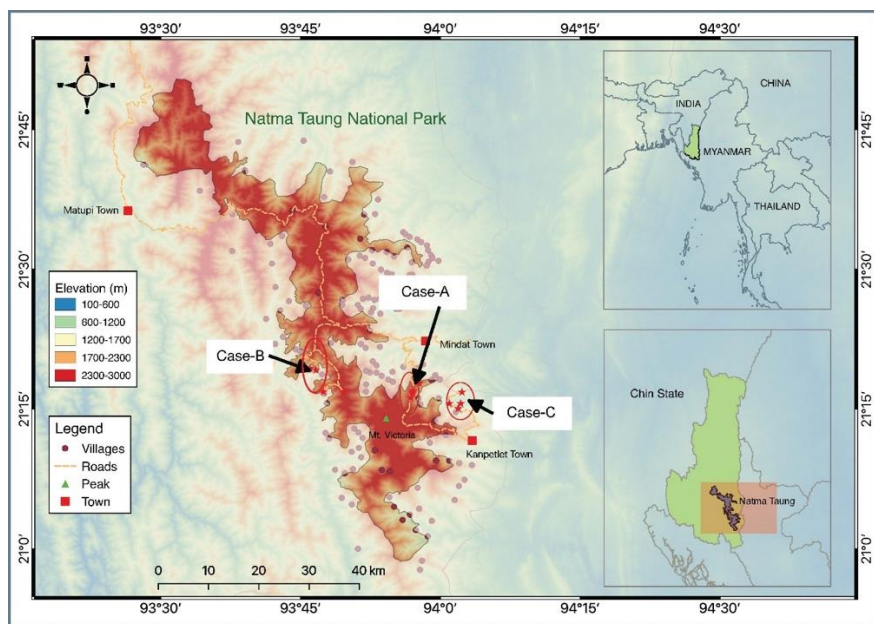


The Republic of the Union of Myanmar
Ministry of Natural Resources and Environmental Conservation
Forest Department



Social-Ecological Coevolution and Its Implications for Protected Area Management: Case study in Natma Taung National Park, Myanmar



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Abstract

The conflict between protected areas and local people is a major challenge for conservation in developing countries. The conventional top-down approach has failed mainly due to the exclusion of local people in conservation. A new management approach that promotes local participation and reduces conflicts is necessary to achieve both conservation and development objectives. Using the case of Natma Taung National Park (NTNP) in Myanmar, this study investigates the relationship between the protected area and local indigenous people living in and around the park. The social-ecological coevolution model is applied to explore the inter-linkages between the protected area and local people. The empirical analyses focus on three main thematic areas: local land tenure system, livelihood dependency on forest resources, and traditional ecological knowledge (TEK) of local people. The study highlights that effective conservation will not be achieved unless management institutions are in line with the social system and the natural environment. To develop effective management strategies, it is important to understand not only the ecological conditions of the protected area but also the socio-cultural context of local people. The study recommends five management strategies to improve the management of protected areas with high social conflicts: (i) formalising customary tenure institutions to increase legitimacy of conservation regulations; (ii) developing target-specific rules to sustain local livelihoods and reduce people-park conflicts; (iii) incorporating traditional ecological knowledge and management practices to enhance local participation in conservation and reduce management costs; (iv) integrating adaptive monitoring and feedback mechanisms to improve resilience and adaptive capacity against unforeseen social-ecological changes; and (v) promoting integrated planning and management at regional level to improve collaboration among government organisations.

Keywords: coevolution, social-ecological system, land tenure, forest dependency, traditional knowledge, adaptive co-management, Myanmar

သဘာဝထိန်းသိမ်းရေးနယ်မြေများ တွင် လူသားနှင့် သဘာဝပတ်ဝန်းကျင် အတူယှဉ်တွဲ ဖွံ့ဖြိုးမှုကို ဖော်ဆောင်နိုင်မည့် စီမံအုပ်ချုပ်မှု နည်းလမ်းများလေ့လာဖော်ထုတ်ခြင်း

ဒေါက်တာပြည့်စိုးအောင်၊ လက်ထောက်ညွှန်ကြားရေးမှူး
သစ်တောဦးစီးဌာန

စာတမ်းအကျဉ်း

ဖွံ့ဖြိုးဆဲနိုင်ငံအများစုတွင် သဘာဝထိန်းသိမ်းရေးနယ်မြေများ စီမံအုပ်ချုပ်ရာ၌ ဒေသခံများ၏ သယံဇာတထုတ်ယူသုံးစွဲမှုများအား ကန့်သတ်ခြင်း၊ ဥပဒေအရ အရေးယူဆောင်ရွက်ခြင်း စသည့် စီမံခန့်ခွဲမှုနည်းလမ်းများကို အသုံးပြုလျက်ရှိသည်။ အကျိုးဆက်အားဖြင့် သဘာဝထိန်းသိမ်းရေးနယ်မြေများ နှင့် ဒေသခံများအကြား ပဋိပက္ခများ ဖြစ်ပွားလျက်ရှိပြီး ထိန်းသိမ်းရေးဆိုင်ရာ ရည်မှန်းချက်များကို အောင်မြင်အောင် ဆောင်ရွက်ရာတွင် အဟန့်အတားများ ဖြစ်ပေါ်လျက်ရှိသည်။ အဆိုပါ ပဋိပက္ခများကို ဖြေရှင်းနိုင်ရန်နှင့် ထိန်းသိမ်းရေးလုပ်ငန်းများတွင် ဒေသခံများ၏ ပူးပေါင်းပါဝင်မှု မြှင့်တင်နိုင်ရန်အတွက် ထိန်းသိမ်းရေးနှင့် လူမှုစီးပွား ဖွံ့ဖြိုးရေးတို့ကို ဟန်ချက်ညီ ထိန်းညှိနိုင်မည့် စီမံအုပ်ချုပ်မှုဆိုင်ရာ နည်းလမ်းအသစ်များ ဖော်ထုတ်ရန် လိုအပ်လျက်ရှိသည်။ ဤသုတေသန စာတမ်းသည် အဆိုပါ လိုအပ်ချက်ကို ဖြည့်ဆည်းရန်အတွက် နတ်မတောင် အမျိုးသား ဥယျာဉ်ကို အခြေပြု၍ သဘာဝထိန်းသိမ်းရေး နယ်မြေနှင့် ဒေသခံများအကြား ဆက်စပ်မှုကို ဆန်းစစ်လေ့လာခဲ့ခြင်း ဖြစ်သည်။ ဆန်းစစ် လေ့လာရာတွင် ဂေဟစနစ်နှင့် လူသားတို့အကြား အတူယှဉ်တွဲဖွံ့ဖြိုးမှုသီအိုရီကို အသုံးပြု ခဲ့ပြီး၊ ဒေသ၏ မိရိုးဖလာ မြေယာစီမံခန့်ခွဲမှုစနစ်များ၊ လူမှုစီးပွားရေးနှင့် သစ်တောထွက်ပစ္စည်း များအပေါ် မှီခိုမှုအခြေအနေများ၊ မိရိုးဖလာဓလေ့ထုံးစံများ စသည့်ကဏ္ဍ(၃)ခုကို ဦးစားပေး လေ့လာခဲ့သည်။ အဓိကတွေ့ရှိချက်အဖြစ် သဘာဝထိန်းသိမ်းရေးနယ်မြေ စီမံအုပ်ချုပ်မှု နည်းလမ်းများသည် ဒေသ၏ ဂေဟစနစ်နှင့် လူမှုစီးပွားရေး အခြေအနေများနှင့် ကိုက်ညီမှုမရှိ ပါက ရေရှည်တွင် ထိရောက်အောင်မြင်နိုင်မည် မဟုတ်ကြောင်း ဖော်ပြထားသည်။ သဘာဝ ထိန်းသိမ်းရေးနယ်မြေအလိုက် စီမံအုပ်ချုပ်မှုနည်းလမ်းများ ချမှတ်ရာတွင် ပိုမိုထိရောက်မှု ရှိစေရန်အတွက် ဇီဝမျိုးစုံမျိုးကွဲများနှင့် ဂေဟစနစ်အခြေအနေများသာမက ဒေသခံများ၏ လူမှုစီးပွားရေးနှင့် ယဉ်ကျေးမှုဓလေ့ထုံးတမ်းများကို ထည့်သွင်းစဉ်းစားရန် လိုအပ်ပါသည်။ ဒေသခံများနှင့် ပဋိပက္ခဖြစ်ပွား

