions of the park. A linear regression model shows that once we account for village membership, the effect of cluster membership on engagement is reduced, suggesting there are mediating factors at the village level. In our model, only accounting for village membership explains 27.7% of the variance while adding cluster membership explains 32.0% (model $p < 0.005$, with $VIF < 1.35$). In other words, even when accounting for village membership, NTFP Collectors appear to be excluded from NEPL activities (see Appendix 5). Moreover, NTFP Collectors have received significantly less income from remunerative park activities than both Commercial Farmers and Government Workers in the past five years, though overall the amounts are marginal compared to other income sources.

The statistical analyses have so far shown that there are village-level characteristics that influence (a) livelihood cluster membership and (b) engagement with NEPL. We now highlight the key livelihood dilemmas facing local residents in order to understand how context-specific factors mediate livelihood responses.

Productive Agricultural Land

All cluster groups rely on access to land and natural resources for their livelihood. Self-sufficiency in rice production is a priority for households but since topographical restrictions limit access to lowland agricultural fields, access to productive upland plots is the only viable means to obtain rice security for the majority of households. This makes recent rounds of land-use zoning, boundary demarcation and enforcement that have excluded many farmers from fallow plots located in the TPZ problematic. As encapsulated by one participant from Ban3,

“The government and NEPL staff have shown the boundaries of NEPL and the village agriculture area, so there is limited land... especially for upland rice. Every 2-3 years, we must move to a new area. If we do not, rice production will not be good. If farmers don’t have enough rice, they will cut the forest for upland rice cultivation inside NEPL.”

Residents typically equate NEPL with the TPZ, as they do not recognise their village land as being part of

NEPL or distinguish the CUZ from the TPZ. In some villages, residents interpret recent rounds of enforcement and boundary demarcation as an expansion of the TPZ to cover previously accessible fallow land. However, the loss of fallow land depends on the village as the degree of enforcement and boundary demarcation varies extensively.

The response of local government agencies has ranged from giving official approval to access plots inside the TPZ to sanctioning. In Ban7 and Ban4, groups of farmers wrote official requests to the district government for permission to cultivate fallow plots inside the TPZ. In 2017, the district government allowed nine farming households from Ban7 to do so for one season. Farmers in Ban4, meanwhile, did not receive permission but cultivated anyway and, after paying a sanction, were permitted to harvest for one season. Other households in Ban4 were sanctioned for accessing fallows but claimed that they were unaware of the TPZ boundary. In some cases, failing yields pushed households to cultivate deep in the forest despite the risk of sanction.

Sanctions for transgressing regulations demonstrate the tensions between jurisdictional authorities and how villages experience this differently. Informants reported sanctions being paid to different offices (the village headman, district agencies, district police or the NEPLMU). In Ban2, four households cultivated fallow plots in the TPZ after gaining permission from the village authorities, and the headman dissuaded sanctioning by NEPL staff upon discovery. However, in the same village, two households were reportedly sanctioned directly by the district agency for cultivating fallow plots in the TPZ. Moreover, as indicated above, sanctions are at times perceived as an access fee. One participant, for instance, had first paid a sanction of 69 USD followed by a yearly fine of 11.50 USD to continue cultivating the plot.

The land constraints for upland plots are causing an increase in interest for paddy land, though village topography often restricts accessibility of suitable land for growing paddy rice. Unexploited potential land is usually located in areas that are difficult to access and requires extensive tilling, terracing and irrigation canals to make them productive. These are very labour-intensive and expensive investments that only the wealthiest households in three villages reported pursuing, some investing in paddy land in the district towns. Paddy investment interacts with NEPL in two ways: first, land constraints for upland plots are driving investments in paddy rice. For instance, a farmer in Ban4 stated:

“I invested in lowland rice fields because NEPL has existed in the village since 2001. NEPL doesn’t allow cutting the forest, so I decided to grow paddy rice.”

