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Wildlife resource use between migrant ethnic minorities and indigenous peoples in Cat Tien National Park, Vietnam

Dinh Thanh Sang*

Faculty of Management Sciences, Thu Dau Mot University, Binh Duong 820000, Vietnam

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Key words: Cultural differences, Ethnic minorities, Origin-based arrangements, Sustainable forest management, Wildlife dependency.

Abstract

Ethnic minorities in Cat Tien National Park (CTNP) have depended much on the wildlife resources and threatened its ecosystem. Also, the real status in the wildlife use between the indigenous ethnic minorities (IEMs) and the migrant ethnic minorities (MEMs) has been poorly understood. Thus, the field surveys combining the participatory rural appraisal (PRA) with the "walk-in-the-wood" method were used to analyze the wildlife resource use between the IEMs and the MEMs. The findings revealed that both of the groups had a high or a relatively high dependency on the wildlife resources and had a tendency of shifting from self-consumption to income generation purpose (p = 0.000). Besides, the IEMs had a better and greater knowledge of edible wild plants than the MEMs, whereas many more MEMs made and used wild animals for medicinal purposes. The MEMs extracted and used the resources more intensively, but the IEMs used them for more subsistence related to their indigenous culture (χ^2 = 26.683, p = 0.000). Based on the findings, wildlife management strategies should emphasize the resource use pattern, the cultural differences and capacity building programs. Likewise, origin-based arrangements would contribute to sustainable wildlife management in CTNP.

***Corresponding Author:** Dinh Thanh Sang ✉ sangdt@tdmu.edu.vn

Introduction

Commonly, wildlife resources in tropical forests of national parks have played a vital role in the rural livelihood. Likewise, poverty and population growth have been found to be major driving forces for locals to extract wildlife products at an unsustainable rate (Carter *et al.*, 2003; Pangau-Adam *et al.*, 2012; Knapp, 2012; Gladman, 2012; Scales, 2014; Dinh, 2020a; Dinh and Pham, 2020a). This negative trend has caused wildlife extinction, biodiversity loss in natural forests of many national parks. Similarly, poor residents and ethnic minorities (EMs) in developing countries have depended much on wildlife resources from forests (Sills *et al.*, 2003; Ticktin, 2004; Dinh *et al.*, 2010; Knapp, 2007 and 2012; Dinh, 2019; Dinh and Pham, 2020b).

With regard to Cat Tien National Park (CTNP), the wildlife resources have been endangered mainly by land encroachment, over-exploitation of edible wild plants, illegal logging, poaching, and grazing inside the forests (Dinh *et al.*, 2012; Pham and Vu, 2013; Emerton, 2014; Dinh, 2020b). Moreover, many households of three main groups including Kinh people, the indigenous ethnic minorities (IEMs), and the migrant ethnic minorities (MEMs) within and around CTNP have depended much on the wildlife resources. Similarly, their resource use has become the main constraint on the park management.

Despite wildlife conservation efforts by the authorities, the wildlife loss and the ecosystem changes in CTNP have been reported (Polet, 2003; Dinh *et al.*, 2010; Pham and Vu, 2013; Dinh, 2020a and 2020b). Hence, the sustainable development goal has not yet been achieved in the park (Dinh, 2021).

Nevertheless, the real status in the wildlife use between the IEMs and the MEMs in CTNP has been poorly understood. Therefore, understanding challenges created by the wildlife use between the two groups in this park is necessary. Thus, this study was to analyze the wildlife use status between the IEMs and the MEMs and to clarify the solutions for the sustainable use and management of the park resources.

Materials and methods

Study site

Geographically, the park is situated in a region with a mixed climate of mountains, plains and highlands in southern Vietnam and covers an area of 82,597.4 ha with a total of 203,000 persons. It has 1,618 species of vascular plants and 1,521 animal ones. Among them 47 plant species and 93 mammal ones are listed in the IUCN Red Data Book. Traditionally, the IEMs have lived inside the park for several centuries. Instead, Kinh people and the MEMs have arrived and settled in CTNP for approximately 40 years.

