Master's thesis

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

Thazin Htay

Determinants of Conservation Support in Local Communities: A Case Study of Indawgyi Wildlife Sanctuary, Myanmar

Master's thesis in Natural Resources Management (Biology)
Supervisor: Eivin Røskaft
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LIST OF ABBREVIATIONS

ASEAN	Association of South-east Asian Nations
BANCA	Biodiversity and Nature Conservation Association
CBD	Convention on Biological Diversity
FD	Forest Department
FFI	Fauna and Flora International
GLMM	Generalized Linear Mixed Model
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN	International Union for Conservation of Nature
IWS	Indawgyi Wildlife Sanctuary
KBA	Key Biodiversity Area
Km^2	Square Kilometer
NGS	National Geographic Society
NTNU	Norwegian University of Science and Technology
PA	Protected Area
SEAFDC	Southeast Asia Fishery Development Centre
SPSS	Statistical Package for the Social Science
UNEP-WCMC	UN Environment World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
US$	United States Dollar

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ABSTRACT

Local communities living adjacent to Protected Areas (PA) play a vital role in biodiversity conservation. Depending on their positive and negative associations with the PA, they can either be conservation allies or conservation adversaries. Understanding community participation and their support in conservation initiatives is pivotal to effectively enforce conservation policy through harmonizing biocentric and anthropocentric goals. This study aimed to assess community conservation support as a function of four essential aspects; (1) dependency on the PA, (2) benefits and costs from the PA, (3) communities attitudes towards conservation and (4) conservation awareness. Furthermore, attitude-behaviour consistency was tested to investigate how well conservation attitudes reflect actual conservation involvement. Using a distance-based stratified random sampling, a total of 230 households from 10 villages around the Indawgyi Wildlife Sanctuary (IWS) were interviewed. Results showed that 43.9% of respondents were involved in PA conservation programmes. Factors influencing conservation support included conservation attitudes, benefits gained from the PA, and conservation awareness. Among them, benefits from the PA had the strongest effect on conservation involvement, followed by conservation awareness. Despite overall positive attitudes, a low level of contribution indicated that conservation attitudes could not fully translate into conservation behaviours. The results also revealed that highly resource dependent communities suffered higher costs due to the PA, and such costs resulted in negative conservation attitudes. This study highlights that future conservation effectiveness of the IWS could be achieved by improving conservation awareness and sharing conservation benefits to the communities.

Keywords: attitudes, conservation support, Indawgyi, local community, protected area, resource dependency

1 INTRODUCTION

1.1 Background

The unprecedented loss of biodiversity has been a global concern for conservation, and we are in the era of the sixth mass extinction of biodiversity (Primack 2006; Symes et al. 2016). The current rate of species extinction is 1000 times higher than that in historical times, and more than 30,000 known species are threatened with extinction (IUCN 2020). Protected areas (PA) are refuges of endangered wildlife species and have been considered as a key strategy for preventing biodiversity loss (Allendorf et al. 2006). That being said, global conservation initiatives have focused on the increased establishment of PAs (West et al. 2006). The Convention on Biological Diversity (CBD)'s Aichi Biodiversity Targets have challenged that at least 17% of terrestrial areas and 10% of marine areas should be conserved as PAs by 2020 (CBD 2010). So far, 14.9% (20 million km^2) of the world's terrestrial landscapes and 7% (6 million km^2) of seascapes have been designated as PAs (UNEP-WCMC et al. 2018). Despite this expansion, the declining trend of biodiversity continues because the established PAs are not sufficiently protected or effectively managed (Leverington et al. 2010; IPBES 2019).

There is no doubt that conservation outcomes are correlated with the management effectiveness of PAs (UNEP-WCMC et al. 2018), and populations and abundances of different species are relatively higher in well-managed PAs (Gray et al. 2016). Nonetheless, the conservation effectiveness of PAs is compromised by human interference (UNEP-WCMC et al. 2018). Currently, one-third of global protected areas is under intense human pressure (Jones et al. 2018). Anthropogenic disturbances such as habitat loss as a result of land use changes and overexploitation of species are the two largest threats to PAs and their biodiversity (Primack 2006). Three-quarters of endangered species are at risk of extinction due to persistent human impacts, even inside PAs (Schulze et al. 2018; IPBES 2019). The ineffectiveness of PA due to the increased level of human-induced threats are shortcomings of the traditional conservation model, which emphasizes only biological values and fails to integrate social values (Andrade & Rhodes 2012).

Historically, the "fences and fines approach" has been the focus of the traditional conservation paradigm, in which human activities are considered incompatible with conservation (Andrade & Rhodes 2012; Oldekop et al. 2016). People living in or around PAs were displaced from the conservation areas and restricted in terms of resource access (Lele et al. 2010). The adverse socio-economic impacts of protection create conflicts with local

communities. Due to the lack of alternatives by which to meet livelihood needs, people encroach into the restricted area and cause undesirable consequences such as illegal resource exploitation and poaching (West et al. 2006). For instance, the exclusionary approach in the Rajaji-Corbett forest corridor of India has led local communities to set fires and illegally extract resources (Badola 1998). Likewise, local people in Mount Cameroon National Park intensified poaching in response to protectionist conservation policies (Nana & Tchamadeu 2014). The failure to consider the needs of local communities in "the fences and fines mechanism" has degraded PAs' biodiversity (Lele et al. 2010; Nana & Tchamadeu 2014). Therefore, community involvement is increasingly stressed as being of primary importance for successful conservation (De Boer & Baquete 1998). Since the late 1980s, community-based conservation has evolved as an alternative to the "fortress conservation" (Salafsky & Wollenberg 2000).

Local communities are intertwined with the ecosystems, and their greater inclusion is crucial to ensuring the integrity of the PA (Andrade & Rhodes 2012). Various studies have demonstrated that communities' involvement in conservation is related to the benefits and costs that they accrue from the PA (Kideghesho et al. 2007; Sarker & Røskaft 2011; Lamsal et al. 2015; Allendorf et al. 2017). For example, local residents who enjoy tourism benefits support conservation of Sariska Tiger Reserve in India (Sekhar 2003), and benefits from a community-based conservation project received proven local conservation support in Western Serengeti, Tanzania (Kideghesho et al. 2007). However, the extent of such benefits and costs vary with people's dependency on PA resources and their socio-economic status. Poor households are usually high in resource dependency and more vulnerable to the costs of restriction (Karanth & Nepal 2012). Local communities will not be motivated enough to support conservation unless the benefits from the PA offset their costs (Nepal & Spiteri 2011). Better knowledge of the distribution of benefits and costs concerning communities' dependency on the PA is critical in designing effective conservation strategies.

Attitudinal studies have also indicated that people's decisions to participate in conservation programmes are strongly linked to their attitudes (Infield & Namara 2001; Tessema et al. 2010; Htun et al. 2012; Karanth & Nepal 2012). According to the "Theory of planned behaviour", people with positive attitudes are more likely to perform conservation-supportive behaviours whereas those with negative attitudes are likely to behave in less-supportive manners (Ajzen 1991; Nepal & Spiteri 2011; Allendorf 2020). Attitude has, therefore, been considered as an indicator of local people's compliance with conservation policy (Andrade & Rhodes 2012). Other scholars, however, have reported that local community

knowledge of PA objectives, activities, rules and regulations influences their conservation participation (Shrestha & Alavalapati 2006; Htun et al. 2012). A clear understanding of these factors associated with community conservation support is essential to reconciling biodiversity conservation targets and socio-economic needs.

As the sustainability of a PA is related to the welfare of local communities, conservation initiatives should not be undertaken at the expense of socio-economic benefits (Oldekop et al. 2016). Even stricter PAs may conserve higher biodiversity (Gray et al. 2016), but they have to receive adequate investments of the staff, budgets and government support (Andrade & Rhodes 2012). On the other hand, strict protection imposes costs to the local communities, increases antagonism and will result in the lack of conservation involvement. Additionally, the pressure of higher resource demands will "leak" into the surrounding areas (Lele et al. 2010). Therefore, a stewardship approach is not a viable solution for developing countries with limited financial capacity and high natural resource dependency (Andrade & Rhodes 2012). Importantly, countries in the tropics where biodiversity is concentrated, should take into account this factor in their PA management. Considering this, partnership with local communities could be a long-term option for the success of PAs in the developing world.

Myanmar is one of the developing countries in tropical Asia with an extent of 676,577 km^2 (Forest Department 2015). Almost all the country area lies within the Indo-Burma biodiversity hotspot (Rao et al. 2013; Prescott et al. 2017) and supports a high level of species endemism. Myanmar's ecosystems are extraordinarily diverse and home to 11,800 plants, 258 mammals, 1,096 birds, 291 reptiles, 119 amphibians, and 1,098 fish species (Forest Department 2015). These ecosystems consist of 159 Key Biodiversity Areas (KBA) and 14 ecoregions, of which four ecoregions are critically endangered (Tordoff et al. 2012; Centre for Responsible Business 2018). At present, Myanmar has 39,593 km^2 of protected land in 45 PAs, covering 5.85% of total country area. Among them, 8 PAs were specially intended for wetland conservation (Forest Department 2015).

However, Myanmar's PAs are threatened by deforestation, agricultural expansion, and poaching (Rao et al. 2002; Tordoff et al. 2005). The threats are mainly due to the subsistence needs of local communities, rather than large scale incompatibilities (Isituto Oikos & BANCA 2011). "Biological resource use" is the most common threat both inside and outside of all PAs. In this category, the extraction of non-timber forest products is ranked the highest and is found in 85% of all PAs. Other threats including fuelwood collection, hunting, grazing and human settlements are observed in more than 50% of them (Rao et al. 2002; Aung 2007). Such kinds

of threats are unlikely to be reduced in the absence of alternatives because 70% of the country's population who lives in rural areas is heavily dependent on natural resources for livelihoods. Due to realizing this, sustainable resource utilization was included in the National Biodiversity Strategy and Action Plan (NBSAP) in support of the management effectiveness of PAs and the long-term survival of their biodiversity (Forest Department 2015).

To manage PA resources sustainably, understanding how the local community depends on the PA resources is of primary importance. Related measures include assessing PA-induced costs and benefits to the local community and the acceptance on the PA as a precondition of their conservation support. Although some attitudinal studies have been conducted in Myanmar, most focused on park-people relationships (Allendorf et al. 2006, 2018; Htun et al. 2012; Hantun 2018). Significant knowledge gaps remain in the understanding of the role of PA in community livelihoods and of PA management implications on their conservation involvement. In an attempt to fill this gap, the current study was conducted in the Indawgyi Wildlife Sanctuary (IWS) to investigate the local resource dependency and associated determinants of community conservation support.

1.2 Problem Statement

The Indawgyi Wildlife Sanctuary (IWS) was selected as a case study because of its unique combination of terrestrial and wetland ecosystems. I expected differences in resource dependency patterns and therefore in the benefits and costs which could further influence conservation participation. According to Isituto Oikos and BANCA (2011), logging and wood harvesting, the collection of terrestrial plants, hunting, fishing and gold mining are the most significant threats related to local resource utilization in the IWS.

The IWS is located in a remote and inaccessible region with limited economic potential. Local residents are mostly agri-dependent, and 48% of them live below the world bank defined poverty index line (Than 2011). This proportion is higher than the national poverty rate (24.8%) and even higher than the Kachin state level (36.8%) (Central Statistical Organization 2019). As poverty is directly related to the dependency on the natural resources, the resources from the PA play a vital role in the sustenance of local communities. The combined effect of extreme poverty and higher resource intensification from an expanding human population gradually leads to the degradation of PA resources (Forest Department 2018). The population growth rate of Kachin state (1.85%) in which the IWS is located, is two times higher than the national rate (0.89%) (Central Statistical Organization 2018). Significantly, agricultural expansion has

become widespread around the PA, and wetland areas northeast of the PA have been converted into agricultural land (Bhandari et al. 2015; Mcinnes et al. 2016a).

Although agriculture is the main livelihood, local farmers are also engaged in fishing as part of their household income generation. The Southeast Asia Fishery Development Centre (SEAFDC) estimated that Myanmar has the largest population of small-scale fishermen in the ASEAN region (SEAFDC 2012). During the last decade, the immigration of small-scale fishermen gradually increased in the study area (Bhandari et al. 2015), and Than (2011) reported in her research that 34% of the respondents were migrants to the IWS. Year-round fishing (except fish spawning season which spans May, June and July) is usually performed using gill nets with mesh sizes ranging from 0.75 to 4.5 inches, fishing vessels and prawn traps (Than 2011). The minimum mesh size identified by the PA is 1 inch, and those under this size are restricted, as their use is detrimental to the fish population (Forest Department 2018). However, the socio-economic survey conducted by Than (2011) found that 14.3% of respondents used restricted mesh sizes, and immigrant fishermen are associated with destructive fishing techniques (Mcinnes et al. 2016b).

