Master's thesis

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

Su Shwe Sin Phyoe

Factors influencing local communities' attitudes toward protected areas: A comparative study of five different PAs in Myanmar

Master's thesis in Natural Resource Management
Supervisor: Eivin Røskaft
July 2022

NTNU
Norwegian University of
Science and Technology

Su Shwe Sin Phyoe

Factors influencing local communities' attitudes toward protected areas: A comparative study of five different PAs in Myanmar

Master's thesis in Natural Resource Management
Supervisor: Eivin Røskaft
July 2022

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

NTNU
Norwegian University of
Science and Technology

Table of Contents

List of Figures

List of Tables

List of Abbreviations

BANCA	Biodiversity and Nature Conservation Association
CWS	Chatthin Wildlife Sanctuary
GLMM	Generalized Linear Mixed Model
IBA	Important Bird Area
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
IWS	Indawgyi Wildlife Sanctuary
MCA	Multiple Correspondence Analysis
MWWS	Moeyungyi Wetland Wildlife Sanctuary
NTNP	Natma Taung National Park
PA	Protected Area
PAs	Protected Areas
PCA	Principle Component Analysis
SPSS	Statistical Package for the Social Science
SWS	Shwe Sett Taw Wildlife Sanctuary
UNESCO	United Nations Educational, Scientific and Cultural Organization

Acknowledgement

First and foremost, I would like to express my heartfelt thanks to my supervisor, Professor Dr. Eivin Røskaft (Department of Biology, Norwegian University of Science and Technology - NTNU) for his invaluable guidance and endless support throughout my study. Without his patience, encouragement, and immense knowledge, I would not have been able to complete my thesis, especially during this difficult time in Myanmar.

Secondly, I special thanks to the Norwegian Environment Agency (NEA) for their financial assistance throughout my master journey. My sincere thank also goes to Ms. Vibeke Husby and Mr. Jan Petter Hubert Hansen from the Norwegian Environment Agency for their kindness, care, and moral support.

I would also like to thank Zaw Min Thant, Khin Nyein San, Zin Phyo Han Htun, Thazin Htay and Hsu Yee Kyaw for allowing me to use their data. Additionally, this study would not have been accomplished without the continual guidance, constructive criticism, useful advice, and insightful conversation provided by Zaw Min Thant (PhD candidate, NTNU), Thazin Htay (PhD candidate, NTNU) and Hsu Yee Kyaw. They gave me their precious time and effort and so I specially thank to them.

I also want to express my sincere gratitude to my beloved friends, Stig-Anders Sørensen, Ye Htut Aung (Peter), Afrida Iqbal, Sonia Pujara, Steff Cherise, Aljona Nowokreschenow, and Rakeb Messy for being with me throughout my master journey. With their love, warmth, and best mental support on me, I was motivated to finish my study. I am lucky to have these friends in my life.

Finally, my greatest appreciation goes to my mother, Khin Mar Wai, my brother, Zwe Win Htutt, and my family members for being the reason of working hard on my study although they cannot be physically present with me.

Abstract

Protected areas (PAs) are one of the most effective mitigation strategies to reduce anthropogenic pressures on biodiversity and natural resources. However, the rights and involvements of local communities living in the vicinity of PAs have often been neglected in the PA management, which has created conservation conflicts and failures of conservation targets. Therefore, understanding local attitudes toward PAs becomes important in developing conservation strategies. To understand people-park interactions better, and to balance a trade-off between conservation and development, comprehensive attitudinal studies are required. This study aims to assess the community attitudes toward five PAs in Myanmar; Chatthin Wildlife Sanctuary (CWS), Indawgyi Wildlife Sanctuary (IWS), Moeyungyi Wetland Wildlife Sanctuary (MWWS), Natma Taung National Park (NTNP) and Shwe Set Taw Wildlife Sanctuary (SWS), by investigating how sociodemographic, resource dependency, benefit gained from PAs and individual PA characteristics influence community attitudes toward PAs and conservation support. Questionnaire surveys were conducted with 1099 local households. Results showed that people who live closer to the PAs were more dependent on the PA resources for their livelihoods than people from intermediate and further distances. Those who depended on the resources acknowledged the PA benefits more than people who were less dependent on such resources. Furthermore, those who recognised the benefits expressed more positive attitudes towards the PAs. Occupation also played an important role in determining the attitudes as fishermen had more positive attitudes than farmers. Men were more aware of the conservation challenges and had more conservation knowledge than did the women. People who had previous experience in conservation, or had conservation knowledge, were more willing to conserve. Results also indicated that spatial differences and PA characteristics (PA shape, PA size, PA age and IUCN categories) could also influence the attitudes. This study suggests that the importance of multiple socioeconomic factors in developing future PA conservation strategies, while recognising context dependent nature of local attitudes, driven by PA characteristics and management.

Keywords: Attitudes, benefits, characteristics, conservation, dependency, protected areas.

1 Introduction

1.1 Background

The wellbeing and sustainability of life on earth depend on healthy planet and its balanced ecosystems (IPBES, 2019). However, during the past decades, the anthropogenic pressure on biodiversity and ecosystems has increased, resulting in the extreme loss of habitat and species (Pereira et al., 2012; Afriyie et al., 2021). IPBES (2019) stated that due to human actions that negatively impact these species, more than one million of the planet's animal and plant species have gone extinct and many of existing species are under pressure of ongoing extinction. The overexploitation of natural resources is one of the major drivers of the loss of biodiversity and ecosystem services (IPBES, 2019). Increased land use for agriculture, industrialization and urbanization derived from an increasing human population have led to fragmentation and deterioration of natural habitats (IPBES, 2019). Additionally, the rising demand for animal products, which has expanded along with human growth also becomes another threatening factor for the wildlife (Holmern, 2007). If no urgent actions are taken to reduce the pressure of these drivers, the rate of the loss of species will likely increase ten to one hundred times compared to the past decades (IPBES, 2019). The extinction of local wildlife species may have catastrophic effects on biodiversity and the functioning of the entire ecosystem, as well as the wellbeing of people who depend on biodiversity and natural resources (Naiman, 1988; Sinclair et al., 2003; Ripple & Beschta, 2004; Lyons et al., 2005; Holmern, 2007).

The establishment of protected areas (PAs) is expected to be one of the most effective mitigation strategies to reduce the current pressure on biodiversity because it can ensure sustainable utilization of natural resources (BANCA, 2011). PAs include various ecosystems such as terrestrial, freshwater, and marine ecosystems. They provide different kinds of ecosystem services, including provisioning, supporting, regulating and cultural services to the people. Additionally, they are the main habitats for a wide variety of wildlife species that are interlinked and interdependent with each other (BANCA, 2011). Such positive outlooks about PAs have increased in number over the last two decades (Birner et al., 2006). Currently, 15.78% of terrestrial and 8.13% of marine areas are covered by global PA systems. Even though regulations and strategies for biodiversity conservation have been strengthened, the threats to biodiversity are continuously growing and the rate of biodiversity loss is continuing between 2011 and 2020 (IUCN, 2022). As a result, PAs and other important biodiversity areas (including KBAs) are expected to be established under the post-2020 global biodiversity framework to cover 30% of the earth by 2030 (IUCN, 2022).

Although PAs can provide significant livelihood benefits, they inevitably face conflict with increased biological, social and cultural challenges (Lewis, 1996). According to Kimengsi et al. (2019), PAs can also be described as "natural resource battlefields" because of the complicated conflicts arising from diverse interests. Most of these conflicts are linked to the disregard for the locals' customary rights and socio-economic needs of the local communities as well as the PAs' attractions to invade (which might be characterised as "greed") (Birner et al., 2006).

When a people-park relationship is studied, it is frequently found that different stakeholders, i.e., local, or indigenous people, policymakers, and park staff, are involving. As they are from different backgrounds, they possess diverse views and interests in the park (Røskaft et al., 2007). However, during the last decades, local people have been marginalized from PAs with strict conservation laws and regulations, frequently called the "fences and fine" approach (Guzman et al., 2020). This approach has created an adverse failure of biodiversity conservation and protected area management. Therefore, conservationists around the world have brought attention to the significance of local communities in the management of PA. This has resulted in a large number of research investigations on community attitudes toward PAs, perceptions of the benefits and challenges provided by PAs, knowledge, and awareness of conservation management actions. These include studies on community attitudes toward conservation (Infield, 1988; Sekhar, 2003; Ferreira & Freire, 2009), the factors that can influence the conservation attitudes (Ormsby & Kaplin, 2005; Kideghesho et al., 2007; Palomo et al., 2014; Aung, 2020), the impacts of wildlife-related conflicts on the attitudes (Gillingham & Lee, 1999; Holmern & Røskaft, 2013). These studies highlighted that local people living near PAs can influence the sustainability of PAs in both positive and negative directions, depending on the PA management strategy (Ormsby & Kaplin, 2005). Therefore, the involvement of local communities and the use of an interdisciplinary approach are essential for the sustainable protection of biodiversity in PAs (Kimengsi et al., 2019).

The understanding of community attitudes plays an important role in making the decision of conservation strategies, as it serves as a bridge between people and the park. Attitudinal studies are often used as a surrogate of peoples' behavioural intentions concerning biodiversity conservation because an attitude is driven by an individual person's like or dislike, beliefs, and his or her behaviour in relation to a particular object (e.g, PA, species, or conservation program) (Beedell & Rehman, 2000; Røskaft et al., 2007; Ajzen & Cote, 2008). In PA management, attitudinal studies are often regarded as an essential element to evaluate local communities' attitudes and beliefs about PAs, PA management effectiveness through time and conservation activities (Bragagnolo et al., 2016). Local people's attitudes towards PAs can be developed by evaluating the benefits and costs that PAs can provide (Røskaft et al., 2007). However, these can differ depending on the different people with various backgrounds and experiences (Røskaft et al., 2007).

Attitudinal studies are required in every PA all over the world, especially in developing countries where natural resources are rich, but the countries are poor. In these countries, there are many conflicts between natural resource management authorities and local communities with rising poverty. Additionally, poor governance (lack of effective laws and regulations, lack of proper boundary demarcation, inadequate compensation, poor communication between PA staff and local communities), lower level of education and lack of employment opportunities can affect the behaviour or actions of local people and create negative relationships between PA management and local people (Pullin et al., 2013). Myanmar, as a developing country has no exception in this regard.

Myanmar possesses a biologically diverse habitats and ecosystem, favourable to many wildlife species, including threatened and endemic species (Allendorf et al., 2006). The country has 14 representative ecoregions and among these, 8 ecoregions are considered as vulnerable and critically endangered according to habitat fragmentation and only 1% of these regions are included in protected areas (Center for Responsible Business, 2018). There are 53 PAs in Myanmar covering 6.58% terrestrial and 0.48% marine areas. However, natural resources and biodiversity in Myanmar are under huge pressure driven

by deforestation, overexploitation, illegal logging and hunting, limited law enforcement, political instability, encroachment and poaching together with an increasing human population (Aung, 2007). These challenges intensify the role of Myanmar's PAs as not being effective with a sustainable conservation (Allendorf et al., 2006). Additionally, in Myanmar, there are complex and deep relationships between protected areas and indigenous people who have a long history with their customary land and therefore, understanding the attitudes of local people plays an important role in the strategic management of PAs in Myanmar (Aung, 2007).

Although many studies on community attitudes toward protected areas have been conducted in Myanmar (Htun et al., 2011; Allendorf et al., 2017; Kimengsi et al., 2019), most of them focus on individual PAs. Attitudinal studies are context dependent and the results from one PA may not be generalizable to another (Allendorf, 2010). A large-scale study representing diverse geographical, and socio-cultural landscapes is required for a more comprehensive conclusion and decision support for PA management in Myanmar (Allendorf, 2010). By developing comparative studies between different protected areas, not only basic issues of people-park interactions can be tested clearly and but also a balance between conservation and development needs can be developed (Allendorf, 2010). This study aims to fill this gap by comparing five different protected areas in Myanmar.

1.2 Objectives

The overall objective is concerned with the influence of multiple factors (sociodemographic, resource dependency and benefits gained from PAs) on the perception of local people living near PAs in Myanmar. For the specific objectives, this study aimed to

1. Test local communities' resource dependency on PAs and their perception of benefits gained from the PA
2. Assess communities' attitudes towards the presence of PA
3. Assess communities' awareness of PA rules and regulations as well as conservation challenges
4. Test similarities and disparities of these underlying factors among five different PAs.

1.3 Hypotheses

It was hypothesized that:

Hypothesis (1): Local communities' resource dependency on PA resources and perceived benefits from PAs vary with sociodemographic factors (gender, age, education, occupation, residency, distance to PA).

Hypothesis (2): Local communities' attitudes towards PAs are influenced by resource dependency level, benefits recognition, and sociodemographic attributes.

Hypothesis (3): Resource dependency, benefit recognition and sociodemographic factors have a positive effect on the conservation awareness and participation of local people.

Hypothesis (4): Residents living close to PAs have more positive attitudes than people living further away from the PA.

Hypothesis (5): The perceptions of residents differ among five different PAs in Myanmar.

2 Methodology

2.1 Study Areas

Five protected areas representing two different ecosystems (terrestrial and wetland) were selected to understand local people's perceptions of PAs in Myanmar. The selected PAs included three terrestrial PAs; Chatthin Wildlife Sanctuary (CWS), Natma Taung National Park (NTNP), and Shwe Set Taw Wildlife Sanctuary (SWS) and two wetland PAs; Indawgyi Wildlife Sanctuary (IWS) and Moeyungyi Wetland Wildlife Sanctuary (MWWS).

CWS is located in Kanbalu and Kawlin Townships of the Sagaing Region, upper Myanmar (Figure 1) (BANCA, 2011). It was established in 1941(BANCA, 2011). It is home to the endangered Eld's deer (*Cervus eldi thamin*) which is a native species of Myanmar (Allendorf et al., 2006). The main threats to this sanctuary are poaching and extraction of natural resources including timber and other non-timber forest products (Allendorf et al., 2006). As the communities near the PA rely on natural resource-based livelihoods, PA management allows subsistence use of fuel wood and NTFP within the buffer zone (Allendorf et al., 2006).

NTNP is located in Matupi, Mindat and Kanpetlet Townships of Chin State, western Myanmar (Figure 1) (BANCA, 2011). It was established as a national park in 1997 (BANCA, 2011) and recognized as an ASEAN heritage park in 2013 (UNESCO, 2014). It is an important watershed area of two rivers and was regarded as an important bird area (IBA) in 2004 (BANCA, 2011). Additionally, it is the main habitat for many world endemic plant species (San, 2017). The main threatening factors to the park include human settlements inside and outside the park, poaching and shifting cultivation (BANCA, 2011).