Data collection

The primary data were gathered initially through the household surveys and the focus group meetings based on the participatory rural appraisal (PRA) method (Chambers 1994). There were 7–12 participants in each group discussion. Besides, the "walk-in-the-wood" method (Prance *et al.*, 1987) was employed. Each field observation was organized with 2-3 elders who knew about the wildlife species. The scientific names of the species were identified by cross-checking the survey interviewees' knowledge and matching the vernacular names with the names in the published books of Do (1995) and Pham (1999 and 2000).

The data were collected in accessible hamlets where there were the EMs and the natural forests, and the local respondents were dependent on the wildlife resources. Based on these criteria, six hamlets in CTNP were chosen. The IEMs and the MEMs made up approximately 89.2% of the population in the study sites. Permissions of the local authorities were sought before the surveys. Thus, questionnaires with 85 questions concerning socio-economy and wildlife resource use were distributed to 170 local families of the two groups.

Data analysis

Each category of the information gathered was coded with a number respectively (Jehn and Doucet, 1996). The collection intensity was classified as (2) high-large amounts of the wildlife products collected on account of high demand, and (1) medium-moderate

amounts of those collected owing to moderate abundance or extraction difficulty. Market demand was categorized as (2) high- easy to sell large amounts, (1) low self-consumption and sometimes sold in the local markets. For the use purposes in terms of cash income, the scale range covered (0) – never, (1) – 1 to 25%, (2) – 26 to 50%, (3) – 51 to 75%, and (4) – 76 to 100%. Based on the extraction frequency – (0) never, (1) rarely, (2) sometimes, (3) very often, (4) always – and the number of the wildlife use categories, the use levels ranged from low to high: (1) low dependency (1–7 times/month), (2) – medium dependency (8–15 times/month), (3) relatively high dependency (16–22 times/month), and (4) high dependency (more than 23 times/month).

To calculate a use index (UI) for each species based on the ethnobotanical inventory, the following equation was used: UI=Us/N (Phillips and Gentry, 1993), where Us was the number of respondents using the species s from the forest in CTNP, N was the total informants interviewed. Pearson's chi-square test and Paired sample *t*-test were used in the analysis.

Results and discussion

Demography

Nearly two thirds (62.4%) of the respondents were the IEMs. All of the IEMs have lived in CTNP for many generations. Just 8.1% of the MEM respondents came there less than 20 years ago. Also, 89.1% of the MEMs arrived and settled in the area approximately 20 to 40 years ago. The informants of the both groups insignificantly varied in education (χ^2 = 1.707, p = 0.789). A near total (96.5%) of the respondents identified themselves primarily as farmers who raised rice and other crops like cashew, coffee, cassava, maize, peanut, green bean and fruit crops. Only 3.5% of the interviewees formally had non-farm jobs like foresters, conservation staff, teachers and cultural officials. About 8.2% of the respondents who were farmers involved in off-farm activities such as seasonal wage earnings, trade and handicraft. Additionally, 61.8% of the respondents had paddy land to produce rice for self-consumption, while 6.5% did not have any aquaculture or arable land types. The ratio of the very poor and poor households in the sites was high: 30.0% and 31.8% of the total respondents, respectively.

Wildlife use

All of the surveyed households of the IEMs and the MEMs harvested and used some or many species of edible wild plants. Overall, the result showed that 117 species of edible wild plants and mushroom belonging to 59 families were used by the IEMs in the area, whereas 75 wild species were used by the MEMs. In addition, the number of edible forest plant species harvested and used differed between the groups. Utilization pattern of edible wild plants between the MEMs and the IEMs was different (Fig. 1). The most frequently harvested species used by the MEMs consisted of many bamboo species, *Scaphium macropodum*, *Auricularia polytricha*, *Peperomia pellucida*, *Piper lolot*, and *Willughbeia cochinchinensis*. Several EMs in the study sites mentioned that their use of the edible forest plant species like bamboo and *S. macropodum* had been much more essential for cash income than for subsistence. Conversely, 100% of the IEMs stated that rattan shoots, young leaves of *Gnetum gnemon* var. griffithii, and *Gnetum gnemon* var. domesticum were very essential for their common meals.

