**BIODIVERSITAS**
Volume 23, Number 1, January 2022
Pages: 581-592

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d230163

# Community awareness and participation in biodiversity conservation at Phong Nha-Ke Bang National Park, Vietnam

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Manuscript received: 24 October 2021. Revision accepted: 31 December 2021.

**Abstract.** *Truong DD. 2021. Community awareness and participation in biodiversity conservation at Phong Nha-Ke Bang National Park, Vietnam. Biodiversitas 23: 581-592.* Local community's perception and attitude towards biodiversity conservation are essential to the sustainable management of national parks in Vietnam. The conservation of biodiversity in national parks is facing pressures from economic development activities, which has led to the degradation of the ecological values of the national parks. People's awareness and their participation in conservation management are crucial to the sustainable management of national parks. This study examined the awareness and participation of local people in biodiversity conservation at Phong Nha-Ke Bang National Park (PN-KBNP), Vietnam. PN-KB is one of the national parks with the highest biodiversity values in Vietnam and is recognized by UNESCO as a world heritage site. To assess participation in conservation management, the study implemented a Contingent Valuation Method for estimating the willingness to pay of households in the buffer zone for biodiversity conservation in PN-KBNP. A survey was implemented to 358 households randomly selected in five communes adjacent to the park. Focus group discussions and in-depth interviews with selected key informants were also practiced for the management of insight information. The result showed that local villagers generally hold a fairly high perception of biodiversity values and positive attitudes towards biodiversity conservation at PN-KBNP. This positive perception comes from the close interaction between household livelihoods and the national park on a daily basis. However, awareness of national park management rules are not high. In addition, local people are willing to sacrifice part of their income to conserve biodiversity for current and future generations. On an average, each household was willing to pay 297,000 VND/year for biodiversity conservation. Payment levels, age, length of residency and education were observed to significantly impact on villagers' participation in biodiversity conservation initiatives. The balance between development and conservation was found to be the key in Park management, where communities need to be given more power to plan, monitor and implement conservation activities while establishing clear forest land user right for households and communities.

**Keywords:** attitude, participation, livelihood, national park, people's perception, UNESCO world heritage site, willingness to pay

**Abbreviations:** CVM: contingent valuation method; FGDs: focus group discussions; NP: national park; NTFPs: non timber forest products; PN-KBNP: Phong Nha-Ke Bang National Park; WTP: willingness to pay

## INTRODUCTION

National parks (NPs) are an area of land or sea preserved strictly from exploitation and interference by humans. They are often established in places of unique ecosystems with endangered species of flora and fauna and protected under national law or regulations (Badola et al. 2012; Castaño-Isaza et al. 2015).

Most NPs have a dual role; on the one hand, they provide a critical source of natural resources for a community such as timber, minerals, forest products and medicine; on the other hand, they are valuable for maintaining ecosystem services, providing wildlife habitats and conserving biodiversity (Adam et al. 2014; Ansong and Røskaft 2011; Gelcich et al. 2013; Megaze et al. 2017). The balance between exploitation of resources and conservation of biodiversity values is a very important challenge for the management system of NP around the world (Kipkeu et al. 2014; Macura et al. 2011; IUCN 2011). Currently, in the South and Southeast Asia regions, NPs are under serious threat from illegal encroachment, deforestation, land conversion and corruption. This threatens the integrity of many valuable habitats (Htun et al. 2012; Islam et al. 2017; Kamil et al. 2017; Mahanta et al. 2013).

The history of NPs in the world involves a number of issues relating to a legal framework, park authorities and human resource consumptions (Whitelaw et al. 2014; Zyl et al. 2019). Currently, in many cases, the government-based restrictive management practices seem to be debilitated to bring about effective conservation and management in protected areas mostly due to institutional weaknesses, ineffective coordination between management agencies and local communities. At the same time, counseling is an influential factor in increasing community participation (Hakim and Darusman 2015). Nevertheless, the reform of parks' management has created some changes for improving the conservation performance of NPs. One of the critical questions is whether management units can mobilize funding for park's conservation improvement (Lee et al. 2019; Thur 2010; Waldron et al. 2013). To date, quite a few studies have analyzed how to finance the conservation of national parks, especially from the private

sector and those who benefit from biodiversity conservation. These studies often estimate the willingness to pay of people and communities through non-market valuation methods such as Contingent Valuation Method (CVM), Choice Modeling or Choice Experiment (Huntley et al. 2019; Riggio et al. 2019; Taczanowska et al. 2019). In addition, it is important that Park's management board acknowledge the interaction between users and authorities for effective management.

In Vietnam, NP is a title officially recognized by the Government through Decrees. Currently, Vietnam has 34 NPs (from the subtropical fog forests to coastal mangroves or *Melaleuca* forests on peat) in order to protect natural ecosystems, landscape, flora and fauna (BirdLife International 2010; Mir et al. 2015). Management wise, NPs located in the territory of many provinces and cities are managed by the Ministry of Agriculture and Rural Development (MARD), while NPs located within the boundaries of a province or city are managed by the People's Committee of provinces (provincial governments) (People Committee of Quang Binh 2009).

Some of Vietnam's NPs have been recognized by UNESCO as world natural heritages, such as Phong Nha-Ke Bang, Tram Chim, Lang Sen or as part of world natural heritages such as Bai Tu Long belonging to Ha Long Bay heritage. Some other NPs are also on the UNESCO's tentative heritage list, such as Cat Tien and Cat Ba NPs in the Cat Ba Islands; Ba Be NP belongs to Ba Be-Na Hang Natural Heritage Area and Con Moong Cave is located in Cuc Phuong NP (Ovel and Nguyen 1998; UNESCO 2015).

Despite playing an important role in ecological conservation, Vietnam's NP system is currently facing many threats, such as over-exploitation of forest, inadequate land-use conversion, hunting and illegal wildlife trade which have led to the reduction of natural forests and habitats (Adam et al. 2014). Many species of flora and fauna are seriously threatened; some are in danger of extinction. Violations in the field of conservation have restricted law enforcement, widened the gap between the rich and the poor among vulnerable ethnic minorities and harmed valuable ecosystems (Lang 2020).