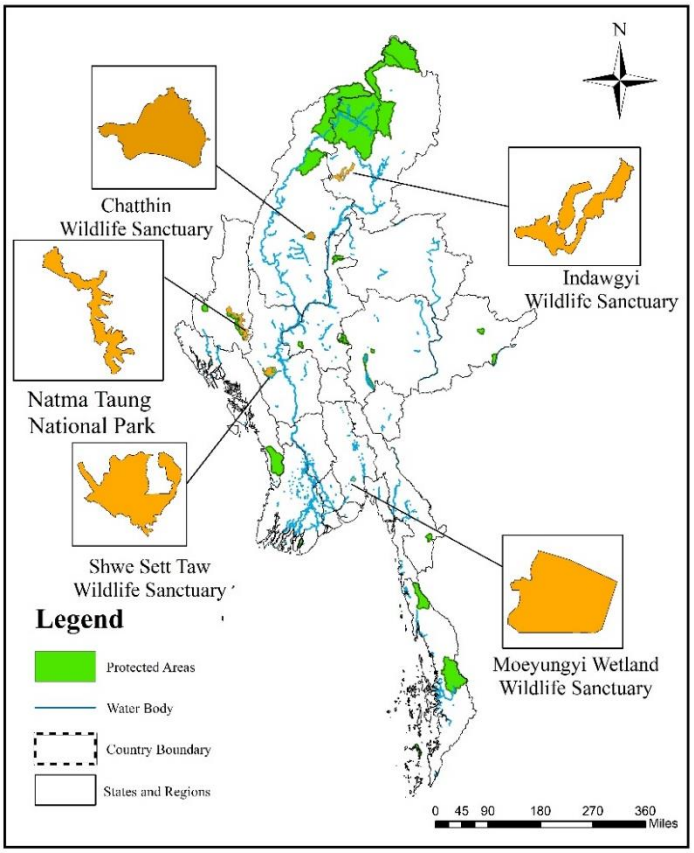


Figure 1: *Locations of five studied PAs in Myanmar*

SWS is situated in the central region of Myanmar (Figure 1) (BANCA, 2011). It includes Minbu, Pwint Phyu, Ngape and Saytotetaya Townships of the Magwe Region (BANCA, 2011). It is bounded by two streams, the Mone and Mann streams (BANCA, 2011). It was established in 1940 (BANCA, 2011). It is part of a dry zone terrestrial ecosystem. It is the habitat of many endangered species, including Myanmar native Eld's deer and Burmese star tortoise (*Geochelone platynotan*), together with other globally threatened species (Dhole (*Cuon alpinus*), Sunda pangolin (*Manis javanica*)) (BANCA, 2011). Major threatening factors to the sanctuary are hunting protected animals and other species and increased encroachment in the sanctuary and human settlements in the buffer area (BANCA, 2011). Shifting cultivation, construction of hydroelectric dams and cable lines are also threatening the area (Kyaw, 2021). Local communities are allowed to collect fuelwood and small nontimber forest products in the buffer zone (Kyaw, 2021).

IWS is located in Monyin Township of Kachin State, upper Myanmar (Figure 1) (BANCA, 2011). It is situated in a remote and inaccessible region compared to other PAs. It was established in 2004 to protect Indawgyi Lake and its watershed system (BANCA, 2011). It was established as a Ramsar site in 2016 (Wetland convention, 2016), and it has become an ASEAN heritage site since 2013 (UNESCO, 2014). It is a combination of terrestrial and wetland ecosystems (BANCA, 2011). It was recognized as an important bird area (IBA) in 2004, as it is the habitat of several threatened bird species (BANCA, 2011). The main conservation challenges for this PA include overharvesting of terrestrial and aquatic resources, i.e., hunting and fishing, increasing land use for agriculture and shifting cultivation practices (Than 2011). In addition, gold mining activities along the streams that flow into the lake are also threatening the biodiversity in that area (Mcinnes et al., 2016).

MWWS is located in Bago Township, Bago Region of the lower part of Myanmar (Figure 1). It is an artificial lake constructed in 1904 (BANCA, 2011). It can provide wetland habitats for migratory birds, aquatic species and some reptiles and amphibians. It is the first Ramsar site in Myanmar, which was designated in 2004 (Davies et al., 2004). Current threats in this area include overfishing and illegal fishing using electricity or explosives, overexploitation of timber and fuelwood in watershed areas, human encroachment, and expansion of the land for agricultural practices (BANCA, 2011). The extraction of natural resources, including fishing, is restricted in the core zone (BANCA, 2011). Table 1 summarizes the five protected areas.

Table 1: *Summary description of five protected areas in Myanmar*

	CWS	**NTNP**	**SWS**	**IWS**	**MWWS**
Location (Figure 1)	Upper Myanmar, Kanbalu and Kawlin Townships, Sagaing Region	Western Myanmar, Matupi, Mindat and Kanpetlet Townships, Chin State	Middle Myanmar, Minbu, Pwint Phyu, Ngape, Saytotetaya Townships, Magwe Region	Upper Myanmar, Monyin Township, Kachin State	Lower Myanmar, Bago Township, Bago Region
Size (km^2)	269	723	553	815	104
Established Year	1941	1997	1940	2004	1988

Habitat	Indaing Forest, Mixed Deciduous Forest (Dry Upper), Grassland	Hill forest (Dipterocarp, pine), Grassland	Mixed Deciduous Forest (Dry Upper), Mixed Deciduous Forest (Moist Upper)	Mixed Deciduous Forest (Moist Upper, Bamboo), Wetland, Evergreen Forest (Riverine), Hill Forest (Pine Forest)	Wetland
Key Resources	Eld's Deer, Sambar Deer, Barking Deer, Gaur	Hilly Ecosystem, Endemic plant species diversity, Wild Orchid, Gaur, Serow, Goral, White-blowed Nuthatch, Avifauna	Dry Zone Ecosystem, Eld's Deer, Sambar Deer, Barking Deer, Gaur, Burmese Star Tortoise,	Wetland Ecosystem, Hoolock Gibbon, Burmese Bushlark, Hooded Treepie, Great Hornbill, Slender-billed Vulture, White-rumped Vulture, Himalayan Vulture	Wetland Ecosystem, Water Birds
IUCN category	IV	II	IV	IV	IV
Data collected by	(Thant, 2017)	(San, 2017)	(Kyaw, 2021)	(Htay, 2020)	(Hanhtun, 2018)
Data collected year	2016	2016	2021	2019	2017

Source: Myanmar Protected Areas; Context, Current Status and Challenges (BANCA, 2011).

2.2 Types of Data

Data were collected by five former master's students at NTNU: Thant (2017), San (2017), Hanhtun (2018), Htay (2020), and Kyaw (2021), who studied community attitudes towards the PA. Questionnaire surveys were used in all studies, and datasets generally included socioeconomic data, resource dependency on the PA, perceptions of benefits and costs from the PA as well as attitudes towards the PA and conservation awareness. However, these datasets were not consistent for all PAs. For instance, perceptions of costs from the PA were not available in some PAs (NTNP, SWS). Therefore, this study used the data that were consistently available to all PAs. These included 1) socioeconomic data (gender, age,

education, occupation, residency, distance to PAs), 2) resource dependency on the PA, 3) perception of benefits from the PA, 4) attitudes towards the PA and 5) conservation awareness. In addition to these factors, PA characteristics such as age (established year), size (area in km^2), shape (elongated or wide), types (terrestrial or wetland), IUCN category (Ia, Ib, II,III,IV,V,VI), presence of clearly defined management zones and population density (number of villages around the PAs) can also influence the attitudes of nearby communities (Fu et al., 2004; Andrade & Rhodes, 2012). Therefore, PA characteristics were also included as additional determinants.

2.3 Data Sorting and Cleaning

Based on the similarities and differences between the five questionnaires, a new questionnaire format was created that was able to cover all different PAs. As different master's students made different wordings in their questions, it was challenging to transform similar questions into new categories that could represent all PAs. Additionally, missing data were another challenge when cleaning the data. Therefore, a threshold was established to deal with them. If data were lacking in only one PA, they were recorded as missing values, but if data for two or more PAs were missing, these questions were skipped.

For sociodemographic data, gender was categorized as male and female. Age was categorized into four age groups (18-29, 30-39, 40-49, 50 years and above). Education was transformed into three groups (no education, primary, secondary, and above). The category "monastery education" used in some studies was moved into the category "primary education". Occupation was reclassified into three groups (farmers, fishermen and others). Occupations that could not be regarded as farmers or fishermen, such as government staff, part-time workers, and own businesses, were moved under the category "others". Respondents born in the study villages were recorded as "native", whereas others were grouped as "non-native (immigrants)". The distance between the centre of each village and the boundary of PAs was calculated in "Google Earth Pro" and categorized as near (<1 km), intermediate (1-4 km) and far (>4 km).

Resource dependency on the PA was recorded in binary responses (yes/no). Local perceptions towards conservation and PAs were categorized as perceived benefits from PAs (yes/no), opinion of the existence of PAs (negative, neutral, positive), perception of the impact of resource use on biodiversity (yes/no), awareness of the current challenges (yes/no), knowledge of conservation activities (yes/no), and willingness to conserve (yes/no).

PA characteristics were concerned with types, IUCN categories, age, size, shape and population density around PAs (Appendix 1). The presence of clearly defined management zones was removed, as all PAs had these zones, and there was no variation in the data. The type of PA was categorized into terrestrial or wetland. In IUCN categories, there were only two categories: II and IV for selected study sites. PA age was categorized into young (<20 established years), medium (20-40 years) and old (40 years and above). PA size was categorized into small (<200 km^2), medium (200-500 km^2) and large (500 km^2 and above). PA shape was categorized as wide and elongated based on the shape of PAs. For population density, the number of villages around the PAs was taken and categorized as few (<20 villages), medium (20-40 villages) and many (40 villages and above). For data cleaning, SPSS version 27 was used (IBM Corp, 2020).

2.4 Data Analysis

Data obtained from the combination were analysed in SPSS version 27 (IBM Corp, 2020) and R version 4.1.0 (R Core Team, 2021). First, to understand the frequencies and distribution of variables, univariate analysis was first conducted. Next, chi-square tests were performed to examine significant differences between predictor and response variables. Finally, generalized linear mixed models (GLMMs) were used to investigate the factors affecting 1) resource dependency, 2) perceived benefits, 3) perception of resource extraction on PAs, 4) awareness of current challenges, 5) knowledge of conservation activities, and 6) willingness to conserve. All GLMMs were fitted with binomial response (yes/no) and logit link function. Ordinal logistic regression was used to investigate factors affecting opinion on PA existence (negative, neutral, positive). Sociodemographic factors and PA characteristics were used as the main predictor variables. However, resource dependency, perceived benefits and awareness of conservation activities were also used as predictors where relevant (e.g., models predicting attitudes towards PA). Before model construction, Cramer's V tests were used to determine the correlation between predictors. If predictor variables highly correlate with each other or there is multicollinearity between predictor variables, model performance will not be reliable. According to IBM Corp (2005), there is weak correlation if the Cramer's V value is less than 0.2, moderate correlation (0.2-0.6) and strong correlation (>0.6). In this study, the maximum Cramer's V value was 0.2, indicating that the variables were weakly correlated.

However, several variables describing PA characteristics were highly correlated (Appendix 2). Therefore, multiple correspondence analyses (MCA) were used to reduce the numbers of correlated variables and to determine whether to keep or remove less significant variables. MCA is a generalization of principal component analysis (PCA) to analyse categorical variables (Abdi & Valentin, 2006). The tests were performed with the MCA function under the FactoMineR package (Lê et al., 2008). There were four components with high eigenvalues among the nine components (Appendix 3). However, only components 1 and 2 were selected to input their scores into GLMM models according to their highest explained percentage of variance (Appendix 3). In addition, these two components included different stronger effects of the variables. In component 1, PA size, number of villages and PA type showed the strongest influence (Appendix 4), and in component 2, PA shape, PA age, PA size and IUCN category showed the strongest effects (Appendix 5). The remaining components were skipped as the effect of variables included in these components were smaller than the former two.

GLMMs were fitted using the glmer function in the lme4 package (Bates et al., 2014). Models with a combination of significant variables from chi-square tests were fitted. Predictor variables were used as fixed effects, and the locations of the five PAs were used as random factors. Model selection was performed in the MuMIn package (Barton, 2022) using the Akaike information criterion (AIC). Ordinal logistic regression was performed in SPSS. The results of the model were interpreted by using odds ratios showing likelihood of the variables.

To test the similarities and differences between the perception of local people from five different PAs, descriptive statistics were used. Seven predictor variables: resource use, perceived benefits, opinion on PA existence, perception of resource extraction on PAs, awareness of challenges, knowledge of conservation activities and willingness to conserve, were used to compare. The answers "yes" and "positive" were put under the "positive perception group", and the answers "no" and "negative" were under the "negative

perception group". However, only the first group was used and compared, as the study focused on positive perception from benefits.

2.5 Characteristics of Respondents

There were 1099 respondents in total; 51.9% were males, and 48.1% were females. However, some results were not representative for all respondents due to missing values. All respondents were adults above 18 years of age. Most respondents were above 50 years old (36.2%), followed by the age group between 40-49 years (25.1%). The remaining 24.5% belonged to the age group of 30-39 years, while the age group between 18-29 years was the smallest, with 14.2% respondents. The majority of respondents (50.1%) had completed primary education, followed by 27.1% who had completed secondary education or higher, and 22.7% who had not completed any education. Most of the respondents (66%) were farmers, while only 11.3% were fishermen. The remaining group of respondents with other occupations (government staff, own business, part-time workers, etc.) counted 22.7%. Most respondents (78.2%) were native, whereas 21.7% were non-native (immigrants). Most respondents (51%) lived near the PA. Approximately 39% of respondents were living in intermediate distances from the PA, while only about 10% were living far away from the PA. Table 1 shows the summary of the characteristics of respondents living in the five different PAs.

