Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Natural Sciences
Department of Biology

Hsu Yee Kyaw

The effect of socioeconomic factors on local community recognition of ecosystem services and support for biodiversity conservation: Case study of local communities in and around the Shwe Sett Taw Wildlife Sanctuary

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LIST OF ABBREBIATION

BANCA	Biodiversity and Nature Conservation Association
CBD	Convention on Biological Diversity
ES	Ecosystem Service
GIS	Geographic Information System
GLMM	Generalized Linear Mixed Model
KBA	Key Biodiversity Area
MEA	Millennium Ecosystem Assessment
NTNU	Norwegian University of Science and Technology
PA	Protected Area
SPSS	Statistical Package for the Social Science
UNEP-WCMC	UN Environment World Conservation Monitoring Centre

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ABSTRACT

Protected Areas (PA) were established in conservation purposes in the past, later inevitably integrated into the local community residing in and around those areas for a certain period of time. One of the most important advantages of establishing PA was the ability to maintain a specific ecosystem and its services for the well-being of people living in the vicinity. The availability and support of ecosystem services is critically important not only for the daily life and long-term sustainable conditions of local communities. Due to the ease of access and naturally existence, ecosystem services (ESs) are not quite easily to notice for local communities apart from some prominent benefits obtained from PA. The recognition of local communities on the contribution of ESs by PA and their importance is extremely crucial for the long-term existence of PA and its biodiversity. In this study, the influencing factors on the utilization and perception of ESs was firstly assessed using three theoretical concepts of ES; provisioning, regulating and cultural services contributed from PA, then the effect of those perceptions on the support of conservation were further evaluated. The study will be conducted as questionnaire survey in every 24 households of 10 sample villages around the Shwe Sett Taw Wildlife Sanctuary (SSTWS). Socio-economic and demographic factors of local communities showed significant effects on how they utilized ESs and recognize the value of ESs. The linkage of perception on the ESs and personal attachment were interestingly revealed the importance of PA and conservation for their locality although there were some unfavourable factors. The recognition of ESs was less likely to relate with the distance from PA which means those who lived far from PA might also have high awareness on ESs (especially intangible benefits), and it was differed from the ordinary benefits they used to obtain. The conservation support of local communities was normally related to their contact with PA and staff, interest, and willingness of participation in conservation and their conservation knowledge.

Key words: conservation support, ecosystem services, perception, protected area, recognition, Shwe Sett Taw, socio-economic, utilization

1. INTRODUCTION

In accordance with the alarming rate of extinction and deterioration of natural features and biodiversity within the recent decade, the adoption of protected areas (Allendorf, T *et al.* 2006) has been the major strategy for maintaining biological diversity and a range of ecosystem services, which are recognized as global assets. Their richness and long-term existence are essential for the socioeconomic and aesthetic wellbeing of present and future generations (Reid, WV *et al.* 2005). Deterioration and loss have been derived from anthropogenic activities such as habitat destruction, overconsumption of natural resources, and the introduction of alien invasive species. The theoretical concept of biodiversity conservation is a compromise among biodiversity, ecosystem functioning and satisfaction of current and future needs of people settled adjacent to conserved areas (Iles, M 2010). According to global records, designated inland protected region comprised 14.7% of all areas in 2016 and 14.9% of all areas in 2018, covering 245 countries and territories, and at least 22.5 million km^2 (16.64%) of land and inland water ecosystems were within protected area (PA)s in May 2021(UNEP-WCMC, I 2021) PAs and conservation sites now partially or fully comprise 65.5% of key biodiversity areas (KBAs), which are required to increase coverage to be able to conserve important ecosystem (UNEP-WCMC, I 2021).

Due to its high species diversity and area of 676,577 km^2 in mainland Southeast Asia, Myanmar is a biodiversity hotspot in Southeast Asia and Indo-Pacific mainland countries (Rao, M *et al.* 2002). According to statistics from the Sixth National Report to Convention of Biodiversity Diversity-CBD, there are more than 18,000 species, including 11,824 plant species, 251 mammal species, 1,056 bird species, 1200 butterfly species, 282 reptile species, 139 amphibian species and 775 fish species in Myanmar, while 82 amphibian species, 1540 medicinal plant species and 96 bamboo species are endemic to Myanmar.

There are 128 globally endangered and critically endangered species, including 25 bird species, 25 mammal species, 2 amphibian species, 10 fish species, 10 reptile species and 32 endangered plant species in Myanmar (Forest Department 2018).

Since the early 20th century, Myanmar has been trying to conserve its diverse biological resources and valuable ecosystems through establishment of a rich PA network, stakeholder engagement, laws and regulation improvements, which are in line with national and international biodiversity targets (Forest Department 2015). Currently, there are 53 PAs covering 44,289 km^2 of total land area, almost 8% of which include designated terrestrial inland freshwater and marine conservation areas across Myanmar (Forest Department 2018).

Myanmar has experienced a tremendous loss of biodiversity resulting from human-induced interventions in natural habitats and ecosystems, similar to the global trend. Without the support of biodiversity conservation and valuation of ecosystem services by local communities, progress has been made, but PAs have only escalated in quantity but not in quality to a considerable extent in terms of effectiveness and they are not effective (Wells, MP and McShane, TO 2004). The challenge to development in Myanmar is that the conservation effectiveness of PAs has been limited to harmonize conservation objectives and people's socioeconomic needs. This is because of the increasing pressure of unsustainable resource utilization, agricultural expansion, illegal activities and improper land-use planning (Isituto Oikos and BANCA 2011).

There have been many studies globally that have highlighted that there is increasing pressure for justification of the existence of PAs, not only from an ecological perspective but also from economic and social aspects contributing to human wellbeing in their surrounding landscapes (Xu, W *et al.* 2017, Lecina-Diaz, J *et al.* 2019). Introduction of the concept of ecosystem services created connections between ecological and socioeconomic systems and provided a common linkage for assessing them (Daily, GC *et al.* 2000). To allow integrated management of PAs that reduces trade-offs to the minimum, it is critically important to fully realize the value of a service to households and communities and the sociocultural value of an ecosystem service (Dawson, NM *et al.* 2017). From a social perspective, PAs provide a set of ecosystem services (e.g., water provision, air quality, recreation) to local people as well as to regional and global beneficiaries. In the Millennium Ecosystem Assessment (MEA), many ES factors were listed and categorized as provisioning services, regulating

services, supporting services and cultural services. Although the study of ecosystems begun less than a century ago, the theoretical concept of ESs has been diversified according to the perspective and interest and differs due to geographical differences (Reid, WV *et al.* 2005).

Provisioning services include the ability of ecosystem that humans obtain as tangible products from its nature and functions, such as food, water, and resources, including wood, oil, medicines, and genetic resources. Regulating services are benefits obtained from ecological processes, including water purification, climate regulation, flood regulation and other natural hazard regulations, pollination and more. Cultural services include nonmaterial benefits that people can obtain from ecosystems. These services include aesthetic and recreation, spiritual enrichment and intellectual contribution (Iniesta-Arandia, I *et al.* 2014). These types of services are frequently hard to monitor and value compared to regulating and provisioning services, but research in this area is growing (Mertz, O *et al.* 2007). Finally, supporting services more or less overlap with other ESs because they relate to habitat functioning themselves and therefore influence survival. Photosynthesis and the water and nutrient cycles are the best examples, and this type of ecosystem service is also existing at the genetic level, such as the maintenance of gene pools for biodiversity conservation (Daily, GC *et al.* 2000, Reid, WV *et al.* 2005) (see also Fig. 1).

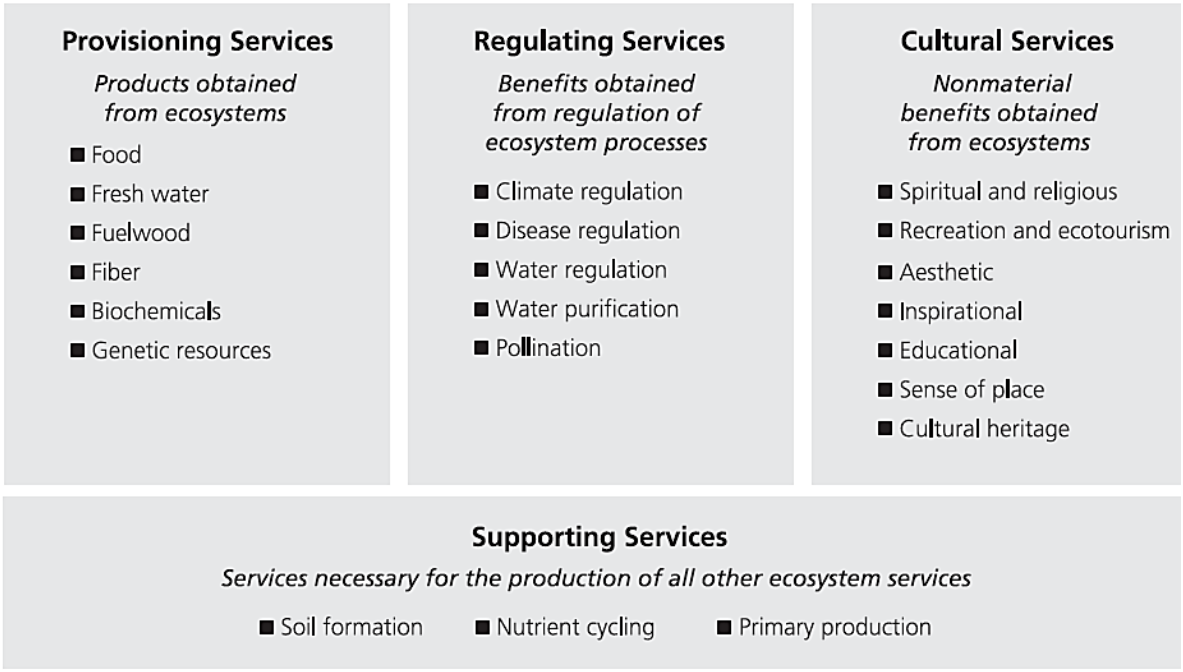

Figure 1: The description of ecosystem services (Reid, WV *et al.* 2005, Thompson, G and Kao-Kniffin, J 2017)