Therefore, strengthening biodiversity protection activities in NPs is extremely important and should be based on local realities to thoroughly address threats by harmonizing benefit sharing and smart management strategies. In this process, awareness and participation of local communities in biodiversity conservation and their coordination with management agencies, NGOs and other development partners play a key role (Wang and Jia 2012; Whittington and Pagiola 2012).

The main purpose of this study was to assess the awareness and participation of local people in biodiversity conservation in a typical NP of Vietnam, Phong Nha-Ke Bang. This is one of the NPs with the highest biodiversity value in Vietnam and is recognized by UNESCO as a world heritage site. In the perception assessment part, the article focuses on the public's perception of the use of biodiversity values in livelihoods, assessing the communities' awareness of the importance of ecological values, identifying threats towards biodiversity, understanding of environmental conservation regulations and attitudes towards biodiversity conservation. In the assessment of community participation, the study was focused on estimating the willingness to pay households in the buffer zone for biodiversity conservation in PN-KBNP. The study contributes to providing more information to the literature on biodiversity conservation in developing countries, and at the same time, draws some implications for sustainable management of NPs in Vietnam.

## MATERIALS AND METHODS

### Study area

Phong Nha-Ke Bang NP is located in Bo Trach and Minh Hoa districts, Quang Binh province in the North Central region of Vietnam (Figure 1), about 500 km south of capital Hanoi (Lang 2020; Meijboom and Ho 2012). This NP borders with Hin Namno nature reserve in Khammouan Province, Laos, to the west and 42 km west of the East Sea. Before becoming an NP, the area was a nature reserve with an area of 5,000 hectares which was officially announced by the government of Vietnam on August 9, 1986. On December 12, 2001, the government issued Decision No. 189/2001/QD-TTg converting Phong Nha-Ke Bang Nature Reserve into an NP. In 2013, the government decided to expand the area of this NP to 1233.26 $km^2$ (Mir et al. 2015; Ovel and Nguyen 2018). Currently, PN-KBNP has a total area of 85,754 ha, including strictly protected area: 64,894 ha (i), ecological restoration area: 3,411 ha (ii), and buffer area: 17,449 ha.

PN-KBNP was established to protect one of the two largest karst regions in the world with about 300 caves and preserve the northern Truong Son ecosystem in the North Central region of Vietnam. Features of this NP are limestone formations, caves, underground rivers and rare flora and fauna. In April 2009, an expedition belonging to the Royal British Cave Association discovered and announced Son Doong cave as the largest cave in the world (over 5 km long, 200 m high, and 150 m wide). The karst formation of PN-KBNP is also the oldest in Asia, which dates back to 400 million years from the Paleozoic period (Timmins et al. 1999).

PNKB is also a part of Truong Son ecoregion. By far, the vegetation type here is a tropical moist evergreen forest on limestone, 800 m above sea level. 96.2% of the NP is covered by forest; 92.2% are primeval forests on typical limestone mountains with typical vegetation types such as gnats (*Burretiodendron hsienmu*), cycads (*Annamocarya* spp.), gagnep (*Platanus kerrii*) and stars (*Hopea* spp.). Vascular plants 152 families, 511 genera, 876 species of vascular plants, of which 38 species are listed in the Vietnam Red Book and 25 species are listed in the World Red Book, 13 are endemic to Vietnam, including *Hopea* spp. and *Parashorea stellata*. Scientists also discovered three rare species of comedian orchid, throughout the territory of Vietnam, which include comedic blue orchid (*Paphiopedilum malipoense*), twisted comedian orchid (*Paphiopedilum dianthum*) and spotted comedian orchid (*Paphiopedilum concolor*) (Ovel and Nguyen 1998).