Table 2: *Summary of characteristics of respondents living in five different PAs in Myanmar.*

Variable (N=1099)	**Name of PAs**					
	CWS	**NTNP**	**SWS**	**IWS**	**MWWS**	**Total (%)**
Gender						
Male	47.1	51.7	42.1	58.3	60.6	51.9
Female	52.9	48.3	57.9	41.7	39.4	48.1
Age (years)						
18-29	12.4	26.6	9.6	16.1	7.4	14.2
30-39	21.9	29.6	31.3	20.0	19.4	24.5
40-49	23.8	25.6	21.7	27.8	26.9	25.1
50 and above	41.9	18.2	37.5	36.1	46.3	36.2
Education						
No education	28.6	32.5	23.8	3.9	26.9	22.7
Primary education	50.0	34.5	66.7	48.7	48.1	50.1
Secondary and above	21.4	33.0	9.6	47.4	25.0	27.1
Occupation						
Farmers	83.3	87.2	63.7	71.7	25.5	66.0
Fishermen	16.7	-	0.8	17.4	38.0	11.3
Others	-	12.8	35.4	10.9	36.6	22.7
Residency						
Native	71.9	80.3	77.9	82.6	77.8	78.2
Non-native	28.1	19.2	22.1	17.4	22.2	21.7
Distance to PA						
Near	59.5	80.3	60.0	40.0	16.7	51.0
Intermediate	16.7	9.9	30.0	60.0	75.0	38.9
Far	23.8	9.9	10.0	-	8.3	10.2

3 Results

3.1 Resource dependency

Most of the respondents (80.9%, n = 1099) depended on PA resources. The use of PA resources varied statistically significantly with gender, age, occupation, residency, and distance to the PA, while education was not a significant variable (Table 3). In addition, resource use differed significantly with PA characteristics in component 1, with a stronger effect of PA size, PA type and population density (number of villages) ($\rho_{spearman}$ = -0.145, n = 1099, $p < 0.001$), and component 2, with a stronger effect of PA shape, PA size, PA category and PA category ($\rho_{spearman}$ = 0.198, n = 1099, $p < 0.001$).

Table 3: *Descriptive statistics including the p value from χ^2 -tests showing the significant differences between resource uses and different variables related to the question "Do you gather any resource use from the PA (yes/no)?"*

Variables	Description	Resource Use (%)			χ^2	df	$p \leq$
		Yes	No	Number			
Gender	Male	83.3	16.7	570	4.57	1	0.05
	Female	78.3	21.7	529			
Age	18-29	85.3	14.7	156	8.69	3	0.05
	30-39	84.8	15.2	269			
	40-49	80.4	19.6	276			
	50 and above	76.9	23.1	398			
Education	No education	84.0	16.0	182	2.08	2	0.35
	Primary	80.2	19.8	646			
	>Secondary	79.5	20.5	271			
Occupation	Farmers	82.5	17.5	725	58.38	2	0.001
	Fishermen	99.2	0.8	124			
	Others	64.7	32.8	250			
Residency	Native	82.2	17.8	859	4.41	1	0.05
	Non-native	76.2	23.8	239			
Distance to PA	Near	89.9	10.1	560	209.83	2	0.001
	Intermediate	79.4	20.6	427			
	Far	22.8	77.2	112			

The best GLMM model with the above question as a response variable, all significant variables as fixed factors and location of PAs as a random factor also found that fishermen were more likely to use resources, whereas respondents with other occupations were less likely to use them (Figure 2). People who lived intermediate and far from the PAs were less likely to use the resources than the reference parameter, people who lived near the PAs. Additionally, according to the model, the characteristics of the PA also contributed to explaining resource use (Figure 2). A one-unit increase in component 1 was expected to decrease resource dependency by 0.77, whereas a one-unit increase in component 2 was expected to increase resource dependency by 0.77 (Figure 2). Residency, age group and gender were no longer significant (Figure 2).

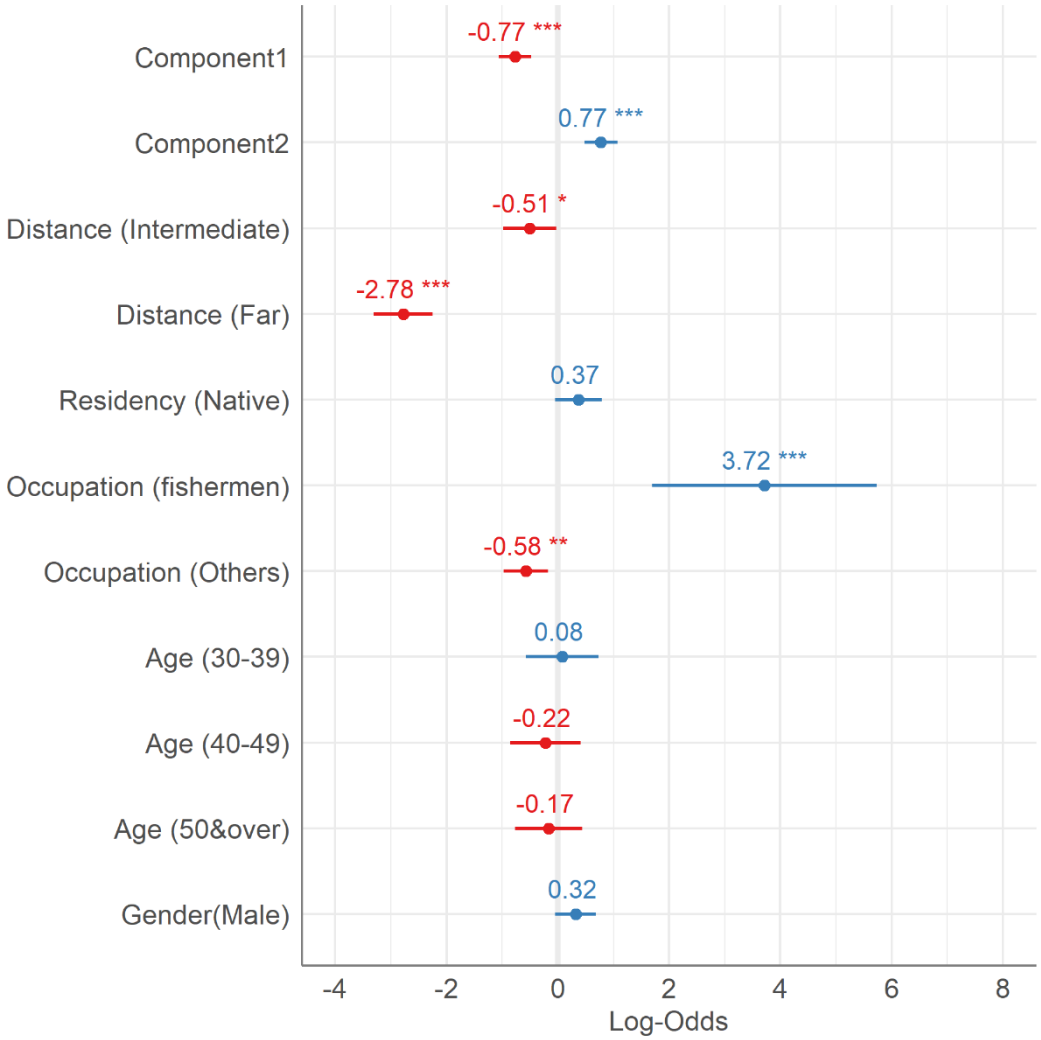


Figure 2: *GLMM, with resource use as a response variable. The x-axis and highlighted numbers depict the log-odds with predictors on the y-axis. The reference level for gender is female, age is age group between 18-29, occupation is farmer, residency is non-native, and distance is near. Significance levels at "* = 0.05, ** = 0.01, *** = 0.001".*

3.2 Perceived benefits from PAs

Most of the respondents (77.3%, n = 1095) believed PAs can provide benefits. The perceptions of local people toward the benefits of PAs varied statistically significantly with gender, age, education, occupation, distance, and resource use (Table 4). PA characteristics in component 1 did not statistically influence benefit recognition ($\rho_{spearman}$ = -0.04, n = 1095, p = 0.183), while component 2 did ($\rho_{spearman}$ = 0.1, n = 1095, p < 0.01).

Table 4: *Descriptive statistics including the p value from χ^2 -tests showing the significant differences between perceived benefits and different variables related to the question "Do you get any benefit from the PA (yes/no)?"*

Variables	Description	Perceived Benefits (%)			χ^2	df	$p \leq$
		Yes	No	Number			
Gender	Male	80.8	19.2	567	6.72	1	0.05
	Female	74.2	25.8	528			
Age	18-29	81.4	18.6	156	10.23	3	0.05
	30-39	82.5	17.5	268			

	40-49	77.7	22.3	274			
	50 and above	72.8	27.2	397			
Education	No education	84.0	16.0	181	10.99	2	0.05
	Primary	74.2	25.8	643			
	>Secondary	81.5	18.5	271			
Occupation	Farmers	78.5	21.5	721	54.77	2	0.001
	Fishermen	98.4	1.6	124			
	Others	64.8	35.2	250			
Distance to PA	Near	84.9	15.1	556	54.32	2	0.001
	Intermediate	74.2	25.8	427			
	Far	54.5	45.5	112			
Resource Use	Yes	86.2	13.8	886	197.89	1	0.001
	No	41.1	58.9	209			

The most parsimonious GLMM model explaining local communities' recognition of PA benefits included all significant variables from the chi-square test as fixed factors, and the location of PAs was a random factor. The model also proved that fishermen were the strongest contributors to the perception of benefits, and they were more likely to contribute than farmers and other occupations (Figure 3). The respondents who used the resources from the PA had more positive recognition of the benefits compared with those who did not use the PA's resources (Figure 3). Age, gender, distance, education, and PA characteristics in component 2 were no longer significant (Figure 3).

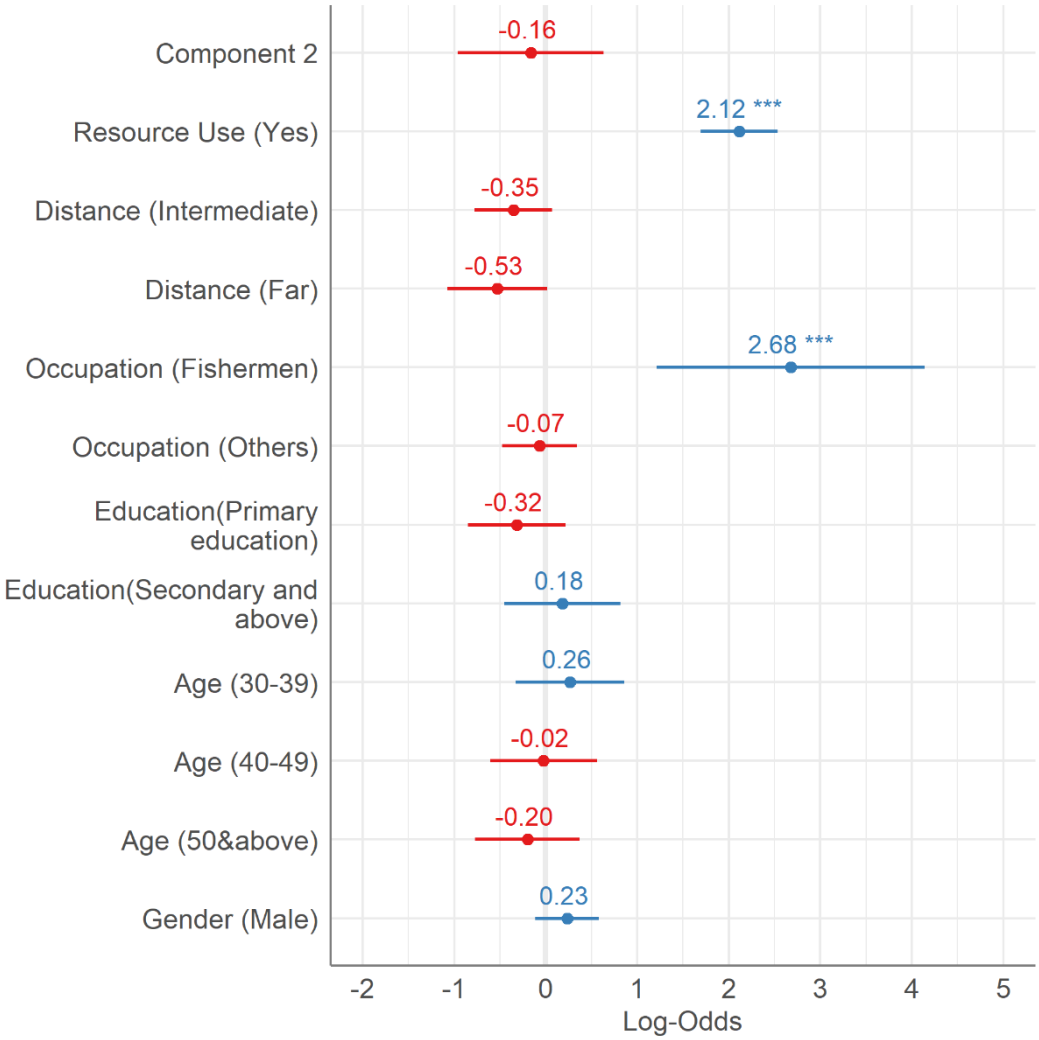


Figure 3*: GLMM, with benefit as a response variable. The x-axis and highlighted numbers depict the log-odds with predictors on the y-axis. The reference level for gender is female, age is age group between 18-29, education is no education, occupation is farmer, distance is near, and resource use is no use. Significance levels at "* = 0.05, ** = 0.01, *** = 0.001".*

3.3 Attitudes towards PAs existence

Most of the respondents (81.5%, n = 1056) indicated a positive perception, whereas 15.3% indicated neutral perceptions and only 3.1% indicated negative perceptions. Gender, occupation, residency, distance to the PA, resource use and perceived benefit significantly influenced the perception (Table 5). In addition, perception of PA existence differed significantly from PA characteristics in both components (component 1, $\rho_{spearman}$ = -0.122, n = 1056, $p < 0.001$, component 2, $\rho_{spearman}$ = 0.175, n = 1056, $p < 0.001$).