The perceptions of PAs by local communities are important for local participation. Such perceptions could be positive or negative according to the way local people use PAs, the degree to which they use PAs, and limitations with the purpose of protection and public awareness. It has generally been assumed that local people do not support protection efforts in cases where negative perceptions of PAs develop (Pietrzyk-Kaszyńska, A *et al.* 2012). The perceptions of biodiversity conservation by the local community are strongly related to perceived benefits, especially in developing countries (Vodouhê, FG *et al.* 2010, Smit, IP *et al.* 2017). Due to problems rooted in poverty, unemployment and weak law enforcement, Myanmar's biodiversity and remaining ecosystems urgently need to be effectively and sustainably maintained. In the current park management plans and natural habitat re-establishment programme, which are in line with the conservation of biodiversity and protected areas law in Myanmar, participation of local communities living at the periphery of PAs has been initiated by expanding buffer zones, providing some allowable use rights with the purpose of long-term sustainability of PAs (Allendorf, T *et al.* 2006). PA policies and

rules in Myanmar prohibit local communities from assessing resources, which creates conflicts and eventually affects the perspectives of local people on PAs in the long term (Htun, NZ *et al.* 2012).

Determinants of the perception and attitudes of local communities toward PAs and conservation are site-specific in terms of resource consumption and livelihood activities, and their interaction effects with attitudes about contributing services of PA ecosystems are essential elements because they shape the effectiveness of sustainability and conservation in specific areas (Holmes, CM 2003). Along with biodiversity conservation of PAs, the linked contribution of ecosystem services (Xu, W *et al.* 2017) has also recently been a focus (Larigauderie, A *et al.* 2012). It is undeniable that local communities have a strong interrelation with ecosystem services in terms of biotic or abiotic means supported by PAs for their livelihood. Socioeconomic background is among the most studied predictors of the perception and attitudes of local communities toward PAs and their services because their subsistence and even wellbeing are based on the contribution of Pas (Tomićević, J *et al.* 2010). The effects of gender, age and education on general opinions are also important factors in creating positive attitudes toward the existence and value of PAs (Allendorf, TD and Allendorf, K 2013). The Shwe Sett Taw Wildlife Sanctuary (SSTWS) is one of the oldest PAs; it was established in the early 1940s and is surrounded by a number of villages that have a wide range of resource utilization levels according to a socioeconomic survey conducted under the Protected Area Management Plan formulation (Isituto Oikos and BANCA 2011). Moreover, the site is under the influence of human intervention in and around the conservation area, which urgently needs resource planning and benefit-oriented approaches to sustain the existing status quo. As an area under human pressure and in which infrastructure, such as electricity, is less accessible, the local community has to focus only on their livelihood, which becomes a trade-off for the ecosystem, its services and diversity. Elucidating the interactions among ESs, people's perceptions and conservation is the rationale for this research.

To determine the correlation between resources, humans and ecosystem services, this study assessed how these components of PAs are interlinked and have reinforced to

conservation support of the Shwe Sett Taw Wildlife Sanctuary (SSTWS) of Myanmar through two main objectives: (1) to evaluate the critical determinants of communities' recognition of ESs provided by PAs and (2) to test the interaction between the local communities' perception of ESs and their conservation support.

The study also tests the following two hypotheses:

H1: Local people's recognition of the importance of ecosystem services is shaped by their socioeconomic factors, such as gender, age, education level and distance to the PA.

H2: Conservation support by local communities is positively related to the recognition of ESs and the existence of PA

2. MATERIALS AND METHODS

2.1. Description of the study area

The Shwe Sett Taw Wildlife Sanctuary (SSTWS), designated as a PA on 29 June 1940, is located in the dry zone area of Myanmar, 20° 3' - 20° 19' North latitude and 94° 21' - 94° 42' East longitude and covers the Pwint Phyu, Minbu (Sagu), Ngaphe and Setote-taya townships of Minbu District of the Magway Region (Figure 2). The total protected area is 464 km^2, with a buffer zone area of 94.3 km^2 (Rao, M *et al.* 2002). The study area was dominated by the major forest types of dry upper mixed deciduous forest (DUMD), Indaing forest, Than-Dahet forest and a small area of moist upper mixed deciduous forest along the border of Rakhine Yoma, as well as scrub and grassland. The sanctuary contains 17 mammal species, 113 bird species, 43 reptile and amphibian species, 39 butterfly species, 89 tree species, 3 orchid species, and 26 medicinal plant species (Isituto Oikos and BANCA 2011). Eld's deer (*Rucervus eldii thamin*) and Burmese Star Tortoise (*Geochelone platynotan*) are the most prominent conserved species in SSTWS. The two major waterways: Mone stream and Mann Stream demarcated the periphery of the PA as the watershed areas which are under the pressures of human intervention (McShea, W *et al.* 2018). There are approximately 50 villages along the boundary of the PA. Most of the nearby villages practice two major forms of cultivation: agriculture and shifting cultivation. The extraction of bamboo for

bamboo thatches is also an important alternative seasonal livelihood according to the management plan of PA.

2.2. Questionnaire Survey

Among the villages on the periphery, 42 are highly dependent on the PA according to socioeconomic data from the forest department. A questionnaire survey was carried out using face-to-face interviews including both close-ended and open-ended questions. Before the start of data collection, a pilot study was carried out in the village nearest to the PA (U-Yin village) to check the feasibility and comprehensibility of the questionnaire and to understand the knowledge level of the general respondents. Sample villages around the boundary of the PA were randomly selected by using the proportionate sampling method to categorize the ratio of the township area located in the PA and the location of each sample village to ensure that they selected villages were representative. A total of 10 villages were selected, and 24 households were randomly selected from each village, for a total of 240 (10 x 24) households. The yellow points illustrated sample villages selected from 50 villages and applied in this study, and red point represented the village surveyed as pilot (Fig 2). The survey consisted of a brief explanation of the research aims, questions on demographic details of respondents including their age, gender, education, and occupation as well as their perceptions of the importance of ecosystem services and attitudes on the PA and its services.

To avoid confusion and any misunderstandings, the technical term “ecosystem services” was not used during the interview; instead, the concept was simply expressed as benefits that humans may obtain from the PA, such as tangible and intangible benefits, and how the respondents recognized these contributions of the PA was examined.

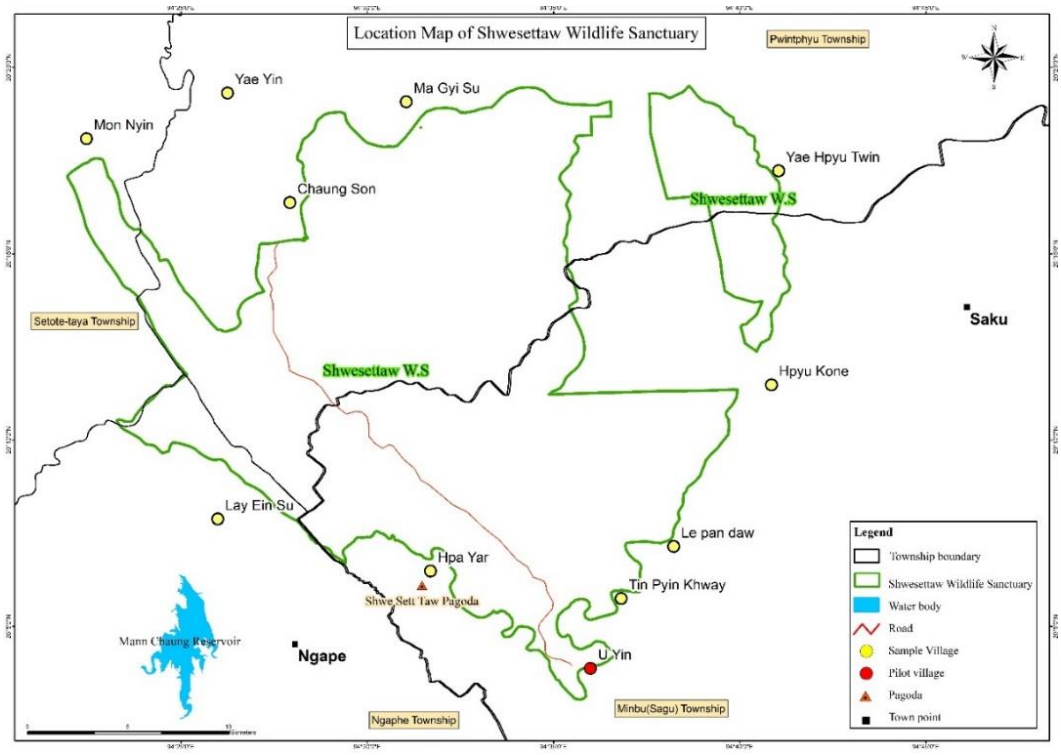

Figure 2: Location of sample villages around Shwe Sett Taw Wildlife Sanctuary

2.3. Characteristics of respondents

2.3.1. Education

Level of education was first categorized into five classes: (1) No education, (2) Monetary education, (3) Primary education, (4) Secondary education and (5) Beyond secondary education. The percentage of respondents with a secondary education or above was quite low, and most of the respondents had only a primary education (66.7%). Based on the number of respondents at the different education levels, the categories were recategorized into three simple groups: (1) No education (10%) and (2) Primary education (13.8%) and Higher education (76.3%).