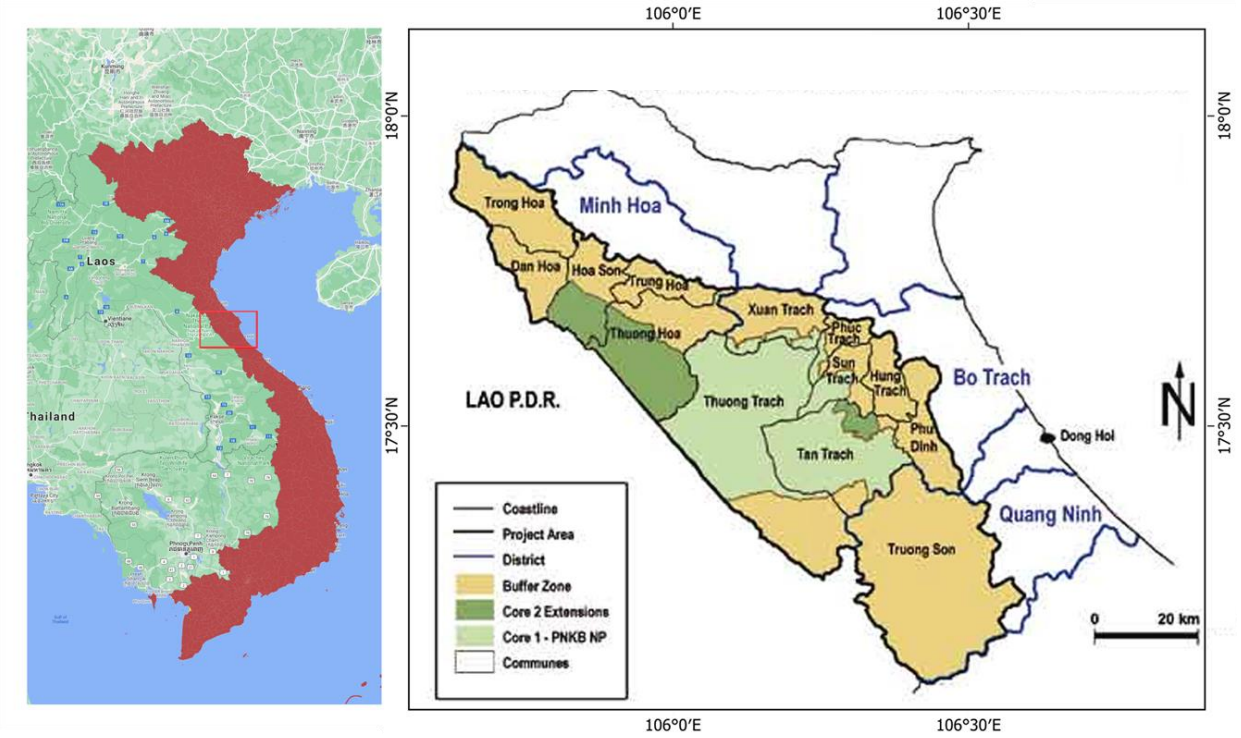


**Figure 1.** Phong Nha-Ke Bang National Park location, Vietnam, its buffer zone and planned extensions

PN-KBNP is home to 140 species of mammals belonging to 31 families and ten orders, most notably tigers and gaurs, the largest bison in the world, 302 species of birds, of which at least 43 species are listed under the Vietnam Red Book and 19 species in the World Red Book; 81 species of reptiles and amphibians (18 species in the Vietnam Red Book and 6 species in the World Red Book); 259 species of Lepidoptera; 72 species of fish, of which 4 are endemic to Vietnam. There are 10 primate species, accounting for 50% of the total number of primate species in Vietnam, 7 species listed in the Vietnam Red Book, especially Ha Tinh langur, saola, and gill (mammal). The World Wildlife Fund (WWF) has conducted a survey and said that PN-KBNP has 4 species that are classified as endangered on a global scale, namely Ha Tinh langur, jet-black langur, iridescent langur and white-cheeked gibbon (Meijboom and Ho 2012).

In the buffer zone of the Park, there are 8,756 people living in 5 communes with a total area of 1,479 km² in Minh Hoa district (Dan Hoa and Hoa Son communes), Bo Trach district (Tan Trach and Thuong Trach communes) and Quang Ninh district (Truong Son commune) (Quang Binh Province Statistics Office 2020). These population areas mainly live along major rivers such as the Chay River, Son River and stream valleys to the east and northeast of this NP. These areas belong to the remote areas of Quang Binh province, with underdeveloped infrastructures, such as roads, electricity, education and health care. The principal livelihood of locals here are farming and gathering of forest products (People's Committee of Quang Binh Province 2009).

Since becoming a world heritage site, the number of tourists coming here has skyrocketed. Activities of loggers, wildlife poaching are threats to PN-KBNP, while the force of forest rangers is quite thin. The increase in visitors to this NP also causes problems for the environment here such as garbage, water pollution, human impact on the caves, especially threats to biodiversity (Ovel and Nguyen 1998).

The construction of a coal-fired thermal power plant in Vinh Son village, Quang Dong commune, Quang Trach district, 40 km northeast of Phong Nha-Ke Bang with a capacity of 3,600 MW is assessed as potentially polluting air and water in NP area. Wildfires in the dry season are also a constant threat to the whole region (Lang 2020; Mir et al. 2015).

Due to poor management, the forest areas in the buffer zone have been severely damaged recently, many areas have been nearly cleared, and precious timber species have been exploited to exhaustion. It is estimated that, about 1 ton of timber is harvested daily for commercial purposes, especially high-priced precious woods such as ebony (*Diospyros* spp.) and Giang Huong (*Pterocarpus macrocarpus*).

Hunting wild animals in the NP and selling them to local restaurants is also very serious problem. Wild animals are hunted, traded, and slaughtered due to poor awareness of the people and also ignored by local authorities. Currently, PN-KBNP is no longer significant for the conservation of tigers (*Panthera tigris)*, elephants (*Elephas maximus*) and wild bovine species (Ovel and Nguyen 1998; Lang 2020).

**Procedures**

The overall objective of this study was to assess the awareness and participation of local people in biodiversity conservation at PN-KBNP. In which, people's participation was assessed through their willingness to pay for the conservation of biodiversity values in the area. The study was conducted using primary data from the field survey and secondary data collected through comprehensive reviews of published documents relating to NPs biodiversity governance in Vietnam especially focused on PN-KBNP. This information was used to provide stories of how socio-ecological processes and governance have changed with time. Primary data were collected in two different ways, viz. focus group discussions (FGDs) and structured interviews during March and April, 2021 in the buffer zone's communes of the park.

*Focus group discussions (FGDs)*

Two FGDs were conducted in the study area to identify biodiversity values, management issues and to develop a questionnaire for the research survey.

The first FGD was conducted with 15 households with forest-based livelihoods in 5 buffer zone villages. During the discussion, residents were asked about the values that PN-KBNP provides for family livelihoods, perception of biodiversity values of NP, identification of threats to NP, possible activities to participate in NP conservation and initial WTP bid levels for biodiversity conservation. This FGD also collected ideas to complete the questionnaire.

The second FGD was conducted with state and professional management agencies in the province (Forest Protection Department, Districts People Committees-local governments, PN-KBNP Board of Management, commune and village management staff). This group discussion aimed to provide a forum for managers and experts to discuss relevant park management issues and questionnaire development. Some contents of this FGD include: (i) biodiversity values of NP, (ii) threats to NP and challenges, (iii) the current status of Park's management, (iv) difficulties and recommendations for biodiversity conservation, (v) proposed structure and content in the questionnaire, (vi) and a possible strategy to ask questions for villagers.

*Household survey*

The household samples were selected in two stages. First, a spatial allocation map of households in each sample commune was prepared. Then, using random sampling households in each village were selected for the survey.

According to Quang Binh Statistics Office (2020), 17,765 people were living in 5 communes in the PN-KBNP buffer zone (Dan Hoa, Hoa Son, Thuong Trach, Xuan Trach and Truong Son) with about 3,455 households (on average, each household had 5.2 people). The study used the following formula (Carson 2000) to estimate the number of survey samples:

$$n = \frac{N}{1 + Ne^2}$$

Where: n is the sample size, N is the total number of households in population, e is accepted errors.

**Table 1.** Distribution of survey sample by commune

| Commune | Total population (2019 census) | Households surveyed |
|---|---|---|
| Dan Hoa | 4,012 | 79 |
| Haa Son | 1,614 | 33 |
| Thuong Trach | 2,911 | 59 |
| Xuân Trach | 4,857 | 96 |
| Truong Son | 4,571 | 91 |
| Total | 17,965 | 358 |

With $e$ = 0.05 (the estimated error is 5%), and for a total of 3,455 households, the estimated number of samples to ensure reliability was 358. Therefore, 358 households were chosen (10.3% of total households) for interviews. To ensure representation in each commune. The total number of research samples allocated is presented in Table 1.