Table 5: *Descriptive statistics including the p value from the χ^2 test showing the significant differences between perception of PAs existence and different variables related to the question "What is your opinion on the existence of PA (Negative, Neutral, Positive)".*

Variables	Description	Perception on PAs existence%			χ^2	df	$p \leq$
		Negative	Neutral	Positive			
Gender	Male	3.4	11.7	84.9	12.21	2	0.01
	Female	2.8	19.5	77.7			
Occupation	Farmers	3.9	13.2	82.9	57.746	4	0.001
	Fishermen	0.8	1.6	97.6			
	Others	2.1	28.8	69.1			
Residency	Native	3.4	13.8	82.8	7.43	2	0.05
	Non-native	2.2	20.9	77.0			
Distance to PA	Near	3.2	9.5	87.3	35.20	4	0.001
	Intermediate	2.9	19.4	77.7			
	Far	36.4	49.4	37.2			
Resource Use	Yes	3.5	7.8	88.7	194.42	2	0.001
	No	1.5	46.8	51.7			
Benefit	Yes	2.2	5.7	92.1	303.24	2	0.001
	No	6.9	51.4	41.7			

The GLMM model including all significant variables as fixed factors and the location of PAs as a random factor best explained the perception of PA existence. Respondents who used the resources and received benefit, as opposed to people who did not, were associated with a higher likelihood of having a positive perception of the PA existence (Table 6, Appendix 7). However, gender, residency, distance, occupation, and PA characteristics were no longer significant (Table 6, Appendix 7).

Table 6: *The results from ordinal logistic regression analyses showing coefficients, standard error and p value of variables influencing the perception (negative and positive) of the existence of PA.*

Perception on PA existence	Variables	Coefficient	Std. Error	$p \leq$
Negative	Intercept	-11.513	8.081	0.155
	Gender (Male)	0.206	0.374	0.528
	Gender (Female)	0*		
	Occupation (Farmers)	0.455	0.525	0.3860
	Occupation (Fishermen)	-0.219	1.187	.854
	Occupation (Others)	0*		
	Residency (Native)	0.25	0.512	0.624
	Residency (Non-native)	0*		
	Distance (Near)	-0.48	0.659	0.467
	Distance (Intermediate)	-0.531	0.706	0.452

	Distance (Far)	0*		
	Resource Use (No)	-1.226	0.723	0.09
	Resource Use (Yes)	0*		
	Benefit (No)	1.97	0.404	**0.001**
	Benefit (Yes)			
	PA characteristics (Component 1)	2.385	2.568	0.353
	PA characteristics (Component 2)	1.124	4.246	0.791

*** = This coefficient is set to zero because it is redundant.**

3.4 Perception of resource extraction on PAs and their biodiversity

Approximately half of the respondents (49.9%, n = 1030) recognized the impact of resource use on PAs and their biodiversity. Age, education, occupation, distance to the PA, resource use and benefit recognition influenced the perception of the impact of current resource use on biodiversity (Table 7). Additionally, there was a significant difference between PA characteristics and local perception on the impact of resource use in both components (component 1, $\rho_{spearman}$ = -0.459, n = 1030, $p < 0.001$, component 2, $\rho_{spearman}$ = 0.396, n = 1030, $p < 0.001$).

Table 7: *Descriptive statistics including the p values from the χ^2-tests showing the significant differences between perception of resource use impact, and different variables related to the question "Do you think resource use has impacts on PAs and their biodiversity (Yes/No)".*

Variables	Description	Impact (%)			χ^2	df	*P* ≤
		Yes	No	Number			
Age	18-29	63.5	36.5	148	20.51	3	0.001
	30-39	58.7	41.3	254			
	40-49	54.2	45.8	262			
	50 and above	44.5	55.5	366			
Education	No education	56.5	43.5	168	10.85	2	0.05
	Primary	49.1	50.9	609			
	>Secondary	60.9	39.1	253			
Occupation	Farmers	60.2	39.8	663	40.65	2	0.001
	Fishermen	33.1	66.9	124			
	Others	44.4	55.6	243			
Distance to PA	Near	65.5	34.5	533	71.09	2	0.001
	Intermediate	38.2	61.8	427			
	Far	51.4	48.6	70			
Resource Use	Yes	56.8	43.2	868	28.621	1	0.001
	No	34.0	66.0	162			
Benefit	Yes	56.6	43.4	804	16.95	1	0.001
	No	41.1	58.9	224			

The best GLMM model included only the distance to the PA and PA characteristics as fixed factors and locations of PAs as random factor. The model showed that people who were living at an intermediate distance from the PAs had a lower likelihood of accepting the impact of resource use on biodiversity than the reference parameter, who were living near the PAs (Figure 4). A one-unit increase in component 1 was expected to decrease the perception of resource use impact by 1.45, whereas a one-unit increase in component 2 was expected to increase the perception of resource use impact by 1.85 (Figure 4).

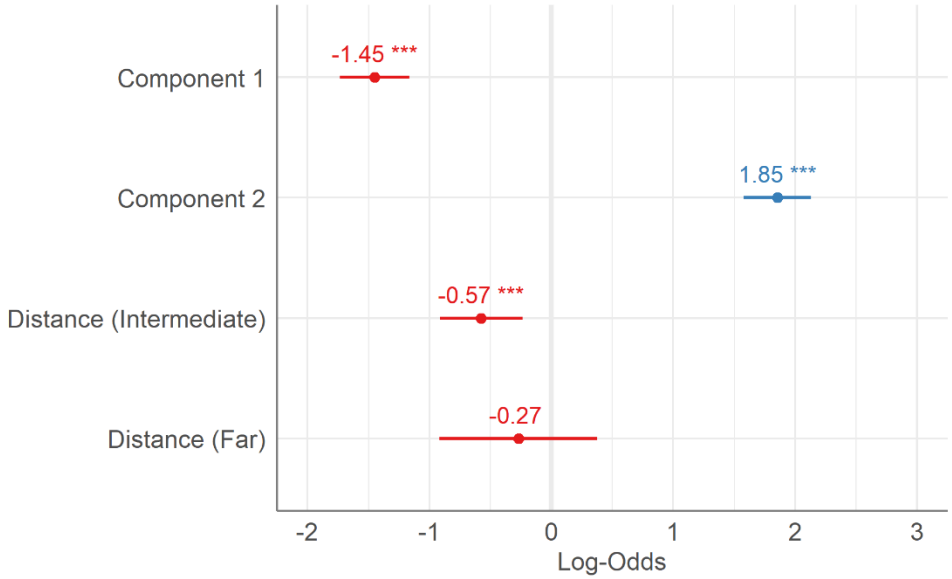


Figure 4: *GLMM, with perception of resource use impact as a response variable. The x-axis and highlighted numbers depict the log-odds with predictors on the y-axis. The reference level for distance is near. Significance levels at "* = 0.05, ** = 0.01, *** = 0.001".*

3.5 Awareness of the challenges of PAs and their biodiversity

Most of the respondents (78.5%, n = 985) were aware of the current challenges that the PAs and their biodiversity were experiencing. Gender, education, occupation, distance to PA, resource use and perceived benefits influenced their awareness of the current challenges that the PA is experiencing (Table 8). Additionally, there was a significant difference between local awareness of challenges and PA characteristics (component 1, $\rho_{spearman}$ = 0.13, n = 985, $p < 0.001$, component 2, $\rho_{spearman}$ = -0.14, n = 985, $p < 0.001$).

Table 8: *Descriptive statistics including the p values from the χ^2-tests showing the significant differences between awareness on challenges, and different variables related to the question "Do you aware any challenges of PAs and their biodiversity (Yes/No)".*

Variables	Description	Awareness on challenges (%)			χ^2	df	p≤
		Yes	No	Number			
Gender	Male	92.0	8.0	525	17.63	1	0.001
	Female	83.3	16.7	460			
Education	No education	92.5	7.5	160	7.5	2	0.05
	Primary	85.6	14.4	576			

	>Secondary	90.4	9.6	249			
Occupation	Farmers	90.0	10.0	643	37.66	2	0.001
	Fishermen	96.7	3.3	123			
	Others	76.7	23.3	219			
Distance to PA	Near	92.8	7.2	516	27.63	2	0.001
	Intermediate	83.5	16.5	407			
	Far	75.8	24.2	62			
Resource Use	Yes	92.7	7.3	848	130.59	1	0.001
	No	58.4	41.6	137			
Perceived Benefit	Yes	94.2	5.8	773	135.22	1	0.001
	No	64.6	35.4	209			

The best GLMM model including all significant variables as fixed factors and locations of PAs as random factor demonstrated that respondents who had strong beliefs about the benefits of PAs strongly contributed to explaining their awareness of the PA challenges. Fishermen and respondents who used the resources were more aware of the current challenges the PAs are experiencing than farmers and respondents who did not use the resources (Figure 5). Males had more likelihood to have knowledges about PA challenges than females (Figure 5). Education, distance to PA and PA characteristics were no longer significant (Figure 5).

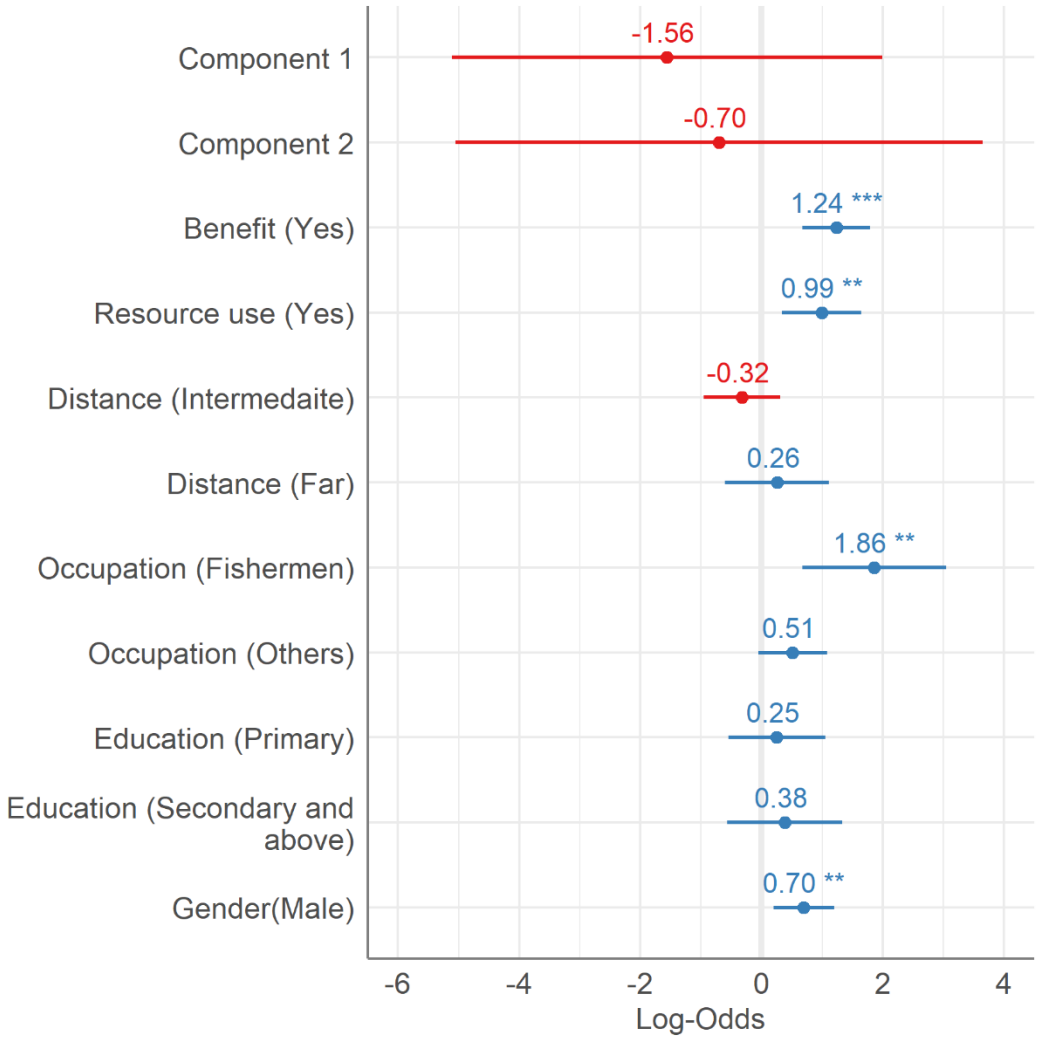


Figure 5: *GLMM, with awareness of PA challenges as a response variable. The x-axis and highlighted numbers depict the log-odds with predictors on the y-axis. The reference level for gender is female, education is no education, occupation is farmer, distance is near, resource use is no use, and benefit is no benefit. Significance levels at "* = 0.05, ** = 0.01, *** = 0.001".*

3.6 Knowledge on conservation and willingness to conserve PAs

Most of the respondents (78.3%, n = 1096) had knowledge about the conservation, including the laws and regulation of the PAs. This knowledge was statistically significant with gender, age, occupation, distance to the PA, resource use and perceived benefits (Table 9). PA characteristics in component 2 also influenced local knowledge on conservation ($\rho_{spearman}$ = -0.131, n = 1096, $p < 0.001$), while component 1 did not ($\rho_{spearman}$ = 0.026, n = 1096, p = 0.381).

Table 9: *Descriptive statistics including the p values from the χ^2 tests showing the significant differences between conservation awareness and different variables in response to the question "Do you know any conservation activities of PAs and their biodiversity (Yes/No)".*

Variables	Description	Conservation Awareness (%)			χ^2	df	*P* ≤
		Yes	No	Number			
Gender	Male	86.1	13.9	568	40.57	1	0.001
	Female	70.3	29.7	528			
Age	18-29	67.3	32.7	156	17.96	3	0.001
	30-39	82.9	17.1	269			
	40-49	82.6	17.4	276			
	50 and above	77.0	23.0	395			
Occupation	Farmers	78.8	21.2	722	30.21	2	0.001
	Fishermen	94.4	5.6	124			
	Others	69.6	30.4	250			
Distance to PA	Near	81.5	18.5	558	37.58	2	0.001
	Intermediate	80.3	19.7	427			
	Far	55.9	44.1	111			
Resource Use	Yes	84.7	15.3	887	105.83	1	0.001
	No	52.2	47.8	209			
Benefit	Yes	83.5	16.5	848	57.72	1	0.001
	No	60.8	39.2	245			

The best model in GLMM included awareness of conservation as a dependent variable, significant variables from chi-square tests as fixed effects and the location of the PAs as a random effect (Figure 6). According to the model, males were more likely to know about the conservation activities than were the females (Figure 6). People in all age groups had positive likelihood to have conservation knowledge (Figure 6). Fishermen were more likely to be aware of conservation activities compared with the reference parameter, farmers (Figure 6). Additionally, people who gained benefits and those who used the resources from the PA increased the likelihood to have conservation awareness by 0.63 and 0.99, respectively, compared to people who did not gain benefits and did not use the resource (Figure 6). Distance and PA characteristics in component 2 were no longer significant (Figure 6).