မှုများ ပြားသည့် သဘာဝထိန်းသိမ်းရေးနယ်မြေများတွင် ထိရောက်သည့် စီမံအုပ်ချုပ်မှုများ ရရှိနိုင်ရန် သုတေသနတွေ့ရှိချက်များအပေါ် အခြေခံ၍ လုပ်ငန်းစဉ် (၅) ရပ်ကို အဆိုပြုထား သည်။ ယင်းတို့မှာ (က) ထိန်းသိမ်းရေးဆိုင်ရာ စည်းမျဉ်း စည်းကမ်းများ ပိုမိုထိရောက်မှု ရှိစေရန်အတွက်ဒေသ၏ မိရိုးဖလာစီမံအုပ်ချုပ်မှုပုံစံများကို တရားဝင်ဖြစ်စေရေး ဆောင်ရွက် ခြင်း၊ (ခ) သယံဇာတ ထုတ်ယူသုံးစွဲမှုနှင့် စပ်လျဉ်းသည့် တားမြစ်ချက်များကို ဇီဝမျိုးစုံ မျိုးကွဲ ရှုထောင့်မှသာမက ဒေသခံများ၏ လူမှုစီးပွားရေးလိုအပ် ချက်တို့အပေါ်အခြေခံ၍ ချမှတ် ပြဌာန်းခြင်း၊(ဂ) ဒေသခံများ၏ ပူးပေါင်းပါဝင်မှု မြှင့်တင်ရန် နှင့် စီမံအုပ်ချုပ်မှု ကုန်ကျ စရိတ်များ လျှော့ချရန်အတွက် မိရိုးဖလာလေ့စည်းကမ်းများကို သဘာဝထိန်းသိမ်း ရေးနယ်မြေ စီမံအုပ်ချုပ်ရာတွင် ပေါင်းစပ်ထည့်သွင်းခြင်း၊ (ဃ) ဂေဟ စနစ်နှင့် လူမှုစီးပွား ရေး အခြေအနေများ ပြောင်းလဲမှုကို လိုက်လျောညီထွေဖြစ်စေသည့် စောင့်ကြည့် လေ့လာ ခြင်းနှင့် ပြန်လည်သတင်းပို့ခြင်းစနစ်များ တည်ထောင်ခြင်း နှင့် (င) ဆက်စပ်ဌာနဆိုင်ရာ များအကြား ပူးပေါင်းမှုကို မြှင့်တင်နိုင်ရန် ဘက်စုံပူးပေါင်းပါဝင်သည့် စီမံခန့်ခွဲမှုစနစ်များ တည်ထောင်ခြင်းတို့ ဖြစ်သည်။

Social-Ecological Coevolution and Its Implications for Protected Area Management: Case study in Natma Taung National Park, Myanmar

Introduction

Protected areas are one of the important tools to conserve biodiversity and ecosystem services (Dudley and Stolton, 2010). Empirical evidence has shown that protected areas contribute significant reduction in deforestation, habitat destruction, and loss of wildlife species compared to other land management options (Bruner, 2001; Nagendra, 2008). Due to the increasing awareness of conservation, the global coverage of protected areas has increased up to 15.4% of the total land area in 2014 (Juffe-Bignoli et al., 2014). The global community has also committed to increasing protected areas up to 17% of total land area and 10% of the coastal and marine area by the year 2020 (CBD, 2011). However, creating protected areas not only provides ecological benefits but also incurs social costs (Ferraro, 2002). Major impacts of protected areas include involuntary displacement of local people, limiting access to natural resources, and altering traditional livelihoods and associated cultural practices (Coad et al., 2008). Consequently, the conflicts between protected areas and local people have increased resulting in limited political and social support for conservation practices (Watson et al., 2014).

Being a signatory country to Convention on Biological Diversity (CBD), Myanmar has committed to establish protected areas up to 10% of the country's area by 2020 (Forest Department, 2015). As of 2020, Myanmar has established 46 protected areas covering about 6.08% of the country's total area. Due to political and economic constraints, about half of the protected areas are regarded as “paper parks” without effective management system in place (Aung, 2007). Moreover, most protected areas in Myanmar are located in rural areas where local people greatly depend on forest resources for their livelihoods (Rao et al., 2011). Since protected areas restrict local use of forest resources, there is an increasing conflict between park authorities and local people (Allendorf et al., 2006). Consequently, the legitimacy of existing protected areas has decreased resulting in habitat degradation, resource extinction, and social conflicts (Rao et al., 2013).

To achieve effective conservation, Myanmar has transformed its protected area management strategies from strict protection approach towards more participative approaches. For instance, the National Biodiversity Strategy and Action Plan (NBSAP) was updated by including a set of action plans to promote local participation in conservation, such as implementing co-management in protected areas, recognising the indigenous and community conserved areas, and designating buffer zones to support local livelihoods (Forest Department, 2015). Although the government has promoted local participation in conservation, no proper guideline or management model is in place to implement community-based conservation approaches in Myanmar. To complement this knowledge gap, this study takes Natma Taung National Park (NTNP) as a case study to analyse the social-ecological relationships particularly on local land tenure systems, livelihood strategies, and traditional knowledge in order to propose management strategies that promote community participation in conservation and reduce people-park conflicts.

Materials and Methods

The overall objective of this research is to analyse the social-ecological relationship between protected area and local communities in order to develop management strategies that promote conservation and reduce social conflicts. The social-ecological coevolution model is applied to explore the inter-linkages between protected area and local communities living in and around the national park. The model conceptualises that both social and ecological systems are interconnected to each other so that changes in components of each system will have consequences on the whole system (Pretzsch et al., 2014). Using this model as a conceptual framework, the study focuses on three main thematic areas: traditional land tenure system, local livelihood system, and traditional ecological knowledge system (Figure 1).

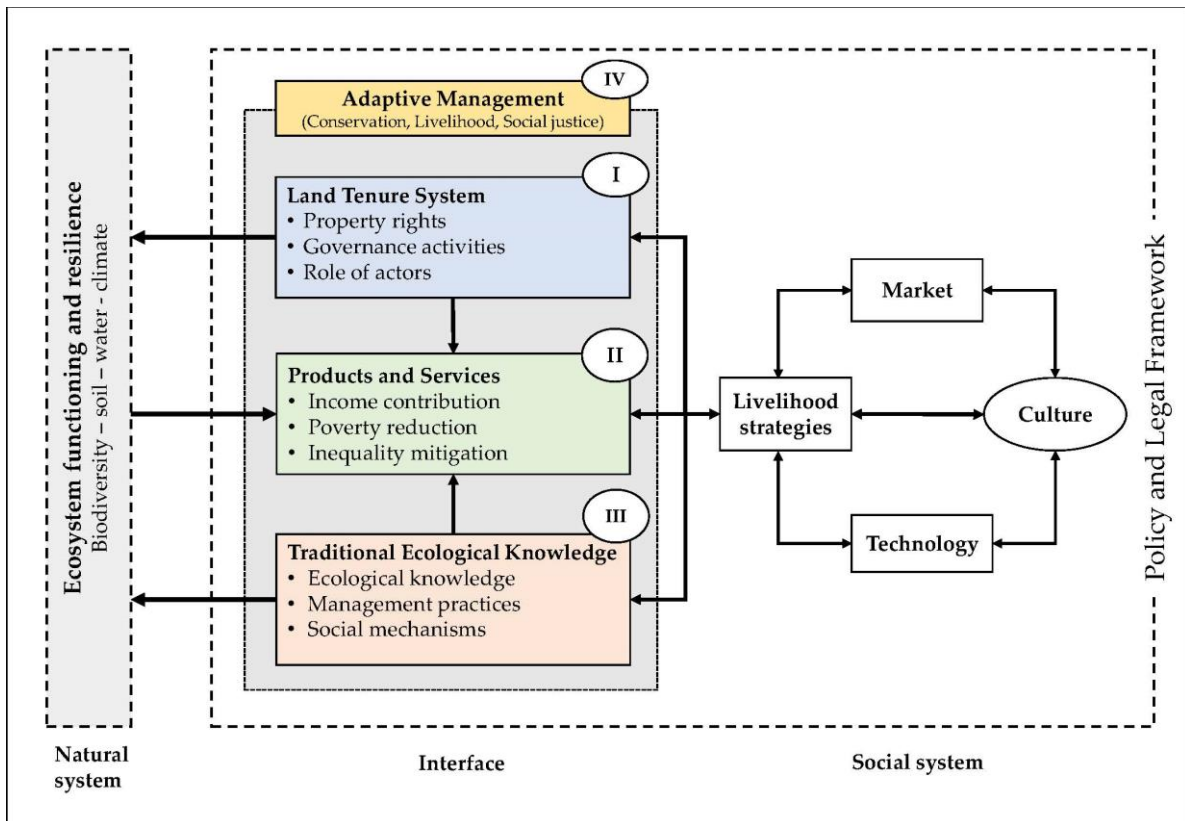


Figure 1. Conceptual framework of the research (Adapted from Pretzsch et al., (2014))

Three village communities—Case A, Case B, and Case C—that are located inside, bordering, and outside the national park are selected as embedded case studies for empirical analysis (**Figure 2**). Data collection was conducted at two different levels: (1) community level and (2) household level. At community level, 36 key informant interviews and 16 focus group discussions including 12 participatory land-use mapping exercises were conducted across three case study communities.