2.3.2. Age group, gender, and family head status.

The ages of the respondents were 18 and over and classified into four groups. The first group included respondents aged 18 to 34 years (26.3%), the second group included respondents aged 35 to 53 years (45.4%), the third group included respondents aged 54 years and above (28.3%). A total of 57.9% of the respondents were women, and 42.1% of the respondents were men; 52.5% of the respondents were family heads, and the

remaining 47.5% of the respondents were not.

2.4. Socioeconomic status

2.4.1. Land ownership, length of residency and livestock ownership

The majority of the respondents owned farmland (67.9%), while the remaining 32.1% did not. Regarding the residency period, the primary four categories were used: (1) Less than 1 year, (2) 2–10 years, (3) > 10 years, and (4) Born in the village. The first three categories were combined into one simple group, “Non-native” (22.1%), while the last category was changed to “Native” (77.9%).

2.4.2. Distance from the PA

Based on the location of each village, its distance to the boundary of the PA was measured using ArcGIS 10.8. Distances measured in kilometres were categorized into three groups: (1) less than 1 km from the PA (near = 3 villages), (2) between 1 and 3 km from the PA (intermediate = 3 villages), and (3) greater than 3 km from the PA (far = 4 villages).

2.5. Ecosystem services utilization

2.5.1. Provisioning ecosystem services

Most respondents (85.4%) answered “Yes” to the question “Do you go to the forest to extract forest products?” (Yes, No), while 14.6% answered “No.” If the respondent answered “Yes,” questions about how often they collect different resources, which part of the PA they use for resource collection, how many years they have used those resources, the trend of those resources, how important those resources are for the individual and how important the resources are were asked. The three most answered resources under the provisioning service title were fuelwood, timber (poles and posts), and bamboo. The frequency of extraction for each of the three most common resources was classified into 6 categories: (0) = Never, (1) = Occasionally, (2) = Seasonally, (3) = Monthly, (4) = Weekly and (5) = Daily to assess the utilization status. The sites from which the provisioning services are extracted in the PA were classified into four different categories: (1) = No use of the PA, (2) = Less than 8 km from the PA

boundary, (3) = Inside the PA and (4) = Both inside and outside the PA. Regarding the question about how long the respondents have utilized the provisioning services, two different utilization periods were used: (1) = Not a very long period and (2) = For generations. The respondents to describe the current conditions of the resource using three categories: (1) = Declining, (2) = Stable and (3) = Increasing. The answers regarding how important the provisioning service is for the respondents were categorized into (1) = Important for daily livelihood and (2) = Important for earning income. Answers about resource importance were categorized as follows: (1) 0–55%, (2) 6–25%, (3) 26–50%, (4) 51–75% and (5) 76–100%.

2.5.2. Regulating Services

The question "Do you visit the forest for purposes other than collecting forest products?" (Yes, No) was followed up by the question "Do you think the forest in the PA provides other benefits?" (Yes, No). The majority of respondents answered "Yes" to the first question (93.8%), while 6.3% answered "No." To the second question, 84.2% answered "Yes", while 14.2% answered "No."

If the respondents were convinced that a benefit was obtained, subsequent questions about the type of service they perceived, the trend of the resource compared to the last 10 years and the importance of this service for them were asked. Three main regulating services provided by the PA were prioritized: purified water, rainfall, and forest regrowth. The trend of the regulating services was evaluated by using a Likert scale. However, the answers were later pooled into three categories: (1) = Worse, (2) = The same and (3) = Better. The question about the importance of each service was asked to the respondents that had answered yes to the question about whether they receive this service. The degree of importance of the service was also given using a five-point Likert scale later recategorized into two simple categories: (1) Important, and (2) Not important.

2.5.3. Cultural and supporting services.

The role of cultural and supporting ecosystem services was evaluated using a five-point Likert scale, and the answers later recategorized into three simple categories: (1) =

Negative, (2) = Neutral and (3) = Positive. If the respondents provided a positive opinion, a subsequent question of whether they receive a benefit from the PA or suffer a loss from it was asked. The importance of the service was graded by using a five-point Likert scale, the answers to which were later combined into two simpler categories: (1) Important, or (2) Not important.

2.6. Statistical analysis

The predictor variables included socioeconomic information such as age, gender, religion, education, residency period, occupation, size of farmland, land ownership status, land ownership period, major crops, and livestock ownership status. The interaction of local communities with the PA, the recognition of the ESs provided by the PA by local people and the conservation knowledge and support of local people, were examined. A dichotomous scale (Yes, No) was used to assess the general opinion of local people regarding ESs, and categorical variables and five -point Likert scales were used to evaluate the importance of ESs. Conservation support and willingness to participate in conservation of the PA were characterized using categorical variables, Likert scales and open-ended answers.

The collected data were processed and cleaned by using Microsoft Excel. Then, the output data were analysed with IBM SPSS Statistics version 27 to identify the frequency of different variables. To assess the relationship between the dependent variables and independent variables, chi-square tests with a significance level of $p < 0.05$ were used (Marchant-Shapiro, T 2015). The effect size among the explanatory variables was interpreted using Cramer's V, in which variables with $p > 0.5$ were excluded due to the multicollinearity among them, which affected the significance of the model (Table 9, Appendix)(Marchant-Shapiro, T 2015). For further detailed analysis, SPSS was used to run the model for multilevel categorical variables, and RStudio Version 0.97.551 was used to run the generalized linear mixed models (GLMMs) for binary variables using the lme4 package, which identified the determinants of local people's perception of ESs and PA conservation due to the nonnormality of the data (Team, R 2020) (Table 1). Model selection was carried out by using model averaging from all possible candidate modes produced by the Global

model package by the dredge function (MuMIn: Multi-Model Inference), which allowed automated model selection through sub-setting (Anderson, D and Burnham, K 2004, Barton, K 2009). Model parameter and prediction averaging model.avg (MuMIn) were performed based on model weights derived from information criteria (AICc and alike) or custom model weighting schemes in which the threshold of sub-setting the delta value was set to less than 2 (Anderson, D and Burnham, K 2004).

All models were fitted with binomial and multinomial distributions, and the significance level was set at $p \leq 0.05$. To validate the plausibility of averaged candidate models with optimal fixed and random effect structures, variance inflation factor (vif) value was calculated in which a value specifically less than 2 was be selected with the model (O'brien, RM 2007), and an additional variance analysis (Anova) was secondly calculated.

3. RESULT

3.1. Perception of ecosystem services by the local community

3.1.1. Interaction with the PA and perception of the provisioning ESs

Regarding the question "Do you go to the forest to extract forest products?", more than half of respondents (57.9%) reported that they visited the PA and its vicinity to collect the different tangible benefits provided by the PA, such as forest products required for daily use and earning income. To determine the factors influencing how local communities interact with the PA for provisioning ESs, GLMM analysis was carried out using predictor variables and villages as random variables. According to the results from the model, the most significant predictors that influenced the interaction of local communities with the PA were livestock ownership and residency (Fig. 3). People who had livestock that did not need to be pastured were less likely to visit the PA than livestock owners, especially those who owned cows (coefficient estimate = 1.89, SE = 0.52, $p < 0.001$; Table 1 and Table 10, *Appendix*). However, residency had no influence on visits to local communities in the PA for provisioning ESs.

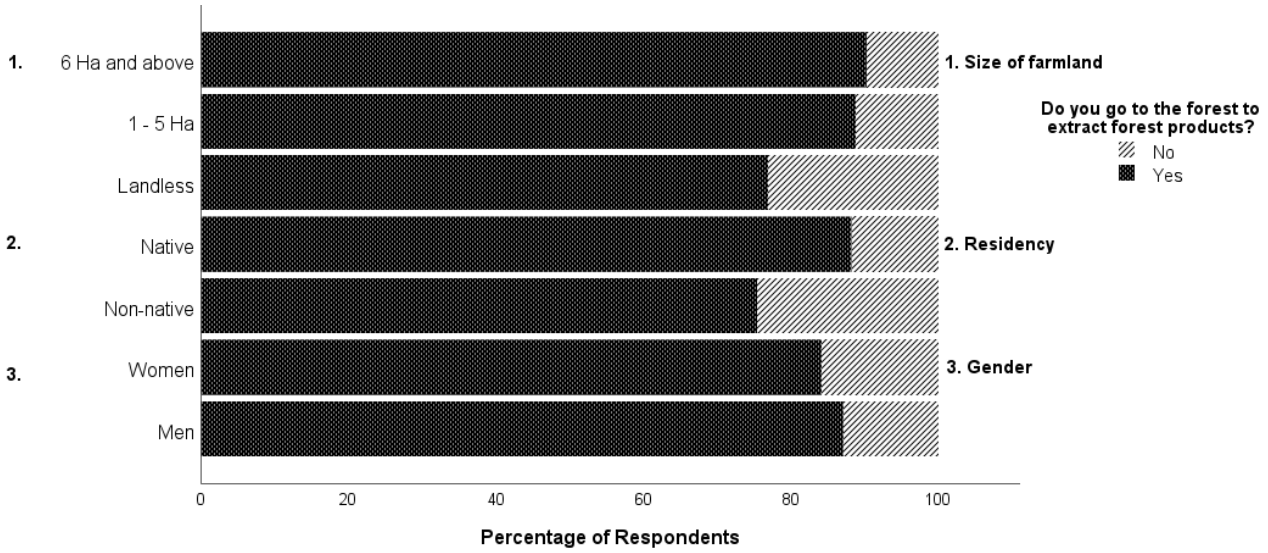

Figure 3: Interaction of local communities with the PA for provisioning ESs

Table 1. Model-averaged coefficients and standard error for the variables influencing the interaction of local communities with the PA for provisioning ESs

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	1.070	0.491	0.491	2.171	0.030
Livestock ownership (Cows)	1.934	0.523	0.526	3.680	0.001
Livestock ownership (other)	0	.		.	.
Residency (native)	0.414	0.496	0.497	1.195	0.233
Residency(non-native)	0	.		.	.