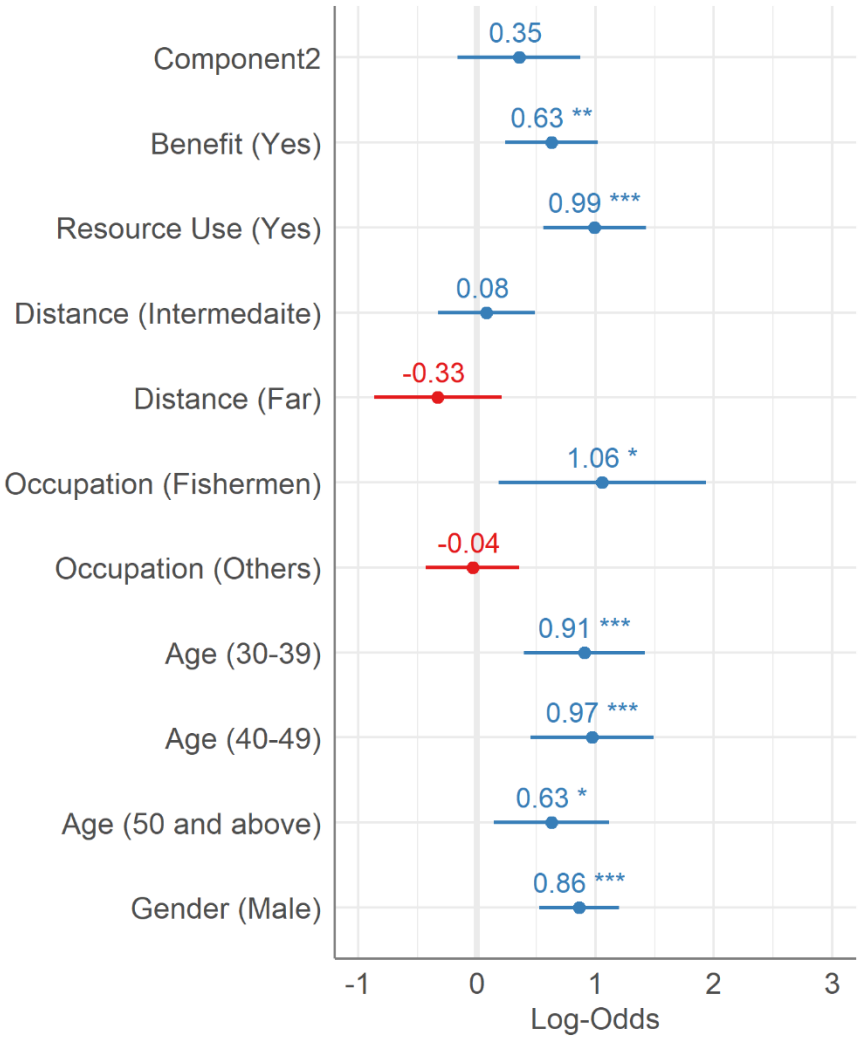


Figure 6: *GLMM, with awareness of conservation activities as a response variable. The x-axis and highlighted numbers depict the log-odds with predictors on the y-axis. The reference level for gender is female, age is 18-29, occupation is farmer, distance is near, resource use is no use and benefit is no benefit. Significance levels at "* = 0.05, ** = 0.01, *** = 0.001".*

For the local support for conservation, most of the respondents (52.7%, n = 1096) indicated a willingness to conserve. Gender, education, occupation, distance, resource use and perceived benefits were significant variables (Table 10). Additionally, respondents who had knowledge of conservation activities (Table 10) and PA characteristics in component 2 ($\rho_{spearman}$ = -0.376, n = 1096, $p < 0.001$) were also statistically significant.

Table 10: *Descriptive statistics including the p values from the χ^2 tests showing the significant differences between conservation willingness and different variables in response to the question "Do you want to conserve the PAs and their biodiversity (Yes/No)".*

Variables	Description	Conservation willingness (%)			χ^2	df	$p \leq$
		Yes	No	Number			
Gender	Male	60.2	39.8	568	25.79	1	0.001
	Female	44.9	55.1	528			

Education	No education	42.0	58.0	181	10.64	2	0.01
	Primary	55.7	44.3	645			
	>Secondary	53.3	46.7	270			
Occupation	Farmers	48.1	51.9	722	40.81	2	0.001
	Fishermen	79.0	21.0	124			
	Others	53.6	46.4	250			
Distance to PA	Near	52.5	47.5	558	16.50	2	0.001
	Intermediate	57.6	42.4	427			
	Far	36.0	64.0	111			
Resource Use	Yes	57.0	43.0	887	33.21	1	0.001
	No	34.9	65.1	209			
Perceived Benefit	Yes	55.3	44.7	848	9.61	1	0.01
	No	44.1	55.9	245			
Knowledge on conservation	Yes	60.6	39.4	860	95.47	1	0.001
	No	24.7	75.3	235			

The best GLMM model included conservation willingness as a response variable, all significant variables as fixed effects and PAs' locations as a random effect. Respondents who had more conservation knowledge were the strongest predictors in explaining local support for conservation (Figure 7). Males increased the likelihood of conserving biodiversity more than females (Figure 7). Respondents who recognized the benefits had more likelihood to increase their willingness than the respondents who did not (Figure 7). Respondents with higher education increased the likelihood of supporting the conservation compared with the reference parameter, no education (Figure 7). PA characteristics in component 2 were not significant in the model (Figure 7).

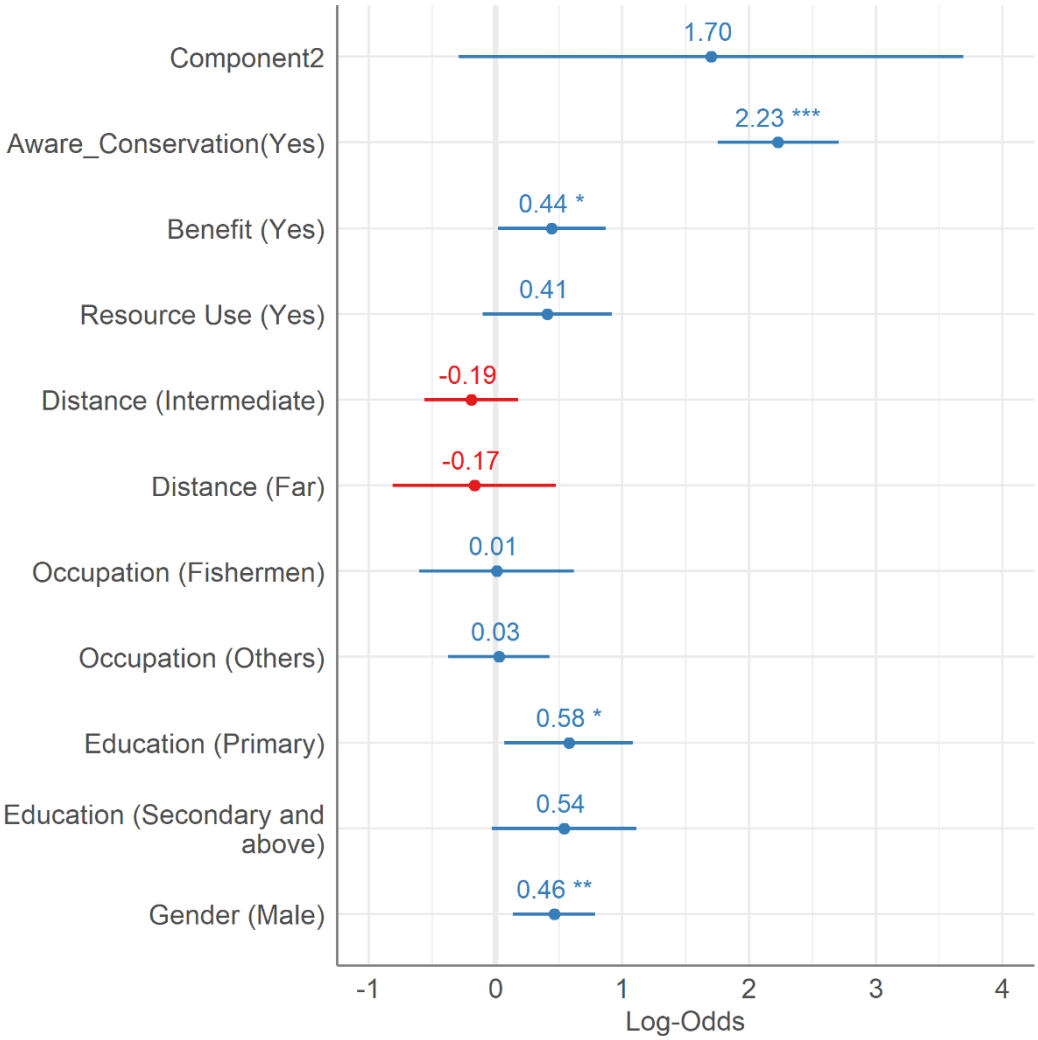


Figure 7: *GLMM, with conservation willingness as a response variable. The x-axis and highlighted numbers depict the log-odds with predictors on the y-axis. The reference level for gender is female, education is no education, occupation is farmer, distance is near, resource use is no use, benefit is no benefit, and conservation awareness is no awareness. Significance levels at "* = 0.05, ** = 0.01, *** = 0.001".*

3.7 Variation of perceptions among five different PAs

Respondents in the IWS and NTNP used the resources more than respondents in the CWS, SWS and MWWS (Figure 8a). Respondents in CWS, IWS, and NTNP recognized the PAs' benefits more than respondents in the other two PAs (Figure 8a). Respondents from the NTNP had the highest positive perception of the PA existence, followed by respondents in the IWS and CWS (Figure 8a). However, respondents in CWS and IWS were completely aware of the challenges of PA (100%), followed by respondents in NTNP (96%), while only over 70% of the respondents in MWWS and SWS were aware of it (Figure 8b). Respondents in IWS and NTNP had good knowledge of conservation activities, followed by respondents in MWWS and SWS, whereas respondents in CWS needed more conservation awareness (Figure 8b).

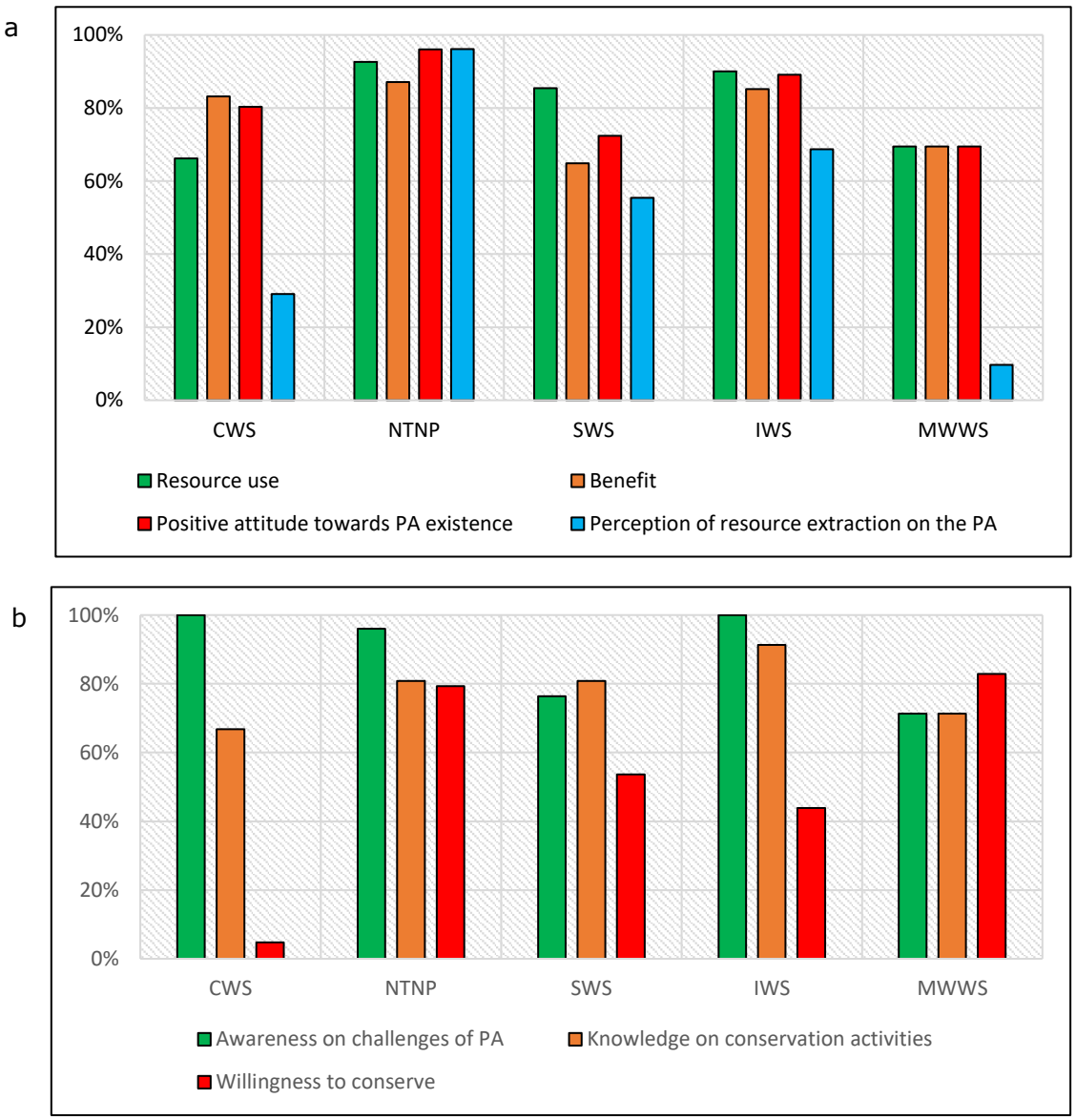


Figure 8: *(a) Figure showing the fluctuations of four variables (resource use, perceived benefit, positive attitudes towards PA existence and perception of resource extraction impact on the PA) among five different PAs. (b) Figure showing the fluctuations of three variables (awareness of the challenges of the PA, knowledge of conservation activities and willingness to conserve) among five different PAs. All values are based on only the answers of "Yes" and "Positive".*

4 Discussion

4.1 Resource Dependency on PAs

Most of the respondents relied on the PAs' resources for their livelihoods. They include timber, bamboo, and thatch as well as nontimber forest products like fuelwood, medicinal plants, mushrooms, honey, water, bushmeat and fish (San, 2017; Thant, 2017; Hanhtun, 2018; Htay, 2020; Kyaw, 2021). Occupation was the strongest predictor in explaining resource dependency. Fishermen acknowledged using the resources more than farmers did, although most of the respondents were farmers. One likely reason can be the differences in their livelihood nature and level of economic dependency on the PAs. For fishermen, they have a direct interaction with the PA resources for their subsistence, i.e., extracting fish mainly from the PAs and so they get significant profit from the PA, i.e., daily income from the fish markets. Alternatively, farmers do not depend highly on the PA resources for their subsistence except for collecting some forest products. Another likely cause can be asymmetric numbers of respondents for farmers and fishermen (66% and 11%, respectively) in my study.