*Questionnaire*

A questionnaire is a crucial tool in collecting information and data for analysis. In this study, the research team designed a questionnaire according to the standard procedure by Carson (2000) and information collected from FDGs. The questionnaire consists of 3 main parts focusing on the following main aspects: Part 1: Socio-economic and demographical characteristics of households. Part 2: Perception of households toward PN-KBNP values and protection regulations. Part 3: Attitude of local households in management of the park. Part 4: Participation of households in PN-KBNP biodiversity conservation (through households' WTP for preserving biodiversity values).

*Biases solutions*

According to Haab and McConnell (2002), one of the biggest difficulties while conducting CVM studies is the existence of biases. In order to eliminate and minimize biases, the study followed a very strict design and investigation process according to the standards that Carson (2000) applied and recommended. (i) For strategic bias, in order to eliminate the strategic attitude of the respondents when answering the questions, in the questionnaire and during the interviews, the respondents were explained in detail the objective of the study which was to assess farming households' attitudes and perceptions about biodiversity conservation and their participation in Park management for their own benefit and that of community. (ii) With the starting point bias, the dichotomous CVM technique was applied to eliminate this bias. Dichotomous CVM requires a detailed experimental research process including focus group discussion, field pilot to identify and adjust the WTP range, then integrating it in the official questionnaire. The tested WTP range and the Yes/No binary question will help reduce starting biases. (iii) Information bias and hypothetical bias were minimized through the design of user-friendly questionnaires, the use of visual images and illustrations, and the information was seamlessly designed and close to the experience and local people's perception, which helped them answer more

authentically. This information was collected and commented on by experts and scientists and explained carefully and in detail to the respondents before answering.

*Research model and data analysis*

Collected data was initially tabulated in MS Excel and then transferred to SPSS 22.0 for analysis. The analytical focus was on respondent perceptions of biodiversity values and involvement in the management of the park. The unit of analysis was households. Measures of central trend (mean) and dispersion (standard deviation) were calculated to summarize the socio-economic data. Perception and attitude variables on biodiversity were analyzed using descriptive statistics. To test for statistical differences between the most important values perceived by respondents in communes, Anova statistics were used.

To assess the participation of local people in the conservation of biodiversity values in the PN-KBNP area, the study employed the Contingent Valuation Method (CVM) to estimate WTPs of the households for biodiversity conservation.

CVM is an ingenious technique developed to assess individual payments for non-market values of the environment (in this study, the value of biodiversity conservation). For years, CVM has become one of the most rigorous approaches for determining the public's WTP for public goods due to its flexibility and ability to estimate the total economic value of the environment, including non-use values (Carson 2000; Harris and Roach 2017). CVM uses survey questions to elicit people's preferences for public goods by finding out what they are willing to pay for the goods' specified improvements. The method is thus aimed at estimating their WTP in monetary (Hanemann 1994). It solves the absence of markets for public goods by presenting consumers with a hypothetical market in which they have chances to buy goods in question (Kamri et al. 2017; López-Mosquera 2016; Murphy et al. 2018).

Specifically, in this study, a binary CVM model was used to estimate the community's WTP level for biodiversity conservation (Tabachnick et al. 2014). Binary CVM has been used in many studies on valuing environmental commodities in the world for conservation management and sustainable use of environmental goods (e.g. Carson 2000; Bateman et al. 2004; Brouwer et al. 2016; Casey et al. 2018; Lal et al. 2017).

In dichotomous CVM model, information is directly elicited from individual i, when a CV questionnaire is applied is simply a dichotomous answer (yi = 1 if the individual answers Yes and yi = 0 if the answer is No), given a question about paying a pre-determined amount for environmental quality improvement (ti-randomly varies across individual). It is possible to estimate the WTP as the following function:

$$WTP_i(z_i, u_i) = z_i\beta + u_i$$

Where: zi is a vector of explanatory variables, β is a vector of parameters and ui is an error term. It was expected that the respondent would answer yes when his WTP was greater than the suggested amount (WTPi > ti). In that case, the probability of observing a positive response given values of explanatory variables would be:

$$\begin{aligned} Pr(y_i = 1|z_i) &= Pr(WTP_i > t_i) \\ &= Pr(z_i\beta + u_i > t_i) \\ &= Pr(u_i > t_i - z_i\beta) \end{aligned}$$

If assuming that ui ~ N(0, σ2) we have:

$$\begin{aligned} Pr(y_i = 1|z_i) &= Pr\left(v_i > \frac{t_i - z_i'\beta}{\sigma}\right) \\ &= 1 - \Phi\left(\frac{t_i - z_i'\beta}{\sigma}\right) \\ Pr(y_i = 1|z_i) &= \Phi\left(z_i'\frac{\beta}{\sigma} - t_i\frac{1}{\sigma}\right) \end{aligned} \quad (2)$$

Where: vi ~ N(0, 1) and Φ(x) is the standard cumulative normal.

The above equation is the basis for a parametric WTP function of which the most common form is linear. This model can be estimated by using maximum likelihood estimation by solving for β and σ (Haab and McConnell 2002; Gessa-Perera et al. 2016).

The likelihood function for logit form then will be:

$$lnL(\alpha, \beta|y, z, t) = \sum_{j=1}^{T} I_j \ln\left[\left(1 + e^{-\left(\frac{\alpha x_j}{\sigma} - \frac{\beta t_j}{\sigma}\right)}\right)^{-1}\right] + (1 - I_j)\ln\left[1 - \left(1 + e^{-\left(\frac{\alpha x_j}{\sigma} - \frac{\beta t_j}{\sigma}\right)}\right)^{-1}\right]$$

The parameter vector coefficients are estimated by running the binary model on the matrix data $\left\{z_j, ln\left(\frac{M_j - t_j}{M_j}\right)\right\}$, allowing the average value of WTP as:

$$E_\varepsilon[WTP_j] = M_j\left[1 - exp\left(-\frac{\alpha}{\beta}z_j + \frac{1}{2}\frac{\sigma^2}{\beta^2}\right)\right]$$

## RESULTS AND DISCUSSION

### Socio-economic characteristics of respondents

Table 2 summarizes the socio-economic characteristics of the sample. The men and women rates were fairly different (66% male and 34% female). 98.8% of the respondent investigated was born locally and 1.2% of people were coming from other places. The average age of household members in the village was 40.8 years. 89% of respondents were Kinh ethnic and the remaining 11% were Chuc minority group.