Shifting cultivation is a traditional agricultural practice in upland areas where land is scarce. The shifting cultivation practices of local communities are potentially sustainable if the fallow periods are long enough. However, growing food requirements from the increased population drive shorter fallow periods, and the method is no longer sustainable. Such practices are prevalent in the hills surrounding the IWS and are difficult to phase out since they are customary practices of mountainous ethnic communities (Forest Department 2018). This results in the widespread degradation of forests in the southern and western parts of the PA. Furthermore, anthropogenic fires from slash and burn agriculture negatively impact the terrestrial chelonian populations (Rao et al. 2013). Other wildlife species that prefer fire-induced new shoot or regrowth vegetation in the burnt areas are frequently hunted (Lwin et al. 2018). Hunting is also a part of the Kachin tradition and is usually more frequent during the crop harvesting seasons (Rao et al. 2005, 2010). Moreover, poison hunting is common in the IWS when a high population of migrating birds accumulates (Than 2011).

In the IWS, gold mining is found along the inflow streams in the forested area in the south-western corner of the PA (Mcinnes et al. 2016a). Poor segments of local communities who lack agricultural land work as labourers in the gold mines. Pollution from gold mining, e.g., elevated mercury levels negatively impacts biodiversity. The lethal effects of pollutants occur in the fish species of the lake and extend to birds through the food chain. The persistent

effects of mercury in the soil also inhibit plant growth, reducing the forage quality and habitat suitability of wildlife species that habituate along the stream bank. Furthermore, sedimentation and landfills impair the functioning of ecosystems through the diversion of waterways. Bird and fish census data collected yearly from the PA show a declining trend (Forest Department 2018). Although the underlying causes of the population declines of these species are not limited to mining, it might be one of the causes.

Political instability also has profound effects on the conservation of biodiversity and natural resources of the IWS. The pressure on natural resources is higher in the insurgent area due to limited economic opportunities. Higher resource demands from neighbouring countries have fuelled this situation. Especially, timber and wildlife resource demands from China foster illegal logging and poaching (Aung 2007). The forest cover of Myanmar has been reduced from 58% in 1990 to 43% in 2015, and Kachin state is one of the regions with the highest deforestation rates (Forest Department 2015; Michinaka et al. 2020). Illegal resource extraction has become accelerated due to weak law enforcement in the conflict area (Prescott et al. 2017). The consequences of logging result in increased open areas and facilitate hunting and human encroachment into the PA.

Awareness and conservation support of local communities mean a lot in these situations with limited government enforcement and external conservation aid. Neighbouring communities could be either conservation allies or conservation adversaries, depending on their positive and negative associations with the PA (Lele et al. 2010). If the PA has positive impacts on their livelihoods, the locals will have favourable attitudes and will support the conservation of the PA (Allendorf et al. 2012). If not, the PA brings costs to them, and this will result in negative conservation attitudes that are detrimental to the conservation objectives (Oldekop et al. 2016). A thorough understanding of community-related indicators, the utilization of natural resources, interaction with the PA, and attitudes of the bordering villages is a very important issue in PA management (Aung 2007). Therefore, the current study aims to understand and analyse community conservation support as a function of four important aspects: (1) local communities' dependency on the PA, (2) benefits and costs from the PA, (3) communities attitudes towards conservation and (4) conservation awareness.

1.3 Research Question

The overall research question concerns understanding the resource dependency, associated costs and benefits from the PA, conservation attitudes and knowledge of local communities, as well as how these factors shape their conservation involvement. Specifically, I want to

1. investigate how much the local communities depend on the PA's resources and which factors influence their dependency on the PA;
2. evaluate what kind of benefits and costs local communities have experienced from the PA and how they shape their attitudes towards the PA;
3. understand local communities' knowledge about PA and how they perceive the impacts of their resource exploitation on the biodiversity of the PA; and
4. assess whether conservation attitudes are consistent with conservation behaviours and the factors that determine community participation in conservation programmes.

1.4 Hypotheses

H1: Communities living closer to the PA are more dependent on the PA's resources. However, the dependency is regulated by different socio-demographic factors.

H2: Communities who are more dependent on the PA resources are more affected by the costs of resource restrictions.

H3: Benefits from the PA are positively related to conservation attitudes, and therefore, communities who perceive benefits from the PA will have more favourable attitudes.

H4: Communities around the PA are not well-educated and are therefore less conservation-conscious and less likely to be aware of their own impacts on the PA's biodiversity.

H5: Communities who benefit from the PA and have favourable attitudes are more likely to participate in conservation initiatives of the PA.

2 METHODOLOGY

2.1 Study Area Description

The Indawgyi Wildlife Sanctuary (IWS) is located in the Mohnyin Township of Kachin State, Northern Myanmar, with geographic coordinates between 24° 56' N - 25° 24' N and 96° E - 96° 39' E (Isituto Oikos & BANCA 2011). It was established in 2004 to protect Indawgyi Lake and its associated wetlands and forest catchment areas. The IWS covers a total area of 815 km², including the lake area of 259 km² plus wetlands, lakeside grasslands, and hill forests in the lake watershed (Forest Department 2018). Indawgyi Lake is the largest inland freshwater lake

in Myanmar, and it stretches 24 km from north to south and 10 km from east to west (Bhandari et al. 2015). The lake is fed by eight streams draining from the hills south, east and south-west of the sanctuary. The Indaw Stream that flows to the north of the sanctuary is the only outflow and eventually drains into the Ayeyarwaddy River. The area has a subtropical monsoon climate with an average annual rainfall of 2,196 mm and an average temperature of 24.1°C (Forest Department 2018). The landscape of the IWS consists of the lake in the centre surrounded by the wetland, which is encircled by forested mountain ranges up to 1180 masl (Fig. 1). The biodiversity value of the IWS is very high because of a unique combination of three types of ecosystems. Key species are Hoolock gibbon (*Hoolock leuconedys*), Hog deer (*Axis porcinus*), water birds and endemic fishes (Lwin et al. 2011, 2018). Therefore, it was designated as an ASEAN Heritage Park in 2013, an Important Bird Area in 2014, a Ramsar site in 2016, and an UNESCO Man and Biosphere Reserve in 2017 (Forest Department 2018).

As the study area is in the Indo-Burma biodiversity hotspot, it has high levels of plant and animal endemism and is also included in IUCN category IV to protect the species and habitats of conservation concern (Tordoff et al. 2012). The dominant forest types are mixed evergreen and deciduous forests and, teak (*Tectona grandis*) is the characteristics species covering large areas. Other species include *Dipterocarpus tuberculatus*, *Hopea odorata*, *Shorea obtusa*, *Gmelina arborea*, and *Terminalia tomentosa* which have high commercial value. These forests are important habitats of globally threatened mammals, including the Hoolock gibbon, Shortridge langur (*Trachopithecus shortridgei*), Chinese pangolin (*Manis pentadactyla*), and Himalayan black bear (*Ursus thibetanus*) (Forest Department 2018). The sanctuary preserves mammals (38 species), birds (448 species), reptiles (41 species), amphibians (34 species), fish (80 species), butterflies (50 species), trees and medicinal plants (165 species) (Isituto Oikos & BANCA 2011). The IWS is also an important stopover point of the East-Asian-Australian Flyway and supports a large number of migratory birds. Particularly, the lake and wetlands are roosting and breeding sites of threatened bird species including the Slender-billed vulture (*Gyps tenuirostris*), White-rumped vulture (*Gyps bengalensis*), and Sarus crane (*Grus antigone*) (Forest Department 2018). The lakeside grasslands are home to the endangered Hog deer (Lwin et al. 2018).

There are 36 villages near the lake and a sanctuary boundary with a population of 50,357 people in 8,806 households (Forest Department 2018). As the area is under-developed, the general education level is low, and more than 90% of the residents have only a basic education. Farming is the primary livelihood of the communities, while other livelihoods include fishing,

hunting, shifting cultivation, logging and gold mining (Than 2011). The development of ecotourism is in its infancy. The communities in the IWS are ethnically heterogeneous, mainly consisting of Shan, Kachin, Bamar and other small ethnic minorities, each having their own culture and traditions that shape their dependency on the PA in different ways. A zoning system characterizes the resource utilization in the IWS. In the buffer zone of the PA, local communities can have access to forest resources for non-commercial purposes and to lake resources to some extent for economic uses. However, resource exploitation in the core zone and during fish spawning season is not officially allowed (Forest Department 2018).

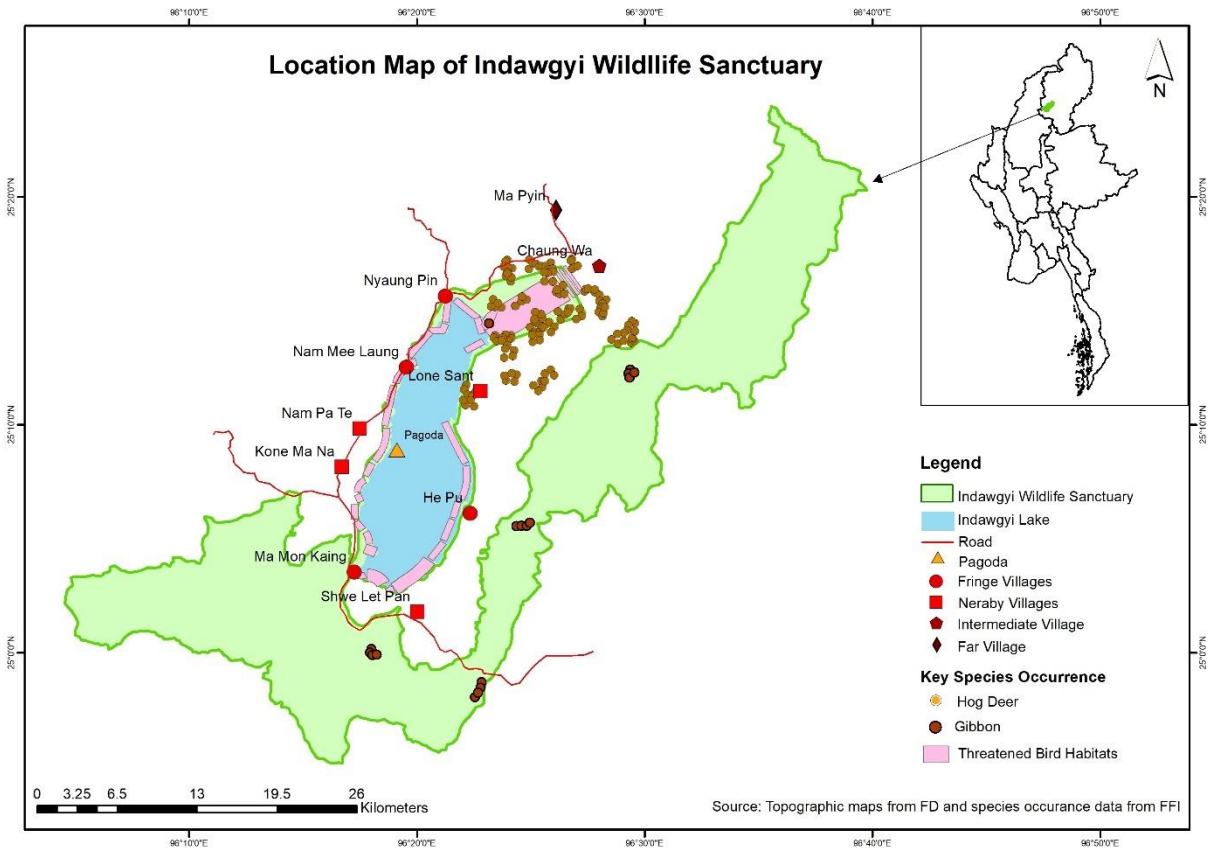

Figure 1: Map of the study area with key species occurrences (gibbon, hog deer and threatened birds) and the distribution of sampled villages. Inset at the right corner is the map of Myanmar with location of Indawgyi Wildlife Sanctuary.

2.2 Types of Data

To fulfil the research objectives, the study was conducted using primary data from the field as well as secondary data sources. The primary data were collected from an interview survey. The secondary data included published and unpublished documents, reports and maps from IWS, Forest Department Headquarter, and Fauna and Flora International-FFI (Myanmar

Programme). Scholarly articles, scientific publications and relevant books used for the comprehensive literature review were accessed from the Norwegian University of Science and Technology (NTNU) library and online databases.

2.3 Data Collection

The main methodology employed face to face interviews using a questionnaire survey (Appendix). As a starting point for the sample selection, general information about the villages including major economic activities, resource extraction patterns from the PA, and the accessibility was briefly discussed with the PA staff and local authorities. Following the discussion, ten villages were randomly selected from four strata divided by their relative distances to the PA boundary, which were on the fringe (less than 1 km), near (1 to 2 km), intermediate (2 to 3 km), and far (more than 5 km) respectively (Fig. 1). The village distances from the PA boundary were determined using ArcGIS Version 10.5 based on topographic maps from the Forest Department. This sample selection ended up with four villages each in the first two strata and one village in each of the last two strata.

Given the equal chance of being selected and minimal observer's bias, 23 households were randomly selected in each village. Only one respondent was interviewed from each of the selected households who (1) was above 18 years old, and (2) agreed to participate in the survey. Therefore, in total, 230 participants from 10 villages were included in the study. The determination of the sample size was also based on the common criteria of behavioural science, which indicated the need to represent a minimum of 10% of the total population (Sophat et al. 2019). Interviews with 230 households from 10 villages consisting of 2,357 households were in agreement with this criterion. The logistics and accessibility during the monsoon season were also taken into consideration in the selection of sample villages.