Second, as exemplified by experiences in Ban4, paddy farmers have often been exploiting land within the TPZ since

before they first heard of NEPL. A conflict between paddy farmers and NEPL staff emerged in 2006, leading to short jail terms as farmers refused to abandon their fields. Since then, district authorities have tacitly accepted the paddy farmers’ claims, which has encouraged households to invest in extending and building irrigation in the area to enhance tenure claims. More recently, however, as highlighted by a farmer who had previously been fined for cultivating land in the TPZ,

“NEPL staff came and informed us they don’t permit paddy rice cultivation inside NEPL. But farmers didn’t want to follow the rule because they don’t have alternative land. Some had paid a lot of money to prepare the soil and wanted to keep the paddy rice field for their children.”

Access to paddy land can have important path dependencies for livelihood options in a particular village, as early settlers are able to claim the most productive land. This is exemplified by the differences between Ban2 and Ban3. When Ban2 was established, farmers claimed all suitable land for paddy rice production surrounding the village. When Ban3 was relocated adjacent to Ban2, farmers were unable to access the paddy land in their village area as it had already been claimed. The secure access to paddy land provided farmers in Ban2 with the capacity to invest in large livestock, while farmers in Ban3 have been compelled to find alternative income sources. As a result, Herders dominate Ban2, while NTFP Collectors and Workers & Migrants are prevalent in Ban3. These dynamics illustrate how livelihood diversification opportunities are highly context-dependent. For instance, households in Ban2 reported 36 income-generating improvements in the past five years and nine decreases, compared to eight improvements and 31 decreases in Ban3. Moreover, the median income is more than three times as high in Ban2 as in Ban3 (Table 2).

Communal Grazing Lands

Conflicts over buffalo and cattle grazing inside the TPZ were present in seven of the eight villages. Farmers often retain grazing lands inside the TPZ, particularly in areas that villagers claim as old village lands, as these are usually the only suitable grassland areas to sustain large herds. Large livestock is an important form of capital investment and income source for all livelihood groups, which has been enabled by improvements in road infrastructure: 67% of households own at least one, and 70% (n = 73/103) of loans are for livestock investment. According to traditional husbandry practices, livestock are left to forage freely in the forest. Due to the collective nature of this practice, and because many elite

community members maintain large herds, most villages have been successful in negotiating conditional, albeit temporary, access to these grazing lands. However, land constraints are restricting this livelihood option for several villages. In Ban3, three households had sold their entire herd in the past year, citing lack of accessible grazing land, and in Ban4, four families reported selling nearly all their livestock as they were previously kept in upland plots that are now needed for rice production.

Traditional husbandry practices involve constructing small huts (*sanam*) in the grazing area for periodic monitoring of livestock, often in combination with other practices such as hunting wildlife for subsistence and sale. The park's policy is to forcefully remove identified *sanams* from the TPZ while negotiating with herders to adapt their practices and remove herds from the TPZ. As an example, herders in Ban1 were requested to move the herd from one of their grazing areas inside the TPZ in 2012. After receiving an official letter in 2016, the *sanam* was destroyed by the authorities. In turn, the villagers temporarily relocated their herds to another location, but due to lack of viable land to host a large herd, they ultimately returned to the original area.

In Ban2, meanwhile, the village authorities negotiated continued use of two grazing areas overlapping with the TPZ, albeit for a restricted period, as well as maintaining *sanams* in these areas. The NEPLMU's suggested solution for herding households is to grow grass in upland plots, but doing so would reduce space for rice production, and likely produce inadequate amounts of grassland for many herders. The dilemmas experienced are pertinent, as noted by one participant:

“First they limit the area for upland rice, and they ask us to focus on livestock instead. But then they limit the area for livestock as well.” [and], “if the NEPLMU will fine [us], we suggest they should buy our livestock. Then we will stop raising livestock in NEPL.”

The proposed solution to convert one of their upland plots to fodder production has mostly been met by lack of interest due to associated constraints and the view that livestock is a form of investment and buffer capital in times of need rather than a stable income source. However, in some villages such as Ban2, wealthier households with the capital to absorb these trade-offs and the risk of poor grass production are adopting the practice. Overall, despite these dilemmas, investment in livestock remains a critical livelihood pursuit and many participants claimed that it is the most feasible option for improving livelihoods.

