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Values and Livelihood Adaptation for Wetland Management and Climate Change: Lesson Learns from Kiat Ngong and Phapho villages, Beung Kiat Ngong Ramsar, Lao PDR

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Abstract

Wetlands play a crucial role in community livelihood and water security management. The study was conducted in Kiat Ngong and Phapho villages inside the Beung Kiat Ngong (BKN) wetland Ramsar site, in the Pathounphone district, Champasack province. By gathering data from GIS, remote sensing, and ground study for referent and social-economic situations with communities. Farmers from two villages heavily rely on natural biodiversity resources from BKN for consumption and income. By looking at land use types, it shows farmers have paddy and crop fields inside and surrounding Ramsar sites, more than 16% of the catchment area. The majority size is broadleaf evergreen and deciduous forests at 24.9% and 24.3%, with 11.69% claimed as fallow land and located inside Xe Pain NPA. Recently, sources of income have varied, from livestock, rice, fish, cassava, and labor. People earn from aquatic resources an average of 300-400 US dollars/year. Since 2020, cassava has become a main source of income, especially for rich families. Then cassava has expanded quickly to fallow lands inside NPAs, but not yet intends to turn paddy into cassava. Agricultural activities rely solely on surface water. About 70% of paddy areas use water from wetland and rainfall; 20% of households use water from wells and rain; and 10% of people buy purified water from private companies for drinking and cooking. The experiment game to learn how people plan and manage their land and water needs shows that rich families (9% of the population in two villages) are well managed and looking for the alternative crop to grow and thinking of pumping up groundwater for gardening and rice fields, but petrol cost is a concern. While poor families (19% of the population in two villages) are lacking land, they only think of raising cattle and exchanging labor for a living. Collecting golden apple snails for sale becomes a good choice for family income.

Keywords: Beung Kiat Ngong, Ramsar site, Water resources, Wetland values.

1. Introduction

The Beung Kiat Ngong wetland covers 2,360 ha and is located in Pathoumphone District, Champassak Province, in southern Lao PDR, approximately 75 km south of the provincial capital, Pakse. The site's elevation is 120 to 200 meters above sea level. The southern parts of the wetland, as well as most of the village of Ban Kiat Ngong, are located within the Xe Pian National Protected Area (NPA) (Duckworth, 2008). Figure 1 shows the wetland's location between the two NPAs. Detailed studies on biodiversity have not yet been undertaken in the Beung Kiat Ngong Wetlands; although the exact numbers of species are not known, the existing data show that it hosts an important array of aquatic and terrestrial biodiversity. During the wet season, the wetlands provide spawning grounds as well as a passage for a variety of fish to move upstream along these rivers and streams. The wetlands also form an especially important habitat for fish during the low-water dry season. Forty-three fish species have been reported in the wet season, while during the dry

season, only about 20 fish species remain in the area (IUCN, 2009a). Northwestern perennial peatlands Southeastern seasonal/semi-peatlands. The Beung Kiat Ngong Wetlands provide small and medium nesting sites for water birds, as well as a source of food, such as plants, insects, fish, and other small animals, for birds, wild and domestic animals, and humans. In 1996, a survey of the wetlands found 33 wetland-associated bird species (Claridge, 1996). A similar number of bird species were found in surveys in six main villages around the wetlands in 2009. These included Cattle egrets (*Bubulcus ibis*), Immediate egrets (*Mesophoyx intermedia*), Lesser tree ducks (*Dendrocygna javanica*), Painted snipes (*Rostratula benghalensis*), and Chinese pond herons (*Ardeola bacchus*) (IUCN, 2009a). More detailed bird surveys would undoubtedly reveal a much larger number of wetland-associated bird species.

The wetlands also support a human population of around 11,500 from eight core villages and another five surrounding villages. These villages are primarily reliant on subsistence agriculture, wild-capture fisheries, wild vegetables, and nontimber forest products (NTFPs) for their livelihoods, food, and income. Some income is also earned from tourism businesses, particularly in Ban Kiat Ngong. Paddy fields are found around the edge of the wetlands, especially in the seasonal wetlands in the east of the site. In addition, about 4,300 cattle, water buffalo, and 27 elephants are living in the wetland area (IUCN, 2008b). The economic value of all agricultural, fishery, and NTFP products coming from the Beung Kiat Ngong Wetlands is estimated to be about USD 850,000 per year (IUCN, 2009b). This study is to understand the value of ecosystem services from Beung Kiat Ngong, the Ramsar site, to community concern. And To understand how communities are tied to water security and water supply from Beung Kiat Ngong wetlands