People who visited the PA for the provisioning ESs reported that the products they commonly obtained from the PA were fuelwood, bamboo, and timber (including poles and posts), while fuelwood was the most recognized tangible benefit among those products. It was recognized as the most prominent resource for the recognition of

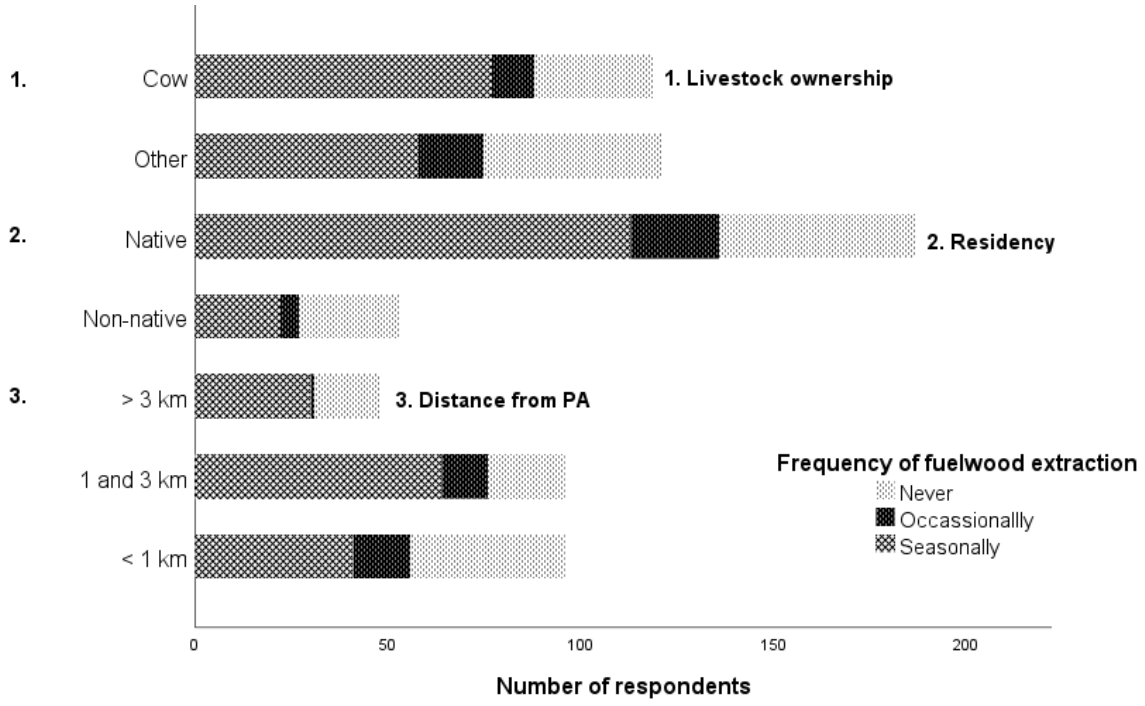

Figure 4: Utilization of fuelwood in relation to 1. residency, 2. distance from the PA boundary[1], and 3. livestock ownership.

provisioning ESs provided by the PA. For fuelwood extraction, 11.7% of respondents visited the PA occasionally, 56.3% visited seasonally and 32.1% of respondents never visited the PA. Fuelwood collection was mostly performed by native residents, although the frequency of collection differed ($\chi 2$ = 10.65, df = 2, N = 240, $p < 0.01$; Fig-4). People who practised livestock breeding, especially cow owners, reported extracting fuelwood seasonally ($\chi 2$ = 10.77, df = 2, N = 240, $p < 0.01$; Fig-4).

Among the tangible benefits contributed by the PA, the perception of fuelwood by local communities is the most important, not only for daily utilization but also for earning income. Factors influencing the perception of local communities toward tangible benefits were evaluated using GLMM analysis, in which socioeconomic variables were used as predictors and villages were used as random factors. The predictor variables influenced how local communities perceived the provisioning ESs mostly obtained from the PA. Residency was identified as the most significant predictor of the perception of local communities for receiving the provisioning ESs (coefficient estimate = 0.81, SE = 0.38, $p < 0.05$; Table 2 and Table 11, *Appendix*).

Table 2. Model-averaged coefficients and standard error for the variables influencing the perception of the PA by local communities for the provisioning ESs

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	0.247	0.767	0.770	0.320	0.749
Age group (35–53 years)	-0.080	0.385	0.387	0.208	0.835
Age group (54 years and above)	0.885	0.555	0.557	1.588	0.112
Age group (18–34 years)	0	.	.	.	.
Livestock ownership (Cows)	0.699	0.454	0.455	1.536	0.125
Livestock ownership (other)	0	.	.	.	.
Residency (native)	0.860	0.388	0.390	2.206	0.027
Residency (non-native)	0	.	.	.	.
Size of farmland 1(1–5 Ha)	0.159	0.334	0.335	0.475	0.635
Size of farmland (more than 6 Ha)	0.301	0.532	0.533	0.564	0.573
Size of farmland (none)	0	.	.	.	.
Education level (primary education)	-0.041	0.274	0.275	0.149	0.882
Education level (higher education)	-0.116	0.367	0.368	0.315	0.753
Education level (no education)	0	.	.	.	.

[1] 1 Acre = 0.4 Ha

Distance (1–3 km)	0.414	0.496	0.497	1.195	0.233
Distance (> 3 km)	-0.067	0.396	0.398	0.175	0.861
Distance (< 1 km)	0	.		.	.
Gender (Women)	0.013	0.113	0.114	0.115	0.909
Gender (Men)	0	.		.	.

3.1.2. Interaction with the PA and perception of the regulating ES

Whether local communities visit the PA for reasons other than tangible benefits was determined using the question "Do you also visit the forest for reasons other than collecting forest products?", and almost all of the respondents (98.3%) admitted they visit the PA for reasons other than resource extraction. Visiting the PA was not generally related to any of the predictor variables. In detail, men visited the PA for reasons other than extraction of forest products, but the difference was not statistically significant ($\chi 2$ = 1.56, df = 1, p = 0.21; Table 3). The determinants of visiting the PA for intangible benefits were identified using GLMM analysis. Land ownership status had no significant effect on visiting PA for intangible benefits (Table 3).

Table 3. Model-averaged coefficients and standard error for the variables influencing the interaction of local communities with the PA for the regulating ESs

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	2.361	0.749	0.751	3.143	0.001
Size of farmland (1-5 Ha)	0.731	0.725	0.72713	1.006	0.315
Size of farmland (more than 6 Ha)	1.078	0.995	0.998	1.080	0.280
Size of farmland (none)	0	.		.	.
Distance (1–3 km)	0.202	0.574	0.575	0.352	0.725
Distance (> 3 km)	0.032	0.271	0.272	0.116	0.907
Distance (< 1 km)	0	.		.	.
Gender (Women)	-0.136	0.387	0.389	0.350	0.726
Gender (Men)	0	.		.	.
Residency (native)	-0.077	0.348	0.350	0.220	0.826
Residency (non-native)	0	.		.	.
Livestock ownership (Cows)	0.089	0.342	0.343	0.259	0.796
Livestock ownership (other)	0	.		.	.

To differentiate clearly between the benefits that the local community received and recognized from the PA, the question "Besides forest products, do you think the PA provides other benefits?" was asked. The answers indicated that the regulation of rainfall, regulation of purified water and regrowth of nearby forests were commonly known regulating ESs. Age was a significant predictor of the perception of intangible

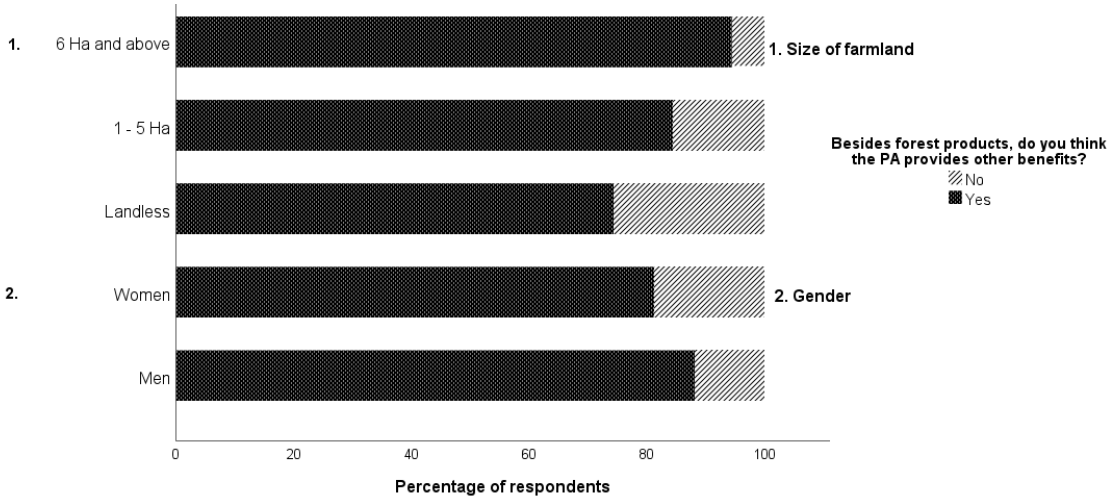

Figure 5: Recognition of intangible benefits from the PA

benefits by the local community, whereas the younger age group (18–34 years) had less recognition of the regulating ESs of the PA ($\chi 2$ = 11.69, df = 2, N = 240, $p < 0.005$; Table 4). People who did not own farmland had the lowest recognition of the regulating ES ($\chi 2$ = 6.65, df = 1, N = 240, $p < 0.01$; Fig- 5 and Table-4).