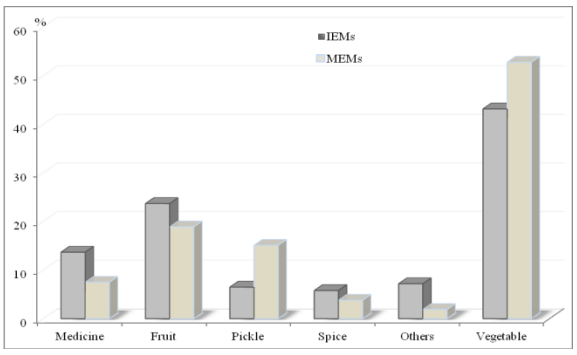

Fig. 1. Utilization pattern of edible forest plants and fungi by the IEMs and the MEMs.

The IEMs and the MEMs (60.6%) both logged poles for the construction of their houses, pigsties, hen-coops, and stalls. The ratio of the households harvesting construction poles was different between the groups (χ^2 = 13.284, p = 0.000), 15.2% and 46.6%, respectively. Besides, logging activity also

differed between the two groups (χ^2 = 10.134, p = 0.001). There were higher percentages of the IEMs who were involved in logging activity (Fig. 2). Like another case study in CTNP (Dinh *et al.*, 2010), more IEMs involved in that activity because outsiders hired some IEMs for harvesting timber "illegally". According to the survey, 17.6% of the respondents were involved in the illegal logging activity for income generation, while the fig. in 1998 was about 27.4%. All of the surveyed IEMs and nearly 100% of the MEMs collected and used many wild plant species as firewood.

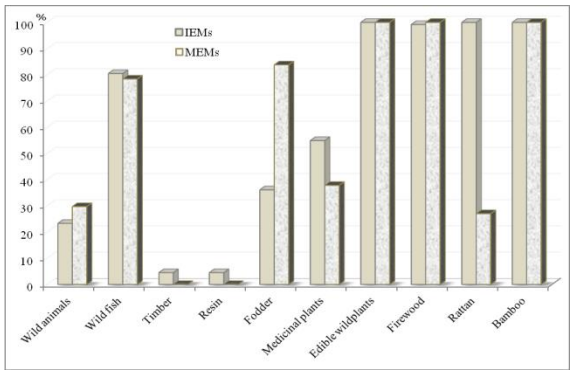

Fig. 2. Frequencies of the wildlife use between the IEMs and the MEMs.

Resin of *Dipterocarpus alatus* used to be a vital resource bringing high income to most EMs in CTNP. They gathered resin on the ground and used fire to extract resin from trunk of the species. The extraction method not only destroyed the timber trees but also caused forest fire which damaged the habitat. According to the surveys, 3.5% of the respondents involved in this activity, but this fig. was high in 1998 – around 15.9%. All of the resin harvesters interviewed used fire to extract resin in 1998, but recently they have not used this method. Most of them reported that this resource was used mostly for cash income; some of them used a little amount for self-consumption. This resin was used for traditional medicine, waterproofing baskets, handicraft, dossers and boats. Moreover, there was no difference in extracting ratio between the IEMs (23.3%) and the MEMs (29.7%) (χ^2 = 2.335, p = 0.126 > 0.001).