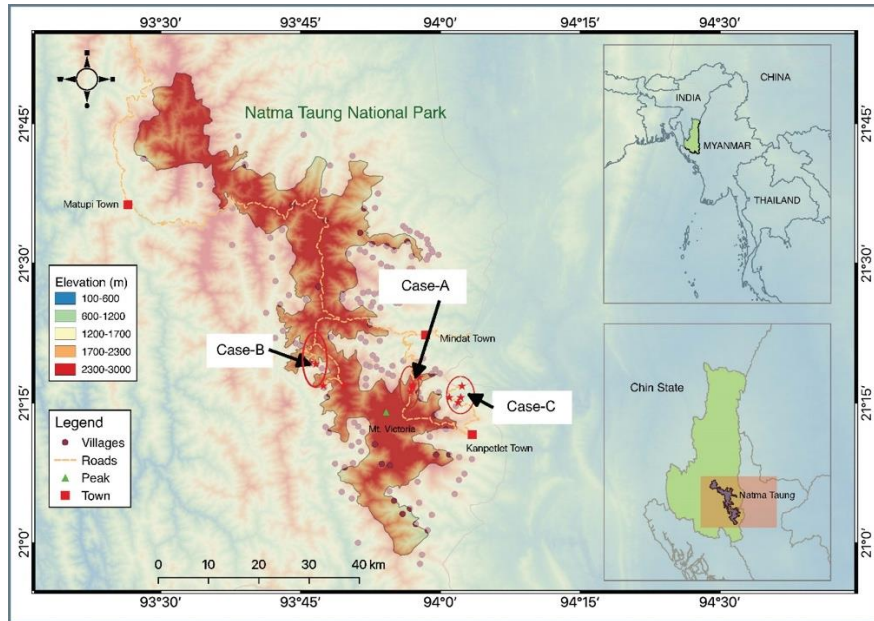


Figure 2. Location map of Natma Taung national park and case study communities

Source: Park management office

At household level, face-to-face interviews were conducted at 150 households selected from three cases. Each household was visited at least three times to conduct interviews in relation to (1) current livelihood activities and income, (2) households use and preferences on forests, and (3) individual awareness and compliance with traditional practices. List of villages in three cases and number of sample households are presented in Table 1.

Table 1 List of villages and number of sample households in three case study communities

<i>Case A (Inside park)</i>			<i>Case B (Bordering Park)</i>			<i>Case C (Outside Park)</i>		
Villages	HH	Sample	Villages	HH	Sample	Villages	HH	Sample
Kwe lon thar	42	15	Ung	58	15	Kitaw	40	15
Kauktu	20	10	Chaing	58	15	San Eaim Nu	31	11
Htet Shwe	26	15	Kulu	26	10	Kapan	43	15
Htan Aum	21	10	Hnum	22	10	Ma Swi Twi	9	9
Total	109	50		162	50		123	50

Note: HH = number of households

Data analyses were conducted at three main levels. The first level includes the in-depth analysis of each case-study community to explore social-ecological relationships in each particular context. The second level focuses on comparative analysis across the three embedded cases in order to provide similarities and differences among different social-ecological context. The third level synthesizes at the national park level to provide policy implications for the future management of the national park. To analyse local land tenure system, this study first identified different types of rights associated with each land ownership system as classified by Schlager and Ostrom (1992). Second, it explored local governance structures in accordance with the governance principles proposed by Ostrom (1990). Third, it determined the roles and responsibilities of each actor regarding land use rights and governance activities.

For livelihood analyses, this study first explored different types of livelihood activities that households had engaged within the last twelve months. Income from each activity was estimated by using income accounting methods proposed by Vedeld et al. (2004). Both cash and subsistence income were considered for income estimation. Family labour was omitted because the labour market in the study area was limited so that the opportunity cost of labour was extremely low and may not be realistic Sjaastad et al. (2005). In order to determine the relative importance of forest income, the three Foster–Greer–Thorbecke (FGT) poverty measures (i.e. poverty headcount ratio, poverty gap ratio, and poverty severity index) were calculated by using equation as proposed by Foster et al. (1984). The FGT indices with and without forest income were compared in order to indicate the effect of forest income on poverty reduction. The Gini decomposition method proposed by Lerman and Yitzhaki (1985) was also used to measure the effect of forest income on total income inequality.

For analysing traditional ecological knowledge (TEK), this research first identified different types of TEK regarding the use, control and management of natural resources. The awareness and compliance scores for each TEK were calculated by using cultural consensus method (Romney et al., 1986). The scores were compared across the three case studies in order to determine its variations in response to the national park regulations. The identified TEKs were further categorised based on normative and instrumental aspects in order to understand the patterns of changes in local compliances.

Results

Land tenure and property right system

Descriptions of local land tenure: Participatory land use mapping exercises reveal that local people in study communities tend to follow their own informal (*de facto*) tenure system rather than formal (*de jure*) government regulations. Each village has its own traditional territory which has been recognized by neighboring communities since British colonial times. Within each village territory, local land tenure system can be classified into three different categories: (1) village settlement areas, (2) agricultural lands, and (3) forest lands. For village settlement area, traditional system ensures every villager to get a space for housing for living in the village. The house site can be inherited or transferred among the villagers; however it is not allowed to sell to outsiders who do not live in the village (Table 2).

Table 2 Summary of local land tenure regarding village settlement areas in all case studies

Types of rights	Formal rules	Local rules (villagers)		Non-villagers
		Village area	Housing site	
Access	Yes	Yes	Yes	Yes
Use	No	Yes	Yes	No
Manage	No	Collective	Individual	No
Exclude	No	Collective	Individual	No
Inherit	No	Collective	Individual	No
Sale	No	No	No	No

Land tenure for agricultural land varies between shifting cultivation and permanent plots. For shifting cultivation, local land tenure exists at two main levels. The first level is related to cultivation fields, where farmers need collective decisions to open a new shifting cultivation

field. Within selected field, individual farmers have the rights to cultivate, manage, or transfer to others within the village; however, selling the plot to outsiders is prohibited in order ensure rotational practices. Regarding permanent cultivation plots, such as Yam or other horticultural crops, individual farmers have all types of right including selling the plots to outsiders. Under formal regulation, farmers do not have the rights to exclude, transfer, or sell due to lack of formal registration (Table 3).

Table 3 Summary of local land tenure regarding agricultural lands in all case studies

Types of rights	Formal rules		Local rules (Swidden)		Local Rules (Permanent)
	Inside Park	Outside Park	Clan land	Private	
Access	Yes	Yes	Yes	Yes	Yes
Withdraw	No	Yes	Yes	Yes	Yes
Manage (field)	No	Yes	Collective	Collective	Yes
Manage (plot)	No	Yes	Collective	Yes	Yes
Exclude	No	No	Collective	Yes	Yes
Inheritance	No	No	Collective	Yes	Yes
Sale (within village)	No	No	Yes	Yes	Yes
Sale (outsiders)	No	No	No	No	Yes

Forest lands can be differentiated into three different categories depending on their functions and services. The first category is watershed forests mainly protected for sustainable provision of drinking water. Only hunting and collection of non-timber forest products (NTFPs) are allowed within the watershed forests, where cutting trees and clearing for cultivation are prohibited. The second category is village use forests, which permit villagers for subsistence timber uses, hunting, and NTFPs collection. The third category is sacred forests, where only collection of NTFPs is permitted and other types of right are prohibited (Table 4).

Table 4 Summary of local land tenure regarding forest lands in al case studies

Activities	Watershed forests		Village use forests		Sacred forests	
	Villager	Non-villager	Villager	Non-villager	Villager	Non-villager
Access	Yes	Yes	Yes	Yes	Yes	Yes
Cutting timber	No	No	Own-use	No	No	No
NTFP	Yes	Yes	Yes	Yes	Yes	No
Hunting	Yes	Yes	Yes	Yes	No	No
Manage	Collective	No	Collective	No	Collective	No
Exclude	Collective	No	Collective	No	Collective	No
Inheritance	Collective	No	Collective	No	Collective	No
Sale	No	No	No	No	No	No

Changes in local land tenure: Focus group discussions highlight three major changes in local land tenure across case study communities. Firstly, there is a change from communal to private tenure mainly due to introduction of Yam cultivation and increasing market accessibility. Household surveys indicate that about 40% of households in *Case A*, 94% in *Case B*, and 84% in *Case C* have engaged in Yam cultivation within the last twelve months. Since permanent plots are allowed to sell to outsiders, there is a tendency to increase the risk

of land grabbing. Moreover, increasing private tenure motivates farmers to clear unoccupied forests so that open access forests within village territory are likely to decline in the future.