Table 4. Model-averaged coefficients and standard error for the variables influencing the perception of intangible benefits of the PA by local communities

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	0.640	0.428	0.430	1.488	0.137
Age group (35–53 years)	0.805	0.412	0.414	1.943	0.052
Age group (54 years and above)	1.312	0.566	0.568	2.309	0.021
Age group (18–34 years)	0	.		.	.
Size of farmland (1–5 Ha)	0.496	0.420	0.422	1.174	0.240
Size of farmland (more than 6 Ha)	1.548	0.606	0.609	2.539	0.011
Size of farmland (none)	0	.		.	.
Gender (Women)	-0.043	0.210	0.211	0.205	0.838
Gender (Men)	0	.		.	.
Livestock ownership (Cows)	-0.043	2	0.223	0.194	0.846
Livestock ownership (other)	0	.		.	.

Table 5. Model-averaged coefficients and standard error for the variables influencing the perception of the regulating ESs of the PA by local communities

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	0.559	0.451	0.454	1.231	0.218
Size of farmland (1–5 Ha)	0.192	0.364	0.365	0.525	0.599
Size of farmland (more than 6 Ha)	1.017	0.446	0.448	2.277	0.023
Size of farmland (none)	0	.		.	.
Livestock ownership (Cows)	0.074	0.222	0.223	0.331	0.740
Livestock ownership (other)	0	.		.	.
Gender (Women)	-0.039	0.168	0.168	0.229	0.819
Gender (Men)	0	.		.	.

GLMM analysis was conducted using socioeconomic predictors as fixed effects and villages as random effects. Landless people were observed to have less recognition of the intangible benefits of the PA than landowners, especially those who had more farmland (coefficient estimate = 0.48, SE= 0.4098, $p < 0.05$: Table 4 and Appendix 5). The younger age group (18–34 years) was less likely to recognize the intangible benefits than the older age group, especially those who were 54 years old and older, who recognized more intangible benefits of the PA (coefficient estimate= 1.32, SE= 0.5625, $p < 0.05$; Table 4 and Table 12, *Appendix*).

Among the regulating services, local people especially recognized the regulation of rainfall. After two years in a row of drought, rainfall regulation by the nearby PA was realized to be the most prominent regulating ES. According to GLMM analysis, recognition was influenced by land ownership. People who had more farmland

recognized the regulating ES more, and the difference was significant (coefficient estimate = 1.017, SE= 0.46, $p< 0.05$; Table 5 and Table 13, *Appendix*).

3.1.3. Interaction with the PA and perception of cultural ESs

People who recognized the intangible benefits also mentioned the cultural and spiritual services of the nearby PA. When the question "What is your opinion on the presence of the PA named Shwe Sett Taw in your area?" was asked, answers differed statistically significantly between men and women ($\chi 2 = 16.47$, df = 3, N = 240, $p < 0.001$; Fig. 6) and between those born in the village and those not born in the village ($\chi 2 = 8.75$, df = 3, N = 240, $p < 0.05$). The opinion of the local community on having a PA in their vicinity differed by gender, and men had a more positive perception of the PA than women. The GLMM results confirmed that there was a significant variation in the opinion on the existence of the PA between men and women (coefficient estimate = 0.7, SE=.27, $p < 0.05$; Table 6 and Table 14, *Appendix*).

Table 6. GLMM analysis of the predictors influencing the opinion of the presence of the PA

Corrected model	Coefficient	SE	t	$p \leq$
Intercept	-0.910	0.280	-3.175	0.002
Gender (Women)	0.700	0.270	2.592	0.010
Gender (Men)	0	.	.	.
Age group (54 years and above)	0.410	0.350	1.195	0.233
Age group (35 – 53 years)	0.600	0.310	1.971	0.050
Age group (18 – 34 years)	0	.	.	.

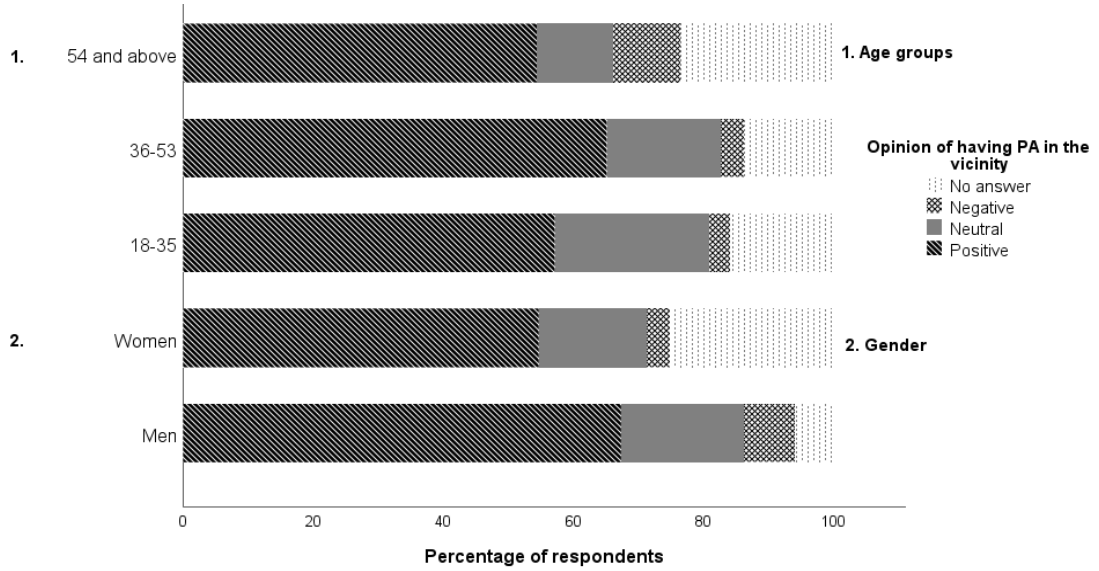

Figure 6: Opinion on the presence of the PA in the vicinity.

3.2. Knowledge of and participation in conservation

The opinion of local communities on future PA establishment was assessed to evaluate conservation support using the question "Do you know any conservation activities around your village?". More than half of respondents (80.4%) answered "Yes" to the question, and 19.6% answered "No." Knowledge of conservation activities, including education and extension, patrolling, monitoring, and reporting, and local community development activities, was significantly explained by land ownership status, with those with more farmlands especially being knowledgeable (coefficient estimate = 1.18 5, SE =0.45, p= 0.009; Table 7 and Table 15, *Appendix*). To assess the participation of local communities in conservation activities related to PA, the question "Are you or any of your family members currently involved in conservation of PA?" was asked. A total of 53% of respondents answered that they had experience with different conservation activities related to the PA. The GLMM results revealed that participation in conservation was explained by land ownership, with people not owning farmland being less likely to participate in conservation than owners of large farmland (coefficient estimate = 1.45, SE=0.43, p = 0.001; Table 8 and Table 16, *Appendix*).

Table 7. Model-averaged coefficients and standard error for the variables influencing the knowledge of local communities about conservation

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	0.966	0.559	0.561	1.721	0.085
Gender (Women)	-0.470	0.451	0.452	1.039	0.299
Gender (Men)	0	.		.	.
Size of farmland (1-5 Ha)	0.920	0.403	0.405	2.273	0.023
Size of farmland (more than 6 Ha)	1.177	0.454	0.457	2.581	0.009
Size of farmland (none)	0	.		.	.
Distance (1–3 km)	-0.116	0.351	0.352	0.328	0.743
Distance (> 3 km)	0.273	0.467	0.467	0.584	0.559
Distance (< 1 km)	0	.		.	.
Education level (Primary education)	-0.044	0.370	0.373	0.119	0.905
Education level (Higher education)	0.161	0.378	0.379	0.424	0.672
Education level (No education)	0	.		.	.

Table 8. Model-averaged coefficients and standard error for the variables influencing the participation of local communities in conservation related to the PA

	Coefficient	SE	Adjusted SE	z value	$p \leq$
Intercept	-0.979	0.940	0.942	1.039	0.299
Education level (Primary education)	1.042	0.885	0.887	1.174	0.240
Education level (Higher education)	0.805	0.690	0.691	1.164	0.245
Education level (No education)	0	.	.	.	.
Size of farmland (1–5 Ha)	0.679	0.377	0.379	1.792	0.073
Size of farmland (more than 6 Ha)	1.391	0.432	0.434	3.207	0.001
Size of farmland (none)	0				
Age group (35–53 years)	-0.250	0.389	0.390	0.641	0.522
Age group (54 years and above)	-0.360	0.532	0.533	0.675	0.499
Age group (18–34 years)	0	.	.	.	.
Gender (Women)	-0.201	0.332	0.333	0.604	0.546
Gender (Men)	0	.		.	.
Residency (native)	-0.060	0.210	0.210	0.287	0.774
Residency (non-native)	0	.	.	.	.
Livestock ownership (Cows)	-0.011	0.102	0.102	0.115	0.908
Livestock ownership (other)	0	.		.	.