The results showed that respondents who lived closer to the PAs depended on the resources more than people from intermediate and far villages, and this finding agrees with other studies by (Shrestha & Alavalapati, 2006; Musavi & Khan, 2016; Rahman et al., 2017; Kyando et al., 2019). This can be because they have easy access to the PAs. Among the five PAs, resource use in NTNP was the highest, followed by IWS, although resource uses in the other three PAs (CWS, SWS, MWWS) were also high. One likely reason could be that the former two PAs were located in remote and inaccessible regions where there was no alternative livelihood opportunity except relying on PA resources (San, 2017; Htay, 2020). A study by Ambastha et al. (2007) in India also argued that resource dependency can vary with geographic location and different land use activities.

4.2 Perception of benefits from PAs

Most of the respondents recognised benefits provided by the PAs. Occupation was the strongest predictor in explaining benefit recognition. Fishermen recognised the benefits more than farmers. This can be explained by the fact that fishermen admitted relying on PA resources more than farmers, and the results from GLMM also showed that people who used the resources recognised PA benefits more than those who did not. Another reason can be that the costs farmers suffered from the PAs were higher than the benefits they gained (Heinen, 1993; McClanahan et al., 2005; Allendorf et al., 2006; Shrestha & Alavalapati, 2006; Xu et al., 2006; Kideghesho, 2008; Sarker & Røskaft, 2011). In Myanmar, most of the farmers have their customary land inherited from generations to generations before the PAs were established. In addition, before national land use policy was developed in 2016, it was common to encounter these croplands inside the PAs due to complicated land use system between the government and the landowners, and lack of proper boundary demarcation (MONREC, 2016; Aung, 2020). And most of these farmers lost their traditional farmlands due to the establishment of PAs (Lewis, 1996). Moreover, they also have conflict with wildlife from the PAs, such as the destruction of their crops, livestock depredation or poultry losses by the animals from the PAs (Thant, 2017; Hanhtun, 2018; Htay, 2020). In this way, farmers might become less recognised on PA benefits. As an example, people from MWWS had the least benefit recognition among the five PAs, which can be explained by the fact that they experienced economic losses due to the crop

damages by the golden apple snails, loss of domestic animals (ducks) by diseases transmitted from migratory birds, and felt injustice in the way that PA staff were disturbing their rights to use the resources from their ancestors' land (Hanhtun, 2018). However, the above findings supported my first hypothesis that local's resource dependency and perceived benefits are varied with sociodemographic factors.

4.3 Attitudes towards PAs

Most of the respondents indicated positive attitudes towards PAs. The results showed that people who recognised the benefits were the strongest predictor in explaining the attitudes of local people. People who have strong beliefs about the benefits have more positive attitudes than the other respondents. Studies by (Allendorf et al., 2006; Bragagnolo et al., 2016; Dewu, 2016; Tumusiime et al., 2018; Htay et al., 2022) also support my finding that there is a positive relationship between benefits received and attitudes towards PAs.

Occupation also plays an important part in explaining the attitudes of local people towards PA. Interestingly, the results showed that fishermen had more positive attitudes than farmers and other occupations. Farmers could experience fewer benefits from the PA because they were the main residents who suffer costs from crop raiding, loss of customary land due to the establishment of the PA, and negative management activities such as restricted land use, strict conservation laws and regulations. Some attitudinal studies have observed that fishermen showed more negative attitudes because they were not allowed to go fishing during the spawning season, patrolling for illegal fishing in the lakes, prohibition the using of large explosives in fishing and they were arrested and punished (Dewu, 2016; Hanhtun, 2018; Htay et al., 2022).

When five different PAs are compared, respondents in the NTNP indicated the highest positive perception of the existence of PA, followed by respondents in the IWS and CWS. This could be explained by the fact that respondents in NTNP and IWS used the resources more than respondents in the other two PAs. Additionally, respondents in CWS, IWS, and NTNP recognised the benefits from the PA more than respondents in the other two PAs. Respondents from SWS and MWWS indicated a lower frequency of positive attitudes, probably because of a lack of understanding of the benefits provided by PAs, suffering higher costs from the PAs, as well as a poorer engagement level of local communities in the management of PAs (Hanhtun, 2018; Kyaw, 2021). Hanhtun (2018) observed that most of the people who depended on the resources from MWWS had negative attitudes because of different interests in the land use of the wetland and complicated conflicts between land use rights. People living near MWWS wanted to drain the wetland for their agriculture, while the aim of the PA authorities was to conserve the water level for water birds (Hanhtun, 2018). Residents in SWS had the same farmland loss problems, and they desired to have a buffer zone along the boundary of PA to provide compensation for them, as well as infrastructure development to improve their villages (Alkan et al., 2009; Kyaw, 2021). The results supported my second hypothesis that local people's attitudes are influenced by resource dependency, perceived benefits, and sociodemographic factors. However, they did not support my fourth hypothesis as distance was not a significant predictor for local's attitudes.

4.4 Perception of resource extraction and awareness of the challenges of PAs

People who lived near the PAs admitted that the use of resources had an impact on the PA more than people who lived intermediate or further away from the PAs. One speculation can be that they used PA resources more than other people, had direct interaction with PA

staff and therefore recognised the changes in forests and biodiversity over time. Nearly all respondents who lived closer to five PAs were more aware of human impacts on biodiversity than people from further away villages. And they admitted that there has been a decline in wildlife populations, degradation of forests and decreased water level in the lakes because of overexploitation of natural resources, illegal hunting and overfishing, mining, increased human population and increased agricultural practices, including shifting cultivation (San, 2017; Thant, 2017; Hanhtun, 2018; Htay, 2020; Kyaw, 2021).

Males were more aware of these changes than females. It is reasonable to argue that they were the primary gatherers of resources (Sarker & Røskaft, 2011) and they noticed the challenges. In addition, social values and norm which are common in Asia can also be another reason (Asian Development Bank and The Asia Foundation, 2018). Men tend to receive more privileges and are viewed as the head of the households in these nations or regions (Asian Development Bank and The Asia Foundation, 2018). They can involve in social activities and awareness raising events more than women. This could make them broaden their knowledge than women. Another likely reason could be that most of the respondents were farmers or fishermen, which are traditionally male-oriented occupations in Myanmar.

4.5 Local people's awareness of conservation

Most of the respondents indicated some knowledge about conservation activities, including conservation policies. The results indicated that people who were most dependent on the PAs were more aware of the conservation, which are in line with studies by Macura et al. (2011) in India and Rahman et al. (2017) in Bangladesh. Respondents in the IWS and NTNP who used the resources the most had good knowledge of conservation activities. However, even respondents from MWWS and SWS who used the least resources had better knowledge of conservation compared to respondents in CWS, showing that more conservation awareness is needed in CWS.

According to the results, males were more aware of conservation than females. This may be because most of the males took part in conservation activities such as education and awareness programmes and received benefits from local development and finance supporting programmes. Only a few females could do it so because they might be busy with their house work. Allendorf and Allendorf (2013) also observed that there was less knowledge among women of biodiversity and conservation values and less recognition of the benefits provided by the PAs, although females went to the PAs at the same rates as did males. Based on my findings, it is reasonable to suggest that awareness-raising programmes need to recognise the importance of these knowledge gaps and consider how to add women targeted activities (Allendorf & Allendorf, 2013; Asian Development Bank and The Asia Foundation, 2018).

The youngest age group (18–29) was less aware of conservation activities than the other age groups. One speculation could be that they rarely participated in awareness programs because they were busy making their living, including gathering resources or spending time in other places, such as doing social activities or playing sports, as they regarded conservation programmes as being less important or ineffective. Therefore, it is important to ensure a balance with all age groups participating in awareness programmes.

The results indicated that fishermen had more conservation knowledge than farmers. One likely reason could be that fishermen had a more frequent interaction with the PA and its management. Therefore, it is important for them to gain knowledge about conservation policies, including rules and regulations about the allowed fishing zone,

fishing season, and which fishing species are prohibited. This is because if they are arrested, they will face many consequences, such as paying the fine and their fishing equipment being confiscated (Hanhtun, 2018; Htay, 2020). Macura et al. (2011) in India also observed that people having easy access to the PA depended on more resources and had more concern about conservation activities. Additionally, the results showed that people who live near the PAs had more conservation knowledge than people living further away from the PAs. However, Htay (2020) in IWS reported that people living at different distances from the PA had similar conservation knowledge, while the other studies by Rahman et al. (2017) in Bangladesh and Thant (2017) in CWS support my findings. This can be because people from nearby villages recognised human impacts on natural resources and the challenges of the PA conservation of biodiversity. This can also be because awareness raising, and conservation programs mostly targeted people living near PAs. However, this study suggest providing such kinds of conservation and development programs to the further away villages where conservation knowledge and concern about the challenges were low.

4.6 Local people's willingness for conservation

Local people's willingness to conserve is influenced by many factors, including gender, education, perceived benefits and having knowledge about conservation. Among these variables, local people who had conservation knowledge had the strongest influence on their willingness to conserve. This may be because they had previous experiences in conservation activities, such as participating in conservation awareness programmes (Xu et al., 2022), or they recognised the advantages of conservation and development programmes. A literature review by Andrade and Rhodes (2012) also mentioned that if local people have more conservation knowledge, they will recognise the importance of their involvement in conservation activities. And as a result, they will feel more like owners of the PA and will have more willingness to conserve. The results also agrees with other studies (Nepal & Weber, 1995; Sah & Heinen, 2001; Shrestha & Alavalapati, 2006; Andrade & Rhodes, 2012; Rahman et al., 2017; Xu et al., 2022), where recognising the role of local people in conservation activities and focusing on the participatory approach in PA management, as well as including local people in decision-making processes, are the key to the success of conservation programmes.

Males were more willing to conserve than females. This may be because males were aware of the challenges of the PA and mostly took part in conservation programmes, while females had less knowledge of conservation activities. However, it is important for authorities of conservation programmes to note that they should focus on a gender balance and recognise the role of women's empowerment (Allendorf & Allendorf, 2013). A study by Xu et al. (2022) in China reported that willingness differences can be due to psychological differences between males and females. For example, women might neither want to participate physically in conservation activities nor feel generous to pay for the conservation as they might feel they have different matters to prioritize (for example, family business) than conservation. According to the results, people with higher education level had more willingness to conserve. The results agree with the general rule that higher educated people have higher conservation knowledge and higher conservation willingness (Infield, 1988; Sah & Heinen, 2001; Kideghesho et al., 2007; Rahman et al., 2017). These results supported my third hypothesis that resource dependency, perceived benefits, and sociodemographic factors have positive effect on conservation awareness and conservation willingness. In addition, influence of these factors was different among five studied PAs

based on the geographic situation and management systems. And in this way, my fifth hypothesis about variation between five different PAs was supported.

4.7 Influence of PA Characteristics

The results showed that PA characteristics influenced the perception of local people towards PAs, although detailed information on each PA characteristic could not be studied due to limited data. In the two components of PA characteristics, component 2, with a strong influence of PA shape, PA size, PA age and IUCN categories, has a greater and more positive effect than component 1, with a strong influence of PA size, number of villages and PA type. When five different PAs were studied, it seems that people from elongated PAs (NTNP, IWS) used resources more than people from wide PAs because elongated PAs have easier access to enter PAs than wide PAs. Additionally, the results showed that people from larger PAs used more resources than people from smaller PAs. With regard to PA age, people in younger and middle-aged PAs (NTNP, IWS) admitted that they use more resources and are aware of the resource use impact than people from older PAs (CWS, SWS). This seems opposite to the common assumption that people from older PAs used more resources and noticed the challenges of PAs due to resource uses over time. One reason can be that there will be some other confounding factors influencing the perception, such as how PAs were managed and how conservation strategies and awareness programmes were improved throughout the years (Andrade & Rhodes, 2012). For IUCN categories, although my study could not represent all categories, it seems that people in PAs with strict protection (IUCN categories I to IV) also depended on PA resources for their basic needs and livelihood; therefore, creating low levels of exploitation can lead to conflict between local people and PA management and affect their perception and attitudes towards PAs (Andrade & Rhodes, 2012). For population density (number of villages), the results based on five study areas showed that people from PAs with higher population density (NTNP, SWS) used more resources, leading to a higher impact on PAs and their biodiversity; in this way, people experienced the consequences of these changes and became aware of the challenges. MWWS, with fewer villages having less awareness of challenges and conservation, support that this speculation is realistic. For the PA type, people from terrestrial PAs used more resources and were aware of the resource use impact than people from wetland PAs. However, it is important to note that these factors will not alone determine resource dependency and perceptions and that there will be more confounding factors.

4.8 Limitations

In my study, the data were recalled from the original data and transformed into new general categories that could cover all PAs. Therefore, there could be certain biases in the data transformation, which might have some effects on the data analysis and data reliability. Additionally, there were many skipped questions and variables, such as the cost of PAs and their relationship to PA management, due to data limitations. For PA characteristics, the study could not explore in detail how each variable of PA characteristics affects local attitudes.

5 Conclusion and Recommendation

In conclusion, local communities, especially those who live near PAs, depended on PA resources for their basic needs and livelihood. The perception of benefits had a positive interaction with resource dependency; that is, people who use resources recognised more benefits from PAs. Most of the respondents had positive attitudes towards PAs, and sociodemographic factors played an important role in determining these attitudes. This study found that in lack of alternative livelihoods, local communities still need to depend on PA resource for household supplements, even though they know the impact of resource use on PAs and their biodiversity. Therefore, it is important to provide alternative livelihood opportunities for their interests and needs. Additionally, people who had previous experience participating in conservation activities had more conservation knowledge, and those who had conservation knowledge had more willingness to conserve. Therefore, educational, and awareness-raising programmes are required. However, the purpose of these programmes, to change the local people's attitudes, could not be effective if these programmes do not provide a two-way communication with an open dialogue for the targeted population (Aung, 2020). It is also necessary to use different educational approaches developed according to the specific needs of the situation(Lewis, 1996). Additionally, these conservation outreach programmes should address female-focused activities and concern gender ratios. Furthermore, there should be more outreaches for villages located intermediately and distant from the PAs as well as for nearby villages. The study also found that geographical locations and spatial differences can also influence the community attitudes. People who live in remote areas or inaccessible regions depended on natural resources and recognise the benefits more than the people in other places.