Traditionally, wild animal poaching has been carried out by the IEMs and the MEMs for self-consumption, high cash income. Yet, this activity makes a severe conflict between the EMs and the forest rangers in term of wildlife resource protection. Approximately a quarter of the households (24.7%) surveyed involved in poaching forest animals and 3.5% of them harvested wild honey. This ratio was considered high and the conservation impact of poaching was high in the area. The common wild animals poached by the two groups were fish, frogs, snails, snakes, pythons, bamboo rats, wild pigs, Java mouse-deer, birds, pangolins, gecko, eels, monkeys, varans, weasels, jungle fowls, but many other less common species were also poached. Like the another case in Ke Go Nature Reserve (McElwee, 2010) and Bu Gia Map National Park (Dinh and Pham, 2020a), the IEMs and the MEMs in CTNP also poached wild animals in conjunction with other activities such as logging, collection of other non-timber forest products (NTFPs), or farming inside the natural forests. There was no difference in poaching ratio between the IEMs (23.3%) and the MEMs (29.7%) (χ^2 = 0.642, p = 0.423 > 0.001). Nonetheless, the ratio of the poachers between the two groups making and using wild animals for medicinal purposes was significantly different, 9.7% and 72.7%, respectively. Interestingly, some medicinal products were made by the MEMs including wild animal glues such as monkey glue; animal wines like venomous snake wine, gecko wine, scorpion wine; scales of pangolins; python fat; and so on. Like the case in Papua New Guinea (Mack and West, 2005), approximately 97.8% of the poachers in CTNP agreed that poaching had shift from "wild meat" to "bush meat", or from self-consumption to income generation. In other words, the wildlife conservation impact of this trend was likely to be high.

Fishing in the wetlands of CTNP has been the most popular activity of the EMs since this livelihood strategy has been considered as their customary use of wildlife. About 80.0% of the respondents involved in harvesting wild fish. Wild fish have been the common food in the daily meals of the EMs in CTNP. Unfortunately, some local families have used electric fish shockers to harvest wild fish and other aquatic species.

The number of households involved in this unsustainable fishing method accounted for 34.1% (58) of the surveyed households, those were not significantly different between the IEMs and the MEMs (χ^2 = 2.018, p = 0.155 > 0.001).

Overall, the EMs in CTNP extracted and used many different categories of the wildlife resources which were edible wild plants (100%), firewood (99.4%), wild fish (80.0%), thatch (73.5%), medicinal plants (51.2%), wild animals (24.7%), logging and carrying timber (17.6%), and resin (4.7%). As shown in Fig. 2, the ratio of use of the wildlife resources in terms of timber, rattan (χ^2 = 115.379, p = 0.000), building poles, and folder (χ^2 = 26.470, p = 0.000) differed significantly between the IEMs and the MEMs, but that of the others was not significant difference. Hence, the resource management and conservation impacts were likely to be different between two different original groups.

A majority of the families (62.4%) were highly dependent on the wildlife resources. Approximately 13.5% of the respondents belonged to the relatively high dependency, the medium dependency had 11.8%, and the low dependency accounted for 12.4% (Fig. 3). The patterns of wildlife resource use differed significantly between the MEMs and the IEMs (χ^2 = 21.598, p = 0.000).

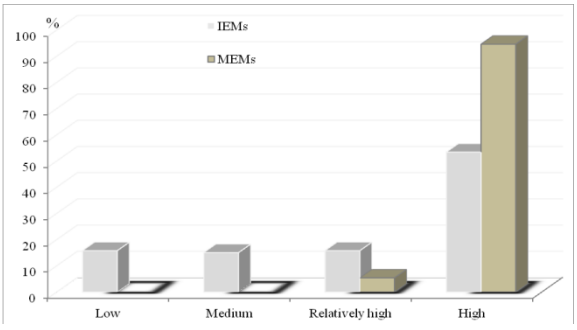

Fig. 3. Wildlife use patterns between the IEMs and the MEMs.

According to Fig. 4 and the Paired sample t-test, the purposes of wildlife use were shifted from self-consumption to income generation and the change was significant (p = 0.000). In particular, nearly half of the households interviewed (48.2%) used 76-100% of the wildlife resources for cash income, whereas this fig. was only 18.8% in 1998 (Fig. 4). Also, the fig. of 51-75% of the resource use for that purpose between 2019 and approximately 21 years ago was different: 28.2% and 15.3%, respectively. Furthermore, 8.8% of the households surveyed did not use the resources for cash income in 2019, but the fig. was 35.9% in 1998. To sum up, it was apparent that traditional use patterns of wildlife in CTNP tended to shift from subsistence to commercialization. The wildlife conservation impact of this trend was likely to be high, so more sustainable livelihood strategies should be found.