On the day before the data collection started in each village, the village head was contacted and informed about the study with the help of local PA staff. First, I went to the village administration office to be sure that permission was granted, and households were selected from the village register. Upon arrival to the selected households, I briefly explained the purpose of the research and asked if they would like to be involved in the survey. For ethical reasons, the respondents were informed that their identity would be anonymous. Additionally, they were assured that their answers would be used only for research purposes. The use of electronic devices such as mobile phones or voice recorders was avoided, as it would interfere with the respondent's trust in the interviewer.

The questionnaire was administered in four sections consisting of (1) socio-demographic information, (2) resource dependency on the PA, (3) the perception of benefits and costs from the PA, and (4) knowledge and attitudes towards the PA, as well as conservation involvement. Questions about resource utilization were collected at the household level, whereas those concerning perceptions, attitudes and conservation support were recorded at the individual level. Most of the questions were structured to be closed-ended, whereas a few questions asking about future PA management were kept open-ended. Although the main ethnicity of the study area was Shan, all respondents were able to understand and speak Burmese very well. Therefore, the interview was conducted in the Burmese language. Data were collected from June to August 2019.

Before the actual survey, all the questionnaires were pre-tested with a few villagers near the IWS (not part of the villages in the selected sample) to ensure that the questions were understandable to the respondents. Afterwards, some changes were made to improve the clarity and data quality. Pre-testing allows the interviewer to gain familiarity with the questionnaire and to be consistent when asking the questions (Bragagnolo et al. 2016). To avoid inconsistency and between-observer bias, no survey assistant was employed, and only one interviewer asked all the questions. However, the author acknowledged possible sources of some bias regarding sensitive questions such as income generation from forest resources (especially timber) because the economic exploitation of these resources is illegal. Therefore, income dependency on the PA mainly focused on the lake resources, which were officially allowed for use for the household's subsistence.

2.4 Characteristics of Respondents

The socio-economic attributes of the 230 respondents included gender, age, ethnicity, religion, education level, occupation, migration status and residency period. Among the respondents, 58.3% were males, while 41.7% were females. The age structure was divided into four categories as follow: 16.1% (18-29 years), 20% (30-39 years), 27.8% (40-49 years) and 36.1% (50 years and above). The dominant ethnic community (77%) was Shan while 23% were Bamar or other ethnicities, including Kachin and Rakhine. Regarding literacy, almost half of the respondents (48.7%) had attained primary education, including 1% with a monastic education. Approximately 4% were illiterate, while 32.2% had reached the secondary level, and another 15.1% had pursued higher education. Approximately 70% of the people interviewed were farmers, while 20% were fishermen, and the remaining 10% relied on the other jobs including

mining, shifting cultivation, owing a business, and performing labour. As the majority (98.7%) of respondents were Buddhists and very few (1.3%) were Christians, religion was not considered in further analyses. Most of the respondents (82.6%) were native inhabitants, while 17.4% were immigrants to the study area. More than 80% of the respondents had a residency of over 20 years and had settled in the study area since before the PA establishment in 2004.

At the household level, the family size, working capacity, income level, land size, type of crop cultivated, and number of livestock were recorded. The size of the household was grouped into three categories, where 24.8% were small (2-4 family members), 39.1% were medium (5-7 family members), and 36.1% were large (>7 family members). The daily income of each household was collected separately for the good season (crop harvesting season or fishing season) and the bad season (crop growing season or fish spawning season). During the good season, more than half of the households (52.6%) earned above 10$[1] per day while 47.4% earned less than 10$ a day. In the bad season, however, 81.3% earned below 10$ while only 18.7% earned more than 10$ per day.

Approximately 90% of the households possessed livestock, including buffaloes (7.4%), cows (38.3%), pigs (57.8%), and chickens (76.1%), while two owned captive elephants. All buffaloes, cows and elephants were grazed inside or near the PA boundary. However, pigs and chickens were raised domestically. The landholding size per household was recorded in three categories, indicating that 39.6% were landless, 34.8% owned less than 10 acres[2] and 25.7% owned above 10 acres. Later, the respondents were pooled into two categories as either landowners (60.4%) or landless (39.6%). Of those who owned land, rice (60%) was the main crop grown in the study area, followed by peanuts or beans (12.2%), while 27.8% did not grow any crops and rented their land out to other farmers.

[1] 1 US$ = 1,513 Myanmar Kyats (Reference exchange rate on 1.7.2019 from the Central Bank of Myanmar)

[2] 1 Acre = 0.405 Hectare

2.5 Data Analysis

Primary data collected from the field were recorded, coded and organized in Microsoft Excel 2010. All the statistical analyses were performed using IBM SPSS Version 25. As most of the variables were categorical and not normally distributed, non-parametric tests were applied for the analysis. First, descriptive statistics were used to understand the nature of the data and identify the frequencies of different variables. Secondly, the relationships between the dependent and independent variables were tested with Pearson's chi-squared statistics.

Then, a generalized linear mixed model (GLMM) was fitted to seek the strongest predictors for each dependent variable. The GLMM assumed non-constant variability or non-independence of the data due to the unbalanced research design, i.e., the unequal number of respondents in each stratum might not be independent. The model also expected more than one source of random variation, which may have either been individual variations among participants or grouping variations due to the stratification used for the village selection (Lee et al. 2009). Therefore, further clarification of the effects of predictors on the resource dependency, benefits and costs from the PA, attitudes, and conservation involvement was achieved using the GLMM, in which the village was set as a random factor. Before running the model, the collinearity among the potential predictors (i.e., significant variables in prior analyses and chi-squared tests) were checked (Andrade & Rhodes 2012), and some correlated variables (Spearman's rho, $\rho > 0.5$) were left out (Lee et al. 2009; Allendorf et al. 2018). Model selection was not included in the analysis, as the study was only interested in the effects of predictors on the response variables (Sodhi et al. 2010). All GLMMs fitted for one categorical dependent variable with either a binomial or multinomial distribution, and the logit link function was used in all cases. Both the overall model fit by the predictors and the coefficient estimates of significant predictors were reported. All the statistical tests were two-tailed, and the significance level was set at $p \leq 0.05$.

3 RESULTS

3.1 Household Dependency on the PA

3.1.1 Extraction of resources from the PA

Local communities in the study area extracted PA resources not only for their household use but also for economic purposes. Most (90%, N = 230) of the villages consumed 15 types of extractive resources in total, 11 of which were obtained from the forests around the PA, while the other 4 resources were derived from inside the lake. The most common resources were timber and bamboo for construction, fuelwood for cooking, fruits and vegetables for food supplements, and fishes as a source of protein (Table 1).

For these resources, timber was occasionally extracted (82.2%, N = 207) to meet the need of building materials. Fuelwood was used for daily cooking, and a sufficient amount for the home use was collected yearly (85.2%, N = 207). However, fish (87.4%, N = 207), and fruits and vegetables (60.9%, N = 207) were consumed on a daily basis. Of these PA resources, all forest resources were extracted for household consumption, whereas those from the lake (fish, prawns and molluscs) were aimed at income generation in addition to own use.

Table 1: Types of resources from the PA, and their relative importance to the local households.

Forest Resources	Utilization (Yes) N = 230	Lake Resources	Utilization (Yes) N = 230
Timber	90.0%	Fish*	89.6% (44.4%)
Fuelwood	90.0%	Prawns*	68.3% (20.4%)
Fruits & Vegetables	90.0%	Molluscs*	48.6% (12.6%)
Bamboo	89.0%	Birds	3.0%
Mushroom	88.3%		
Bamboo shoot	87.8%		
Medicinal plants	71.3%		
Honey	63.5%		
Bushmeat	61.3%		
Thatches	57.0%		
Fodder	45.7%		

(*) denotes resources with economic importance, and their values are in the parentheses

3.1.2 Income from the PA

More than half of the respondents (51.3%) answered "yes" to the question "Does your household income depend on the PA?", while 48.7% said they were not economically dependent on the PA's resources. The respondents who said "yes" (N = 118) were asked to mention the share of income from PA resources in their total household income, to which 37.3% replied that it constituted almost all of their earnings, while 28.8% reported that it constituted about half, and 33.9% said that it constituted partially.

The household economic reliance on the PA varied depending on the residential distance to the PA ($\chi^2 = 37.6$, df = 3, $p < 0.001$). Income dependency was relatively higher in the intermediate village than those were in the other villages, fringe, near and far. Furthermore, fishermen more than other occupations ($\chi^2 = 55.7$, df = 2, $p < 0.001$) and people who extracted resources from inside or near the PA ($\chi^2 = 72.0$, df = 1, $p < 0.001$) generated more income (Fig. 2). Gender ($\chi^2 = 4.8$, df = 1, $p = 0.027$), ethnicity ($\chi^2 = 7.6$, df = 1, $p = 0.006$), and land ownership ($\chi^2 = 5.0$, df = 1, $p = 0.025$) also differed significantly regarding household's dependency on the PA.

A generalized linear mixed model was constructed with income dependency on the PA as the dependent variable, while the resource collection place, ethnicity, gender, distance from the PA and occupation were used as fixed factors, and the village was used as a random factor. Because of its significant correlation with occupation, land ownership was excluded from the model ($\rho = 0.553$). The model was statistically significant only with the effect of the resource collection place, while other variables were no longer significant [F (8, 221) = 3.422, $p < 0.001$, Accuracy = 85.2%] (Table 2). Again, the GLMM revealed that household incomes were significantly higher among those who collected resources from inside or near the PA compared to those who collected from outside the PA (coefficient estimate = 2.601, SE = 0.662, $p = 0.001$; Fig. 2).

Table 2: Generalized linear mixed model with "Does your household income depend on the PA? (yes or no)" as the dependent variable; the resource collection place, ethnicity, gender, distance from the PA and occupation as fixed factors; and the village as a random factor.

Source	*F*	df 1	df 2	$p \leq$
Corrected Model	3.422	8	221	**0.001**
Resource collection place (Inside or Outside PA)	18.527	1	221	**0.001**
Ethnicity (Bamar or Shan)	2.930	1	221	0.088
Gender (Male or Female)	2.535	1	221	0.113
Distance from the PA (Fringe, Near, Intermediate or Far)	1.762	3	221	0.155
Occupation (Farmer, Fisherman or Other)	1.540	2	221	0.217

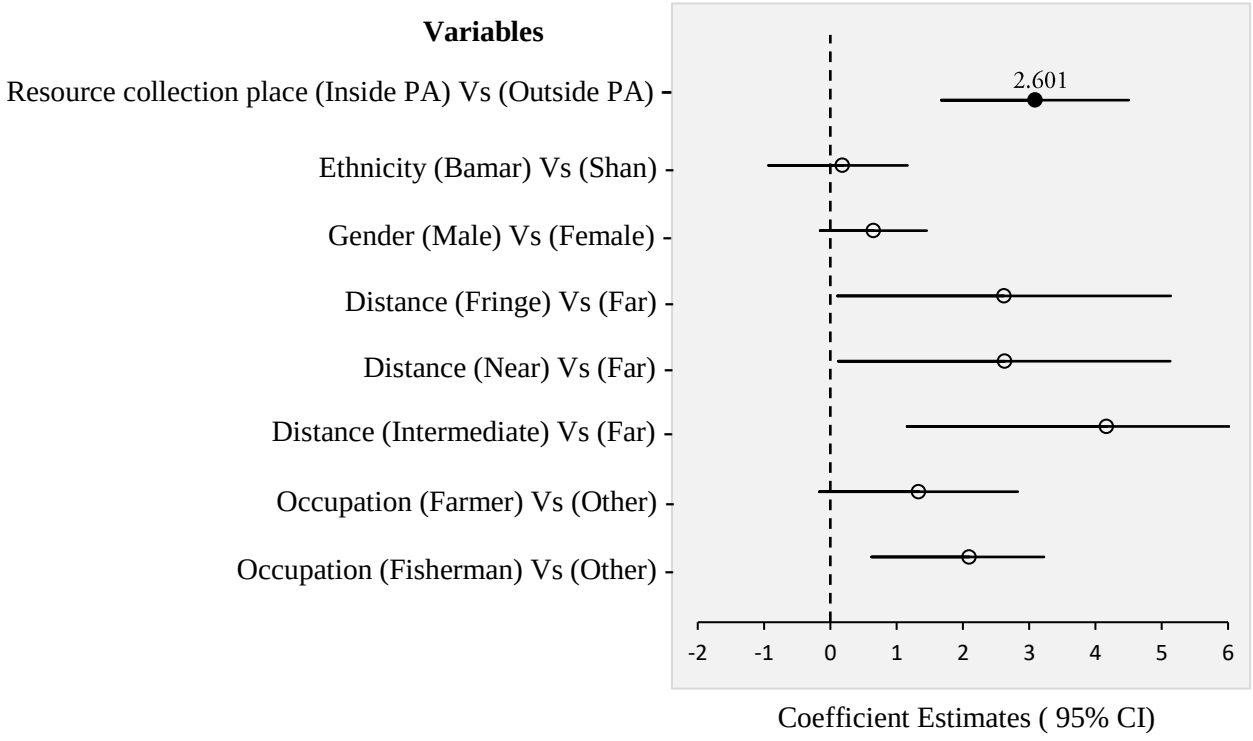

Figure 2: Coefficient estimates of predictors of the income dependency on the PA

3.2 Perceived Benefits and Costs from the PA

3.2.1 Benefits from the PA

When the respondents were asked whether they received any benefits from the PA, 85.2% reported that they received benefits, and 14.8% reported that nothing was obtained from the PA. Among those agreeing with gaining benefits (N = 196), 31.6% acknowledged exploitable benefits (timber, fuelwood, food, etc.), while 18.9% appreciated non-exploitable benefits (i.e., climate regulation, flood control, and aesthetic and cultural values), and the remaining 49.5% indicated that they received both. Participants living closer to the PA perceived more benefits than did those living farther from the PA ($\chi^2 = 126.18$, df = 3, $p < 0.001$, Fig. 3). Fishermen more than farmers ($\chi^2 = 10.6$, df = 2, $p = 0.005$) and landless individuals more than landowners ($\chi^2 = 4.2$, df = 1, $p = 0.038$) placed significantly higher credit on the PA's value ($\chi^2 = 41.5$, df = 1, $p < 0.001$).