**Table 2.** Socio-economic characteristics of the sample

| Socio-economic characteristics | Percentage |
|---|---|
| **Gender** | |
| Male | 66% |
| Female | 34% |
| **Respondents' place of birth** | |
| Local | 98.8 |
| Outside | 1.2 |
| **Age (years)** | 40.8 |
| **Ethnicity** | |
| Kinh | 89% |
| Chuc | 11% |
| **Household time of living in commune (years)** | 41.6 |
| **Education level of respondents** | |
| No school | 5.4% |
| Elementary | 70.9% |
| Secondary | 16.1% |
| High school | 4.6% |
| University and College | 3.0% |
| **Annual income of households (million VND)** | 78.27 |
| **Average number of people in households** | 5.2 |
| **Main jobs of households** | |
| Planting and harvesting forests | 6.3% |
| Hotels, services, tourism, restaurants, cafes | 2.1% |
| Farmers | 89.1% |
| Civil servants, office workers (or no job) | 2.5% |

Regarding education level, the number of people who finished elementary school accounted for a fairly large proportion, 70.9%. High school students accounted for a relatively small percentage (about 4.6% of the total sample). The rate was similarly low for university/college level (only 3.0%). However, no one had a post-graduate degree. Thus, it can be seen that the education level of the respondents in the five buffer zone communes is relatively low. According to the survey results, an average of 5.2 people lived in a household (this variable is quite similar in all five communes). The largest families had eight people, and the smallest ones had two persons. The average household income was 78.27 million VND/household/year. At the same time, the lowest and the highest income level of the household were 56 million and 280 million VND/household/year, respectively.

**Awareness of the role of forests for household livelihoods**

According to villagers, the biodiversity in PN-KBNP is very important for their livelihood. One of the reasons people appreciate the importance of forests' biodiversity is its ability to supply forest products. The study ranks the importance of 10 types of forest resources for household livelihoods. Accordingly, people list important plants and animals that they can hunt or get from the forest in the NP. These plants and animals were then ranked based on their importance to a particular use category (number of uses).

Bamboo (*Bambusoideae*) is considered an important bioresource in most of the area, which is used for food (young bamboo shoots), for construction activities such as building houses, fencing, barns for livestock and poultry, and forage for cattle (Table 3). Apart from its low price, bamboo widely functions because it is more robust than other woods (Setiawati et al. 2017). In addition, bamboo can also be sold to chopstick manufacturers against cash. This valuable tree often grows in the forests near the village, or is planted by people along the creeks and streams that pass through the village.

Another important plant identified was the rattan. Rattan was used both for knitting, making lanyards, and sold to bamboo and rattan processing establishments to make household items. People often used to go to the periphery of the forest to collect rattan. After harvesting, rattan was transported to the village by the river. However, forest protection units were not strict with this activity. Acacia was also appreciated for its economic efficiency, and bananas were valued as a source of food for people (and for some other villagers, sometimes it was marketed).

Macka wood ranked the most important tree in terms of timber. The wood of this tree had two uses: for heavy construction and production tools. Many other tree species such as pheo, lily, a sponge, and melaleuca also had similar uses, but Macka was considered the best plant. However, due to the importance of hardwood timber, people were not allowed to cut such trees from the forest. Some villagers said they had to plant hardwood trees in the garden for household wood needs. Otherwise, they had to purchase wood at a very high price.

Regarding animals, a species of a rat named A binh was considered as the most important forest animal for the households, partly because it was an important food source, partly because it was an easy animal to hunt. According to people's assessment, wild animals had four uses: the main use was for food, next for home decoration, then for medicine, and finally, they were sold for cash (Table 4).

In general, people's knowledge of biodiversity in the forest areas near the village and the important tree and animal species in their livelihood framework was quite high (e.g. plants that can be used as fodder for livestock etc.). The species of trees and plants identified and evaluated include both rare and easy to find as well as cheap and expensive species. Example: Macka wood (lim), the type of tree used to make local heavy construction and labor tools, was listed as globally endangered by IUCN.

When ranking the roles of forests for households' livelihoods, the future value was the most appreciated (18%), followed by the ability to provide food (12%), the ability to provide fodder (11%), provision of products that can be sold for cash (10%), the ability to provide materials for heavy construction (9%), and the ability to provide other working tools (9%) (Figure 2).

**Local people's perception of forest land**

There were six main types of land use patterns in the study area viz. bare land, large tree forest and small tree forest representing natural vegetation types, while the garden, plantation forest, rice field and dry land were used for plantation and agricultural processes. During the FGDs, people listed in official terms a number of lands contracted by the government for agricultural activities, for example, 'land allocated for the cultivation of rubber trees', commonly used by Chuc people, 'cutect rubber', as opposed to land that occupies a larger area, such as 'small tree forest' (paput) (Figure 3).

**Table 3.** The most important forest trees, ranked by number of categories uses

| Trees | Scientific name | Knitting | Fire-wood | Food for animal | Food for humnan | Heavy construction | Hunting function | Hunting site | Light construction | Sell for cash | Make medicine |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pheo | *Bambusoideae* | | | | | | | | | | |
| Ki re | *Calamus walkeri* | | | | | | | | | | |
| Tràm | *Acacia auriculiformis* | | | | | | | | | | |
| Pe | *Musa balbisian* | | | | | | | | | | |
| A xốp | *Wendlandia glabrata* | | | | | | | | | | |
| A ro | *Licuala spinosa* | | | | | | | | | | |
| Huện | *Tarrietia javanica* | | | | | | | | | | |
| Pa lar | *Cleistanthus aff. myrianthus* | | | | | | | | | | |
| Tu viền | *Melocalamus compactiflorus* | | | | | | | | | | |
| Lim | *Afzelia xylocarpa* | | | | | | | | | | |