NTFP-abundant Areas

With 90% of sampled households reporting income from NTFPs, this is the most common income source across

all livelihood groups. The practice focuses mainly on a few high-value commodities, particularly red mushroom (*Russula rosea* Pers.), which provides an income for 73% of households. The market links for red mushroom were first established in villages through Chinese traders in 2005–2012, and trade links have since drastically increased with some villages reporting 50 individual traders for this product, both local and external, largely as a result of improved road infrastructure.

For NTFP Collectors, sale of NTFPs, and especially red mushroom, is perceived as the only viable option to make an income. Only in Ban7 are there weak trader ties for red mushroom, although NTFP Collectors dominate this village because of a few other high-value NTFPs and because there is a scarcity of alternative income sources. Interviewees confirmed that collection points for high-value NTFPs are typically found in primary forests inside the TPZ. Though official regulations state that entry to the TPZ is not permitted for any reason, access is often negotiated and conditional. We identified a range of perspectives on access rules and experiences with NEPL enforcement between households and villages.

Because red mushroom is highly ephemeral (quick to mature), seasonal (only a few weeks per year), and has a strong price differentiation depending on age and whether it has been dried (by a factor of up to 10), a favoured strategy is to intensively collect in small groups for a few days. The mushroom is then dried in temporary huts that resemble *sanams*. On multiple occasions, NEPL staff had reportedly destroyed these huts and confiscated equipment from villagers in areas with stronger enforcement because they suspect that collectors also use the *sanams* as temporary houses to stay overnight for hunting. Collectors responded by rebuilding huts deeper in the forest and finding ways to circumvent patrols as NTFPs provide a crucial income source that is worth the risk of sanction. In villages where enforcement has been stricter, NEPL regulations have made it considerably more difficult to optimise this livelihood option. For instance, in Ban8 an NTFP trader was concerned over recent income decreases because people are no longer collecting as many NTFPs. The capacity to absorb sanctions from NEPL differs across livelihood clusters. The fines are reportedly at 23 USD for entering the TPZ, and significantly higher if the collectors bring hunting equipment.

Alternative Options for Livelihood Diversification

Across all villages, households with lower asset endowments exhibit a very strong risk averseness related to the adoption of cash crops and adopt a strategy of observation and imitation because of negative historical experiences with commercial traders and the uncertainties of market access. This was particularly acute for hybrid maize, which had been

introduced to the region more than a decade ago. Only 15% of households reported having sold maize in the past year, and 43% stopped doing so in the past five years, citing price decrease and underpayment, unpredictable trader practices, lack of production area and issues with poor soil quality. Households have mostly reverted to rice production and in some cases diversified to other commercial crops such as ginger. Because of these experiences, households tend to wait and observe production levels, trader commitment and market accessibility before deciding to invest in new cash crops introduced by traders or through other external interventions.

However, such market links and experiences differ between villages. In Ban5, 37% of households in the village had planted cardamom in the past year after observing favourable prices and production from one farmer, and similar approaches were reported for coffee and fruit trees in other villages. Another potential livelihood activity is the sale of small livestock, which is an important income source for all groups except NTFP Collectors. However, 20% of households reported having stopped the sale of small livestock due to diseases, sometimes having lost their entire stocks.

Nonfarm and off-farm private sector income is a limited and often ad hoc opportunity that includes work for private companies (10.2% of households), sale of farm labour (9.0%), sale of handicraft (7.8%), trading (7.5%), and owning a shop (2.8%). Workers & Migrants dominate this livelihood strategy, which is mostly found in Ban8, Ban3 and Ban4. Ban8 is nearby the district centre where work opportunities can be found, and in Ban4 a large government-supported project to promote weaving and an ecotourism project have led to income generation. In the other villages, there are fewer prospects for private sector income.

Although the NEPLMU and district authorities encourage alternative livelihoods, farmers often claimed they do not get adequate long-term extension support. Once a particular intervention for adopting new livelihood activities fails, farmers tend to revert to shifting cultivation and NTFP collection.