A generalized linear mixed model was fitted, with benefits from the PA as the dependent variable, distance from the PA and occupation as fixed factors, and village as a random factor. Land ownership was removed from the model, as it correlated significantly with the occupation ($\rho = 0.553$). The model demonstrated that only the distance from the PA had a significant effect on predicting variations in the acceptance of the benefits, while the effects of the other variables were not significant [F (5, 224) = 9.023, $p < 0.001$, Accuracy = 93.5%] (Table 3). The coefficient estimates of fixed effects from the model indicated that the perception of benefits followed the distance gradient, in which the villages near the PA received significantly more benefits (fringe: 5.166, SE = 0.880; near: 4.935, SE = 0.876; and intermediate: 3.348, SE = 0.858 respectively; all at $p < 0.001$) than did those of the far village (Fig. 3).

Table 3: Generalized linear mixed model with "Do you get any benefits from the PA? (yes or no)" as the dependent variable; distance from the PA and occupation as fixed factors; and the village as a random factor.

Source	F	df 1	df 2	$p \leq$
Corrected Model	9.023	5	224	**0.001**
Distance from the PA (Fringe, Near, Intermediate or Far)	13.393	3	224	**0.001**
Occupation (Farmer, Fisherman or Other)	0.325	2	223	0.723

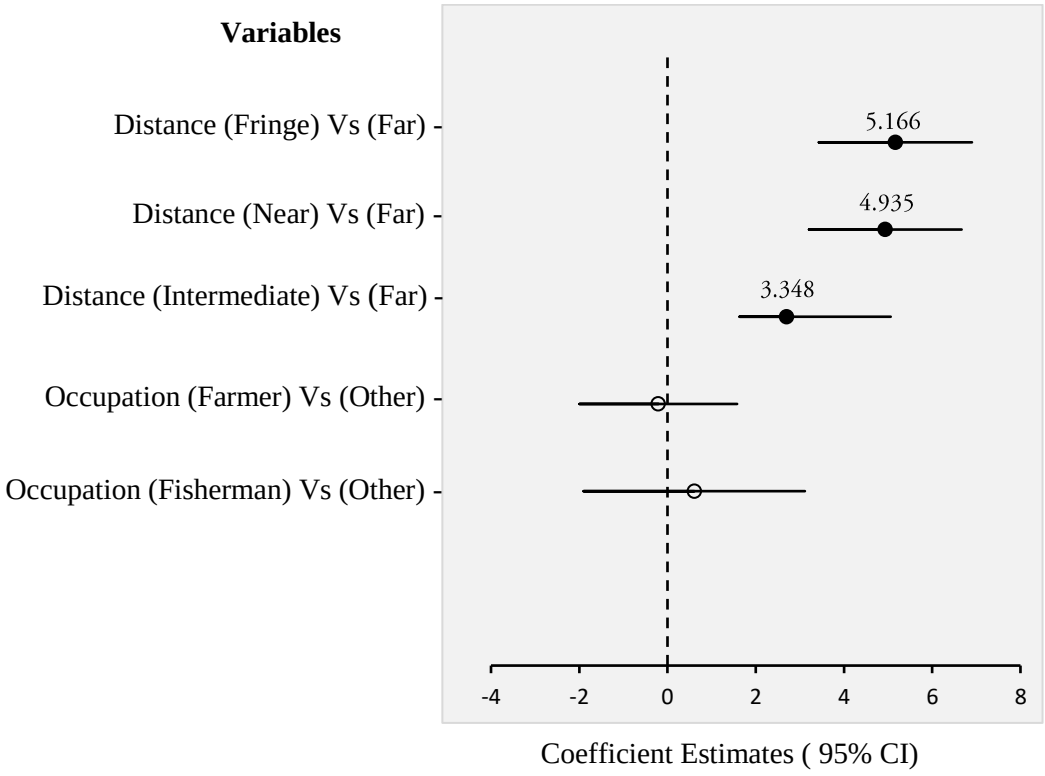

Figure 3: Coefficient estimates of predictors of the perceived benefits from the PA.

3.2.2 Costs from the PA

To the question "Do you suffer any costs from the PA?", more than half (53.9%) of the respondents confirmed losses incurred by the presence of the PA in their vicinity. Of those who suffered the costs (N = 124), 87.9% experienced only one kind of loss, whereas 12.1% encountered two or more problems. Different kinds of problems included crop damage by wild animals and birds (N = 74), restricted resource access (N = 60), and the other problems, such as conflicts with PA staff concerning land uses, flooding agricultural land and erosion along the river bank (N = 7).

The costs of living near the PA were significantly higher to the respondents who depended on the PA resources for household income ($\chi^2 = 35.1$, df = 1, $p < 0.001$). These PA-induced costs were relatively higher in the intermediate village located in the alluvial area of the PA than those were in the other villages, fringe, near and far ($\chi^2 = 36.2$, df = 3, $p < 0.001$, Fig.4). Fishermen and farmers more than other business owners ($\chi^2 = 9.7$, df = 2, $p = 0.008$),

and peanut cultivators more than rice cultivators ($\chi^2 = 13.1$, df = 2, $p = 0.001$) experienced more problems due to the PA existence nearby. Furthermore, gender ($\chi^2 = 3.7$, df = 1, $p = 0.052$) and ethnicity ($\chi^2 = 10.7$, df = 1, $p = 0.001$) were also significantly related to the perceived losses.

A generalized linear mixed model was constructed, in which the costs from PA were set as the dependent variable, while income dependency on the PA, gender, ethnicity, distance from the PA and occupation were set as fixed factors, and the village was set as a random factor. Crop type was not included in the model, as it was significantly correlated with occupation ($\rho = 0.631$). The model confirmed that all the variables other than occupation were significant predictors of the perception of costs [F (8, 221) = 3.972, $p < 0.001$, Accuracy = 74.3%] (Table 4). The coefficient estimates of significant variables indicated that distance had the strongest influence on the cost of the PA, (fringe: 2.620, SE = 1.276, $p = 0.041$; near: 2.634, SE = 1.271, $p = 0.039$; intermediate: 4.252, SE = 1.575, $p = 0.007$), followed by income dependency on PA (1.212, SE = 0.411, $p = 0.004$), gender (-0.866, SE = 0.351, $p = 0.014$), and ethnicity (0.947, SE = 0.444, $p = 0.034$) (Fig. 4).

Table 4: Generalized linear mixed model with "Do you suffer any costs from PA? (yes or no)" as the dependent variable; income dependency on the PA, gender, ethnicity, distance from the PA, and occupation as fixed factors; and the village as a random factor.

Source	*F*	df 1	df 2	$p \leq$
Corrected Model	3.972	8	221	**0.001**
Income dependency on the PA (Yes or No)	8.711	1	221	**0.004**
Gender (Male or Female)	6.087	1	221	**0.014**
Ethnicity (Bamar or Shan)	4.549	1	221	**0.034**
Distance from the PA (Fringe, Near, Intermediate or Far)	2.435	3	221	**0.045**
Occupation (Farmer, Fisherman or Other)	1.859	2	221	0.158

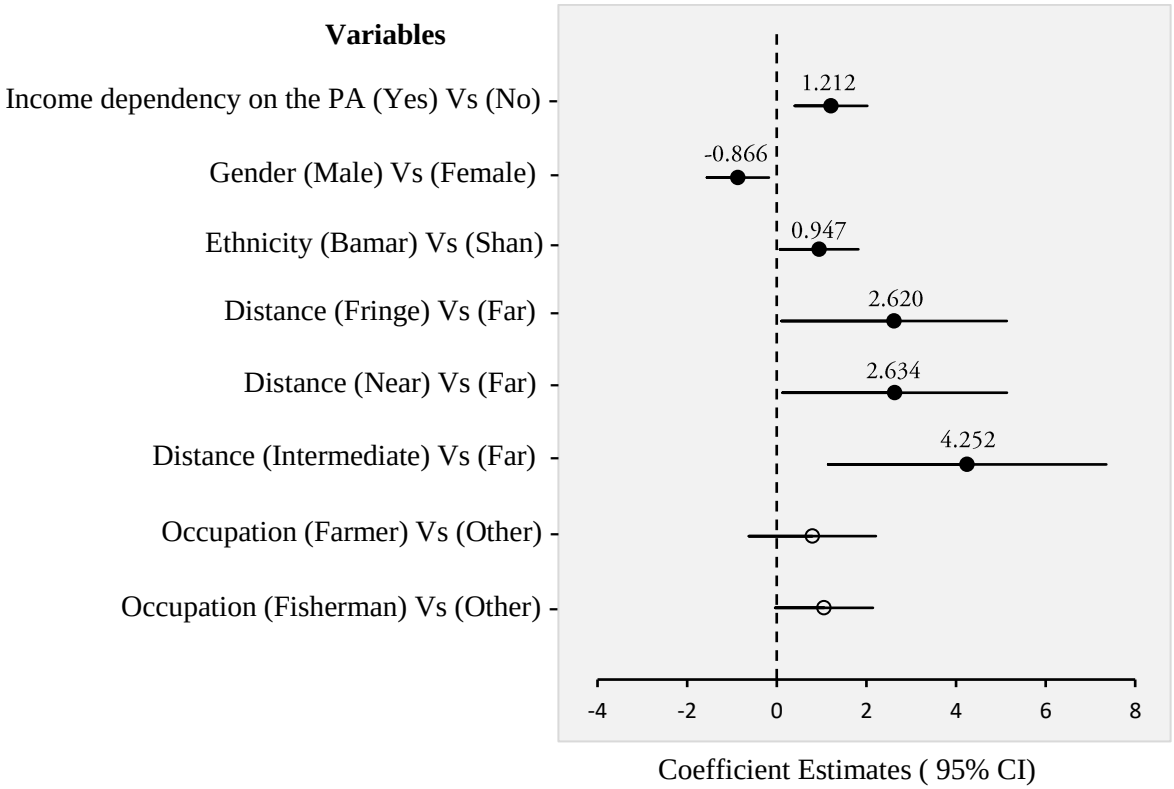

Figure 4: Coefficient estimates of predictors of the perceived costs from the PA.

3.3 Attitudes towards the PA and its Management

Local communities' attitudes towards the PA existence were explored by asking "What is your opinion on the presence of PA?" with three responses: positive, neutral and negative. Overall, 89% of the respondents were positive towards the presence of the PA, 6.5% were neutral, and 4.5% were negative. People's attitudes towards the PA differed significantly among the respondents with the benefits and costs they experienced from the PA. People who perceived benefits from the PA expressed positive attitudes ($\chi^2 = 21.6$, df = 2, $p < 0.001$). Alternatively, villagers who suffered costs due to the PA were more negative towards the existence of the PA ($\chi^2 = 9.1$, df = 2, $p = 0.011$). Peanut cultivators more than rice farmers ($\chi^2 = 73.6$, df = 4, $p < 0.001$) and people who were economically dependent on the PA ($\chi^2 = 13.2$, df = 2, $p = 0.001$) were more likely to show negative attitudes. Furthermore, distance from the PA significantly influenced people's attitude towards the PA. Villagers on the fringe and near the PA were more positive than were those at an intermediate distance and far away ($\chi^2 = 111.2$, df = 6, $p < 0.001$).

When asked "How is your relationship with PA staff?", 53.5% of the respondents said that they had a good relationship, 24.8% were neutral, and 21.7% answered that their relationship with the park's staff was bad. Villagers who benefitted from the PA indicated better relationships ($\chi^2 = 13.6$, df = 2, $p = 0.001$) whereas those who indicated costs due to the PA depicted bad relationships ($\chi^2 = 24.9$, df = 2, $p < 0.001$). Respondents who economically relied on the PA ($\chi^2 = 21.2$, df = 2, $p < 0.001$) more than those who did not rely on the PA, more fishermen and farmers than other business people ($\chi^2 = 16.1$, df = 4, $p = 0.003$), and migrated Bamar people than indigenous Shan ($\chi^2 = 7.4$, df = 4, $p = 0.024$) portrayed negative relationships with park authorities. Moreover, people's relationships with the PA were more desirable in the villages closer to the PA than those in the intermediate and farther away villages ($\chi^2 = 105.4$, df = 6, $p < 0.001$).