**Table 4.** The most important forest animals, ranked by number of category uses

| Animals | *Arvicolinae* | *Viverricula indica* | *Felis silvestris catus* | *Lethocerus indicus* | *Timaliidae* | *Gallus* | *Pholidota* | *Gracupica nigricollis* | *Cervidae* |
|---|---|---|---|---|---|---|---|---|---|
| Knitting | | | | | | | | | |
| Firewood | | | | | | | | | |
| Fodder | | | | | | | | | |
| Food (for people) | | | | | | | | | |
| Hunting function | | | | | | | | | |
| Decoration | | | | | | | | | |
| Sell for cash | | | | | | | | | |
| Medicinal | | | | | | | | | |

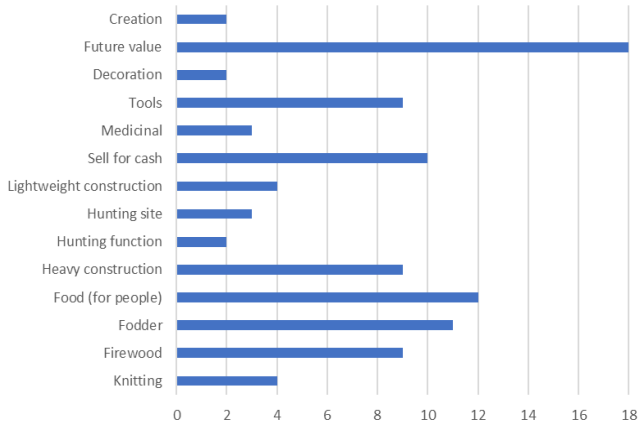


**Figure 2.** Roles of forest products for households' livelihood (% of most important)

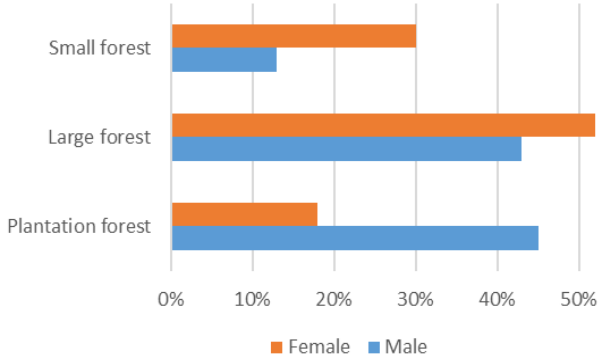


**Figure 3.** Importance of forest types by male and female (% of most important)

Based on the purpose of use, people divide forest land into three types: large tree forest (primary forest), small tree forest (young, secondary regeneration), and plantation forest. However, men and women had different views on the importance of these forest lands.

Males considered plantation forest as the most important type of forest (45%), because of their foresight that afforestation will bring more stable cash income. Large forests ranked 2nd (43%), because according to the people, this was the place where they get the most products than other forest types. Women considered forests with large trees to be the most important (52%). They explained that the large forest provides many valuable products. The uses of these products include food, medicine, heavy construction, knitting, decoration, and things that can be sold. Women also often used to go to the forest to pick leaves to make conical hats.

**Awareness of households on ecosystem values of PN-KBNP**

The study then evaluated people's awareness of the ecosystem service values of the park through questions about identifying and understanding these value groups.

Five groups of ecological values were disseminated to the survey sample: (i) The Park provides disaster protection values, (ii) The Park provides clean water, (iii) The Park provides landscape value and conserves biodiversity, (iv) The Park regulates regional climate, and (v) The Park has bequest value for future generation (Figure 4).

The statistical results are shown in Table 5. A pretty surprising result was that 88% of the respondents knew the value of assets for their future descendants. 74% of respondents (n=265) said that they were well aware that the park was valuable asset to their descendants and that up to 14% (n=68) answered that they knew to some extent that they needed to protect biodiversity for their future children. They wanted to preserve the value of biodiversity resources and the environment so that their children and grandchildren could enjoy these values.

Regarding the value of biodiversity conservation of the park, up to 47% of people knew this value very clearly, 43% knew a little (known to some extent), 10% answered that they didn't know (n= 36).

The disaster prevention value of PN-KBNP was also perceived to a relatively high degree as 41% of respondents knew it well, and 52% knew it to some extent. The reason was that the PNKB area annually witnesses around 5-7 storm incidences and the forests there act as a protective shield for people's livelihood activities and local facilities.

**Awareness of threats to PB-KBNP**

Since ancient times, people in PN-KBNP have lived on forests and fringes of the NP, thereby accumulating a large amount of traditional knowledge and experience about indigenous forests and the biodiversity of those forests. Understanding and applying knowledge and experience is essential in planning the management of protected areas. When asked about the dangers to native forests and biodiversity, people provided a variety of answers. This shows that the nature of the hazard assessment for forests had a close relation to their area of residence and each individual's life experience.

Logging was identified by local people as the greatest danger to the forest (17 out of 19 respondents). The local government issued a decision to ban logging in 2010, followed by the development of an investment plan for the conservation PNKB forest area. People perceived that logging caused deforestation. This was also a sensitive issue because while they were banned from logging, people from other places still ventured into NP to harvest wood. Even so, they could not stop these people from practicing because they themselves did not have the slightest right to manage and protect the forest. People expect this situation to change in the future.

Wildfires were also considered as one of the hazards to the National Park. The causes of forest fires were burning forests to search for war scraps, collecting honey, smoking while in the forest, or burning fields. People here used metal detectors to detect war scraps. In order to detect scrap in densely wooded areas, they had to burn trees to facilitate detection. In the summer, the danger of this element was higher because the fire could rise out of control.

People believed that hunting could also jeopardize the existence of forest animals. Although hunting was not allowed by the government, the people sometimes still encountered groups hunting rare animals in the forest. The activities of collecting firewood and non-timber products were considered by the people to insignificantly affect the habitat of forest animals.

**Awareness of regulations governing PN-KBNP**

The resident knowledge about the zoning system in the park and its rules was important because they determined the conservation performance of each zone (Yoshida 2012). PN-KBNP has three zones (core, ecological restoration and buffer zone), and it was necessary for the local people to be aware of it.

However, the survey showed low knowledge on the functions of zones by local communities. 63% of people did not know the main functions of zones, 29% knew to a certain extent, and only 8% knew each zone's functions. Specifically, there was insufficient knowledge that households were allowed to do in the buffer zone. The proportion of people who knew this rule was only 10.4%. About 86.6% did not know it at all, and 34.0% were ensured. Similarly, the knowledge on the collection of non-timber forest products in the core zone was relatively low. The people who knew this rule were only about 24.5%, and the rest, 75.5%, did not know it.