4. DISCUSSION

4.1. Effect on the recognition of ecosystem services

The local communities near SSTWS obtain and perceive the different types of ESs provided by the PA based on their responses to different questions of the questionnaire. As the most important provisioning services obtained from the PA, fewer respondents answered that they visit the PA for the extraction of fuelwood and bamboo than for other provisioning services such as fruits and vegetables, medicinal plants, fish, bushmeat, mushroom and fodder. Among 85.4% who reported visiting the PA for provisioning services, 47.1% obtain fuelwood, 25% obtain bamboo and the remaining 4.1% obtain other services. The obtained provisioning services were mainly for used daily livelihood or for earning income, which meant that the basic needs of local communities were fulfilled by provisioning services from the PA (Zhang, J *et al.* 2020). The findings from the study by Guerbois, C and Fritz, H (2017) stated that distance and other sociodemographic factors determine the perception of provisioning ESs.

According to the results, the residency of the respondents had an effect on visiting the PA for acquiring provisioning ESs, with native people not going far into PA to extract provisioning ESs compared to non-native people due to the abundance of services available near their village. Villages in Pwintbyu township, such as Chaung Sone and Magyi Su, rely on the extraction of forest products for daily livelihood and earning income, especially Chaung Sone village, which is located within the buffer zone of the PA, where the land is hilly and there is less farmland. Timber extraction from the PA for household use and earning income was mostly observed in the villages of Minbu (Sagu) due to accessibility and yearly requirements for the religious festival. Bamboo extraction was especially observed in the villages of Pwintbyu and Minbu (Sagu) township and was performed to make traditional bamboo thatches (100 sheets = 6000 MMK, 2017). Due to the lack of electricity accessibility in eight of the ten sampled villages, fuelwood was the most utilized provisioning ES from the PA. The minimum fuelwood consumption was two to four bullock carts 2 per household per year for the

[2] 1 bullock cart = 0.7 ton

combined use of advanced cooking stoves delivered by forest departments and solar batteries according to the data from SSTW management plan in 2019.

Among the tangible benefits and provisioning ESs, fuelwood the most recognized because the legal use rights of forest products differed from that of timber products. If the use rights of timber and other associated products meet the requirements of local communities, the recognition of provisioning ESs might be different. This result supports hypothesis (H1), which proposes that people who easily obtain resources and services have more appreciation and a more positive view of the provisioning services of the PA (Holmes, CM 2003).

Recognition of the provisioning ESs was affected by the ownership of livestock, such as cows and sheep, along with distance and residency. Almost half of the villages (46%) were engaged in cow farming, not only for agricultural activities, as most of the respondents were farmers. Livestock farming, especially cow herding, was practised along the periphery of the PA and in the abandoned farmland inside the PA. According to the respondents who were farmers, they visited the PA or the area near the PA nearly every day for livestock farming. The GLMM results also supported the fact that those who own livestock (cows) visited the PA and perceived the provisioning ESs of the PA more than those who did not own any livestock. The livestock owners who pastured on abandoned farmland inside the PA agreed that fodder quality and availability were better than in the randomly selected pasture site near the village (Songer, MA 2006).

In addition to visiting the PA for the provisioning ESs, the respondents interacted with the PA for its regulating ESs, and these interactions were affected by age, farmland ownership status and livelihood activities. Regulation of rainfall was observed to be the more recognized regulating ESs than other services, such as fresh air, purified water, erosion control and temperature control. Among 98.3% of respondents who responded that they visited the PA for reasons other than acquiring provisioning ESs, 81.7% realized the importance of rainfall PA, while the remaining 6.6% visited the PA for its other services. Unlike men, women were less likely to recognize the importance of regulating services in their daily lives and their locality. The study of gender influence on attitudes towards PA in three PA in Myanmar also supported these

findings of women's less recognition on the services provided by PA in compared to men (Allendorf, TD and Allendorf, K 2013) The respondents who fell in the middle age group (from 36–53 years old) recognized the regulating ESs provided by the PA more than the other two groups. The minimum rainfall was 425 mm ten years before the massive flood in late July 2015 according to the data from SSTW management plan in 2019.

The importance of rainfall as a regulating service was more appreciated by the respondents who had farmland than landless people. A similar result was obtained for the importance of forest regrowth for those who owned farmland compared with those who did not own farmland (Pietrzyk-Kaszyńska, A *et al.* 2012). The GLMM results also supported the fact that farmers w realized the importance of regulating ESs provided by the PA more than individuals with other occupations due to their personal experience with the loss of crop productivity for almost 3 years in a row. This result supported the first hypothesis (H1) assessing the recognition of intangible benefits.

For the assessment of the opinion of local communities toward the cultural and supporting ESs provided by the PA, it was first determined how respondents viewed the PA in general and how they felt about the intangible benefits provided by the PA. The most common answer was that the respondents enjoyed the scenery of the PA when they passed by or observed the nearby forest. Among the 67.5% of people who responded, 34.6% enjoyed the view of the PA, 14.6% felt quiet and peaceful when they got to the forest or saw the forest in the PA, and the remaining 8.3% felt fear when they passed through or saw the PA. There was no difference in sociodemographic variables, especially gender status, regarding the preliminary opinion on the PA in terms of cultural ESs. The GLMM results regarding the attitudes of local communities about the cultural and supporting ESs of the PA showed that gender was a significant variable explaining the difference in perception (Christie, M *et al.* 2012). Women had a more negative perspective than men on the PA in terms of cultural value because they knew less about the PA than men since women have lower education levels in the rural area of Myanmar and focused more on the direct benefits of the PA (Allendorf, TD and Allendorf, K 2013) This result was later supported by the answers of female

respondents who barely visited and experienced the forest in the PA due to the cultural dominance of the head of household and spiritual belief (Amin, A *et al.* 2015). Whether the negative perception of the PA by women was due to their negative feelings or the dryness of the forest, which made them uncomfortable, is controversial. This may be because women express their feelings in personal terms differently from men who show their opinion from a broader perspective. Although they might generally have negative attitudes about the PA, women had the opposite opinion about the environmental contribution of the PA than men (Allendorf, TD and Allendorf, K 2012)

4.2. Effect on the acceptance of PA existence

The socioeconomic determinants of the opinion of the PA and the establishment of more PAs were assessed; 64.6% responded that their responses differed, while 35.4% responded that their perception did not differ. The respondents' individual perceptions and the interaction between themselves and staff of the PA affected their acceptance on the current existence of the PA and the establishment of more PAs (Htay, T 2020). Men accepted the existence of the PA and the establishment of more PAs due to their greater experience with sharing knowledge and participating in activities related to the PA than women. Their experience and knowledge and the close interaction with park staff gave them more positive perceptions of the PA and the establishment of more PAs (Htun, NZ *et al.* 2012). Age was also assumed to be a significant determinant of the local communities' embracing of PA existence and PA establishment. The long-term experience of older people related to the loss of farmland or property due to the establishment of the PA increased their negative perspectives on PA existence and PA establishment(Newmark, WD *et al.* 1993). This finding also supported the abovementioned statement that previous experience relating to the PA, such as the loss of pasture land or farmland, due to changes in the government's rules and policies regarding land use at the periphery of the PA affects perception (Martinuzzi, S *et al.* 2015). Although there were some complaints about farmland loss due to the establishment of the PA in the past, landowners still had positive perception toward the PA which meant the assumption of H1 was supported. However, the respondents

requested extending the buffer zone area along the boundary of the PA to sustain their livelihood as compensation for native farmers (Alkan, H *et al.* 2009).

4.3. Conservation support and PA management

Knowledge of conservation activities was assessed by mentioning the predetermined activities run by the PA. Eighty percent of the respondents knew most conservation activities that were common for their locality, such as extension and education activities, local community development activities and monitoring activities. Their knowledge of conservation activities was associated with the size of farmland owned (Vodouhê, FG *et al.* 2010). Although almost 80% of respondents knew of conservation activities, only 53.3% of the respondents practically participated in the abovementioned conservation activities related to PA. The results of the GLMM analysis similarly indicated that those who owned more farmland participated more in conservation. The ownership of more farmland explained the broader scope of livelihood activities and higher income than those who had small areas of land. More favourable living conditions also increased participation in conservation activities, as discussed by Vodouhê, FG, et.al., (2010), who assessed how communities perceive biodiversity conservation in protected areas in Benin. Farmland ownership was also the major predictor in the assessment of recognition on the service provided by PA to the local people (Htay, T 2020). The result supported the second hypothesis (H2), which proposes that local communities with positive opinions of ESs also support conservation support. Education level also played an important role in participation in conservation activities according to the model results. Respondents who had a higher education level knew more about conservation and participated more than those with a primary education or lower(Allendorf, TD *et al.* 2018).

Respondents' support for the PA and its conservation activities also depended on whether they truly thought that their extraction and dependence affected the biodiversity and resources of the PA. Most respondents accepted that their action could affect the PA, while the remaining respondents argued that they did not overexploit and were not overdependent on the PA and its resources because daily use could not negatively impact the PA (Pietrzyk-Kaszyńska, A *et al.* 2012). One of the interesting

responses was that the depletion of resources from the PA was due to migrants who settled in the forest and extracted the bulk of resources from the PA. Concern about the future resources and biodiversity of the PA led to conservation support and positive response toward the PA. Those who used the PA for livelihood, especially farmers, had less concern about the future of PA biodiversity and resources than landless individuals (Iñiguez-Gallardo, V *et al.* 2021). Lack of high concern by farmland owners reflected past experience and historical conflict related to park management and land use in combination with the particular affluence of farmland ownership and stable economic conditions, which caused the individuals to have less interest in PA resources than those who had subsistence livelihoods (Newmark, WD *et al.* 1993). The study of local communities' attitude at two National Parks in Ghana Dewu, S and Røskaft, E (2018) discussed conservation support of local communities influenced by their personal prosperity to some extent. Those who had positive opinion on conservation activities showed that they were worried about decreases in biodiversity, deforestation, loss of habitats for wildlife species and resource availability in the future(Iniguez Gallardo, V *et al.* 2018). Systematic land use planning was also requested along with conservation.