As presented in Table 5, a generalized linear mixed model fitted with the relationship with PA staff as the dependent variable, with costs from the PA, occupation, ethnicity, income dependency on the PA and benefits from the PA as fixed factors, and with the village as a random factor was significant [F (12, 216) = 2.061, p = 0.021, Accuracy = 70.9%]. The coefficient estimates of the model depicted that costs from the PA (1.194, SE = 0.555, p = 0.033) and occupation as fishermen (3.618, SE = 1.379, p = 0.010) were significant in explaining the variation of people's negative relationship with park staff (Fig. 5). However, the effects of ethnicity, income dependency on the PA and benefits from the PA were not significant in the model. Distance from the PA was left out of the model because of its significant correlation with benefits from the PA ($\rho = 0.503$).

Table 5: Generalized linear mixed model with "How is your relationship with PA staff? (bad, neutral or good)" as a dependent variable and with costs from the PA, occupation, ethnicity, income dependency on the PA, and benefits from the PA as fixed factors and village as a random factor.

Source	F	df 1	df 2	$p \leq$
Corrected Model	2.061	12	216	**0.021**
Costs from the PA (Yes or No)	3.918	2	216	**0.021**
Occupation (Farmer, Fisherman or Other)	2.674	4	216	**0.033**
Ethnicity (Bamar or Shan)	1.518	2	216	0.221
Income dependency on the PA (Yes or No)	0.083	2	216	0.920
Benefits from the PA (Yes or No)	0.037	2	216	0.963

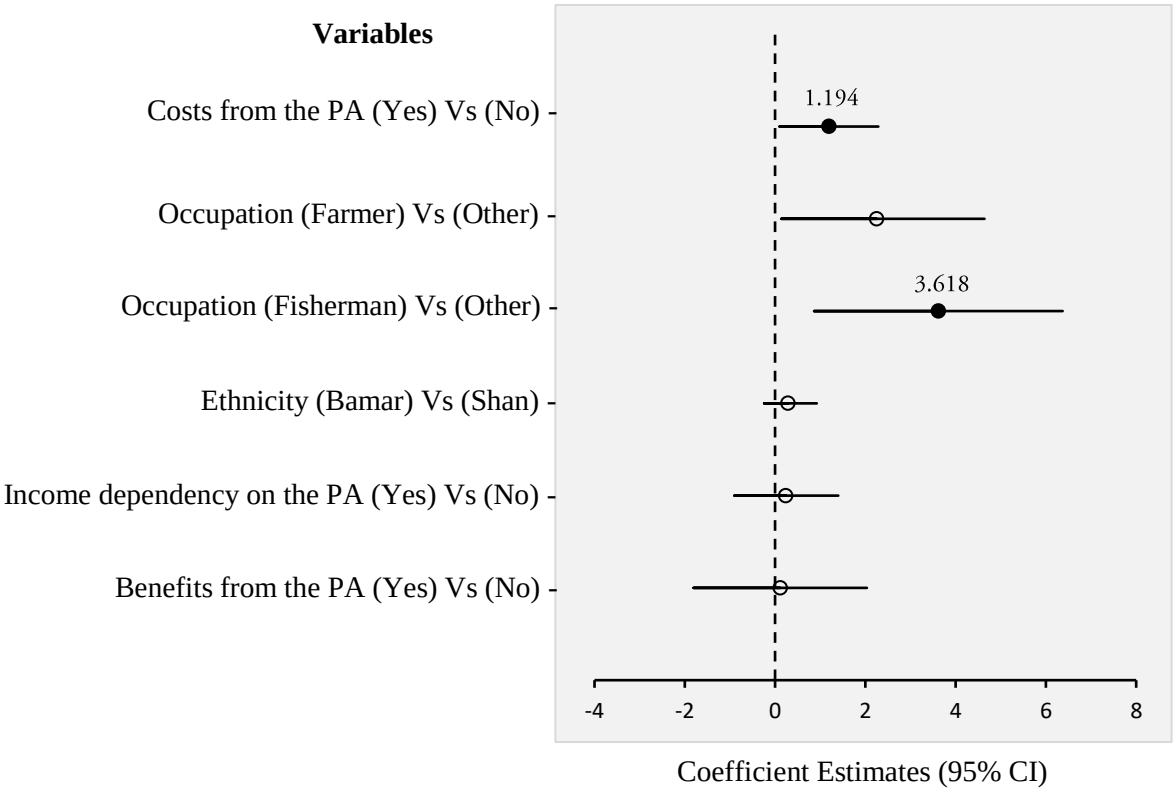

Figure 5: Coefficient estimates of predictors of people's relationship with PA staff.

3.4 Local People's Knowledge of the PA and its Key Biodiversity

The majority of respondents (91.3%) knew that the PA was a conservation area, and the purpose of establishment was to conserve the lake and forests around it. The reported key species of the park included fish (65.2%), birds (61.7%) and mammals including gibbons, hog deer, muntjacs, wild cats and wild pigs (27.8%). All the villages were equally aware of the presence of the PA in their surroundings since there was no significant difference among the four village categories ($\chi^2 = 6.7$, df = 3, $p = 0.082$).

When knowledge on threats to the PA's biodiversity was captured in open responses, logging (54.8%) was the most common threats, followed by human population pressure (36.1%), land encroachment (30%) and unsustainable fishing (22.2%). The other types of the threats included hunting (18.7%), pollution from gold mining (16.5%), pesticide use in agriculture (10.6%), improper waste management (11.3%). When the total number of reported threats were grouped into three levels as low (1 threat), medium (2 threats), and high (3 and

more threats), the high level of threats was more frequently mentioned by the respondents living in the intermediate village than did those living in the other villages ($\chi^2 = 12.4$, df = 6, $p = 0.05$; Fig. 6).

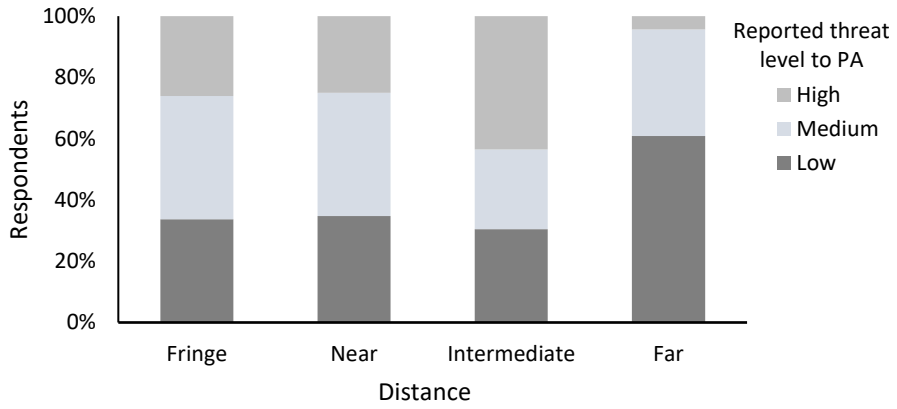

Figure 6: Local people's knowledge of the threats to the PA.

When asking "Do you think that local resource extraction has some impacts on the biodiversity of the PA?", 68.7% answered "yes", while 31.3% said that there was no impact. People were aware of the declining trend of the PA biodiversity in relation to the resource availability in their daily life. Overall, 88.3% realized that deforestation, through the decline of timber and fuelwood availability, was the most serious threat. Moreover, 69.6% noticed that the fish population decline, and that the fish species diversity and fish catches became lower than those in the past. Also, the decline of mammal species was mentioned by 63% of respondents.

3.5 Conservation Support of the Local Community

3.5.1 Conservation involvement

To investigate local communities' support for the PA conservation, respondents were asked, "Are you currently involved in the conservation of the PA?". 43.9% answered "yes" and 56.1% said "no". The conservation activities they were involved in were tree planting, community fishery and fish releasing, waste management, patrolling and community forestry. Living closer to the PA increased the likelihood of conservation involvement, as the communities living in the fringe and near villages were more engaged in conservation activities than were those living in the intermediate and far away villages ($\chi^2 = 26.5$, df = 3, $p < 0.001$).

There was a significant difference in local support for conservation between people who received benefits and those who did not receive benefits (χ^2 = 27.1, df = 1, p < 0.001). Respondents who had knowledge about the PA conservation activities participated more in the conservation initiatives (χ^2 = 13.5, df = 1, p < 0.001). Significantly, villagers who had positive attitudes (χ^2 = 12.0, df = 2, p = 0.002) and better relationships with the PA staff (χ^2 = 11.3, df = 2, p = 0.004) were more likely to be engaged in conservation programmes.

A generalized linear mixed model was fitted with the conservation involvement as the dependent variable, with benefits from the PA, knowledge about the PA conservation activities, attitudes towards the PA, and relationships with the PA staff as fixed factors, with the village as a random factor. Distance from the PA was not included in the model due to its significant correlation with benefits from the PA (ρ = 0.503). The results of the model indicated that benefits from PA and knowledge about conservation were the two significant variables, while attitudes toward the PA and relationships with PA staff were not significant anymore in the model [F (6, 223) = 3.248, p = 0.004, Accuracy = 68.7%]. Coefficient estimates of the model showed that benefits from the PA (3.234, SE = 1.063, p = 0.003) had the strongest contributions to the participants' conservation involvement, followed by conservation knowledge (2.483, SE = 1.072, p = 0.003) (Fig. 7).

Table 6: Generalized linear mixed model with "Are you currently involved in the conservation of PA? (yes or no)" as the dependent variable; benefits from the PA, knowledge about the PA conservation activities, attitudes towards the PA and relationships with PA staff as fixed factors; and the village as a random factor.

Source	*F*	df 1	df 2	$p \leq$
Corrected Model	3.248	6	223	**0.004**
Benefits from the PA (Yes or No)	9.253	1	223	**0.003**
Conservation knowledge (Yes or No)	5.364	1	223	**0.021**
Attitude towards the PA (Positive, Neutral or Negative)	1.099	2	223	0.335
Relationship with PA staff (Good, Neutral or Bad)	0.878	2	223	0.417

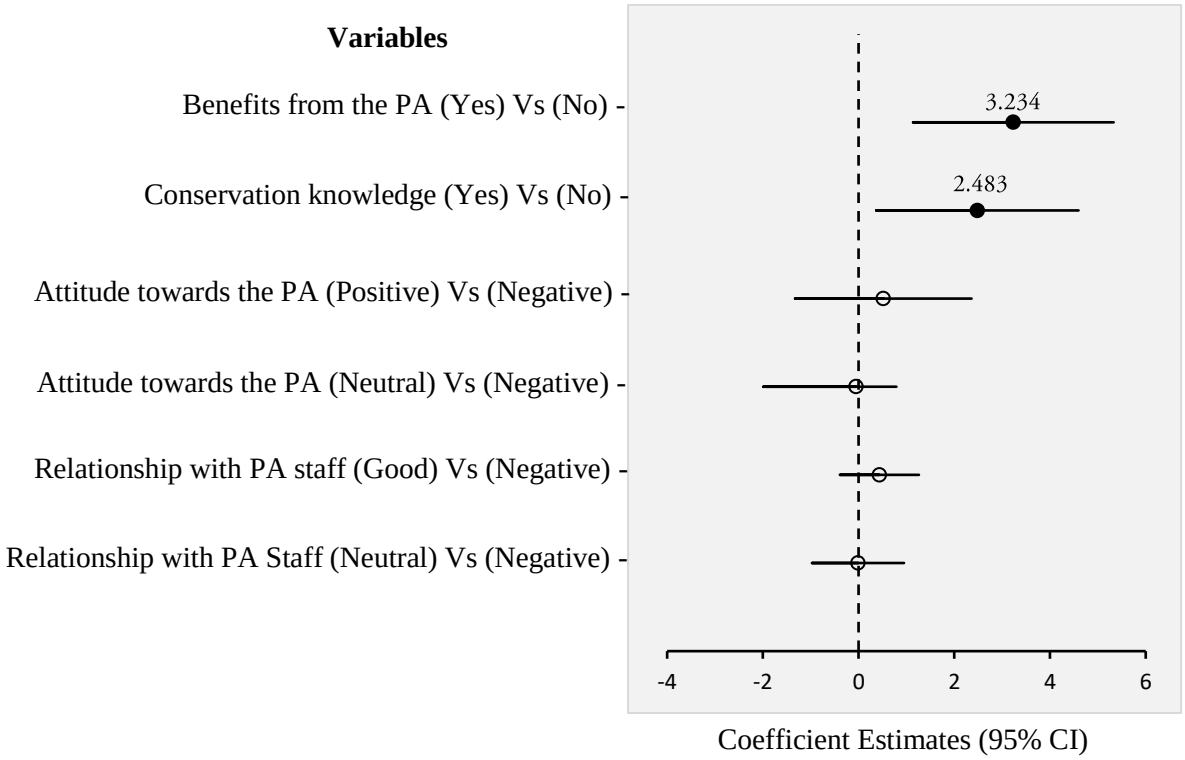

Figure 7: Coefficient estimates of predictors of the community involvement in conservation

3.5.2 Compliance with the rules and regulations of the PA

Totally 88.3% of the respondents answered "yes" to the question "Do you know the rules and regulations of the PA?" while 11.7% said that they did not know the rules of the PA. Those who said "yes" (N = 203) were asked how well they did know the regulations of the PA, 18.2% answered that they knew these regulations due to the awareness-raising programmes, 33.5% referred that notification signs around the PA were sources of information, and the remaining 48.3% were aware of the PA regulations due to boundary makers around the fish conservation zone (especially near the pagoda area).