People's knowledge about the park boundaries was also not good enough; only about 21.3% of respondents were aware of it, and the remaining 781.7% did not know and were less likely to know. The people's knowledge about the outer boundary was mainly obtained from information independently heard from their daily activities around the village.

**Table 5.** Awareness of ecological values of the Phong Nha-Ke Bang National Park, Vietnam

| | Clearly know | | Know to some extent | | Don't know | |
|---|---|---|---|---|---|---|
| | Amount | % | Amount | % | Amount | % |
| The park provides disaster protection values | 147 | 41% | 186 | 52% | 25 | 7% |
| The park provides clean water | 47 | 13% | 97 | 27% | 215 | 60% |
| The park provides landscape value and conserves biodiversity | 168 | 47% | 153 | 43% | 36 | 10% |
| The park regulates regional climate | 82 | 23% | 168 | 47% | 103 | 30% |
| The park has bequest value for the future generation | 265 | 74% | 68 | 14% | 8 | 12% |

**Table 6.** Respondent views about conservation in Phong Nha-Ke Bang National Park, Vietnam

| Statement | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| It is important to protect the plants in the park | 88.9 | 7.6 | 2.1 | 1.2 | 0.2 |
| It is important to protect the wild animal in the park | 86.5 | 6.2 | 4.1 | 2.2 | 1 |
| It is a waste of time and money to conserve wildlife | 8.7 | 13.5 | 23.6 | 33.6 | 20.6 |
| People can hunt in the park | 10.6 | 32.1 | 15.3 | 27.9 | 14.1 |
| People can collect trees from the park | 58.3 | 23.6 | 10.1 | 4.2 | 3.8 |
| Poaching should be punished | 71.9 | 18.1 | 6.2 | 1.8 | 2 |
| Local forest land should be protected | 57.7 | 23.3 | 14.5 | 3.1 | 1.4 |
| I think the park was created to make our community better | 33.7 | 47.6 | 13.2 | 4.2 | 1.3 |
| I am happy that my commune borders the park | 60.4 | 32.2 | 4.6 | 1.9 | 0.9 |
| Conservation worsen my situation | 13.5 | 22.7 | 22.6 | 30.1 | 11.1 |

Note: Figures indicate % of respondents align with the statements

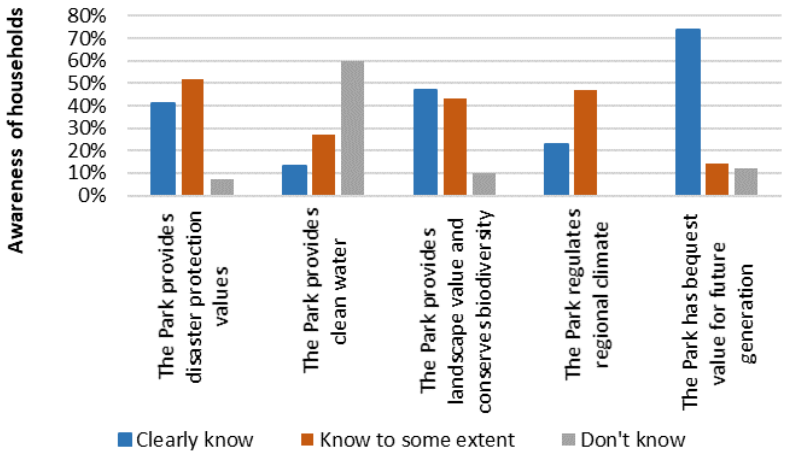


**Figure 4.** Awareness of households on ecosystem values of Phong Nha-Ke Bang National Park, Vietnam

**Biodiversity conservation attitude at PN-KBNP**

To evaluate conservation attitude, respondents were presented with statements in which they were asked to agree, be neutral or disagree and indicate the level of their agreeableness or disagreeableness, ranging from strongly agree to strongly disagree (Table 6). During preliminary data analysis, the statement responses were analyzed and ranked to reflect local communities' attitudes towards conservation.

The survey and analysis results showed that local people have a positive attitude towards PN-KBNP conservation. The majority of people consider the protection of plant and animal species in the NP important (88.9% and 86.5% respectively). Only 14.1% of people strongly agreed that hunting activities should not be conducted in the park while 71.9% thought that they could collect trees in the park's forest. Also, more than 98% of respondents said that illegal poaching should be punished, while 81% said that the local forest land should be protected. The majority of people agreed at a very high and high level that the NP makes their lives and communities better (about 90% respondents). The analysis also showed that people were quite hesitant in assessing the impact of conservation on their lives when the response rate in 5 options was relatively similar, of which 30% disagreed that conservation made their lives worse.

**People's participation in biodiversity conservation**

The study used Binary regression model based on the CVM approach to estimate the WTP of local communities to conserve biodiversity values at PN-KBNP (Table 7). It then analyzed factors affecting the probability of conserving participation. In 358 questionnaires distributed, 15 households could not participate in the conservation. The debriefing question indicated that these 15 families did not participate since they were not trusted the local management agencies (8 households) and did not believe in the program's results (7 households). No household said that biodiversity conservation wasn't meaningful to them. These 15 households; therefore, were withdrawn from our analysis (considered as protest responses according to Carson 2000), the final number for regression was taken as 343.

The model estimates WTP as the probability function of accepting payments for biodiversity conservation which is:

$$Pr(Yes) = a_1 + b_1 BID + b_2 EDU + b_3 MEMBER + b_4 INCOME + b_5 AGE + b_6 SEX$$

The results of running the model with binary regression are presented in Table 8.