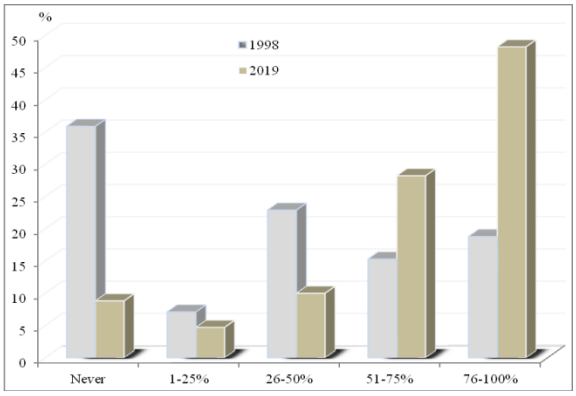

Fig. 4. Ratio of the households using wildlife resources for income generation.

As shown in Fig. 5, the ratio of wildlife resource use for income generation differed significantly between the MEMs and the IEMs (χ^2 = 26.683, p = 0.000). It was obvious that the MEMs tended to use the resources for cash income more intensively than the IEMs. Using the resources for subsistence was one of the most important livelihood strategies among the IEMs.

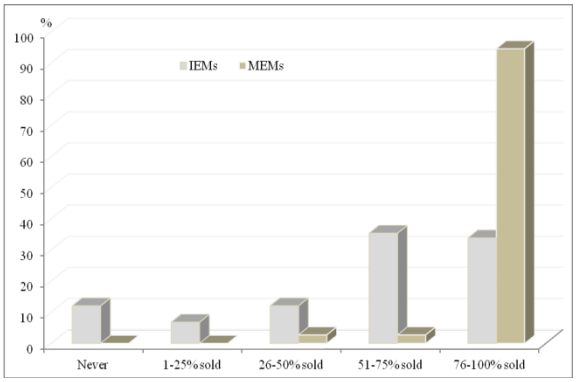

Fig. 5. Ratio of the wildlife use for cash income between the IEMs and the MEMs.

Practical implications

Similar to the other cases in some protected areas (Nepal and Weber, 1993; McElwee, 2010; Dinh *et al*., 2012; Pangau-Adam *et al*., 2012; Dinh and Pham, 2020a and 2020b; Pham and Vu, 2013; Dinh, 2020a), with the large population in and around CTNP, the demand of the two groups on the wildlife resources was at a high intensity. The results showed that both groups living inside CTNP depended heavily on available wildlife resources such as edible forest plants, firewood, wild meat, medicinal plants, and construction materials, shelters, handicrafts, furniture, ethnic instruments, and agricultural tools. Indeed, the reason for the high usage rates of the resources was that 61.8% of the surveyed households were poor or very poor and the majority of them had low education levels. In particular, like the other cases (Mack and West, 2005; Pangau-Adam *et al*., 2012), the use purposes of wildlife products from poaching in CTNP had a tendency of shifting from self-consumption to cash income. This trend raised the highly negative impact on the wildlife protection. The IEMs and the MEMs lived in a finite area, whereas the wildlife resources in CTNP could not be maximized at the same time. Consequently, the tragedy of the commons happened (Hardin, 1968; Nepal and Weber, 1993) because the wildlife resources were overused in CTNP. A previous case study showed that despite conservation efforts, one of the biggest challenges in CTNP was the forestry law violation (Dinh, 2020b). In order to overcome the tragedy of the commons, participatory wildlife management has been an effective solution because it has had positive impacts on natural forest resource conditions and local livelihood strategies (Carter *et al*., 2003; Dinh *et al*., 2012; Dinh and Pham, 2020a; Dinh, 2021). Also, both of the groups should be involved in income generation-based programs.