Secondly, land allocation programs by national park have disrupted local land tenure and create social conflicts among villagers. The conflicts are more common in *Case A* where the government allocated lands to landless farmers without prior consents from traditional land owners. As a result, traditional land owners were excluded from their lands by land borrowers. The conflicts are less common in *Case B* because most land recipients are traditional land owners. No conflict between formal and informal tenures is observed in *Case C* due to the absence of land allocation program. The summary of changes in local tenure due to government land allocation program is presented with **Table 5**.

Table 5 Summary of local land tenure regarding allocated lands

Types of rights	Formal rules	Local rules (owners)		Local rules (recipients)	
		Before	After	Before	After
Access	Yes	Yes	Yes	Yes	Yes
Withdraw	Own-use	Own-use	No	Own-use	Own-use
Manage	Individual	Collective	No	Collective	Collective
Exclude	Yes	Yes	No	No	Yes
Inheritance	No	Yes	No	No	Yes
Sale	No	No	No	No	No

Thirdly, local initiatives on watershed protection and village use forests have increased in all case studies. However, the main purposes of the initiatives differ across cases. In *Case A*, villagers designate watershed forests mainly because of declining water availability at village water springs. In *Case B*, villagers establish rules for watershed and village use forests in response to increasing wood demand for house constructions. In *Case C*, villagers designate watershed forests and village use forests mainly to protect land grabbing by government and private investors. In all cases, the villagers could not effectively protect their forests due to limited legal authorities among village governance institutions (**Table 6**). Therefore, formal recognition by government is needed to maintain their resilience against increasing socio-economic changes.

Table 6. Summary of local governance structure in all case studies

Activities	Village Tract Committee		Informal Village Council	
	Legal rules	Local rules	Legal rules	Local rules
Defining boundary	Yes	No	No	Yes
Creating rules	No	No	No	Yes
Giving permission	Yes	No	No	Yes
Monitoring	Yes	No	No	Yes
Sanctioning	Yes	No	No	Yes
Conflict resolution	Yes	Yes	No	Yes

Comparative analyses show that local people mainly follow the informal (*de facto*) land tenure systems rather than formal (*de jure*) government regulations. In all three cases, tenure rules are associated with different land-use types, such as settlement areas, agricultural lands,

and forest lands. A total of 15 different customary rules are still being applied across the three cases. Household surveys indicate that although more than 85% of total households still aware of the identified rules, only about 75% are still in compliance with local tenure rules. Local compliance with traditional rules also differs depending on land ownership. Comparative analysis shows that local compliances with communal lands are similar among the three cases ($\chi^2=0.07$, $p=0.7$). However, the compliance scores for the clan and private tenure rules are significantly different across the three cases ($p<0.05$). Particularly, households located outside the national park are more in compliance with traditional tenure rules than those inside and bordering the park ($\chi^2=14.40$, $p<0.001$). This indicates that local compliances with traditional rules have declined in response to the national park regulations. Moreover, young and educated households are less in compliance with local rules than old and less-educated households. Furthermore, increasing access to market due to political transformation has motivated farmers to engage more in permanent farming. This, in turn, has increased private ownership rather than communal or clan ownership.

Livelihood strategies and forest income

Local livelihood and income distribution: Livelihood activities in all case studies can be classified into five major groups: agriculture, livestock, forest, wage labour, and non-farm business. Each livelihood activity contributes not only as cash income but also as subsistence income from household consumption and uses. Regarding cash income, agriculture and livestock contribute the highest share of household income across the three case studies. However, when subsistence income is included, forest income represents the highest share of income contributing about 49%, 39%, and 29% of total household income respectively (**Figure 3**).

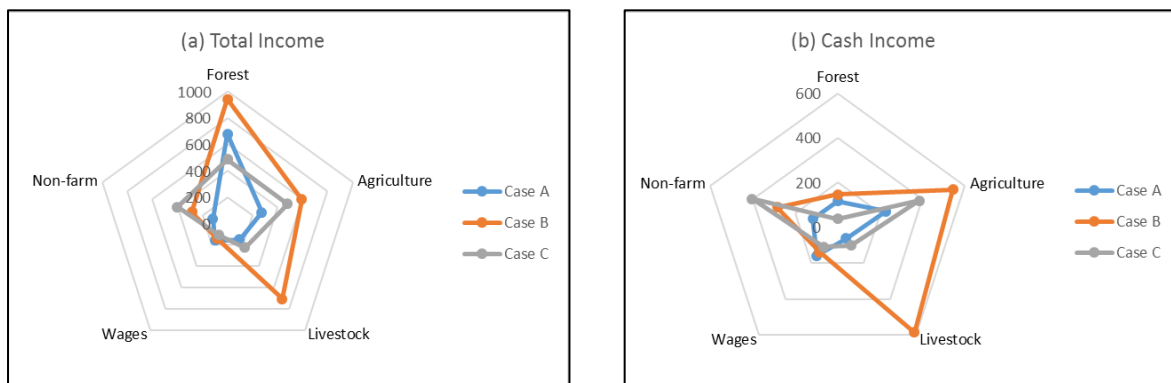


Figure 3. Income portfolio by different livelihood activities across three case studies

Distribution of total forest income is significantly different across three case studies ($\chi^2=16.27$, $p<0.001$). Multiple comparisons show that *Case A* and *Case B* have higher forest income than *Case C* indicating that communities living inside or closer to the national park receive more forest income than the one living outside the park. In terms of cash income, *Case B* receives significantly higher forest income than *Case A* and *Case C*; however, there is no significant difference between the latter two cases. However, for subsistence income, there is no significant difference among three cases ($\chi^2=8.10$, $p>0.01$). This indicates that household use of forest products for commercial purpose varies depending on exogenous conditions such as biophysical environment or government regulations. However, the use of

forest products for subsistence purpose is not significantly influenced by exogenous conditions (**Figure 4**).

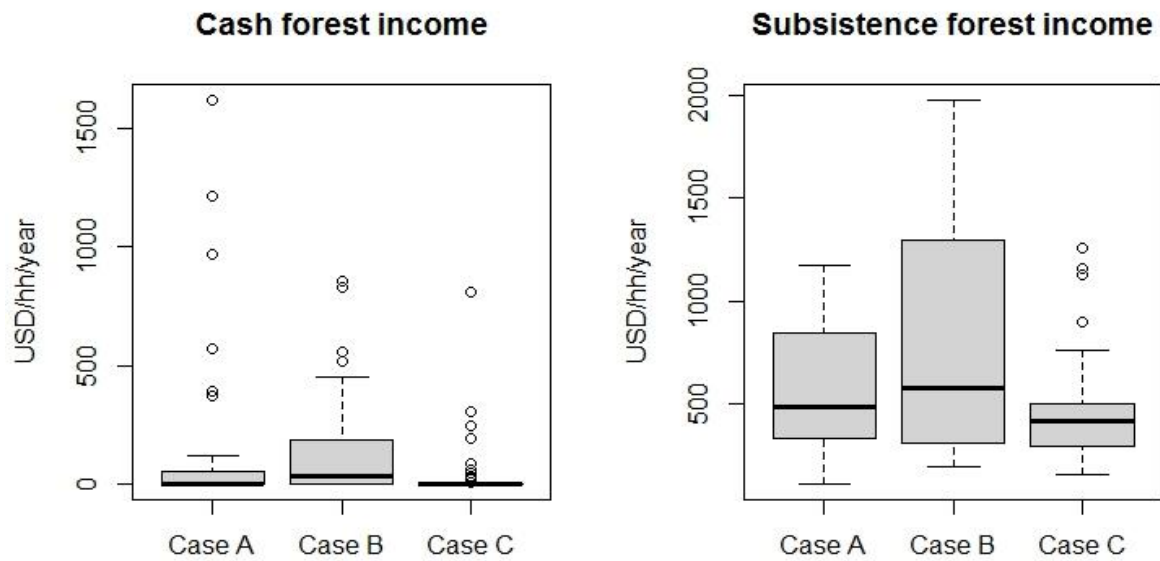


Figure 4 . Comparisons of cash and subsistence forest income across case studies

Contribution to poverty and inequality: Forests provide a major source of income to reduce poverty among households in three case studies. The FGT (Foster–Greer–Thorbecke) poverty decomposition indices show that poverty headcount ratio has reduced by 52% in *Case A*, 80% in *Case B* and 46% in *Case C* due to forest income. This means that limiting access to forest may increase the number of people that live below national poverty line. Moreover, forest income significantly reduces local poverty gap and severity in all case studies indicating that the use of forest resources minimise the depth and magnitude of poverty among poor households (**Table 7**). The effect of forest income on poverty is significantly higher in *Case B* than *Case A* and *Case C*, because the former receives the highest amount of forest income compared with other two cases.