Concerning the legal access to the PA resources, the respondents were asked "Are you allowed to collect the resources that you mainly depend on?". Totally 65.2% replied "yes", which meant that the resource collection was allowed for non-commercial purpose. However, economic utilization of fish resources was allowed by issuing fishing licenses during the seasons that were out of the fish spawning time. The villagers who lived within 3 km from the park ($\chi^2 = 17.3$, df $= 3$, $p = 0.001$), fishermen ($\chi^2 = 47.4$, df $= 2$, $p < 0.001$) and the households whose incomes were dependent on the PA resources ($\chi^2 = 51.7$, df $= 1$, $p < 0.001$) were more likely to say that they were not allowed for the resource collection (Fig. 8).

A generalized linear mixed model in which the permission to collect resources from the PA was chosen as the dependent variable, income from PA, occupation, and distance from the PA were set as fixed factors, and the village was chosen as a random factor was significant [F (6,223) = 5.334, p < 0.001, Accuracy = 78.3%]. The model reaffirmed that there were two significant effects, the occupation as fishermen (coefficient estimate = -2.22, SE = 0.944, p = 0.020) and household dependency on the PA in explaining variation of the permitted access to the resource collection (coefficient estimate = -1.657, SE = 1.063, p = 0.001). However, the distance from the PA was no longer significant (Fig. 8).

Table 7: Generalized linear mixed model with "Are you allowed to collect the resources that you mainly depend on? (yes or no)" as the dependent variable; income from PA, occupation and distance from the PA as fixed factors; and the village as a random factor.

Source	F	df1	df2	$p \leq$
Corrected Model	5.334	6	223	**0.001**
Income dependency on the PA (Yes or No)	12.760	1	223	**0.001**
Occupation (Farmer, Fisherman or Other)	4.111	2	223	**0.018**
Distance from the PA (Fringe, Near, Intermediate, or Far)	0.283	3	223	0.838

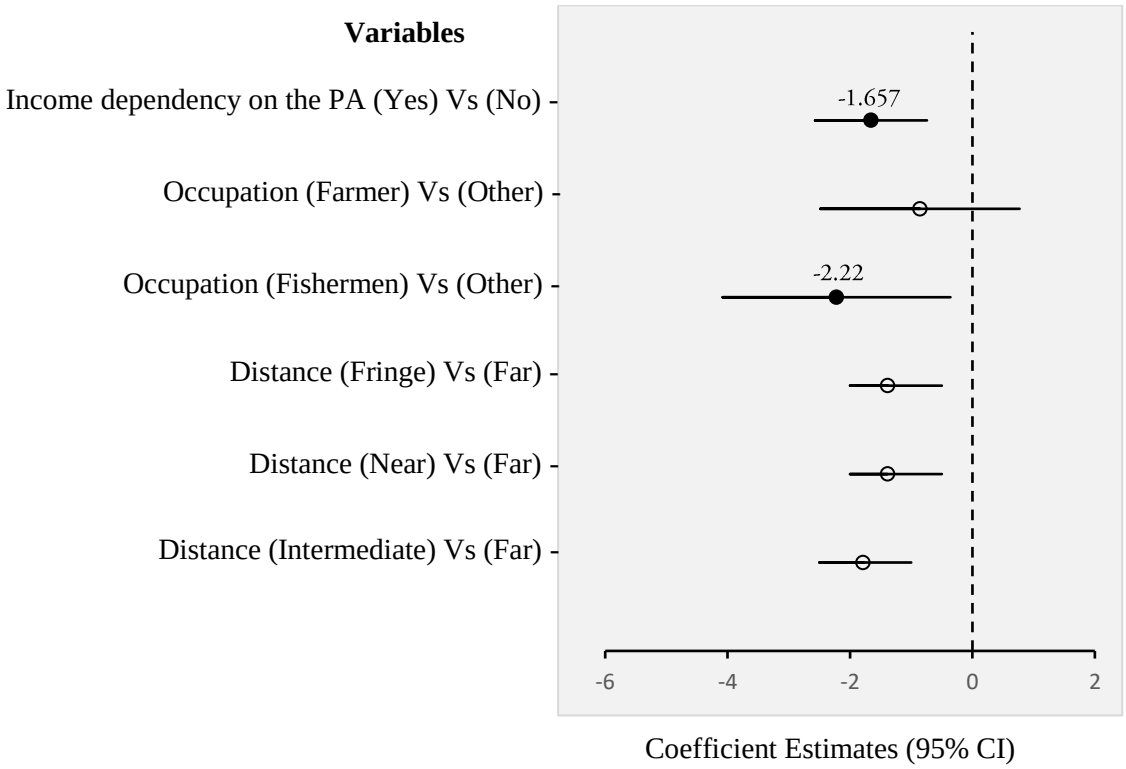

Figure 8: Coefficient estimates of predictors of permitted access to PA resource exploitation.

4 DISCUSSION

4.1 Household Dependency on the PA

Forest resources from the PA were used as building materials and household energy supplements. Timber and bamboo were the main construction materials, and 80% of the houses interviewed were mainly built of either timber or bamboo. Than (2011) also found that timber and bamboo houses were predominant house structures in the IWS, and 70% of those houses used bamboo as a walling material, while 41% used timber as a flooring material. Timber and bamboo were also used as fencing materials in agricultural fields because livestock were pastured in the open grazing system in the IWS. Fuelwood was used as the primary source of energy for cooking, and almost half (47.8%) of the households relied entirely on it, while the other half shared it with electric energy. The minimum fuelwood consumption was two bullock carts[3] per household per year, and the maximum reached 20 bullock carts. Wood fuel requirements for cooking food to feed domestic livestock (pigs) increased the consumption rate (Than 2011). The high consumption of fuelwood can also be explained by the lack of alternative energy sources (Aung et al. 2015), inaccessibility or unaffordability of high installation costs and higher electricity charges (Badola 1998; Baral & Heinen 2007; Garkoti 2014). Even some respondents who had access to electricity said that they used only fuelwood because of the unpredictability or irregular supply of electricity, as well as concerns over electric shocks. This finding suggests that not only alternative energy supplies but also educating people regarding electric use should be the prerequisites for reducing fuelwood consumption in the IWS.

Although the majority of respondents were farmers, they switched their activities between fishing and farming alternately (Than 2011). Fish was not only the main source of protein but was also a source of income. Seasonal variation of household incomes was also detected between fishing and off-fishing seasons. While 52.6% of the households earned 10$ and above per day during the fishing season, only 18.7% of the households earned the same amount during the off-fishing season. This reduction was more acute among fishermen and farmers than among other types of occupations. Even though the seasonal differences in household incomes were not solely attributed to fishing, these findings suggest that PA resources significantly contribute to the household economy of villages around the IWS. This assertion was further evidenced by the results of the GLMM, in which people who collected

[3] 1 bullock cart = 0.7 ton

resources from inside the PA generated significantly higher income than did those who collected from outside. Since no commercial exploitation of forest resources was allowed in the IWS, this income variation relative to the resource collection place could be inferred to only lake resources.

The results also revealed that income dependency on the PA was relatively higher in the intermediate village than were those in the other villages. This finding contradicts the common phenomenon documented by different studies (Shrestha & Alavalapati 2006; Garkoti 2014; Rahman et al. 2017; Kyando et al. 2019) in which households closest to the parks were more reliant on the PAs than were those located relatively far away. However, Ambastha et al. (2007) found that the share of PA income relative to the total household income differed with the locality and geographic conditions which facilitated different land uses. This scenario agrees with the present study and well explains why the dependency level of the intermediate village (Chaung Wa) was the highest among all villages. The drainage system of the IWS is fed by eight inflow streams and one outflow stream, and Chaung Wa is located in the alluvial outflow basin in the northern edge of the sanctuary (Forest Department 2018). This geographical distinction makes the dependency of Chaung Wa different from those of other villages. Unlike other villagers who own permanent agricultural land, Chaung Wa villagers grow their crops on land which reappears when the water level lowers during the open dry season. Only a few of these villagers owned permanent agricultural land, and most were engaged in natural resource-based livelihoods. Sekhar (2003) reported that landless people usually lack the capital to invest in agriculture or other livelihood options to diversify their income. Automatically, natural resources become alternatives with which to meet their livelihood needs (Moshi 2016). Other studies in Myanmar and elsewhere reinforced this finding. Aung et al. (2015) in Nat Ma Taung National Park and Parker and Thapa (2012) in the Kanchenjunga Conservation Area of Nepal observed that PAs located in areas with limited agricultural land drove the local households to be more dependent on the PA resources for their living. Additionally, the non-significant effects of distance in the GLMM explained that the distance was not the main influencer of resource dependency. Therefore, hypothesis (H1) is not supported.

4.2 Perceived Benefits and Costs from the PA

There was a strong recognition of the benefits from the PA because the majority of respondents (85.2%) reported gaining benefits. Local communities acknowledged extractive goods such as food, fuelwood, and timber, as well as non-extractive services such as climate regulation, recreation, aesthetics, and the religious and cultural significance of the PA as a local pride, which was similar to the results that Tolbert et al. (2019) found. The perception of these benefits was found to be associated with the proximity to the PA. Residents living on the fringe and near the PA perceived higher benefits than did those of the intermediate and far villages. This finding is consistent with those of other studies by Thant (2017) in Chatthin Wildlife Sanctuary, Myanmar, and Shrestha and Alavalapati (2006) in Koshi Tappu Wildlife Reserve, Nepal. Likewise, Sarker and Røskaft (2011) conducted case studies in four PAs in Bangladesh, and their results also indicated that the perceived level of PA benefits is 1000 times higher in villages closer to the PA than in those far away.

Possible explanations behind the maximized benefits in the communities adjacent to the PA are the convenient access to the resources, short travelling distance and time. Furthermore, nearby villages benefit from community support programmes of the PA such as loans or financial assistance during economically hard times, especially during the off-fishing seasons. This kind of funding support is limited to the accessible villages closer to the PA excluding those located relatively far. Although the tourism benefit was not significant in the current study, villages bordering the pagoda generated tourism income through providing homestay services, selling souvenirs, transports and logistics supplies to the visitors, and operating restaurants (Forest Department 2018). These unequal benefit streams among the villages might result in their different acknowledgements of PA benefits (Coad et al. 2008). Sarker and Røskaft (2011) suggested that the unequal distribution of conservation benefits had negative consequences on people's attitudes towards conservation.

Although a close distance to the PA is related to the accumulation of PA benefits, the results of the GLMMs showed that household dependency on the PA and other livelihood-related variables such as occupation were not strong enough in predicting the perception of benefits. This means that not every resource-dependent household recognized PA benefits. However, the significant effect of household dependency on the prediction of costs explained that these dependent households perceived PA-induced losses. The establishment of the PA imposed costs to local communities because such gazettement more or less involved resource restrictions (Allendorf et al. 2006; Vodouhê et al. 2010; Nepal & Spiteri 2011; Mfunda et al.

2012; Nana & Tchamadeu 2014). The IWS, as one of these PAs, has no exemption from this general trend, and its designation in 2004 restricted land and resource use rights to nearby villages. Local communities were impoverished due to denied access to the resources that are economically important to them. Notably, greater losses were brought to the fishermen who usually lacked land and alternative livelihood options.

Even landowners and middle-income families are affected to some extent of loss when the lands upon which their main livelihood depends on are transformed into conservation areas. As agriculture is the main occupation in the study area, the loss of customary land had enormous impacts on the livelihoods of local communities. Fiallo and Jacobson (1995) found that the socio-economic costs of a conservation area were directly related to its protection level, and the stricter the conservation status, the higher were the costs to the local community (Sarker & Røskaft 2011). Their finding was further underlined by the present study indicating that the highest costs of PA were in Chaung Wa village at the intermediate distance. Since before the PA establishment, Chaung Wa villagers have been using the fertile alluvial plain for growing peanuts during the dry season. The villagers in Chaung Wa switch their profession between peanut cultivation during the dry season and fishing during the other seasons. The loss of customary land use rights due to the PA establishment in 2004 created land-use conflicts between the PA and Chaung Wa villagers. Although some extent of land (384 acres of cultivated lands) were excluded as the local privilege (Forest Department 2016), villagers claimed that this was not the same amount of land that they lost to the PA. Additional costs implied when the PA was designated as a Man and Biosphere Reserve in 2017, and agricultural activities within 2 km from the PA boundary were prohibited. This village suffered disastrous consequences, e.g., land-charged extra costs and reduced crop yield when the replaced land was fallow vacant land with low fertility. This finding suggests that the socio-economic costs of the PA are greater when the impacts directly affect the main livelihood from which household income is generated (Shibia 2010). If the costs are too large at the expense of economic benefits, conservation will be compromised. The results of this study demonstrated that household dependency on the PA significantly influenced the people's perceptions of the costs, while distance and other socio-economic factors functioned as covariates. Dependency on the PA, however, was not a significant predictor of perceived benefits. Therefore, the hypothesis (H2) that highly resource dependent communities are affected by higher costs of resource restriction is supported.