**Table 7.** Description of variables in the Dichotomous CVM model to estimate WTP

| Variable | Meaning | Values |
|---|---|---|
| Pr (Yes) | Probability of willingness to pay pre-determined level of a bid to conserve biodiversity | Yes to pay = 1<br>Not to pay = 0 |
| BID | Bid levels (thousands of VND/year). | With values 100, 200, 300, 400 and 500 |
| SEX | Gender | Male = 1, Female = 0 |
| AGE | Age of respondents | Continuous |
| EDU | Education level (years of schooling) | Continuous |
| MEMBER | Number of people in the household (person) | Continuous |
| INCOME | Household income (VND/year) | Continuous |

**Table 8.** Parametric regression results to estimate WTP for biodiversity conservation

| Variables | Coefficients | Std errors | p-value |
|---|---|---|---|
| Constant | 10.256 | (0.554) | |
| BID | -0.035*** | (0.008) | 0.000*** |
| EDU | 0.018 | (0.069) | 0.023** |
| MEMBER | 0.065 | (0.035) | 0.121 |
| INCOME | 0.000* | (0.000) | 0.042** |
| AGE | 0.006 | (0.006) | 0.036** |
| SEX | 0.176 | (0.171) | 0.124 |
| -2 Log likelihood | 689.77 | | |

Note: ***: significant at 1% error level. **: significant at the 5% error level, *: significant at the 10% error level,

The expected value of WTP for biodiversity conservation was estimated according to the theoretical formula presented in the methodology section. Estimation result showed expected value of WTP was 297 thousand VND/household/year. Among the predictor variables, bid, age and education significantly explained the probability of conserving participation through WTP. Among significant variables, bid emerged as the strongest predictor of WTP probability, followed by the age of respondents. Since the coefficient of age was positive, the likelihood of payment for conservation increased with age. The coefficients of households' income were also significantly positive, which suggested that with the increase in income, there was a higher probability of payment for biodiversity conservation at PN-KBNP.

## Discussions

Vietnam has been in the process of renovating forest management under the consent of households and local organizations. The government has been proactive in giving local people rights in forest management. According to Emilia et al. (2013), the role of the government as a facilitator is demanded to achieve community-based natural resource management. However, in the current volatile environment, local people's awareness of biodiversity values and rights is still limited, and state agencies are less interested in local knowledge and views. In the process of granting land use right certificates and decentralization of management. The challenge is how to get the stakeholders to better understand the views of the communities living in or near the protected area. In addition, it is essential to clearly define the local capacity in forest management to ensure effective decision-making.

PN-KBNP has implemented various land-use policies in the buffer zone. Forests in the village are first considered as production forests, followed by watershed protection forests. Because of the importance of biodiversity and the presence of rare species that are in danger of being threatened, the forest here is planned to become part of the PN-KBNP. However, forests in the areas surrounding the village have been severely damaged by the war, by mining activities, logging and other agricultural activities. The government has prohibited local people from conducting mining activities in the reserve forest, and supporting the other activities to generate income for all households has been promoted. Whether these programs will bring the source cash income for local people, some residents are still concerned about their future interests in afforestation, and they expect to have rights to manage natural forests and bare lands in a sustainable way. The lack of land for agricultural activities has become an issue related to the conservation process food security, and this shortage has left many people with little alternative activities for the utilization of natural forests.

Most people in villages spend most of their time on production activities in home gardens, rice fields, and plantations. People have classified a large number of land-use types, some of which correspond to mainstream scientific terminology. Among the six mainland types, forests account for three of them. This classification is also related to the 'forest origin' of bare land that has been used for afforestation. The plantation is part of the project land allocation and forest restoration, initiated by local authorities to generate more income from local and 'stable' operations, in order to bring people to get rid of over-dependence on the forest (logging and other NTFPs). Although, people have a high understanding of the forest's use-values and their expectations in the future, which are directly linked with household livelihoods, this wealth of knowledge about the village's vicinity, however tend to lose over time, and participatory mapping and documentation of the village's natural resources, knowledge of forest products, wildlife and natural resources similar to what local biodiversity and associated traditional knowledge conservation effort have brought by People's Biodiversity Register exercise in India (NBA 2013) are needed. The results of the group discussion also show that planted forests have not yet brought many benefits because afforestation has just been carried out recently. However, in the future, they promise to become the main source of income. This factor is related to the fact that afforestation is a key element of government policy for the settlement process. Government officials stress that reforestation will increase income and stable livelihoods for local people than shifting cultivation. However, the perception of local people showed a different prospect

about the importance of natural forests and plantations for their livelihoods. This indigenous knowledge can also be used as a reference in conservation work to determine exactly which species of trees and animals need to be prioritized for protection. We found that local people can provide a lot of information about the quantity, distribution, as well as other parameters of the biodiversity of species. People's experiences, knowledge, and perceptions about forest resources can be a valuable contribution to the conservation area. Because of that, creating opportunities for people to participate in the management of protected areas could be very important.

The biggest threat to the forests was logging, followed by forest fires for people. Most people want to plant new forests in areas. The opinion of the people was influenced by orthodox views, which showed that they have a deep awareness of the risks posed by unsustainable activities.

Although the government has carried out some initial activities on land allocation, land ownership remained a matter of local concern and sensitivity, especially the problem of forest land allocation. In this regard, people must be given the right to use the land for a longer period to avoid the situation that they rely only on limited contracts to exploit it (Nastran and Istenič 2015).

Community forestry should be seen as an optimal choice for increasing the participation of people in the management of protected areas by facilitating more access to sustainable practices. In the context of nature reserve management, the local people are in need of other income to replace the lack of products that PN-KBNP provides them (saleable things, building materials, tools, etc.). Although the importance of forests to local people may change over time, forest awareness should be considered on a broad and multi-dimensional level. Local people should be directly involved in the public conservation area management. At the present time, people are following the route. The management process has been designed by the government and conservation agencies available. With this route, they are not allowed to conduct internal mining activities in the conservation area. Local people are very useful human resources for conservation (e.g. barring loggers, hunters). Citizen localities are clearly interested in being directly involved in the management of conservation areas in the form of protection work. Further, local people should be encouraged to participate in negotiations.

Information on endangered species needs to be provided to the people to increase their perception of the acute necessity of conservation. Some rare species are being used by people in different purposes, so this use should be widely discussed to make people aware of and choose other species over such rare species. Regulation of protection zone with community participation also needs to be encouraged. Traditionally, part of the reserve belongs to the community forest. Therefore, local people should not be ignored in conservation work that needs to be involved in decision-making to ensure sustainability in management. Seeing local people as part of the solution to protect PN-KBNP is still not the government's only option; it can help limit the encroachment of loggers. It is necessary to agree on the accessibility of forests, and even access to protected areas in high time points (drought or flood) to collect some important forest products.

## ACKNOWLEDGEMENTS

The author would acknowledge the National Economics University, Vietnam for supporting this study.

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