2. Methods

2.1 Study site

The study was conducted in the Beung Keit Ngong wetland area and covered the Ramsar site in Pathoumphone district, Champasack Province. Which is about 75 km from Champasack City to Khon Waterfall. Kiat Ngong (KN) village is in the upper part of the Ramsar Site, and Phapho (PP) Village is located in the lower part (see Figure 1). Kiat Ngong village is considered a poor village with 1,263 people (223 households) (2021), while Phapho is reported as a wealthy village with 1,852 people (325 households). People from the two villages are farmers; they grow paddy rice and consume natural resources for their livelihood.

Data collection gathered from GIS, remote sensing data, then ground referents. Field surveys covered socioeconomic information, benefits from wetland and development activities, and the livelihoods of communities. Also, organized group discussions focused on the benefits of wetland resources for the community, both direct and indirect. By using village resources mapping, drawn by local people, prioritize sources of income and resource use. Key informants included the elderly, village headman, female, and male, also in different household statuses (poor, medium, rich).

Initially, conduct a ground survey to observe the wetland/peatland ecosystem, land use types (paddy, urban area, forests), and record the location coordinate point. While the survey raised some issues or conflict concerns on wetland resources consumption among users, the community also discussed management and the solution applied. The work does community profile (using male and female key informants). Apply in-depth interviews; people were asked if they classified themselves closer in which category (farmer, fisherman, or water user groups) to conduct semi-structured interviews individually. Interview local authority and village headman of two villages to discuss the rules or regulations of the peatland management plan for their community. Other targets for interview: development projects, business, and some related organizations to peatland, wetland, water resource wildlife, working in BKN, Champasak province. The first data collection was done with 180 forms for socioeconomic data; two villages were selected: Kiat Ngong and Phapho villages. Interviewing the people of the two villages identified those who are about 30 years old and above. The interviews are conducted individually and separately between men and women to see the role of men and women and the use of water by men and women. The history of

the village, household income, expenditure, and use of wetlands also asked about the importance of wetlands to their livelihoods. Interviewing is based on the interview form that has been prepared before.

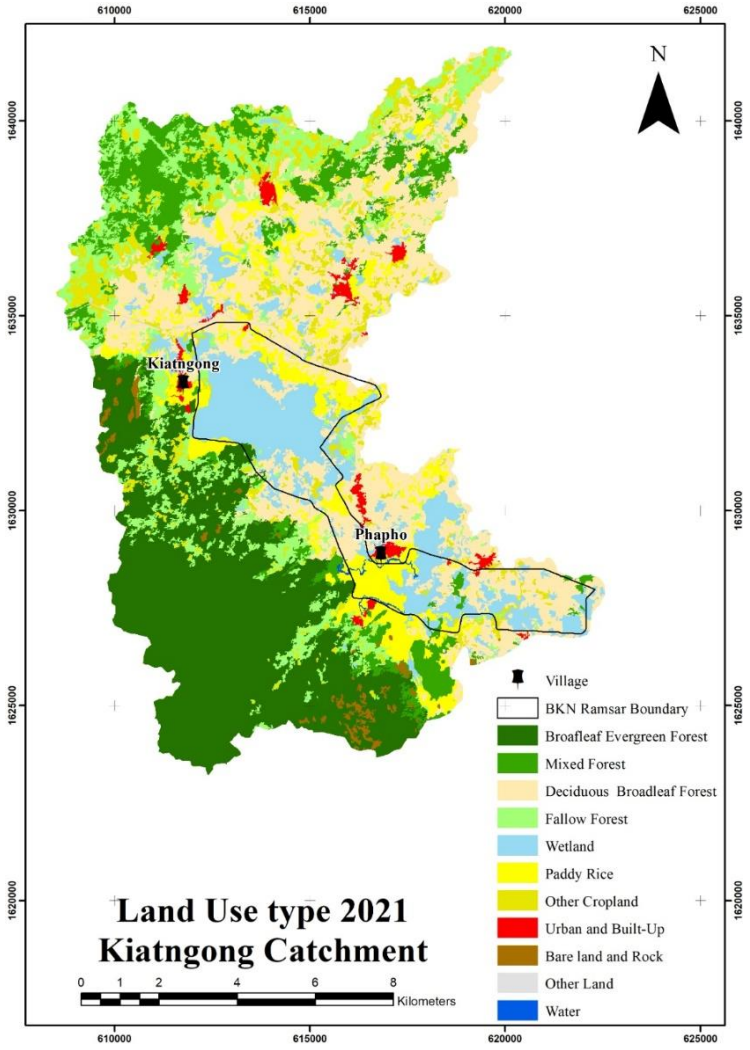

Figure 1. Land Use Type of Beung Kiat Ngong within the area, 2021 and border of Ramsar site inside. Information gathered from satellite image (L1C) in December 2021, dry season.