In addition to sociodemographic factors, the resource dependency, perception, and attitudes of local communities varied with the characteristics of the PAs, geographic locations, and different land use systems. Therefore, PA authorities should consider these points in developing management strategies. Additionally, monitoring in every step of the management should also be implemented to evaluate the positive or negative impacts of the implemented processes. As different stakeholders are involving in PA management, understanding diverse interests, and respecting the rights of local communities are essential components of for successful PA management, including co-management, sharing benefits, and establishing buffer zones.

6 References

Abdi, H., & Valentin, D. (2006). Multiple Correspondence Analysis. In *Encyclopedia of Measurement and Statistics.*

Afriyie, J. O., Asare, M. O., Danquah, E., & Pavla, H. (2021). Assessing the Management Effectiveness of Three Protected Areas in Ghana. *Conservation & Society*, *19*(1), 13-24. https://doi.org/10.4103/cs.cs_20_28

Ajzen, I., & Cote, N. G. (2008). Attitudes and the prediction of behavior. In R. P. W. D. Crano (Ed.), *Attitudes and Persuasion* (pp. 289-311). Psychology Press.

Alkan, H., Korkmaz, M., & Tolunay, A. (2009). Assessment of primary factors causing positive or negative local perceptions on protected areas. *Journal of Environmental Engineering and Landscape Management*, *17*(1), 20-27. https://doi.org/10.3846/1648-6897.2009.17.20-27

Allendorf, Swe, K. K., Oo, T., Htut, Y., Aung, M., Allendorf, K., Hayek, L.-A., Leimgruber, P., & Wemmer, C. (2006). Community attitudes toward three protected areas in Upper Myanmar (Burma). *Environmental Conservation*, *33*(4), 344-352. https://doi.org/10.1017/S0376892906003389

Allendorf, T. D. (2010). A framework for the park–people relationship: insights from protected areas in Nepal and Myanmar. *International Journal of Sustainable Development & World Ecology*, *17*(5), 417-422. https://doi.org/10.1080/13504501003788180

Allendorf, T. D., & Allendorf, K. (2013). Gender and attitudes toward protected areas in Myanmar. *Society & Natural Resources*, *26*(8), 962-976. https://doi.org/10.1080/08941920.2012.729295

Allendorf, T. D., Aung, M., Swe, K. K., & Songer, M. (2017). Pathways to improve park-people relationships: Gendered attitude changes in Chatthin Wildlife Sanctuary, Myanmar. *Biological Conservation*, *216*, 78-85. https://doi.org/10.1016/j.biocon.2017.10.005

Ambastha, K., Hussain, S. A., & Badola, R. (2007). Resource dependence and attitudes of local people toward conservation of Kabartal wetland: a case study from the Indo-Gangetic plains. *Wetlands Ecology and Management*, *15*(4), 287-302. https://doi.org/10.1007/s11273-006-9029-z

Andrade, G. S., & Rhodes, J. R. (2012). Protected areas and local communities: an inevitable partnership toward successful conservation strategies? *Ecology and society*, *17*(4), 14. https://doi.org/10.5751/ES-05216-170414

Asian Development Bank and The Asia Foundation. (2018). *Emerging Lessons on Women's Entrepreneurship in Asia and the Pacific: Case Studies from the Asian Development Bank and the Asia Foundation*. Asian Development Bank https://doi.org/http://dx.doi.org/10.22617/TCS189585-2

Aung, P. S. (2020). *Social-Ecological Coevolution and its Implications for Protected Area Management: Case Study in Natma Taung National Park, Myanmar.* Technische Universität Dresden. Germany.

Aung, U. M. (2007). Policy and practice in Myanmar's protected area system. *Journal of Environmental Management*, *84*(2), 188-203. https://doi.org/10.1016/j.jenvman.2006.05.016

BANCA. (2011). *Myanmar protected areas; context, current status and challenges* (Instituto Oikos, Milano Ancora Libri, Italy. Available at: View, Issue. BANCA.

Barton, K. (2022). *Multi-Model Inference*. In (Version 1.46.0) https://cran.r-project.org/package=MuMIn

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting linear mixed-effects models using lme4. *Journal of statistical software*, *67*(1), 1-48. https://doi.org/10.18637/jss.v067.i01

Beedell, J., & Rehman, T. (2000). Using social-psychology models to understand farmers' conservation behaviour. *Journal of rural studies*, *16*(1), 117-127. https://doi.org/10.1016/S0743-0167(99)00043-1

Birner, R., Maertens, M., & Zeller, M. (2006, August 12-18,2006). *Need, Greed or Customary Rights-Which Factors Explain the Encroachment of Protected Areas? Empirical Evidence from a Protected Area in Sulawesi, Indonesia* International Association of Agricultural Economist(IAAE), 2006 Annual Meeting, Queensland, Australia.

Bragagnolo, C., Malhado, A. C., Jepson, P., & Ladle, R. J. (2016). Modelling local attitudes to protected areas in developing countries. *Conservation and Society*, *14*(3), 163-182. https://doi.org/10.4103/0972-4923.191161

Center for Responsible Business. (2018). *Biodiversity in Myanmar including Protected Areas and Key Biodiversity Areas* (Biodiversity, Human Rights and Business, Issue.

Davies, J., Sebastian, A. C., & Chan, S. (2004). *A wetland inventory for Myanmar*. Ministry of the Environment, Japan.

Dewu, S. (2016). *Fringe Community Attitudes and Protected Areas.-Insights from two Protected Areas in Ghana.* Norwegian University of Science and Technology. Trondheim, Norway.

Ferreira, M. N. E., & Freire, N. C. (2009). Community perceptions of four protected areas in the Northern portion of the Cerrado hotspot, Brazil. *Environmental Conservation*, *36*(2), 129-138. https://doi.org/10.1017/S0376892909990166

Fu, B., Wang, K., Lu, Y., Liu, S., Ma, K., Chen, L., & Liu, G. (2004). Entangling the complexity of protected area management: the case of Wolong Biosphere Reserve, southwestern China. *Environmental Management*, *33*(6), 788-798. https://doi.org/10.1007/s00267-004-0043-8

Gillingham, S., & Lee, P. C. (1999). The impact of wildlife-related benefits on the conservation attitudes of local people around the Selous Game Reserve, Tanzania. *Environmental Conservation*, *26*(3), 218-228. https://doi.org/10.1017/S0376892999000302

Guzman, A., Heinen, J. T., & Sah, J. P. (2020). Evaluating the Conservation Attitudes, Awareness and Knowledge of Residents towards Vieques National Wildlife Refuge, Puerto Rico. *Conservation & Society*, *18*(1), 13-24. https://doi.org/10.4103/cs.cs_19_46

Hanhtun, Z. P. (2018). *Attitudes of Local Communities towards the Conservation of a Wetland Protected Area: a Case Study from the Moeyungyi Wetland Wildlife Sanctuary in Myanmar.* Norwegian University of Science and Technology (NTNU). Trondheim, Norway.

Heinen, J. T. (1993). Park–people relations in Kosi Tappu Wildlife Reserve, Nepal: a socio-economic analysis. *Environmental Conservation*, *20*(1), 25-34. https://doi.org/10.1017/S037689290003719X

Holmern, T. (2007). *Bushmeat hunting in the Western Serengeti: Implications for community-based conservation* Norwegian University of Science and Technology (NTNU). http://hdl.handle.net/11250/244565

Holmern, T., & Røskaft, E. (2013). The poultry thief: subsistence farmers' perceptions of depredation outside the Serengeti National Park, Tanzania. *African journal of ecology*, *52*(3), 334-342. https://doi.org/10.1111/aje.12124

Htay, T. (2020). *Determinants of Conservation Support in Local Communities: A Case Study of Indawgyi Wildlife Sanctuary, Myanmar.* Norwegian University of Science and Technology (NTNU). Trondheim, Norway.

Htay, T., Htoo, K. K., Mbise, F. P., & Røskaft, E. (2022). Factors Influencing Communities' Attitudes and Participation in Protected Area Conservation: A Case Study from Northern Myanmar. *Society and Natural Resources*, 1-19. https://doi.org/10.1080/08941920.2022.2032515

Htun, N. Z., Mizoue, N., & Yoshida, S. (2011). Determinants of local people's perceptions and attitudes toward a protected area and its management: A case study from Popa Mountain Park, Central Myanmar. *Society and Natural Resources*, *25*(8), 1-16. https://doi.org/10.1080/08941920.2011.620597

IBM Corp. (2005). *IBM Cognos Analytics*. IBM Corps. Retrieved 21.7.2022 from https://www.ibm.com/docs/en/cognos-analytics/11.1.0?topic=terms-cramrs-v

IBM Corp. (2020). *IBM SPSS Statistics for Windows, Version 27.0*. In *IBM SPSS Statistics for Windows* (Version 27)

Infield, M. (1988). Attitudes of a rural community towards conservation and a local conservation area in Natal, South Africa. *Biological Conservation*, *45*(1), 21-46. https://doi.org/10.1016/0006-3207(88)90050-X

IPBES. (2019). *The global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* (3947851138). (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Issue. I. S.-P. P. o. B. a. E. S. (IPBES).

IUCN. (2022). *Post-2020 global biodiversity framework*. IUCN Retrieved 12.7.2022 from https://www.iucn.org/resources/issues-brief/post-2020-global-biodiversity-framework-0

Kideghesho, J. R. (2008). Co-existence between the traditional societies and wildlife in western Serengeti, Tanzania: its relevancy in contemporary wildlife conservation efforts. *Biodiversity and Conservation*, *17*(8), 1861-1881. https://doi.org/10.1007/s10531-007-9306-z

Kideghesho, J. R., Røskaft, E., & Kaltenborn, B. P. (2007). Factors influencing conservation attitudes of local people in Western Serengeti, Tanzania. *Biodiversity and Conservation*, *16*(7), 2213-2230. https://doi.org/10.1007/s10531-006-9132-8

Kimengsi, J. N., Aung, P. S., Pretzsch, J., Haller, T., & Auch, E. (2019). Constitutionality and the co-management of protected areas: Reflections from Cameroon and Myanmar. *International journal of the commons*, *13*(2), 1003-1020. https://doi.org/http://doi.org/10.5334/ijc.934

Kyando, M. T., Nyahongo, J. W., Røskaft, E., & Nielsen, M. R. (2019). Household reliance on environmental income in the Western Serengeti Ecosystem, Tanzania. *Environmental and Natural Resources Research*, *9*(1), 54-63. https://doi.org/10.5539/enrr.v9n1p54

Kyaw, H. Y. (2021). *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.* Norwegian University of Science and Technology (NTNU). Trondheim, Norway.

Lê, S., Josse, J., & Husson, F. (2008). FactoMineR: an R package for multivariate analysis. *Journal of statistical software*, *25*, 1-18. https://doi.org/10.18637/jss.v025.i01

Lewis, C. (1996). *Managing conflicts in protected areas*. IUCN, Gland, Switzerland, and Cambridge, UK.

Lyons, K. G., Brigham, C., Traut, B., & Schwartz, M. W. (2005). Rare species and ecosystem functioning. *Conservation biology*, *19*(4), 1019-1024. https://doi.org/10.1111/j.1523-1739.2005.00106.x

Macura, B., Zorondo-Rodríguez, F., Grau-Satorras, M., Demps, K., Laval, M., Garcia, C. A., & Reyes-García, V. (2011). Local community attitudes toward forests outside protected areas in India. Impact of legal awareness, trust, and participation. *Ecology and society*, *16*(3). https://doi.org/10.5751/ES-04242-160310

McClanahan, T., Davies, J., & Maina, J. (2005). Factors influencing resource users and managers' perceptions towards marine protected area management in Kenya. *Environmental Conservation*, *32*(1), 42-49. https://doi.org/10.1017/S0376892904001791

Mcinnes, R., Davidson, N., & Hails, A. (2016). *Conservation of biodiversity and improved management of protected areas in Myanmar: Towards improved management of valuable wetlands*. Norwegian Institute for Water Research (NIVA). Retrieved 6.7.2022 from https://mnenvironment.com/conservation-of-biovdiversity/

MONREC, M. o. N. R. a. E. C. (2016). *Myanmar National Land Use Policy*. Nay Pyi Taw, The Republic of the Union of Myanmar: Ministry of Natural Resources and Environmental Conservation MONREC Retrieved from https://www.burmalibrary.org/sites/burmalibrary.org/files/obl/docs21/Government-of-Myanmar-2016-01-National_Land_Use_Policy-en.pdf

Musavi, A., & Khan, A. M. (2016). Resource Dependence and Local People's Attitudes Towards Conservation: A Case Study From Katarniaghat Terai Ecosystem. *International Journal of Ecology and Environmental Sciences*, *42*(2), 167-178.

Naiman, R. J. (1988). Animal influences on ecosystem dynamics. *BioScience*, *38*(11), 750-752. https://doi.org/10.2307/1310783

Nepal, S. K., & Weber, K. E. (1995). *Managing Protected Areas Under Conditions Of Conflict*.