Table 7 Comparison of FGT poverty measures between with and without forest income

Indicators	Case A			Case B			Case C		
	P _T	P _{T-F}	P _C	P _T	P _{T-F}	P _C	P _T	P _{T-F}	P _C
Headcount	0.42	0.88	-52	0.06	0.30	-80	0.38	0.70	-46
Poverty gap	0.10	0.42	-76	0.01	0.09	-92	0.10	0.31	-67
Poverty severity	0.03	0.25	-88	0.00	0.04	-98	0.04	0.17	-82
Gini	0.32	0.38	-17	0.23	0.24	-4	0.31	0.42	-26

Note: P_T = Total income, P_{T-F}=without forest income, P_C=Relative change (%)

In addition to poverty, forest income also reduces local inequality among households. The Gini coefficient is reduced by 17% in *Case A*, 4% in *Case B*, and 26% in *Case C* due to forest income (**Table 7**). In contrast to poverty, the effect of forest income on reducing local inequality is significantly lower in *Case B* compared with other two cases. This implies that forest income is not equally distributed across households in *Case B* indicating that a particular group of households receives more forest income than the others. Furthermore, Gini decompositions by each income source show that only forest income in *Case C* has

negative correlation with total income inequality (MEF= -0.198), while *Case A* and *Case B* show positive correlation between forest income and total income inequality (MEF=0.02 and MEF=0.005, respectively) (**Table 8**). This means that if forest income in *Case C* is increased by 10% and other income remains equal, total income inequality among households in *Case C* will be decreased by 1.98%. Conversely, if the forest income in *Case A* and *Case B* is increased by 10% and other income remains the same, total income inequality will be increased by 0.2% and 0.05% respectively. This negative marginal effect implies that although forest income reduces income inequality in current circumstances, promotion of forest income will likely to increase income inequality within communities.

Table 8 Gini decomposition by income sources

Income source	Case A			Case B			Case C		
	G _k	R _k	MEF	G _k	R _k	MEF	G _k	R _k	MEF
Forest	0.416	0.807	0.020	0.359	0.701	0.005	0.285	0.359	-0.198
Agriculture	0.444	0.305	-0.112	0.295	0.283	-0.147	0.405	0.587	-0.075
Livestock	0.473	0.266	-0.057	0.486	0.727	0.112	0.577	0.592	0.011
Wage labour	0.847	0.610	0.086	0.852	0.220	-0.013	0.826	0.272	-0.019
Non-farm	0.892	0.647	0.064	0.769	0.455	0.044	0.877	0.865	0.282

Note: G_k=Gini for each income source, R_k= Gini correlation, MEF = marginal effect on total Gini

In terms of livelihood systems, the majority of households greatly rely on the forest products for their livelihoods. On average, forest income contributes from 29% to 49% of total income respectively. Despite the restrictions from the national park, households inside and bordering the park have more forest income than those located outside the park ($\chi^2=16.27$, $p<0.001$). Particularly, households bordering the park received more cash forest income than households inside and outside the park ($\chi^2=19.67$, $p<0.01$). However, there is no significant difference in terms of subsistence forest income across three cases ($p<0.05$). In terms of poverty reduction, forest income is more important among households inside the park than those bordering and outside the park. This indicates that complete restriction of forest resources will impact more on the livelihoods of communities located inside the park. Furthermore, although forest income reduces income inequality, only households outside the park shows positive marginal effects of forest income. Therefore, promotion of forest income for households living inside and bordering the park is likely to increase income inequality in the future.

Traditional ecological knowledge and practices

Identification of TEK: The traditional ecological knowledge (TEK) refers to the cumulative body of knowledge, practices, and beliefs associated with the use and management of environmental resources (Berkes, 2008). Key informant interviews in three case studies indicate 28 different types of TEK that are relevant for the conservation and sustainable use of natural resources. For household surveys, TEK-based practices are categorised according to their nature and related environmental resources as (1) TEK related to forest protection, (2) TEK related to shifting cultivation, and (3) TEK related to specific resource management. The summary of TEK practices identified by the key informants and its relevance for conservation are presented in **Table 9**.

Table 9 Summary of Traditional Ecological Knowledge (TEK) identified in three case studies

Sr.	Description of TEK	Relevant for conservation and resilience
A	Resource Use Practices	
1.	Rotational selection of swidden fields	
2.	Stumps are left standing in plots to promote coppicing.	Enhance soil recovery of fallow lands.
3	Prepare firebreaks before burning.	Reduce destruction of ecosystem.
4	Burning fields during waxing moon only.	Adjust timing of controlled burning.
5	Starting fire from top or near the fire brakes	Enable efficient control of fire.
6	Rotational grazing and pasture management.	Ensure sustainable use of grazing lands.
7	Selective cutting of bamboo culms.	Enhance sustainable use of bamboo.
8	Preparation against pest outbreak during the bamboo flowering seasons	Increase livelihood resilience against pest outbreak
B	Rules and Regulations	
1.	No shifting cultivation outside the chosen fields.	Maintain systematic land use.
2.	To compensate costs if the fire spread outside the field.	Motivate controlled burning.
3.	No cutting of trees near the village water sources.	Enhance water regulation service.
4.	No selling of trees from village forests for commercial purposes.	Ensure the sustainable resource use.
5.	No cutting of trees located at top ridges and near the streams.	Protect against landslides and soil erosion.
6.	No hunting by outsiders within village territory without permission.	Prohibit excessive killings of wildlife.
7.	No taking of animals killed by other people	Support sustainable resource use.
8.	No taking of honey without permission.	Support sustainable resource use.
C.	Customs and Rituals	
1.	Sharing plots within selected field.	Reduce inequality among farmers.
2.	Labour sharing during land clearing.	Enable effective implementation of selective cutting.
3.	Custom of earth eating to resolve conflicts	Enhance social cohesion and conflict resolutions.
4.	Ritual selection of person to start fire.	Enable systematic controlled burning.
5.	Bamboo sharing system among owners.	Enhance sustainable use of bamboo.
6.	Hunting fesitivals after crop harvesting.	Enhance social cohesion and conflict resolutions.
7.	Giving hind leg of wildlife to village headman	Resource monitoring and benefit sharing.
8.	Feast of merit by killing Mithan	Motivate Mithan breeding in forests that influence on rotational grazing.
D.	Taboos and Totems	
1.	No cutting of trees within sacred forests.	Maintain regulation and cultural services.

Sr.	Description of TEK	Relevant for conservation and resilience
2.	No cutting of trees near ritual places.	Support conservation of tree species.
3.	No cutting of large trees around village.	Support forest protection.
4.	No cutting of <i>ficus</i> trees.	Support conservation of tree species.
5.	Prohibition of killing gibbons.	Support species conservation.
6.	No clearing of fields without communal rituals.	Systematic timing of land clearing.
7.	No consumption of crops without harvest rituals.	Enhance social cohesion.

TEK awareness and compliance: Household survey indicates the distribution of local awareness and compliance for identified TEK across three case studies. Regarding TEK awareness, households in *Case C* show lower awareness (80.37%) than *Case A* (88.67%) and *Case B* (86.44%) (**Table 10**). The distribution is significantly different across the three cases particularly in TEK related to specific resource management ($\chi^2=47.88$, $p<0.0001$) indicating that households located closer to the national park have higher knowledge on sustainable resource use practices than those located away from the national park. A similar distribution is observed for local compliance with TEK based practices ($\chi^2=27.88$, $p<0.0001$), where *Case C* shows lower compliance rate (36.44%) than *Case A* (52%) and *Case B* (54.67%).

Table 10 Distribution of TEK awareness and compliance across three case studies

TEK Category	% of total households (n=50)			χ^2	p-value
	Case A	Case B	Case C		
Local Awareness					
Forest protection	88.00	85.43	88.29	0.17	0.9200
Shifting cultivation	90.36	87.45	85.64	5.30	0.0708
Specific resource management	87.11	86.00	67.78	47.88	0.0000
Total TEK	88.67	86.44	80.37	23.16	0.0000
Local Compliance					
Forest protection	64.57	47.14	59.43	15.08	0.0005
Shifting cultivation	74.18	75.03	61.27	15.82	0.0004
Specific resource management	52.00	54.67	36.44	27.88	0.0000
Total TEK	64.30	61.04	52.52	16.27	0.0003

Note: χ^2 = Kruskal-Wallis Chi-square value.