5. LIMITATION

The study has some limitations required to clarify the absolute perception of local communities towards ESs and PA. Firstly, the importance of each service was not fully representative of the whole area due to some constraints including insufficient parameters for assessing their recognition and complexity of theoretical concept of ESs, and therefore more detail study for recognition of ESs should be undertake with caution if extrapolation of these findings have to be referred. Secondly, the clarification for the importance of each predictor for the averaged and selected models was required to express although the candidate models (with the lowest AIC value) were based on averaging of all possible models from interaction among all of the predictors.

6. RECOMMENDATION

The findings of this study suggested that the interaction of local communities with the PA was mostly related to their livelihoods and socioeconomic backgrounds, in accordance with the results of another study (Htun, NZ *et al.* 2012). Although the dependency of local people on the PA for subsistence livelihoods or economic benefits was not analysed in this study, the benefits for which they depend on the PA were taken into consideration in assessing their personal recognition of ESs. According to the response of local communities regarding their interactions with the PA, the tangible benefits, especially provisioning ESs, attracted their attention because they directly affected their daily livelihoods. Although there were some respondents who recognized the intangible benefits of regulating ESs and cultural ESs, it was not enough to separate them from the direct benefits (Martín-López, B *et al.* 2011). Based on the findings, villages around the PA were more willing to use the PA for provisioning ESs than the other two services. To maintain the sustainability of the PA and enhance the effectiveness of the PA, a resource allocation scheme and comprehensive land use planning were suggested in this study (Vandergeest, P 1996).

Although SSTWS is one of the prioritized PAs for species conservation, especially endemic species of Myanmar, the disturbance of conservation is relatively high, such as illegal catching of conserved species, according to information from PA staff. The local people claimed the illegal activities were due to the intrusion of migrant people into SSTWS. It was intermingled between the requirements of local communities and conservation. Although the respondents' opinions about conservation were not quite low, actual participation could not be determined. The respondents preferred tangible benefits even from conservation activities such as local community development activities. Some suggestions for increasing participation and raising support for conservation are as follows: 1) Comprehensive land use planning, which is essential to reduce the trade-off between the requirements of local communities and conservation; 2) Adoption of integrated community development programs, which include education and people outreach programs; 3) Effective resource allocation to increase the appreciation of native residents for natural ecosystems and ESs in the long term; and

4) In-depth study of the utilization pattern of each ES to set up a prioritized management area for ES and biodiversity conservation.

7. CONCLUSION

To provide effective conservation planning, the forces that connect and decouple those linkages must be understood on multiple scales. At the local level, conservation planning must better understand how people use resources and provide platforms for communicating about resource uses and needs across multiple stakeholder groups. An understanding of how local communities recognize the services obtained from the PA can highlight the priorities of planning to reduce the trade-offs among the different ecosystem services and enhance the effectiveness of conservation of the PA. The interest and perception of local communities in each ecosystem service can be demonstrated by their socioeconomic backgrounds. The willingness to develop more infrastructure within the PA by educated people also pointed out the fact that local people's scarcity of alternative livelihoods increases the negative attitudes toward the PA; in turn, the sustainability and effectiveness of the PA might be affected in the long run.

The main conclusion and recommendation of the research is the need for a participatory process to support and build the necessary capital for sustainable livelihoods to achieve sustainable conservation management in the PA. Despite having positive attitudes toward the PA, the local people's perceptions of the future of life in the PA reflect the influence of their poor socioeconomic circumstances in the village and in the country, which is in a very turbulent process of transition. Therefore, the findings of the study show that the positive attitudes of local people toward the PA can be a source of increased hopefulness about their future if they are engaged with management and decision making regarding the PA through a more participatory process.

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9. Appendix:

Table 9. Correlation matrix, Cramer's V test for predictors

	Gender	**Edu**	**AG**	**Dista**	**Res**	**LS**	**Liv_type**	**OC**
Gnd	NA	0.368	0.216	0.096	0.088	0.143	0.032	0.054
Edu		NA	0.428	0.160	0.148	0.174	0.165	0.086
AG			NA	0.161	0.080	0.228	0.065	0.087
Dista				NA	0.093	0.278	0.121	0.248
Res					NA	0.039	0.146	0.097
LS						NA	0.444	0.576
Liv_type							NA	0.253
OC								NA

Gnd = gender, Edu = education level, AG =age group, Dista = distance, Res = residency,

LS= size of farmland, Liv_type = type of livestock owned, OC= occupation

Cramer's V values reveal the strength of association between two categorical variables (Kotrlik, JW, et al., 2011).

0.01 and < 0.10, negligible

0.10 and < 0.20, weak association

0.20 and < 0.40, moderate association

0.40 and < 0.60, relatively strong association

0.06 and < 0.80, strong association

0.08 and < 1.0, very strong association

Table 10. Model selection table, opinion on receiving intangible benefits

No.	Candidate model	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
34	AG, LS	6	-94.423	201.2	0.00	0.565
42	AG, Gnd, LS	7	-94.309	203.1	1.89	0.219
50	AG, Liv_type, LS	7	-94.321	203.1	1.92	0.216

Table 11. Model selection table, perception of receiving provisioning ESs

No.	Candidate models	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
82	AG, LS, Res	6	-127.003	266.4	0.00	0.249
114	AG, Lv_type, LS, Res	8	-125.342	267.3	0.94	0.156
98	AG, LS, Res	7	-126.497	267.5	1.11	0.143
86	AG, Edu, Liv_type, Res	8	-125.526	267.7	1.31	0.129
81	Liv_type, Res	4	-129.854	267.9	1.51	0.117
84	AG, Dista, Liv_type, Res	8	-125.664	268.0	1.58	0.113
90	AG, Gnd, Liv_type, Res	7	-126.923	268.3	1.96	0.093

Table 12. Model selection table, interaction with PA for provisioning ESs

No.	Candidate models	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
81	Liv_type, Res	4	-84.16	176.50	0.00	0.56
17	Liv_type	3	-85.45	177.01	0.51	0.44

Table 13. Model selection table, recognition of regulating ESs

No.	Candidate model	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
33	LS	4	-136.128	280.4	0.00	0.529
49	Liv_type, LS	5	-135.814	281.9	1.46	0.255
41	Gnd, Liv_type, LS	5	-135.978	282.2	1.79	0.216

Table 14. Model selection table, recognition of cultural ESs

No.	Candidate model	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
3	Dista	4	-131.229	270.6	0.00	0.208
5	Edu	4	-131.730	271.6	1.00	0.126
7	Dista, Edu	6	-129.641	271.6	1.01	0.125
65	Res	3	-133.117	272.3	1.71	0.088
11	Dista, Gnd	5	-131.066	272.4	1.76	0.086
67	Dista, Res	5	-131.071	272.4	1.77	0.086
9	Gnd	3	-133.228	272.6	1.93	0.079

Table 15. Model selection table, knowledge of conservation

No.	Candidate model	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
41	Gnd, LS	5	-111.370	233.0	0.00	0.246
43	Dista, Gnd, LS	7	-109.478	233.4	0.44	0.197
33	LS	4	-112.763	233.7	0.70	0.173
45	Edu, Gnd, LS	7	-109.857	234.2	1.20	0.135
35	Dista, LS	6	-109.857	234.2	1.20	0.135
47	Dista, Edu, Gnd, LS	9	-107.804	234.4	1.39	0.122

Table 16. Model selection table, participation in conservation

	Candidate model	**Df.**	**logLik**	**AICc**	**ΔAIC**	**Weight**
37	Edu, LS	6	-142.183	296.7	0.00	0.174
42	AG, Gnd, LS	7	-141.490	297.5	0.74	0.121
38	AG, Edu, LS	8	-140.455	297.5	0.81	0.116
45	Edu, Gnd, LS	7	-141.638	297.8	1.03	0.104
46	AG, Edu, Gnd, LS	9	-139.580	297.9	1.21	0.095
101	Edu, LS, Res	7	-141.809	298.1	1.37	0.088
41	Gnd, LS	5	-143.952	298.2	1.43	0.085
33	LS	4	-145.101	298.4	1.64	0.077
102	AG, Edu, LS, Res	9	-139.857	298.5	1.77	0.072
53	Edu, Liv_type, LS	7	-142.064	298.6	1.88	0.068

APPENDIX: SURVEY QUESTIONNAIRE
General Information

I. Socioeconomic information

1. Age

   18-29 ( ) 30-39 ( ) 40-49 ( ) 50 and over ( )

2. Gender and family head status

   Male ( ) Female ( )

3. Religion

   Buddhism ( ) Christianity ( ) Islam ( ) Other ( )

4. Education

   No education ( ) Monastery education ( ) Primary school ( )

   Secondary school ( ) Education beyond secondary school ( )

5. How many years have you lived in this village?

Less than 1 year ( ) Between 2 and 10 years ( ) More than 10 years ( ) I was born in this village ( )

6. What are the major livelihood activities for your household?

No.	**Livelihood activity**	**Activity with highest income for household**	**Frequency (1 to 3)**
(1)	Agriculture		
(2)	Fishing		
(3)	Gold mining		
(4)	Livestock farming		
(5)	Hunting		
(6)	Home shop		
(7)	Business		
(8)	Shifting cultivation		
(9)	Other (specify)		

Frequency: 1. Occasionally 2. Seasonally 3. Daily

7. Do you own the land for cultivation? Yes ( ) No ( )

If yes, how big is it? ( ) acres

Where is the land?