Ormsby, A., & Kaplin, B. A. (2005). A framework for understanding community resident perceptions of Masoala National Park, Madagascar. *Environmental Conservation*, *32*(2), 156-164. https://doi.org/10.1017/S0376892905002146

Palomo, I., Montes, C., Martin-Lopez, B., González, J. A., Garcia-Llorente, M., Alcorlo, P., & Mora, M. R. G. (2014). Incorporating the social–ecological approach in protected areas in the Anthropocene. *BioScience*, *64*(3), 181-191. https://doi.org/10.1093/biosci/bit033

Pereira, H. M., Navarro, L. M., & Martins, I. S. (2012). Global biodiversity change: the bad, the good, and the unknown. *Annual Review of Environment and Resources*, *37*, 25-50. https://doi.org/10.1146/annurev-environ-042911-093511

Pullin, A. S., Bangpan, M., Dalrymple, S., Dickson, K., Haddaway, N. R., Healey, J. R., Hauari, H., Hockley, N., Jones, J. P. G., Knight, T., Vigurs, C., & Oliver, S. (2013). Human well-being impacts of terrestrial protected areas. *Environmental Evidence*, *2*(1), 19. https://doi.org/10.1186/2047-2382-2-19

R Core Team. (2021). *R: A Language and Environment for Statistical Computing*. In *R Foundation for Statistical Computing* (Version 4.1.0) https://www.R-project.org/

Rahman, M. M., Mahmud, M. A. A., & Shahidullah, M. (2017). Socioeconomics of biodiversity conservation in the protected areas: a case study in Bangladesh. *International Journal of Sustainable Development & World Ecology*, *24*(1), 65-72. https://doi.org/10.1080/13504509.2016.1169453

Ripple, W. J., & Beschta, R. L. (2004). Wolves and the ecology of fear: can predation risk structure ecosystems? *BioScience*, *54*(8), 755-766. https://doi.org/10.1641/0006-3568(2004)054[0755:WATEOF]2.0.CO;2

Røskaft, E., Händel, B., Bjerke, T., & Kaltenborn, B. P. (2007). Human attitudes towards large carnivores in Norway. *Wildlife biology*, *13*(2), 172-185. https://doi.org/10.2981/0909-6396(2007)13[172:HATLCI]2.0.CO;2

Sah, J. P., & Heinen, J. T. (2001). Wetland resource use and conservation attitudes among indigenous and migrant peoples in Ghodaghodi Lake area, Nepal. *Environmental Conservation*, *28*(4), 345-356. https://doi.org/10.1017/S0376892901000376

San, K. N. (2017). *Impacts on the biodiversity by living inside a protected area, Natma Taung National Park, Myanmar; A human perspective.* Norwegian University of Science and Technology (NTNU). Trondheim, Norway.

Sarker, A., & Røskaft, E. (2011). Human attitudes towards the conservation of protected areas: a case study from four protected areas in Bangladesh. *Oryx*, *45*(3), 391-400. https://doi.org/10.1017/S0030605310001067

Sekhar, N. U. (2003). Local people's attitudes towards conservation and wildlife tourism around Sariska Tiger Reserve, India. *Journal of Environmental Management*, *69*(4), 339-347. https://doi.org/10.1016/j.jenvman.2003.09.002

Shrestha, R. K., & Alavalapati, J. R. (2006). Linking conservation and development: An analysis of local people's attitude towards Koshi Tappu Wildlife Reserve, Nepal. *Environment, Development and Sustainability*, *8*(1), 69-84. https://doi.org/10.1007/s10668-005-0188-5

Sinclair, A. R., Mduma, S., & Brashares, J. S. (2003). Patterns of predation in a diverse predator–prey system. *Nature*, *425*(6955), 288-290. https://doi.org/10.1038/nature01934

Than , Z. M. (2011). *Socio economic analysis of the Indawgyi Lake Area, Mohnyin Township* University of Cologne. Cologne,Germany.

Thant, Z. M. (2017). *Costs and benefits associated with natural resource exploitation in Chatthin Wildlife Sanctuary in Myanmar, and its impact on thamin (Rucervus eldii thamin) conservation.* Norwegian University of Science and Technology (NTNU). Trondheim, Norway.

Tumusiime, D. M., Byakagaba, P., Tweheyo, M., & Turyahabwe, N. (2018). Predicting Attitudes towards Protected Area Management in a Developing Country Context. *Journal of Sustainable Development*, *11*(6). https://doi.org/10.5539/jsd.v11n6p99

UNESCO. (2014, 21.6.2022). *World Heritage Site Tentative Lists*. Retrieved 21.6.2022 from https://whc.unesco.org/en/tentativelists/5873/

Wetland convention. (2016, 21.6.2022). *Ramsar Sites Information Service*. Retrieved 21.6.2022 from https://rsis.ramsar.org/ris/2256

Xu, J., Chen, L., Lu, Y., & Fu, B. (2006). Local people's perceptions as decision support for protected area management in Wolong Biosphere Reserve, China. *Journal of Environmental Management*, *78*(4), 362-372. https://doi.org/10.1016/j.jenvman.2005.05.003

Xu, L., Xu, W., Jiang, C., Dai, H., Sun, Q., Cheng, K., Lee, C.-H., Zong, C., & Ma, J. (2022). Evaluating Communities' Willingness to Participate in Ecosystem Conservation in Southeast Tibetan Nature Reserves, China. *Land*, *11*(2), 207. https://doi.org/10.3390/land11020207

7 Appendices

Appendix 1: Table showing the status of PA characteristics in five different PAs

PA Name	Type	IUCN	Age	Size	Length	Number of villages
CWS	Terrestrial	IV	Old	Medium	Wide	Medium
IWS	Wetland	IV	Young	Large	Elongated	Medium
MWWS	Wetland	IV	Middle	Small	Wide	Few
NTNP	Terrestrial	II	Middle	Large	Elongated	Many
SWS	Terrestrial	IV	Old	Large	Wide	Many

Appendix 2: Correlation Transformed Variables showing the correlation between variables of PA characteristics

	Category of PA	Type of PA	PA age	PA size	PA shape	villages
Category of PA	1.000	.393	**-.532**	.215	**.590**	.344
Type of PA		1.000	**.517**	**.615**	-.206	**.687**
PA age			1.000	**.580**	-.493	**.506**
PA size				1.000	.364	**.966**
PA shape					1.000	.377
villages						1.000

Appendix 3: Model summary with eigen value for nine components

Component	Eigenvalue	Inertia	% of variance	Cumulative % of variance
1	3.026	.504	33.616	33.616
2	2.669	.445	29.660	63.277
3	2.403	.400	26.696	89.973
4	.902	.150	10.027	100.000
5	.000	.000	0.000	100.000
6	.000	.000	0.000	100.000
7	.000	.000	0.000	100.000
8	.000	.000	0.000	100.000
9	.000	.000	0.000	100.000

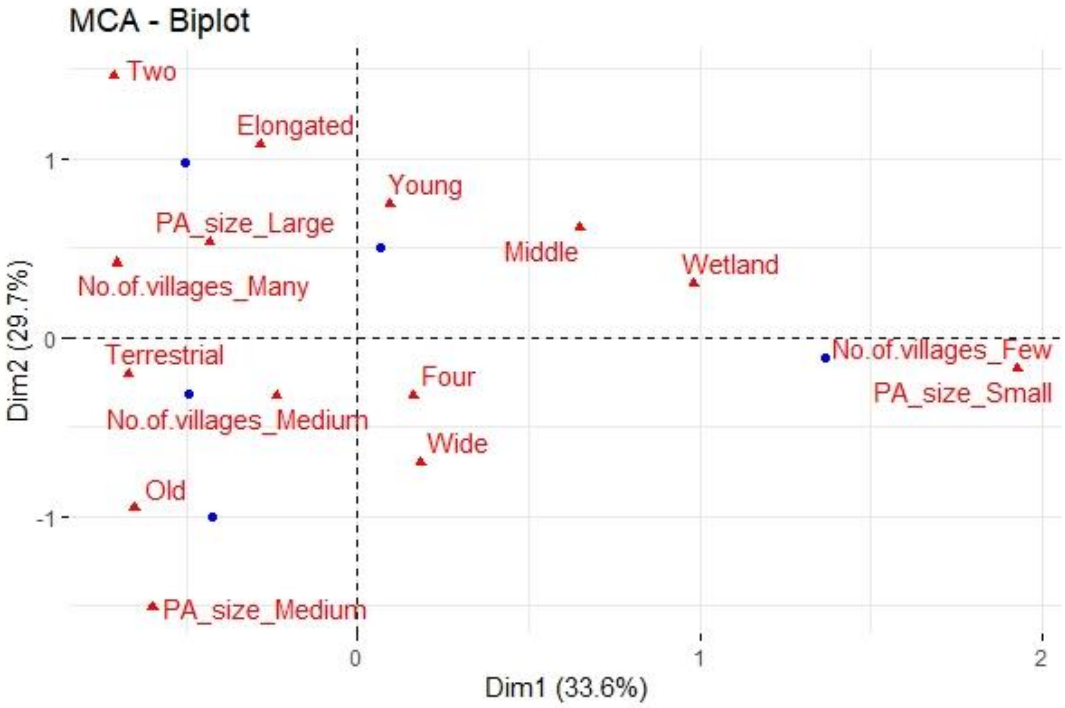
Appendix 4: Table showing PA characteristic categories significantly correlated with component 1

Variables	Effect size	R^2	*p*≤
PA size			
Small	1.156	0.912	0.001
Medium	-0.638		
Large	-0.518		
Number of villages			
Few	1.135	0.952	0.00
Medium	-0.401		
Many	-0.734		
PA type			
Wetland	0.587	0.659	0.001
Terrestrial	-0.587		
PA age			
Middle	0.439	0.336	0.001
Old	-0.484		
PA category			
Four	0.309	0.115	0.001
Two	-0.309		
PA shape			
Wide	0.166	0.052	0.001
Elongated	-0.166		

Appendix 5: Table showing PA characteristic categories significantly correlated with component 2

Variables	Effect size	R^2	*p*≤
PA shape			
Wide	-0.594	0.759	0.001
Elongated	0.595		
PA age			
Young	0.408	0.634	0.001
Middle	0.319		
Old	-0.727		
PA size			
Large	0.611	0.614	0.001
Medium	-0.749		
Small	0.139		
PA category			
Two	0.597	0.482	0.001
Four	-0.597		
Number of villages			
Few	-0.098	0.119	0.001
Medium	-0.199		
Many	0.298		
PA type			
Wetland	0.168	0.061	0.001
Terrestrial	-0.168		

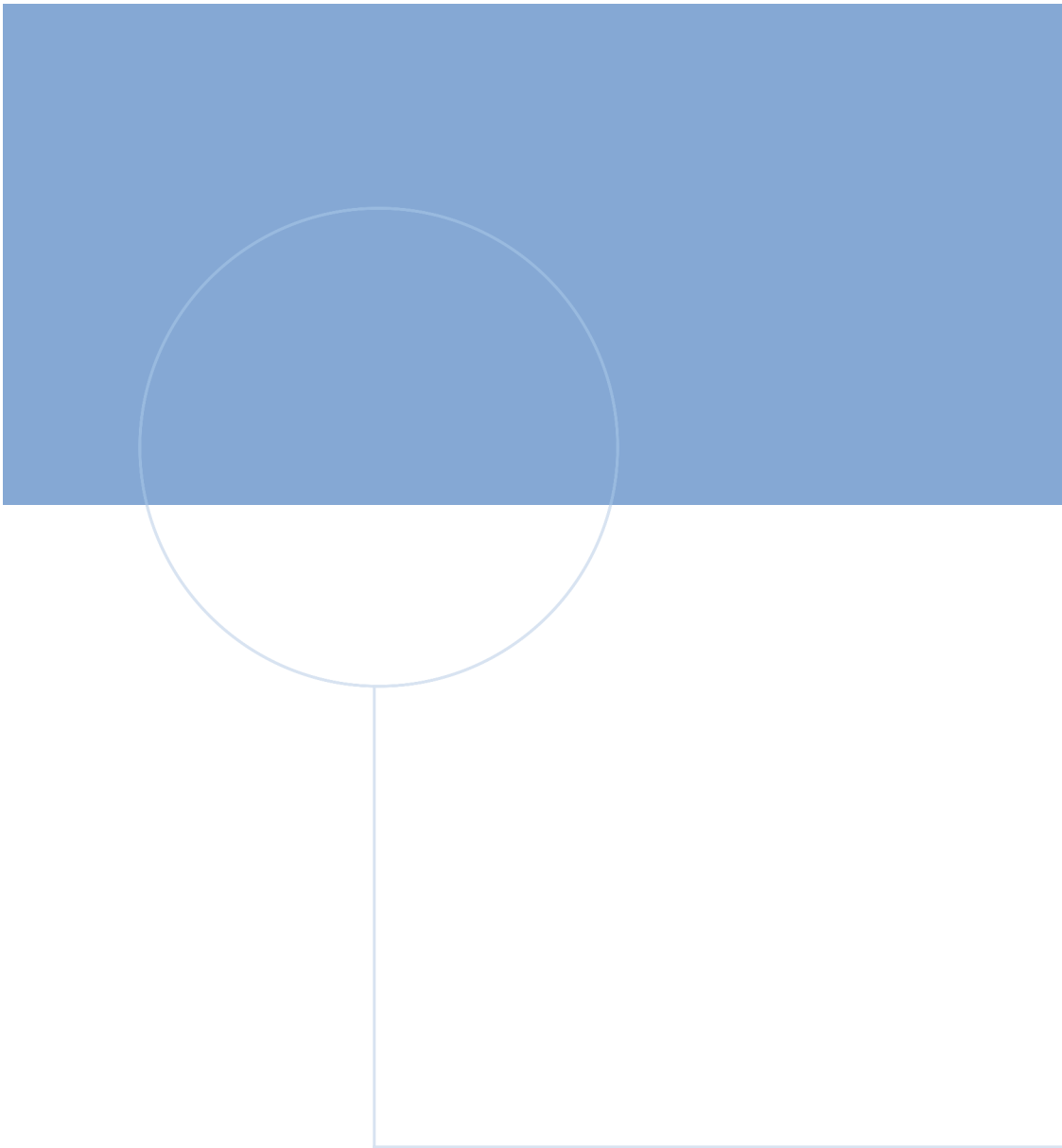
Appendix 6: Biplot showing the association among PA characteristic variables in two components



Appendix 7: The results from ordinal logistic regression analyses showing coefficients, standard error, and p value of variables influencing the perception (neutral and positive) of the existence of PA.

Perception on PA existence	Variables	Coefficient	Std. Error	*p* ≤
Neutral	Intercept	3.306	5.762	0.566
	Gender (Male)	-0.516	0.231	0.025
	Gender (Female)	0*		
	Occupation (Farmers)	0.105	0.269	0.697
	Occupation (Fishermen)	-2.155	0.807	0.008
	Occupation (Others)	0*		
	Residency (Native)	-0.524	0.255	**0.05**
	Residency (Non-native)	0*		
	Distance (Near)	0.626	0.392	0.11
	Distance (Intermediate)	0.555		
	Distance (Far)	0*		
	Resource Use (No)	1.201	0.279	**0.001**
	Resource Use (Yes)	0*		
	Benefit (No)	2.323	0.248	0.001
	Benefit (Yes)	0*		
	PA characteristics (Component 1)	-0.844	2.378	0.723
	PA characteristics (Component 2)	-2.460	3.648	0.500

*** = This coefficient is set to zero because it is redundant.**



NTNU

Norwegian University of
Science and Technology