Changes in TEK: Although a number of TEK-based practices are still common in case study communities, local compliance with those practices has declined among the households. Household surveys indicate that more than 80% of total households in all case studies still aware of all identified TEK-based practices. However, local compliance is lower than the awareness with an average compliance rate of 70.18% for shifting cultivation, 57.05% for forest protection, and 47.70% for specific resource management practices. The main reasons for non-compliances include changes in religious beliefs, the introduction of alternative livelihood opportunities, as well as degradation of environmental resources. The compliance

rates are significantly lower in TEK groups associated with normative beliefs than those based on instrumental perspectives (**Figure 5**).

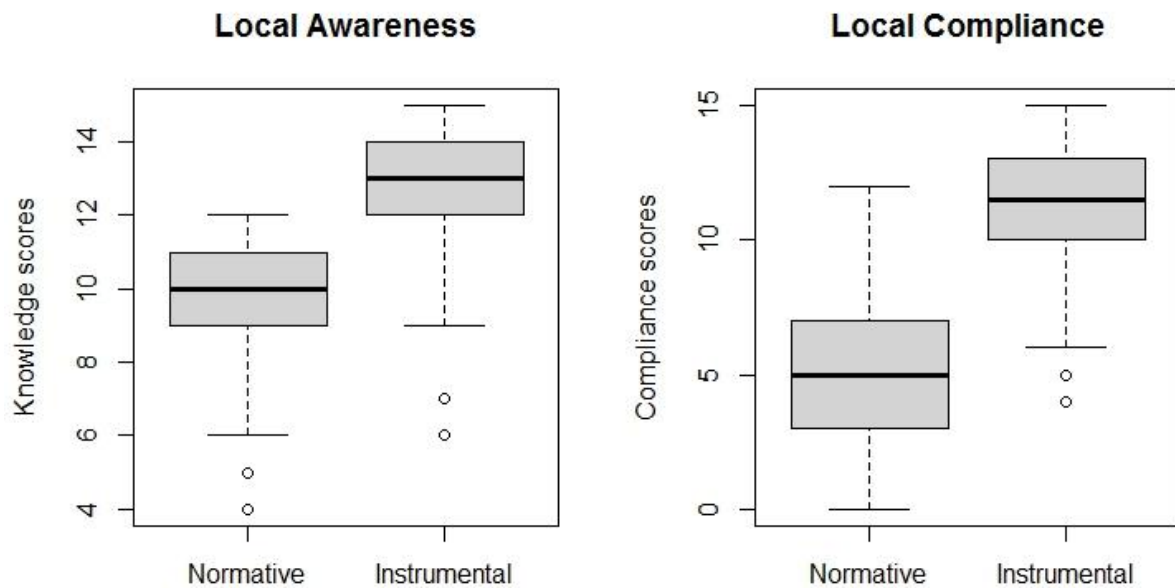


Figure 5 Comparisons of local compliance between normative and instrumental reasons

Future management options

Following Borrini-Feyerabend et al. (2013), this study proposes four management scenarios based on different levels of devolution and local participation in resource governance activities. The first scenario is the Business-As-Usual (BAU) model, where management activities will be continued without significant changes. The second scenario is the Strict Protection model, where management activities are implemented by strict regulations without the involvement of local people. The third scenario is the Community Control model, where local people fully control the management authorities and responsibilities without state intervention. The fourth scenario is the Co-Management model, where management authorities and responsibilities are shared between the state and local people. The management scenarios were presented to the local stakeholders at the participatory scenario planning workshop. Based on the case study results, the workshop participants discussed and evaluated the four management scenarios in accordance with the three sustainable development criteria: 1) biodiversity conservation, 2) livelihood improvement, and 3) social justice.

Theoretically, the strict protection model shows the highest potential for achieving better conservation outcome. However, the participants mentioned that the prospect for effective implementation of this model is very low due to the limited financial support and the existing conflicts between the government and local people. The participants highlighted that the government did not consider the livelihood conditions of local people in formulating the conservation regulations. Particularly, the conservation regulations will not be legitimate under this model due to the lack of transparency and accountability by the government and the limited livelihood options for local people. The participants recommended promoting

alternative livelihood opportunities to achieve effective conservation and to minimise conflicts in the future.

Apart from the strict protection model, the community control model and the co-management model have potentials to improve local participation in conservation. However, the participants indicated that the community control model will have less efficiency and legitimacy due to the declining compliance with customary regulations. They also highlighted that the customary regulations will not be legitimate in the long run because they are not documented as a written statute and may become less applicable due to increasing contact with urban people. Furthermore, the local elites will take the majority of benefits if the community alone protects the forests without state intervention. To achieve effective conservation, the participants recommended that the government should introduce locally acceptable rules and provide legal protection for local people in dealing with rule-breakers and powerful outsiders.

In terms of livelihood aspects, the participants mentioned that the strict protection model will have negative impacts on local livelihood. Since there is no legal provision to permit local use forest products inside the national park, the strict protection model will increase the poverty of local households who depend on forest products inside the national park. Regarding community control model, the participants indicated that the sustainability of forest products will be decreased due to the increasing demand for forest products inside the national park. Especially, the increasing use of cash forest products will also lead to privatization and social conflicts among community members. The participants also discussed that the community control model will be more beneficial to rich people since the extraction cost of timber is expensive for poor households.

Apart from community control model, the participants indicated that the co-management model will sustainably contribute local livelihoods due to the presence of legal supports by park authorities to maintain collective institutions and to prevent land privatizations. Under this model, local people will have a chance to negotiate with park authorities to permit the utilization of certain forest products that are important for sustaining local livelihoods. Incorporating local customary rules such as restrictions against hunting and selling timber to outsiders will prevent over-exploitation of forest resources and will achieve the long-term supply of important forest products.

In terms of social justice, the participants highlighted that the BAU model will increase social inequality due to socio-economic differences within the community. Especially, income inequality will continue to increase due to the differences in local land ownerships. The increasing conflicts between formal and informal land ownership systems will demotivate landless farmers to maintain traditional sustainable land-use practices. In regards to strict protection model, the participants mentioned that increasing government regulations will increase income inequality because only the elite farmers who can avoid the laws will get benefits from forest products due to corruption and weak law enforcement.

Under community control model, social justice will be improved due to less restriction by the government. However, the participants indicated that the risk of elite capture will continue to exist due to weak enforcement of customary regulations. Although land-use decisions will be made by community members, the participants mentioned that traditional landowners will dominate the decision-making processes. Furthermore, customary negotiation processes will

create more social conflicts since the role of tribal leaders and village shaman have diminished within society. For the co-management model, participants indicated that creating a joint-implementing committee between the government and local people will reduce income inequality. For instance, it will permit negotiating with traditional landowners to allow permanent farming on the borrowed lands. It can also minimise social inequality since all villagers can participate in planning and decision-making processes. The participants agreed that the co-management model will promote the preservation of local knowledge and cultural practices by creating opportunities to learn and share between the park authorities and local people. The main limitation of this model is the risk of state domination because most government officers are reluctant to share decision-making power with local villagers.

Results from multi-criteria decision analysis show that the co-management model has the highest ranking scores (3.7) compared to the other management models (**Table 11**). The main argument for selecting the co-management model is because it provides a platform to discuss between park authorities and local communities in order to share local needs and interests in fulfilling basic livelihood needs. This model allows the authorities to formally recognise the existing local institutions. It also supports local participation in conservation and reduce management cost. The participants agreed that the co-management model will enhance social equity in decision-making and reduce the risk of elite capture among the villagers.