Private farm ( ) >5 miles from a PA ( ) 1-5 miles from a PA boundary ( ) <1 mile from a PA boundary ( ) Inside a PA ( )

8. If the land is inside a PA, how long have you owned and used the current cropland?

One year ( ) A few years ( ) 10 years ( ) For generations ( )

9. If the land is inside a PA, what is the soil fertility condition?

Very bad ( ) Bad ( ) Neutral ( ) Good ( ) Very good ( )

10. If inside PA, which crops do you mainly grow? ( )

11. Do you own animals? Yes ( ) No ( )

If yes, what type of animals do you have in the greatest number ( )

12. Where do you pasture your animals?

Private farm ( ) >5 miles from a PA ( ) 1-5 miles from a PA boundary ( ) <1 mile from a PA boundary ( ) Inside a PA ( )

Why? ( )*

I. Ecosystem services

(a) Provisioning services

13.		Do you go to the forest to extract forest products? Yes ( ) No ( )						
		If yes, fill in the table. If no, go to question no. 14.						
No.	**Resources**	**Frequency of Collection** 1. Occasionally 2. Seasonally 3. Monthly 4. Weekly 5. Daily	**Part of PA** 1. No use 2. <5 miles from a PA 3. Inside a PA 4. Both 2 And 3	**Duration of resource use** 1. One year 2. 5 years 3. 10 years 4. For generations	**Trend of resource availability** 1. Decline 2. Stable 3. Increase	**The most important resources *(1 to 5)**		
						Daily livelihood	Earning income	Both
(1)	Timber, poles and posts							

(2)	Fuelwood							
(3)	Fruits and vegetables							
(4)	Medicinal plants							
(5)	Mushrooms							
(6)	Bush meat							
(7)	Thatches							
(8)	Fish							
(9)	Fodder							
(10)	Birds							
(11)	Others							

***Importance (1) 0–5% (2) 25% (3) 50% (4) 75% (5) 100%**

(b) Regulating services

14. Do you also visit to the forest for a reason other than collecting forest products? Yes ( ) No ( )

If yes, how often do you visit to the forest?

Occasionally ( ) Seasonally ( ) Monthly ( ) Weekly ( ) Daily ( )

15. Are you aware of any changes to forest and weather condition in the PA in the past 10 years?

Yes ( ) No ( ) Not sure ( )

If yes, what have the changes been?

(1) No change in the forest, but the weather is changing.

(2) Bad weather after deforestation/degradation.

(3) Good weather when forest conditions are good.

16. Besides forest products, do you think the PA provides other benefits?

Yes ( ) No ( ) Not sure ( )

If yes, what kind of benefit do you get for your locality? If no, go to question 17.

No.	**Benefit/Service**	**Immediately appreciated service**	**Trend in the resource compared to the past 10 years** ***(1 to 5)**	**Importance of the benefit/service** ****(1 to 5)**	
				For you and your family	For all villages around the PA
(1)	Fresh air				
(2)	Purified water				
(3)	Rainfall				
(4)	Temperature				

(5)	Flooding				
(6)	Drought				
(7)	Erosion control				
(8)	Forest regrowth				
(9)	Other				

***Trend 1. Much worse 2. Somewhat worse 3. The same 4. Somewhat better 5. Much better**

****Importance (1) Not important (2) 1–5% (3) 6–50% (4) 52–75% (5) 76–100%**

(c) Cultural services and supporting services

17. How do you feel when you pass by the forest or when you look at the forest?

I enjoy the view ( ) I feel quiet ( ) I feel scared ( ) Not sure ( )

Why you feel like that?

Personal experience ( ) People around me ( ) Local belief ( ) Other reasons ( )

18. What is your opinion on the PA called Shwe Sett Taw in your area?

Strongly negative ( ) Negative ( ) Neural ( ) Positive ( ) Strongly positive ( )

Why do you think it is positive (or) negative?

No.	Benefit/Service	Immediately appreciated service	Importance of the service *(1 to 5)	
			For yourself currently	For the long-term
(1)	Aesthetics (scenery)			
(2)	Tourist attraction			
(3)	Employment opportunities			
(3)	Religious importance			
(4)	Local identity (being a native)			
(5)	Shelter			
(6)	For future generations			
(7)	Support for soil quality			
(8)	Conservation			
	Loss/fear			
(9)	Limitation of more resources			
(10)	Crop raiding			
(11)	Wildlife disease			
(12)	Other			

***Importance (1) Not important (2) 1–5% (3) 6–50% (4) 52–75% (5) 76–100%**

18. Do you want to permanently move to another place for more resources/a better environment?

Yes ( ) No ( ) Not sure ( )

19. Should more areas like this sanctuary be established in the country?

Yes ( ) No ( ) Not sure ( )

20. Would you allow infrastructure construction to be initiated in your area?

Yes ( ) No ( ) Not sure ( )

If yes, why? ( )

If no, why? ( )

III Knowledge and conservation support

22. Do you know any conservation activities around your village? Yes ( ) No ( )

What are they?

23. Are you or any of your family members currently involved in conservation of PAs? Yes ( ) No ( )

If yes, what kind of activities? ( )

24. Do you think local people's resource extraction has impacts biodiversity?

Yes ( ) No ( ) Not sure ( )

If yes, please rate the degree of impact

Very low ( ) Low ( ) Medium ( ) High ( ) Very high ( )

25. Do you have any concerns about the future resources and biodiversity of PAs? Yes ( ) No ( )

If yes, what is it? ……

26. Do you know the restrictions, rules and regulations of PAs?

Yes ( ) No ( ) Not sure ( )

If yes, what are they? ( )

How do they affect PAs? ( )

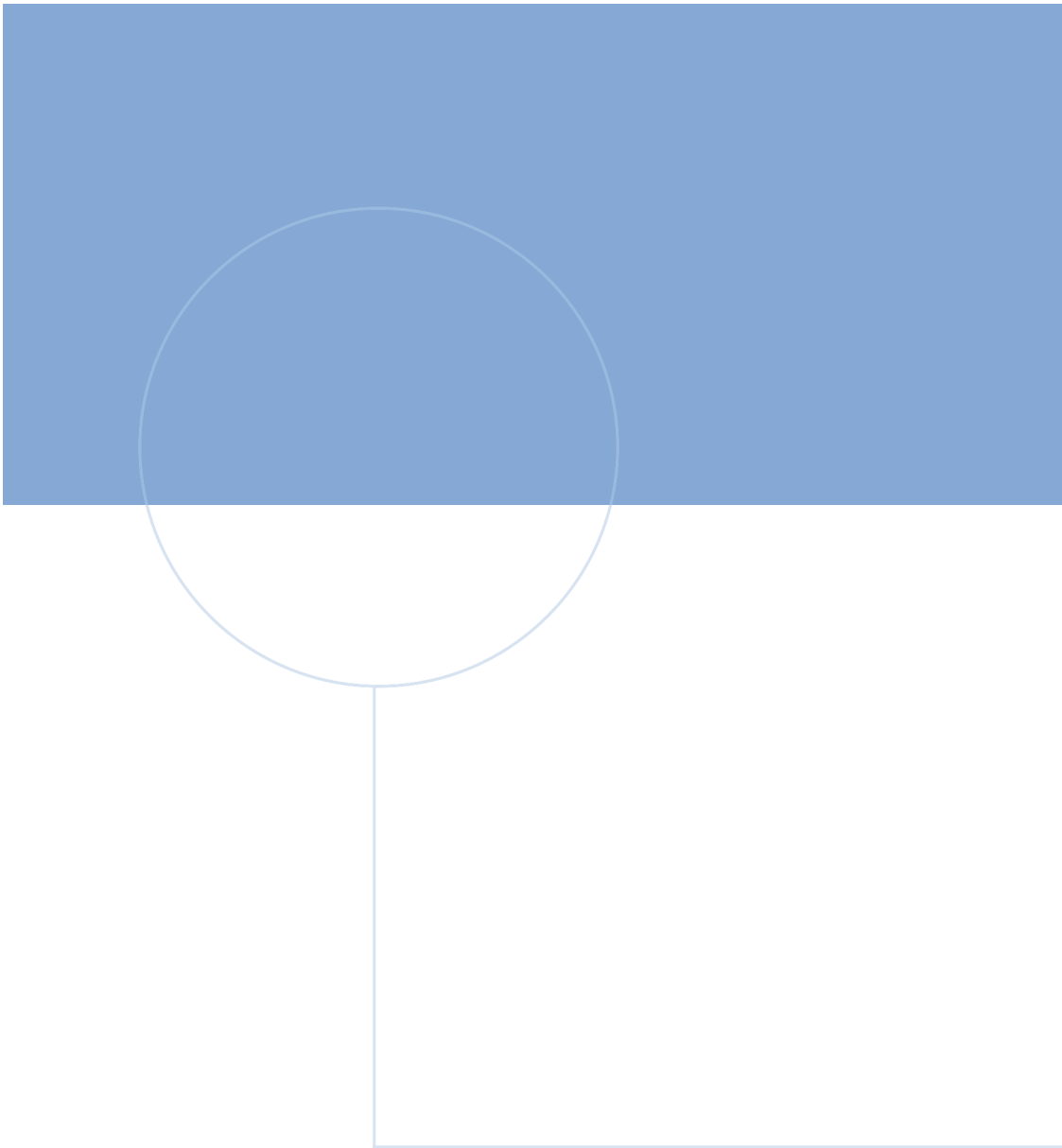
27. In your opinion, who should be responsible for the future management of PAs?

Forest department ( ) Local community ( ) Other ( ) Combination ( )

To what percent should each organization be involved?

Less than 50% ( ) Between 50 and 70% ( ) 100% ( ) Equally ( )

Thank you very much



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