Conservation Activities at Village Levels

As indicated in the previous sections, the livelihood constraints and opportunities presented by NEPL conservation vary extensively between villages. Ban2 and Ban4 have received relatively high levels of attention since the early years of management. However, in the other villages, most respondents had not heard of NEPL until a few years ago, and many lacked a basic awareness of the park. Individual participation in activities is largely determined by village

membership. An ecotourism package in Ban4 has enabled nearly all households to participate in remunerative activities ($n = 23$). In addition, Ban2 and Ban3 are the sites of alternative livelihood activities for organic shade-grown coffee cultivation supported by the NEPLMU and WCS, but participants are normally restricted to households with spare capital and labour, and compliance to the park regulations is a precondition for eligibility. Out of nine households that reported receiving support, there was only one NTFP Collector and one Commercial Farmer. Moreover, several interviewees viewed the project as general government support and did not mention the connection between their participation and NEPL conservation. Apart from occasional meetings where regulations are disseminated, participation in NEPL activities is restricted to patrolling and monitoring. Between 5–10 households from each village reported having participated in the past five years. However, these are usually one-off events and not attractive activities, normally allocated by the headman or performed as an obligation from salaried positions as security personnel. Excluding ecotourism in Ban4, the proportion of respondents who have participated in park activities ranged from 3.3% (Ban7) to 30% (Ban2). Consequently, people's experiences with NEPL are dominated by more restrictive measures.

The strengthening of exclusionary conservation measures through conservation enforcement and the differential market linkages for commodities and income-generating opportunities are exacerbating livelihood dilemmas. 70.5% of participants agreed that park regulations had become stricter in recent years and interviewees were wary of future regulations and enforcement. As we have seen, households, particularly those belonging to the NTFP Collectors group, are largely excluded from market-based livelihood commercialisation, and are often viewed as unable to engage in market processes, as indicated by statements from residents of Ban3:

“some farmers cannot adapt to the new livelihood activities because they don't know how to invest and don't have money,”

or,

“NEPL doesn't allow cutting the forest or hunting wildlife... farmers don't know how to adapt to NEPL. They don't know how to earn an income.”

Interviewees, moreover, often expressed a strong reluctance to discuss livelihood dilemmas with NEPL staff, citing concern for reprisal for simply broaching the subject. However, despite these issues, many participants also expressed an optimism that the NEPL staff and local government would be willing to renegotiate access rules and boundaries if they could demonstrate acquiescence to park regulations.

Discussion

Livelihood diversification is ubiquitous in rural landscapes of the Global South as a way to cope with drastic as well as gradual socioeconomic and political change (Biddulph & Amberntsson, 2017; Dorward *et al.*, 2009; Newton *et al.*, 2016). At the frontiers of PAs, conservation interventions can be understood in terms of how they shape diversification opportunities and should be evaluated in terms of the multidimensional nature of rural livelihoods (Wright *et al.*, 2016). As such, measures tend to be either exclusionary by restricting access to land and environmental resources for subsistence and income-generating purposes, or inclusionary by employing market instruments to create viable alternative livelihoods or engaging local residents in (remunerative) conservation activities. Ultimately, however, PA interventions impose complex livelihood dilemmas that can be difficult to disentangle because of their relational nature and how they interact with prevailing market institutions. People's experiences with conservation are not evenly distributed across a geographical space or within the same community. While market opportunities may offset the negative impacts of conservation enforcement, for instance, market linkages differ drastically between local contexts, and people's ability to engage in market processes depends on household capital endowments. The study captures these complex interactions between PAs and livelihoods.

Our findings that livelihoods in PAs are shaped by context-specific dimensions of resource access and the specific features of conservation interventions echo Thapa Karki (2013) and Baird and Leslie (2013). Thapa Karki (2013) employed mixed methods to show the uneven livelihood impacts across three villages and households in a PA, while Baird and Leslie (2013) position PAs as “disturbances” that affect social relationships and diversification opportunities unevenly. This is in line with research showing how people-park conflicts in the Global South often revolve around exclusionary mechanisms and that conservation measures that exacerbate livelihood dilemmas related to accessing land and natural resources can lead to conflict escalation (Boillat *et al.*, 2018; Rechciński *et al.*, 2019; Soliku & Schraml, 2018).