Table 11 Subjective ranking of management models by local stakeholders

Sr.	Evaluation criteria	Average ranking scores (N=25)			
		BAU model	Strict Protection	Community control	Co-Management
1	Impacts on conservation				
	• Conservation outcome	3.0	3.0	2.0	3.0
	• Legitimacy	2.0	2.0	3.0	3.0
	• Efficiency	1.0	2.0	2.0	3.0
2	Impacts on local livelihood				
	• Meeting local needs	1.0	1.0	1.0	4.0
	• Poverty reduction	1.0	1.0	2.0	4.0
	• Long-term sustainability	4.0	1.0	2.0	4.0
3	Impact on social justice				
	• Income equality	2.0	2.0	2.0	4.0
	• Equity in decision making	3.0	1.0	3.0	4.0
	• Maintain cultural practices	3.0	1.0	4.0	4.0
	Average scores	2.2	1.6	2.3	3.7

Note: Priority ranking (1=low to 5=high)

The community control and BAU models are regarded as the second and third priorities with the average ranking scores of 2.3 and 2.2 respectively. The main criticism against community control model is because local people will not be able to protect forest resources against powerful outsiders without legal support from the government. The potential for meeting local needs is very low mainly because of the risk of elite capture. For the BAU model, the main arguments include poor implementation of conservation regulations and potential negative impacts on local livelihoods. The strict protection model has the lowest average ranking scores (1.6) mainly because of the potential negative impacts on livelihood and social justice. The participants argued that although the strict protection model will have positive

impacts on biodiversity conservation, the applicability of this approach will be limited due to local resistance against park regulations.

Discussions

The three case studies show both similarities and differences in terms of land tenure system, livelihood strategies, and traditional resource management practices. Regarding land tenure systems, individual property rights differ depending on particular products and services. For instance, the right to cut timber is different between watershed forests and village-use forests, although the right to collect NTFP is the same for both land-use types. Apart from differences in property rights, households' compliances with tenure rules also differ across the three cases. Particularly, households located outside the national park are more in compliance with traditional tenure rules than those inside and bordering the park. The results are in line with the findings of other studies (e.g. Mascia and Claus, 2009; Veit et al., 2008), which imply that conservation regulations undermine the legitimacy of local tenure rules among communities associated with the national park. Local compliance with tenure rules differs depending on land ownership types. For instance, the compliance rate for tenure rules regarding clan and private lands are significantly different across the three cases. This dissimilarity in local rule compliance may increase people-park conflicts, particularly if the park authorities adopt the same regulations for all villages without individual consultations.

The legitimacy of local tenure rules has declined among the case study villages. Particularly, households inside and bordering the national park have lower compliance scores for private tenure rules than those living outside the national park. It means that the legitimacy of traditional landowners has declined in response to the national park regulations. The allocation of agricultural lands by the park has also created social conflicts between traditional landowners and the land recipients. Therefore, it is essential to review the existing allocated lands inside the national park and to revise the land allocation policy in line with the traditional tenure regulations. The role of tribal leaders has declined in all case study villages. This particular trend is mainly initiated by government regulations, improved access to public education and the introduction of modern religious practices. Consequently, the local perception of tenure security has declined due to increasing conflicts between formal and informal regulations. Therefore, it is important to integrate both formal and informal institutions in park management activities in order to achieve effective governance system and to reduce social conflicts.

Regarding local livelihoods, most households engage in similar livelihood activities. However, households bordering the park receive a significantly higher amount of income than the other two cases. This result is in line with the findings of Clements et al. (2014) where households bordering the park receive a higher amount of income than those inside and outside the park. This is mainly because households bordering the park have better access to both forest products and other livelihood options. Income comparison between inside and outside the park indicates that there is no significant difference between these two household groups. It means that although households inside the park have limited livelihood options due to conservation regulations, they have received a similar amount of income due to having better access to forest resources.

The contribution of forest income to poverty reduction is higher inside the park than bordering and outside the park. The result indicates that under the current situation, the national park does not have a significant impact on increasing local poverty due to weak law enforcement and informal permission for local resource uses. The enforcement of park regulations will have more negative impacts on households inside the park than bordering and outside the park. Therefore, it is important for policymakers to create alternative livelihood options before increasing law enforcement in accordance with the national park regulations. The marginal effect analysis also shows that forest income has negative marginal effect among households inside and bordering the park. It means that the promotion of forest income inside and bordering the park is likely to increase income inequality in the future. This result contradicts with the findings of other studies (Fisher et al., 2005; Fonta and Ayuk, 2013) which show that increasing forest income reduces income inequality among rural households. Therefore, the promotion of forest income should consider more pro-poor strategies in order to reduce income inequality in the future.

The three case studies show that local people still apply different types of knowledge and management practices in order to sustain forest resources and associated ecosystem services. However, the legitimacy of these practices have declined across the three cases. Particularly, local compliance scores are significantly lower in TEK associated with taboos, customs, and rituals than TEK associated with rules, regulations, and resource-use practices. This result contradicts with the findings of Bofo et al. (2015) that TEK related to rules and regulations received the lowest compliance scores compared to other types of TEK practices. The classification of TEK based on knowledge domains also shows that TEK associated with normative beliefs has lower compliance scores than the TEK based on the instrumental perspectives. It is mainly because the normative domain of TEK is highly associated with traditional spiritual belief. Therefore, local compliance with these types of TEK has changed when traditional spiritual belief has declined within the society in response to modernisation and acculturation processes. The results are in line with other studies in rural Africa (Kangalawe et al., 2014; Osei-Tutu, 2017) who highlighted that local compliance with resource management taboos had declined due to the introduction of modern religions.

The scenario analysis provides both opportunities and challenges in implementing conservation activities under each management model. The multi-criteria decision analysis also indicates that integrating local stakeholders under the co-management scenario is the best option to promote effective conservation, livelihood improvement, and social justice. Based on the outcomes of three case studies and the participatory scenario planning workshop, this study proposes five management strategies to achieve effective conservation and to reduce social conflicts.

1. *The recognition of customary land tenure inside the park is essential to promote conservation and reduce social conflicts.*

The introduction of state regulations without understanding local land tenure arrangements has induced conflicts between formal and informal tenure regimes. On the one hand, state regulations have failed since they do not fit with local socio-cultural practices. On the other hand, the informal rules are not legitimate against outsiders due to the lack of legal enforcement. Therefore, the integration of informal rules into formal government institution is essential to increase both the legitimacy and effectiveness of the conservation initiatives.

As indicated in the case studies, local people comply more with informal rules than with formal government regulations. However, challenges remain in determining how to integrate informal regulations without unintended consequences on the social system and natural environment.

The conventional buffer zone approach will not be sufficient to reduce people-park conflicts in NTNP. Firstly, the conventional approach tends to demarcate buffer zones based on ecological conditions without considering local needs and traditional practices. Most of the past buffer-zone projects usually demarcated the buffer zones within the degraded habitats that are unable to support sufficient products to meet the local livelihood needs (Martino, 2001). Secondly, territorial differentiation among tribal groups is still common in Chin State. Therefore, the demarcation of buffer zones outside the traditional territories will increase social conflicts among different tribal groups. Thirdly, local people are highly dependent on shifting cultivation which requires extensive areas of fallow forests to complete a rotation cycle. Therefore, demarcation of buffer zones without considering rotational fallow cycle will not be applicable unless better livelihood options are available to reduce local dependence on shifting cultivation.

Instead of creating buffer zones, one alternative approach is to formally recognise the customary land ownership and delegate power and responsibilities to manage the land (Andersen, 2016). As the customary tenure rules are complex and may vary depending on particular land-use practices, a simple classification - such as private, common, or state ownership - will undermine the complexity of local tenure arrangements and induce additional conflicts (Pradhan, 2002). However, the degree of legal recognition should be determined based on the nature of tenure rules and local governance institutions (Fitzpatrick, 2005). The choice of a local agency or informal governance institution should reflect the local cultural system in order to increase the legitimacy of conservation regulations (Larson et al., 2010). Nevertheless, as indicated by Ribot et al. (2008), the local political system should carefully be investigated before formal recognition in order to avoid the risk of elite capture in decision-making processes.

Existing policies and regulations provide enabling conditions to implement the formal recognition of customary lands under the co-management scenario. For example, the National Land Use Policy (2016) encourages to recognise the customary tenure and related institutions among indigenous ethnic people (Government of Myanmar, 2016). The National Biodiversity Strategy and Action Plan (NBSAP) also includes targets and action plans to promote co-management activities in biodiversity conservation (Forest Department, 2015). The presence of these policy frameworks will enhance the legitimacy and effectiveness of this scenario in NTNP since the success of co-management approach highly depends on enabling policy conditions (Armitage et al., 2009).

2. Conservation regulations should be flexible and site-specific in order to support poverty alleviation and increase public participation in conservation.

The conservation laws in Myanmar do not permit any resource use within the national park. On the contrary, this study shows that local communities are highly dependent on forest products for their livelihoods. Particularly, the subsistence use of forest products is crucial for reducing poverty within the community. Limiting access to subsistence forest uses will put local people more into poverty. The study also shows that there is no significant difference in

subsistence forest use between inside and outside the park. Limiting subsistence forest uses inside the park will increase inequality between the communities. It means that enforcement of existing conservation regulations will increase local resistance against the park. To achieve both conservation and livelihood objectives, park regulations should be flexible and target-specific to allow local communities to continue their way of life.