4.3 Attitudes towards the PA and its Management

The majority of respondents were positive towards the PA in their vicinity, and most of these respondents were from the fringe and nearby villages. However, those with negative attitudes were mainly from the intermediate village. The results showed that people living on the fringe and near the PA received significantly higher benefits than did those of living in the intermediate and far away villages. Possibly, it could be inferred that a positive attitude is a function of the benefits that the respondents received from the PA, as concluded by different studies such as those in Serengeti National Park in Tanzania (Mfunda et al. 2012), Sariska Tiger Reserve in India (Sekhar 2003) and some PAs in Upper Myanmar (Allendorf et al. 2006). This finding, however, contradicts what Hantun (2018) observed in the Moeyungyi Wetland Wildlife Sanctuary that people who received the most benefits displayed the most negative attitudes.

Different kinds of PA benefits in terms of either exploitable goods or non-exploitable services encouraged the community attitude to be positive. Several case studies around the world have demonstrated the influence of different types of benefits on favourable conservation attitudes. Garekae et al. (2016) in Chobe Reserve in India and Ansong and Røskaft (2011) in Subri Forest Reserve in Ghana found the cultural significance of the PA to be one of the determinants of positive attitudes. However, Sah and Heinen (2001) in Ghodaghodi Lake area, Nepal and Sekhar (2003) in Sariska Tiger Reserve in India, and Sirivongs and Tsuchiya (2012) in the Phou Khao Khouay National Protected Area, Laos, reported that extractive resources and income from the PA influenced people's attitudes towards conservation. Interestingly, the current study found that respondents who were economically dependent on the PA highlighted exploitable benefits, whereas those who were not economically reliant on the PA emphasized non-exploitable services. This finding suggests that providing resource access through the delineation of a systematic resource utilization zone will enhance communities' attitudes.

Additionally, providing resource access was shown to reduce the conflicts between PA staff and local communities, thus improving the people-park relationship (Garkoti 2014). In Chatthin Wildlife Sanctuary, Allendorf et al. (2017) found that local people appreciated PA staff due to the permitted access to the resources in times of need and the creation of a buffer zone. Similarly, Vodouhê et al. (2010) showed that respondents who enjoyed benefits as a member of the village association for wildlife management established good partnerships with the park staff and had favourable attitudes towards the park. The present study supports this finding, as people in the fringe and nearby villages had better relationships than did those of intermediate village who lost their land use rights due to the PA establishment. Some

respondents mentioned that villagers who continued using their land were imprisoned for encroaching into the PA land. This result points out that an exclusionary approach that ignores local community needs would result in negative attitudes, and it is not a viable solution for the future conservation effectiveness of PAs, as Garkoti (2014) found.

People's attitudes towards the PA and its management were also moderated by socio-economic factors (Dewu & Røskaft 2018) because the costs and benefits experienced varied with the socio-economic status of the community (Shibia 2010). In this study, occupation was significantly associated with the attitudes toward PA staff. Protective conservation efforts from the PA create economic difficulties for the fishermen who solely rely on the PA. In the absence of alternative livelihoods, they illegally encroach into the lake, even during the fish spawning season. Again, stricter legal actions against illegal fishing from the PA accelerated antagonism and worsened the villagers' attitudes when they were arrested and punished. In retaliation for their losses, fishermen destroy the boundary pillars or illegally harvest PA resources at night. Therefore, only strong conservation incentives that could fulfil local needs would change their negative attitudes, as suggested by Sah and Heinen (2001).

In addition to the problems related to resource restrictions, wildlife crop raiding was also the reason for not liking the PA among local farmers (Badola 1998). As rice is the major crop grown in the study area, problem animals are mainly birds, wild pigs, and monkeys, and they usually raid during the crop ripening season. Mfunda and Røskaft (2011) stated that crop damage by wildlife was a common problem in areas where agriculture was the main livelihood. In the IWS, crop loss due to birds is substantial because the crop harvesting season coincides with the bird migration period, when more than 20,000 birds migrate into the IWS (Forest Department 2018). People expressed negative views about their economic losses due to crop damage and restrictions on the use of bird nets as protective measures. Allendorf et al. (2006) found that people who encountered wildlife crop damage were five times more likely to have negative attitudes compared to those who did not.

Findings of this study highlighted that people's conservation attitudes are shaped by the benefits and costs they experienced from the PA. Communities who received benefits performed positive attitudes, whereas those suffered losses portrayed negative attitudes. The result of GLMM also supported that the greater influence of costs over benefits has led to the negative attitudes towards PA management. Thus, the postulated hypothesis (H3) is supported.

4.4 Local People's Knowledge of PA and its Key Biodiversity

Local villagers knew the PA as a conservation area, and 90.3% mentioned the lake and its watershed forests as the main conservation areas. Most of the respondents identified the key species of the PA as birds, fish and other mammals such as hog deer, and gibbons. Moreover, people knew very well that the lake and wetlands are the habitats of migratory birds. They estimated that more than 20,000 birds migrated into the IWS during winter, and this information is verified by the official bird census data annually collected from the PA (Forest Department 2018). Some respondents said that the area is an UNESCO Biosphere Reserve and a Ramsar site; therefore, they mentioned that the PA is of global importance. As illustrated by the result, the conservation knowledge was not different among the four village categories. It can therefore be concluded that all the villages are equally aware of the PA and its biological significance.

The major threats to the biodiversity of the PA described by the respondents include logging (legal and illegal), human population pressure, land encroachment, unsustainable fishing and the use of destructive fishing practices. Similar findings were reported by Isituto Oikos and BANCA (2011) in the threat analysis of 39 PAs in Myanmar, including the IWS. However, the threats are much higher in the IWS than in other PAs in Myanmar because of a combination of three ecosystem types: lake and wetland ecosystems nested within the forest. The heavy reliance on forest products such as timber and fuelwood threatens endangered gibbons through habitat fragmentation and loss (Lwin et al. 2011). In addition to higher resource demand due to the population pressure, weak law enforcement due to political instability exacerbates these threats (Thapa & Chapman 2010). As the most forested area of PA overlaps with the territory of armed ethnic groups, illegal logging is difficult to control.

Gold mining was also active in these forest areas, although this activity was not officially allowed. The impacts of gold mining, in combination with the lack of natural vegetation due to deforestation, caused siltation and sedimentation into the lake (Than 2011). Local respondents said that almost 200 acres of the lake area was lost due to sedimentation within five years, and if this trend continues, the lake will disappear in 25 years. Additionally, watershed forests around the lake are the origins of inflow streams, and mining residues such as mercury were carried along with the streamflow and deposited into the lake. Mercury accumulation in water causes adverse ecological impacts on fish and on fish-eating birds via undesirable consequences in the food chain. The significant decline of fish species in the southern part of the lake is mainly because of chemical residues and petrol leakage from the vehicles used in gold mining (Forest Department 2018).

Although threats such as higher resource demand due to population pressure and overfishing were common in all villages, land encroachment was significantly higher in the northern part of the PA. Therefore, the results revealed a higher level of reported threats in Chaung Wa among other villages. Because of agricultural land encroachment, important bird habitats such as reeds, floating vegetation and grasslands are destroyed. These habitat types are major nesting and roosting sites of endangered birds (Sarus crane). Furthermore, Lwin et al. (2018) found that the lakeside grasslands are important habitats of hog deer and reported that agricultural expansion as the main threats to them.

Two-thirds of the respondents realized the human impacts on biodiversity, and they were aware of the decline of the PA biodiversity. Some respondents said that although local resource utilization is not damaging the biodiversity of the PA, the higher demands to feed the increased population caused overexploitation and gradually threatened the PA biodiversity. The immigration of outsiders was also reported as one of the underlying causes of the PA's resource degradation. Native respondents claimed that migrant fishermen are threatening the fish diversity by using destructive fishing methods such as electronic fishing. When these introduced fishing methods yield much higher fish catches, they influence traditional fishing practices. The widespread use of unsustainable fishing practices has resulted in species extinction, and some old participants said that certain kinds of fish species they had seen before are now extinct due to overfishing. Therefore, the hypothesis (H4) that local people are less conservation-conscious and not aware of their impacts on the PA's biodiversity is not supported.

4.5 Conservation Support of Local Communities

Villages on the fringe and near the PA participated more in the conservation activities than did the intermediate and far villages. A higher perception of benefits and frequent exposure to conservation programmes in the vicinity of the PA could be the reasons for the higher conservation involvement (Paudyal et al. 2018). Additionally, positive relationship between favourable attitudes and conservation involvement explains why people with positive attitudes engaged more in conservation as found by many other studies (Tessema et al. 2010; Vodouhê et al. 2010; Sirivongs & Tsuchiya 2012; Lamsal et al. 2015). Similarly, Stapp et al. (2016) observed that attitudinal differences are the underlying causes of different conservation support levels among local households in Chitwan National Park, Nepal. In that study, the authors cross-

checked household survey results with satellite-derived forest gains, and significant forest regeneration was detected in the regions with conservation-supportive attitudes (Stapp et al. 2016).

In the case of the IWS, conservation involvement is relatively low (43.9%), despite the overwhelmingly positive attitudes (89%). This means that a positive attitude would reflect community willingness to participate in conservation; however, they are not consistent with their actual conservation involvement. When people are limited in their livelihood options for survival, a positive attitude cannot truly change into environmentally responsible behaviour (Bragagnolo et al. 2016). People who are struggling with livelihood needs cannot prioritize conservation in the first place (Nepal & Spiteri 2011). Hence, people's participation in conservation depends on whether or not their basic needs are fulfilled. The results of the GLMM also indicated that receiving conservation benefits would increase the likelihood of conservation involvement, and the coefficient estimate showed that benefits from the PA were the strongest predictors of people's conservation participation. This finding points out that local support for conservation will not be guaranteed unless the conservation ensures benefits to them.

On the other hand, 34.8% of the respondents still collect resources from the PA in restricted places and periods, although they are not officially allowed. Most are fishermen and people who are economically dependent on the PA for their survival needs. Most of the fishermen interviewed admitted illegal fishing during the fish spawning season due to their lack of substitutes for their livelihood needs. People will not follow the rules and regulations of the PA when their survival is limited (Bragagnolo et al. 2016). Illegal fishermen are active during the night so that they can avoid the risk of being arrested by the patrol team. Although key informant groups were formed for reporting illegal activities, villagers said that they sympathize with each other over their family needs, and some responded that they are afraid of being harmed by the people who undertake illegal practices. This finding concurs with that Hantun (2018) found in the Moeyungyi Wetland Wildlife Sanctuary. Many of the respondents only ask for the provision of alternative livelihoods, including financial and technical support.

Although benefits and livelihood support could function as strong incentives for conservation, they should be conservation oriented. People are likely to adopt other alternatives if they generate higher benefits than those from the PA, whether or not that livelihood option is in line with the conservation. Nepal and Spiteri (2011) suggested that the perceived linkage of conservation benefits and livelihood, i.e., understanding the contributions of the PA to their

livelihood, is stronger than the perception of benefits alone (Salafsky & Wollenberg 2000). This means that the realization of the importance of the PA and understanding the value of biodiversity to their livelihood should be ensured for long-term conservation involvement (Shrestha & Alavalapati 2006). The results of the GLMM reinforced this finding, indicating that better knowledge about conservation would increase conservation participation.

The realization of conservation benefits as the driving force for more local involvement is further strengthened by the community forestry programme in one of the studied villages (Lone Sant). Respondents said that they have to go deeper inside the forest beyond the buffer zone in which they are officially allowed to collect fuelwood. As they are not officially allowed to extract resources from the core zone, they must take the risk of being arrested and fined by the patrol team. The establishment of community forests in the buffer zone of the forest provides them with the required fuelwood and cash income from intercropping underneath the forests. Local people also recognized that community forests would reduce their dependence on natural forests. One respondent said that they are granted land use right for 30 years until the forest trees grow to an exploitable size, and at the same time, they could extract pole and posts from the forests. They appreciated the provision of seedlings and technical support from the forest department and FFI.

Ecotourism is a promising livelihood strategy in the IWS, yet it is not well developed. Many studies highlighted that ecotourism has a great potential to promote community involvement in conservation (Nepal & Spiteri 2011; Sarker & Røskaft 2011; Sirivongs & Tsuchiya 2012; Mutanga et al. 2015). In the IWS, few villages bordering the pagoda area received some ecotourism benefits, especially in Lone Ton village where the education centre is located. Respondents also mentioned ecotourism as an option for local development by selling local products, handicrafts, and the provision of temporary accommodation. Other villagers wanted to be involved in and get benefits from tourism development. It is therefore suggested that the expansion of ecotourism benefits to all possible villages will improve community participation in conservation. However, political instability and the lack of police stations in some villages limit them from becoming involved in tourism. The findings of this study highlight that conservation involvement is positively related to favourable attitudes and the benefits gained from the PA, in which the primary determinant is the benefit. Therefore, the results support the formulated hypothesis (H5).

5 CONCLUSION AND RECOMMENDATIONS

To conclude, the resources from the IWS play a vital role in the livelihoods of local communities living around the IWS. Household dependency on the PA varies with the landscape ecology of the residential area, which likely defines the main livelihood strategies. Among the villages around the PA, the intermediate village located in the alluvial basin relies the most on the PA resources. This level of dependency on the PA governs how people perceive the benefits and costs from it. Highly resource dependent households suffered higher costs from the PA, and the highest was in the intermediate village. However, fringe and nearby villages perceived more benefits and fewer costs in comparison with the intermediate village. Among all village categories, the perception of both benefits and costs seems to be the lowest in the far village.