Our analysis expands on these studies by demonstrating how livelihood dilemmas are mediated by household capital endowments and context-specific conditions including prevailing market linkages and the spatial features of livelihood activities. We highlight an important scale dimension to explain how conservation and market institutions interact to produce uneven outcomes in livelihoods. Meso-scale factors tied to the village context mediate responses to both exclusionary and inclusionary conservation measures. For instance, we found indications that location-specific land

constraints arising from PA conservation engendered more negative attitudes, particularly in villages with acute land scarcity due to recent years of enforcement, while enforcement activities have created significant barriers to utilising NTFP collection in the TPZ as a livelihood strategy for residents of some villages. Micro-scale conditions, including household asset endowments, mediate individual impacts and experiences. Interlinking the two scales are the spatial dimensions of people's livelihood activities, for which we outlined four in our case, including land for agriculture, NTFP collection, livestock grazing and access to nonfarm income.

This calls attention to how macro-scale processes are mediated to shape livelihood dilemmas at the frontiers of PAs. On the market side, this includes how price signals and production conditions are established by external traders and local middle-men (Friis & Nielsen, 2017) and the multi-level processes through which commodity markets materialise (Hauer & Nielsen, 2020). On the conservation side, PA interventions are manifestations of interactions in multiple arenas that lead to a particular design based on the discursive practices of distant actors and donor preferences (Boillat *et al.*, 2018; Persson & Mertz, 2019). The livelihoods of PA residents are increasingly embedded in local and regional political economies, where the challenges of sustainable land-use cannot be rectified by ICD-type interventions as these often remain marginal to the livelihood aspirations of local residents. Approaches to capture how the distributional impacts of macro-scale processes must accommodate the interactions across scales that condition access and diversification opportunities while remaining grounded in the conditions of a particular place (Scoones, 2009).

To enhance the legitimacy of PA conservation in such contexts, it is critical that interventions explicitly account for at-risk groups in PA conservation based on a multidimensional livelihood assessment. Our findings indicate that the group with least capacity to adapt to exclusionary conservation measures and participate in inclusionary activities is also the group least capable of engaging in market processes to diversify their livelihoods (NTPF Collectors, in our case). Similar to Pasgaard and Chea's (2013) notion of “double inequity”, this group is arguably subject to dual forms of inequity. The inability to adapt to changing market institutions, coupled with enhanced PA enforcement, are self-reinforcing and likely to produce negative outcomes for conservation and local livelihoods. Restrictive approaches compel households into illegal practices to cope with constraints and uncertainties, undermining prospects for sustainable environmental governance (Larrosa *et al.*, 2016; Thapa Karki, 2013). We found indications of this in NEPL, where households with limited diversification options clear plots deep in forests, continue to collect valuable NTFPs in the TPZ despite the

risk of sanction, or revert to shifting cultivation for rice after cash crops failed or livestock died from disease. Diversification opportunities for these households are likely to be inadequate to compensate for the loss of access to natural resources and could accelerate outmigration or other ex-post coping mechanisms. As a result, households are more likely to respond in forms of tacit dissent as residents circumvent enforcement practices they perceive to be illegitimate or cannot influence (Norgrove & Hulme, 2006). Negotiated partial access could improve the legitimacy of PA interventions, as argued by for instance Chechina *et al.* (2018), but these must account for differential capacities to engage in and benefit from conservation.