One possible solution is to permit local people the subsistence-use of forest products inside the park. Focus group discussions with park rangers revealed that they informally permit subsistence use of forest products by local villagers although it is prohibited by the law. Nevertheless, local people still perceive the park as a major constraint for their livelihoods. Although they continue to use forest resources inside the park, they consider that the park has prohibited their rights over land and forest resources inside the park. In order to reconcile between the park and local people, the park needs to deliver more tangible benefits that are visible and recognised by local people (Hoole and Berkes, 2010). Therefore, formal permission of subsistence forest uses will change local perception of the park and will improve collaboration for conservation. However, the government should provide formal permission in line with the customary regulations. The regulations should be site-specific and adaptive to local cultural conditions. For instance, the collection of NTFP within village territories can be permitted in Case-A but it will lead to social conflicts if it is legally permitted for outsiders in Case-B. Similarly, cutting trees within the sacred forest can be permitted in Case-B although it will not be applicable in Case-A due to the potential conflicts between traditional and modern religions.

A major constraint of this approach is that the policymakers are usually reluctant to permit local resource use inside the conservation areas. Previous studies have shown that one of the factors that contributed to the failure of community-based conservation projects was the presence of too little incentives for local communities to participate in collaborative management practices (Berkes, 2004; Winkler, 2011). The win-win scenario, as expected by most policymakers, is hardly realistic between the competing goals of conservation and development initiatives (Ferraro and Hanauer, 2011). In order to achieve conservation with minimum livelihood impacts, the policymakers need to prioritise key conservation objectives and should allow activities that could impact to less important objectives (McShane et al., 2011).

3. The conservation authorities should incorporate local knowledge and experiences to improve collaboration and social learning.

The three case studies have shown that local people apply diverse knowledge and management practices to ensure the sustainable provision of ecosystem services and to minimise future livelihood risks. The majority of these practices share the same purpose as the park management objectives. Therefore, incorporating these practices into formal park management plan will achieve effective conservation and reduce administrative costs (Colding et al., 2003). For instance, providing legal assistance to watershed protection and village-use forests will improve local conservation initiatives and reduce additional management cost. Similarly, participating in field selection meetings for shifting cultivation will support effective land-use practices and will help to negotiate to avoid critical habitats for conservation.

People-park reconciliation is a long-term process and should not be implemented by using top-down interventions (Hoole and Berkes, 2010). First, it is essential to re-establish trust between the park authorities and local people in order to achieve a long-term collaboration (Wells and McShane, 2004). Establishing a communication platform between park authorities and local people is essential to induce local trust-building process (Berkes, 2009). Such platform should be simple and less bureaucratic where the stakeholders could easily share their knowledge and negotiate competing interests among them. Community-based innovation tools, such as Participative Innovative Platform (PIP), will serve as a bridge between park authorities and local people to share knowledge and to improve social learning processes (Alemu and Auch, 2016). Second, the park should support the implementation of local cultural practices such as collective rituals or traditional ceremonies to promote cultural transmission and social learning processes. These activities will improve communication and interaction among community members and will support achieving collective agreements through interactive discussions and feedbacks (Muro and Jeffrey, 2008).

4. Adaptive monitoring and feedback mechanisms should be established in order to cope and adapt with unforeseen social-ecological changes.

Case study results indicate that changes in the social system have influenced local resource demand and management practices which in-turn produce impacts on biodiversity and ecosystem services. Moreover, these changes are mostly induced by external drivers that are beyond the control of the park management office. In order to minimise the adverse impacts of these changes, the park authorities need to revise and adjust the conservation goals regularly in line with the changes in societal needs and ecological conditions (Andrade and Rhodes, 2012). Therefore, it is essential to integrate adaptive management principles into conservation planning in order to cope with unforeseen changes in the future.

Effective implementation of adaptive management in NTNP requires three main preconditions. First, adaptive management requires continuous monitoring and feedback mechanism to modify conservation goals and management options (Allen and Garmestani, 2015). Generally, the park managers in Myanmar are allowed to revise annual management activities within the framework of allocated budget (Emerton et al., 2015). The monitoring and evaluation processes are usually conducted by the general audit department where the auditors mainly focus on accounting and financial procedures rather than the conservation outcomes. Therefore, the establishment of an impact monitoring mechanism is essential to evaluate management outcomes and provide feedback for setting new conservation goals.

Second, the key process of adaptive management is setting conservation goals, management objections, and implementation options based on the outcome from continuous evaluation and feedbacks (Allen and Garmestani, 2015). However, conservation goals in Myanmar are mostly determined by high-level authorities rather than local park management office (Aung, 2007). This process limits to predict future scenario at the local level in order to minimise uncertainty in decision making. Therefore, it is essential to establish a decision-making mechanism at the local level in order to reflect actual conditions and reduce uncertainty. Third, the success of adaptive management approach greatly relies on the role of managers in facilitating decisions, in incorporating local knowledge, and in collaboration with external organisations (Allen and Garmestani, 2015). Therefore, capacity building programs at park

management level should focus on creating visionary leaders in order to facilitate the adaptive governance processes effectively.

5. Integrated planning and management approach is essential, particularly at the regional level, in order to improve collaboration among local government organisations.

The problems facing in NTNP are not merely a local level issue. As indicated in the three case studies, the majority of conservation and livelihood issues had evolved in response to the long-term political conflicts between the central government and local ethnic people. For centuries, the Chin people had enabled to avoid state domination due to limited accessibility and the failures in government institutions (Scott, 2009). Therefore, most government regulations were not effectively enforced in Chin State. The local farmers were used to be living without complying with government regulations. However, the national park has introduced actual law enforcement activities with financial support from international organisations. As a result, only the communities associated with the national park have to follow the formal regulations whereas the communities outside the park are still enjoying traditional customary rights. These asymmetric legal pressures have created inequality between park and non-park communities inducing local resistance against the national park. Therefore, creating legitimate governance structures in other administrative sectors is necessary before imposing conservation regulations inside the national park.

Land tenure and poverty issues should be addressed at the regional level rather than the park authorities alone. Land tenure is a complex issue and related to other government agencies such as the departments of agriculture, livestock, and rural development. Therefore, a broader policy framework is necessary to initiate collaboration among these departments in recognising customary land tenure not only inside the park but also throughout the whole Chin State. Moreover, poverty is not a localised issue in NTNP. More than 70% of the population in Chin State is already under poverty (UNDP, 2011). Therefore, the park authorities alone could not reduce poverty issue in NTNP. A more comprehensive regional development plan is necessary that integrates common visions and goals among relevant departments and administrative organisations.

Conclusions

Despite the increasing critics, protected areas are still crucial to preserve the global biodiversity and related ecosystem services. The expansion of protected areas has rapidly increased due to increasing advocates by national governments, international organisations, and conservation activists. Moreover, the purpose of protected areas has become not only to protect the endangered species and related habitats but also to achieve broader objectives including national economic development through tourism revenue, preservation of cultural identity, and improving resilience against climate change. The increasing number of protected areas has induced conflicts with local communities in fulfilling livelihood needs and economic development to step out of poverty. The conflicts have become more prominent in developing countries particularly among communities who rely on land-based economic activities. The rapid growth of rural population has increased local demand for land and forest products. The political movements for indigenous rights have worsened the conflicts since many of the remaining natural landscapes are overlapping with the land owned by indigenous people. These conflicts have driven the protected area managers to find a way to achieve conservation and minimise conflicts with local people.

The study indicates that the integration of local resource need, cultural institutions, and traditional knowledge into conservation practices is crucial not only to achieve long-term protection of natural resources but also to reduce people-park conflicts. These objectives can be achieved by establishing co-management arrangements that enable to share the decision-making power and management responsibilities between the government and local people. The outcomes will lead to the self-enforcement of conservation practices within the communities instead of forced regulations. The study highlights that local institutions, livelihood strategies, and management practices are not static but are changing over time in response to the changes in technology, market, and cultural beliefs within the society. Therefore, it is crucial to design co-management strategies that are adapted to changing social and environmental conditions.

Although adaptive co-management is a potential tool to reduce social conflicts and to enhance local participation, challenges remain in implementing this approach effectively. Particularly, adaptive co-management is a long-term process with continuous learning and adjustments in response to changes in the social-ecological system. This process requires creating a policy environment that enables better collaborations at both national and regional government organisations. The co-management arrangements should be flexible to motivate social learning and adaptation without having complex bureaucratic procedures to re-organise the management objectives. It should minimise power asymmetry among local stakeholders to allow the actual participation of all stakeholders in decision-making processes. It should also increase public incentives to achieve the continuous commitments of the participants throughout the implementation phases.

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