Overall, people's attitudes towards the PA are positive. Communities' attitudes towards the PA are related to the benefits and costs they have experienced from the PA. People living in the fringe and near villages got more benefits and fewer costs, thus exhibit more positive attitudes. In contrast, intermediate village that gained the fewest benefits and the greatest costs, portrays more negative attitudes. Local communities are aware of the existence of the PA in their periphery and its importance to conservation. They are also aware of the impacts of resource exploitation on the PA biodiversity. Despite the positive relationship with attitudes towards the PA and conservation involvement, positive attitudes cannot fully translate into positive conservation behaviours. Still, people do not follow the rules and regulations of the PA, although they know them. Benefits from the PA are the major determinant of community participation in conservation programmes, and knowledge about conservation also has a significant effect on it.

Although the benefits are found to be the main determinant of community conservation involvement in this study, how effective these benefits are in promoting conservation involvement has yet to be covered. Since the dependency on the PA is different among the villages according to the geographic characteristics and main livelihood strategies, the provision of benefits from the conservation should be compatible with each village's economic needs. Therefore, future research on the effectiveness of different community conservation initiatives is strongly suggested. Based on the findings of the current research, a win-win situation in which community livelihood needs and conservation outcomes could be achieved if the following recommendations are met:

1. Awareness of local communities regarding the PA's zoning management and systematic resource utilization in the respective zones should be promoted. Such zoning management should also be a supplementary to local community basic needs. For example, the introduction of economically important and least ecologically adverse fish species into the lake would support local community subsistence needs and would lessen the pressure on the fish conservation zones. Similarly, the increased establishment of community forests in the degraded areas of the forest buffer zone could fulfil local needs of housing poles and posts.
2. More alternative sources of energy such as electricity at a low cost, and energy-saving cooking stoves should be supported to reduce people's dependency on forest resources. Rice is the major crop grown in IWS, and rice husk pellets are very promising as a substitute for fuelwood.
3. Alternative livelihood options should be diversified to the people who are entirely dependent on PA resources. Enhancing ecotourism opportunities may be helpful as a sustainable option.
4. Tenure rights or land titles outside the PA should be secured to the communities to reduce land-use conflicts and future encroachment into the PA land. PA authorities should coordinate with responsible government departments.
5. Conservation outreaches should be intensified in highly resource dependent villages, and in the communities who bear the most negative attitudes.

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7 APPENDIX (SURVEY QUESTIONNAIRE)

Questionnaire No: ……, Date of Interview: ……..., House No: ……,
Village Name: …….., Village Category: ……, House type:……...

A. Socio-demographic Information

1. Age: ……
   18-29( ) 30-39( ) 40-49 ( ) 50 and over ( )
2. Gender & Family Head
   Male( ) Female( ) Family Head( )
3. Ethnicity:
   Bamar( ) Kachin( ) Shan( ) Others( )
4. Marital Status
   Single( ) Married( )
5. Religion
   Buddhism( ) Christian( ) Muslim( ) Others( )
6. Education
   No education( ) Primary Education( ) Secondary School( )
   Above Secondary( ) Others( )
7. Occupation ……
   Farmer( ) Fisherman( ) Labour( ) Own business( )
   Government Staff( ) Others( )
8. Do you own the land for cultivation? Yes( ) No( )
   If yes, how is its size? ( )
   Which crops do you mainly grow? ( )
9. Family Size

Total number of family member	
Total number of working member	

10. Do you have animals? Yes( ) No( )

Animal	Number	Animal	Number	Animal	Number
Buffalo		Chicken		Pig	
Cow		Duck		Elephant	

11. Where do you pasture your animals?
    Within PA( ) Near PA boundary( ) Far from the PA( ) Private farm( )
12. Settlement History to the village

Status 1.Native 2.Migrant	
No of years living in this village	
If Migrant, distance from your place of origin	

13. What are the sources of energy being used for daily cooking?
    Fuelwood( ) Electricity( ) Solar( ) Charcoal( ) Others ( )

B. Resource Dependency on PA

14. What are the major sources of income for your household? Please rank 1-3 according to importance.

No	Activity	
1.	Agriculture	
2.	Fishing	
3.	Gold Mining	
4.	Livestock Farming	
5.	Hunting	
6.	Business	
7.	Boat Drivers	
8.	Others	

15. What is the average daily income of your household?

Season	Average Daily Income			
	<10$	10-20$	20-30$	30$ and above
Good Season				
Bad Season				

16. How much does your income cover the basic needs of the household?
    More than enough( ) Just Sufficient( ) Not Enough( )
17. Do you extract the resources from PA?
    Yes( ) No( )

(a) If yes, please specify, Direct access( ) Indirect Access( ) Both( ) and

(b) Please indicate what kinds of resources you extract from PA.

No	Resources	Frequency of Collection 1.Daily 2.Weekly 3. Monthly 4.Seasonally 5.Yearly 6.Occasionally 7.Never	Trend of Resource Availability 1.Decline 2.Stable 3.Increase	Importance 1.Own use 2.Sale 3.Both
Forest				
1.	Timber, pole, posts			
2.	Bamboo			
3.	Fuelwood			
4.	Fruits and vegetables			
5.	Bamboo Shoot			
6.	Medicinal Plants			

7.	Mushrooms			
8.	Honey			
9.	Thatches			
10.	Bushmeat			
11.	Others			
Lake				
12.	Fish			
13.	Prawn			
14.	Others			
Both				
15.	Fodder			
16.	Birds			
17.	Others			

18. How long have you been using resources from PA?
    Less than 10 years( ) 10-20 years( ) 20-50 years ( )
    From generations( ) Never( )
19. Are you allowed to collect the resources that you mainly depend on?
    Yes( ) No( ) I don't know( )
20. Which proportion of your income depend on PA resources?
    Almost all( ) Half( ) Partially( ) None( )
21. Which parts of PA do you usually go to collect these resources?
    Inside PA( ) Near PA( ) Both( ) Outside PA( )

C. Benefits and Costs form PA

22. Do you get any benefit from the PA? Yes( ) No( )
    (a) If yes, what kinds of benefits are they?
        Goods( ) Services( ) Both( )
    (b) How much of these benefits do you get?
        Little( ) Sufficient( ) A lot ( )
23. Do you suffer the costs from PA? Yes( ) No( )
    (a) If yes, please indicate the kinds of problem;
        Restriction to access( ) Crop damage by animal( ) Conflicts with PA staff( )
        Others( )
    (b) How is the severity of the losses?
        Low ( ) Medium( ) High ( )
24. What did you do when you saw the animals destroying your crop?
    Scaring the animal( ) Killing the animal( ) Fencing with the nets( )
    Others( )

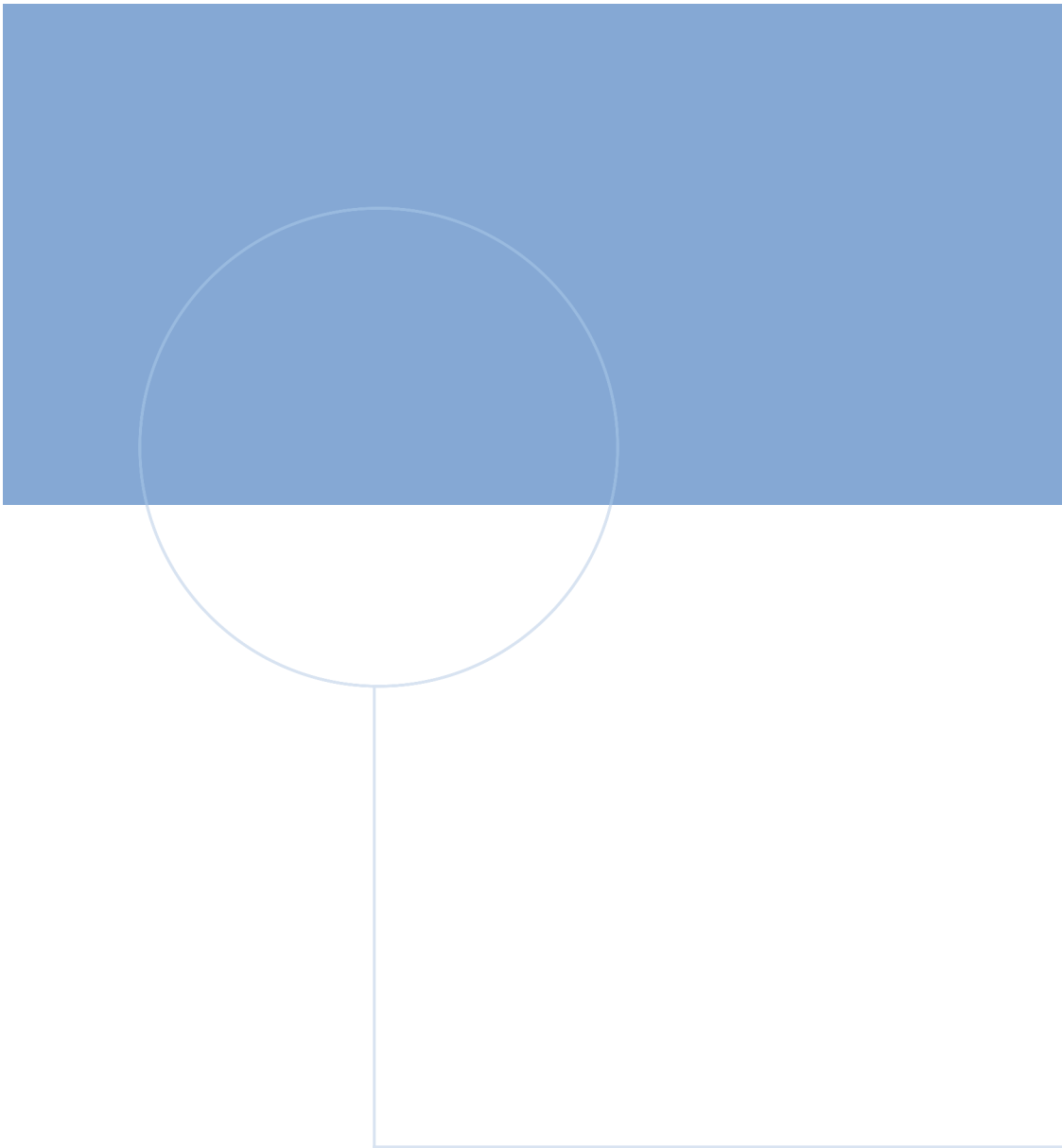
D. Attitudes, Knowledge, and Conservation Support to the PA

25. Do you know any conservation activities around your village? Yes( ) No( )
    (a) If yes, where do you occur? Lake( ) Forest( ) Both( ) Other( )

(b) Which species do they mainly conserve? Fish( ) Mammals( ) Birds( ) Tortoise( ) Others( )

26. What is your opinion on the presence of PA in your area?
    Strongly Positive( ) Positive( ) Neural( ) Negative( ) Strongly Negative( )
27. Do you think local people's resource extraction has some impacts on biodiversity?
    Yes( ) No( ) I don't know( )
    If yes, please rate the degree of impact-
    Very High( ) High( ) Medium( ) Low( ) Very Low( )
28. What are the threats to biodiversity of PA?
    Over fishing( ) Hunting( ) Logging( ) Pesticides( )
    Pollution form Gold mining( ) Land Encroachment to PA boundary( )
    Population Growth ( ) Others( )
29. Do you think that the conservation programs of PA are effective?
    (a) Yes ( ) No ( ) I don't know( )
    (b) If yes, please rate the degree of effectiveness-
    0-20%( ) 20-40%( ) 40-60%( ) 60-80%( ) 80-100%( )
30. Do you have any concern about the future biodiversity of PA?
    Yes( ) No( ) I don't know( )
31. Are you currently involved in conservation of PA? Yes( ) No( )
32. What kind of activities are you involved in PA conservation?
    Patrolling( ) Tree Planting ( ) Community Forest Group( ) Fishery Group( )
    Ecotourism ( ) Waste management( ) Others( )
33. In your opinion, who should be responsible for future management of PA?
    Government( ) Local community( ) NGOs( ) Combination( ) Others( )
34. How is your relationship with PA staff?
    Very Good( ) Good( ) Neutral( ) Bad( ) Very Bad( )
35. Do you know any restrictions, rules and regulations of the PA?
    Yes( ) No( ) I don't know( )
    If yes, In which way?
    Awareness program( ) Notification Sign( ) Boundary Marker( ) Others( )
36. In your opinion, what should be improved for conservation effectiveness of ILWS?
    ---
37. Which methods do you use for fishing from the lake to get the maximum catch?
    Fishing nets( ) Fishing gear( ) Electric shock( ) Others( )
38. What is the mesh size of your fishing nets that you usually use?
    Less than 1 inch( ) 1-2 inches( ) 2-4 inches( ) 4 inches and above( )
39. Which method do you use for gold panning/mining?
    Using Mercury( ) Cyanide( ) Traditional Panning( ) Others( )

Thank you so much for your participation.



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