Our study has implications for environmental governance in Lao PAs. Cash crop promotion and land-use intensification are key dimensions of the government's forest policies and approach to PAs (GoL, 2005; Kallio *et al.*, 2019; World Bank, 2020a, 2020b), and part of a wider programme to reduce traditional subsistence activities based on foraging and shifting cultivation as a viable livelihood strategy. However, our results echo Junquera and Grêt-Regamey (2019) in demonstrating that unfavourable market experiences and uncertainties around future government restrictions engender a highly risk-averse approach to livelihood diversification based on observing and imitating. In our case, most households have abandoned maize as a cash crop (Cole *et al.*, 2019; Vongvisouk *et al.*, 2016), but rather than adopting new cash crops as found in other contexts (Mahanty & Milne, 2016), farmers revert to upland rice production or invest in large livestock. Even when opportunities for non-farm income generation and agricultural intensification exist, rice cultivation for household consumption and sale of NTFPs remain priorities (Hepp *et al.*, 2019; Kallio *et al.*, 2019). Until market institutions and government support are strong enough to enable sustainable transitions to agricultural intensification, households are unlikely to abandon traditional livelihood practices that have proved robust to social-ecological uncertainties for generations.

Moreover, the country's Green Growth strategy positions ecotourism as a primary means to generate alternative livelihood opportunities as well as revenues to finance PA management (World Bank, 2020a, 2020b). The upgrade of NEPL to a national park was an outcome of national-level negotiations under the strategy, which implies stricter regulations and more funding to expand existing activities including enforcement practices (Persson *et al.*, forthcoming). Despite decades of continuous support in NEPL, conservation benefits were minimal in relation to the multidimensionality of livelihood composition and in influencing people's daily lives, albeit with geographical variation. In light of the collapse of tourism since the COVID-19 outbreak (World Bank, 2021), it is questionable whether such conservation activities can provide a legitimate livelihood basis for PAs. Greater engagement with

market processes that people are currently engaging in are more likely to provide viable, low-cost diversification opportunities than restricted ICD projects that are conditioned on capital endowments and compliance to regulations.

Conclusion

This article demonstrated how PA conservation and expansion of market institutions in Nam Et-Phou Louey National Park, Laos are exacerbating livelihood dilemmas for a proportion of local residents, particularly a dominant group that lacks capacities to adapt to a dynamic socioeconomic and political environment. The livelihood impacts of exclusionary and inclusionary conservation measures at PA frontiers are shaped by household capital endowments and context-specific conditions, especially market linkages and the spatial features of livelihood activities. Our findings illustrate the importance of accounting for surrounding market processes and the multidimensionality of local livelihoods in nature conservation efforts.

The methodological approach employed, combining data collection at multiple levels and using both intensive and extensive methods, provides an alternative for evaluating livelihood impacts of conservation interventions. To understand the interactions between markets and PAs, and given the unique conditions of individual villages, both in-depth insights on local contexts and insights on indicative patterns across contexts are needed. By permitting a basis for generating statistical analyses while grounding causal propositions in intensive methods, our approach generated insight on how conservation and markets structure people's behaviours, while being attuned to individual agencies to adapt to changes.

Global efforts to enhance biodiversity are gaining greater political attention and consequently, resources are being mobilised under a number of international mechanisms, not least the Convention on Biological Diversity. These translate into local interventions that engender context-specific trade-offs and unfold unevenly across a given geographic area. The spatial dimensions of livelihood dilemmas may erupt into conflict as exclusionary conservation measures expand and livelihood interests and global conservation goals come into conflict. More research is needed to understand how people affected by conservation interventions are integrated into these processes, including what feedback and response mechanisms are available to influence related meso- and macro-scale processes.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10745-021-00267-4>.

Funding This study was funded by the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie Actions grant agreement No. 765408. SF was funded by the European Union's Horizon 2020 research and innovation programme under the

Marie Skłodowska-Curie Actions grant agreement no. 766417. TV's time was funded by the Managing telecoupled landscapes for the sustainable provision of ecosystem services and poverty alleviation project, under the Swiss Programme for Research on Global Issues for Development (R4D) Programme, funded by the Swiss National Sciences Foundation (SNSF) and the Swiss Agency for Development and Cooperation (SDC), grant number 400440 152167.

Declarations

Informed Consent Written or verbal informed consent was sought for each interview and household survey, following an explanation of the research objectives, data use, anonymity and confidentiality. The research was approved by the Ethics Committee at the faculty of the first author on 18 January 2018. Related approval was obtained from institutions in which the research was carried out.

Conflicts of Interest The authors have no conflicts of interest to declare.

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