The IEMs were far more likely to use the wildlife resources for more self-consumption related to traditional uses than the MEMs. Indeed, the IEMs in CTNP have a traditional culture related to the wildlife resources use for many generations. Among the edible wild plants used by the both groups, the IEMs consumed shoots of some rattan species such as *Plectocomiopsis geminiflora*, *Calamus poilanei*, *Calamus tetradactylus* and *Korthalsia laciniosa* as favorite vegetable, whilst the MEMs did not actually like the bitter taste of the rattan species. For instance, 100% of the IEM respondents were very fond of the bitter taste of *P. geminiflora*, whereas all of the MEMs disliked this taste. Traditionally, the IEMs were so familiar with rattan species that their products appeared almost in common meals as well as home appliances and handicrafts such as dossers. Instead, the MEMs used rattan canes as ropes to combine parts in construction, and they seldom used rattan for other purposes. With their indigenous knowledge (Dinh *et al*., 2012; Dinh, 2019), signals of ripeness or mature, harvest of nut or resin by cutting tree trunks or branches or a large notch on trunks near the ground and then firing could help the IEMs harvest the wild plants more quickly and efficiently. According to Dinh (2019), plants used as vegetable by S'tieng IEMs in CTNP accounted for 59.6% of the total and 12.8% had UI ≥ 0.8, particularly, three following species *G. gnemon* L. var. domesticum, *G. gnemon* L. var. griffithii, and *P. geminiflorus* had UI=1. According to the law on forestry, human intervention in the integrity of wildlife within special-use forests is strictly prohibited (NASRV, 2017). Yet, it is very difficult to stop the IEMs from using some types of wildlife resources because most of them have lived in CTNP for many centuries and wild plants used by them have closely linked to their traditional food culture. In addition, under the decree 75 (GSRV, 2015), EMs who participated in natural forest protection and development had the right to harvest NTFPs under sustainable conditions. According to Dinh (2020a), the IEMs in CTNP should be recognized as partners in the collaborative forest management.

The study identified that the local dependency on the wildlife resources in term of the cultural purpose between the IEMs and the MEMs was different. Likewise, the IEMs used various plant species belonging to Arecaceae and Gnetaceae for more subsistence related to their traditional food, but the MEMs were not familiar with those for common

meals. The biodiversity conservation impact of harvesting the wild plants for traditional food was likely to be high. Thus, the most important species should be domesticated for self-consumption demand of the IEMs. Also, like the other case studies (Tarakini *et al.*, 2018; Dinh, 2019; Dinh and Pham, 2020a), the indigenous knowledge could be applied to sustainable use of the forest resources, domestication and wildlife conservation. Besides, both of the groups should be involved in capacity building activities like training and introduction of high yielding varieties of livestock and crops; agroforestry practices; community tourism; sustainable harvesting practices; and techniques of wildlife domestication.

Conclusion

The findings revealed that both of the IEMs and the MEMs had a high or a relatively high dependency on the wildlife resources and had a tendency of shifting from subsistence to income generation purposes. Moreover, the MEMs extracted and used the resources more intensively, but the IEMs used them for more self-consumption related to their traditional culture. Yet, unsustainable extraction in the face of increasing cash income as well as subsistence was threatening the resource sustainability and presented a big challenge for effective conservation management in CTNP.

Based on the local context, fitting institutional strategies for effective wildlife management and sustainable development in CTNP are suggested. In other words, wildlife conservation programs should be designed more specific for each group. Origin-based arrangements would contribute to planned use, balanced harvest and sustainable wildlife management. In addition, both of the groups should be involved in capacity building programs. Besides, the IEMs should be motivated to participate in wildlife management activities focusing on fulfilling their sustainable subsistence consumption. To decrease the EMs' dependence on the wildlife resources; income generation activities, more sustainable ways of the resource use and wildlife conservation education should be motivated. In particular, it is essential to domesticate the most important wild species retained on the indigenous culture as well as ensure the two groups' potential importance in nutrition. In addition, farms of NTFPs reflecting the indigenous culture and providing cash income for the two groups should be established. Eco-industrial parks should be established in the buffer zone of CTNP. Further study is required to survey the wildlife trafficking status in the park. Additionally, improving forestry law enforcement and regular monitoring of wildlife use over time are needed to ensure wildlife conservation in CTNP.

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