To understand how communities are tied to water resources and how their managing plan is. The study applied the Companion Game, which was adopted from The Millionaire Game. In this sample collection, we have divided it into 3 major tasks, such as social economy, hydrology, and gaming, which divide the role of the community and the government in the management of wetlands, water security, etc. The simulation game is to share lessons learned between participants on how important (a) wetland ecosystem service providing and water availability are; (b) the dynamic interactions among components of wetland ecosystems and community socio-economic development; and (c) to discuss farmers' opinions on the adaptation to climate change and uncertain climate events in the future, focusing on water resources for households and agriculture (5 years, 10 years). Followed by an earlier field survey, a group of farmers was collected and interviewed about their type, cost and profit activities, source and water use, climate change events, and their impacts. water security and water supply from wetlands (Dumrongrojwatthana & Chaichana, 2024).

The game structure and role: There were three groups: C (Rich), B (middle), and A (Poor). Each group will have resource capital as a piece of land and money.

Farmers	Piece of Land	Money (Kip)
Group A	0.5 (ha)	10 million
Group B	2.0 (ha)	30 million
Group C	5.0 (ha)	50 million

Note: Kip = Lao currency

Game structure:

An earlier field survey was collected and interviewed groups/types of farmers, cost and profit activities, sources and water use, climate change events, and their impacts. The game was developed based on the millionaire (monopoly) classic game. Gameboard and game artifacts (e.g., events; scenario cards, (fake) money, record sheet, Excel file for income calculation, and question cards/topic for individual discussions) were prepared.

Game procedure:

To conduct the game, 6 farmers were invited. 2 people for each group (A, B, C), with a mixed group of genders and age range 25-55 years old. And they were allowed to share ideas and discuss during playing. The game played 2 rounds as 2 seasons (dry and rainy) of the year.

Researchers started with an introductory objective of the game, then the background, the current situation of wetland resource uses, climate change effects, water utility, and the new dam construction inside the Ramsar site. The gameboard with all materials and steps to play the game was explained.

With the game, players had to manage their farms and land as they wished. Also, players had to pick a question card, and the discussion proceeded. Questions related to wetland resource use, affected by climate change and adaptation, and management. The discussion mentioned and compared situations that might happen in dry and rainy seasons. Also, some solutions that farmers applied before and may apply in the future.

3. Result and Discussion

3.1 Land Use Type inside Beung Kiat Ngong catchment area

The Beung Kiat Ngong catchment area covers 143.3 km2, which contains a wetland Ramsar area of 23.6 km2 (Gtec, 2019). Figure 2 shows that two large land use types are broadleaf evergreen forests (dark green in Figure 1) for 24.92% and deciduous broadleaf forests for 24.33% of the total area. One is an area in Xe Pain National Park (at the southeast part of the area), and another is the Dong Hua Sao National Park area. Other types of land use located near and inside wetland Ramsar sites are fallow forest (11.69%), wetland area (11.22%), mixed forest (9.52%), then paddy (8.02%) and cropland (7.66%), respectively.

In practice, fallow and deciduous broadleaf forest areas located inside both NPAs are old agricultural fields owned by the community, some tree plantations, coffee, and rice fields. After the COVID-19 pandemic, 2020-2021, most local people turned old fields: the coffee and teak plantations started to turn into cassava plantations, as cassava prices increased at the time. In the Dong Hua Sao NPA area, cassava plantation increased from 138 ha (2020) to 386 ha (2021) (Phengsisomboun *et al*., 2022). From Figure 1, inside the wetland Ramsar site is a paddy rice field and communities.

From the study, Phapho is bigger than Kiat Ngong in terms of population and agricultural area. PP, located in the lower part of the Ramsar site, has a paddy area more than KN and less of a cassava plantation. KN reported a low-income village compared to PP, located in the upper part

of the Ramsar site, which has less in paddy fields (IUCN, 2012). Old-generation families have fallow fields in Xe Pain NPA, and in 2021 some families started to plant cassava.

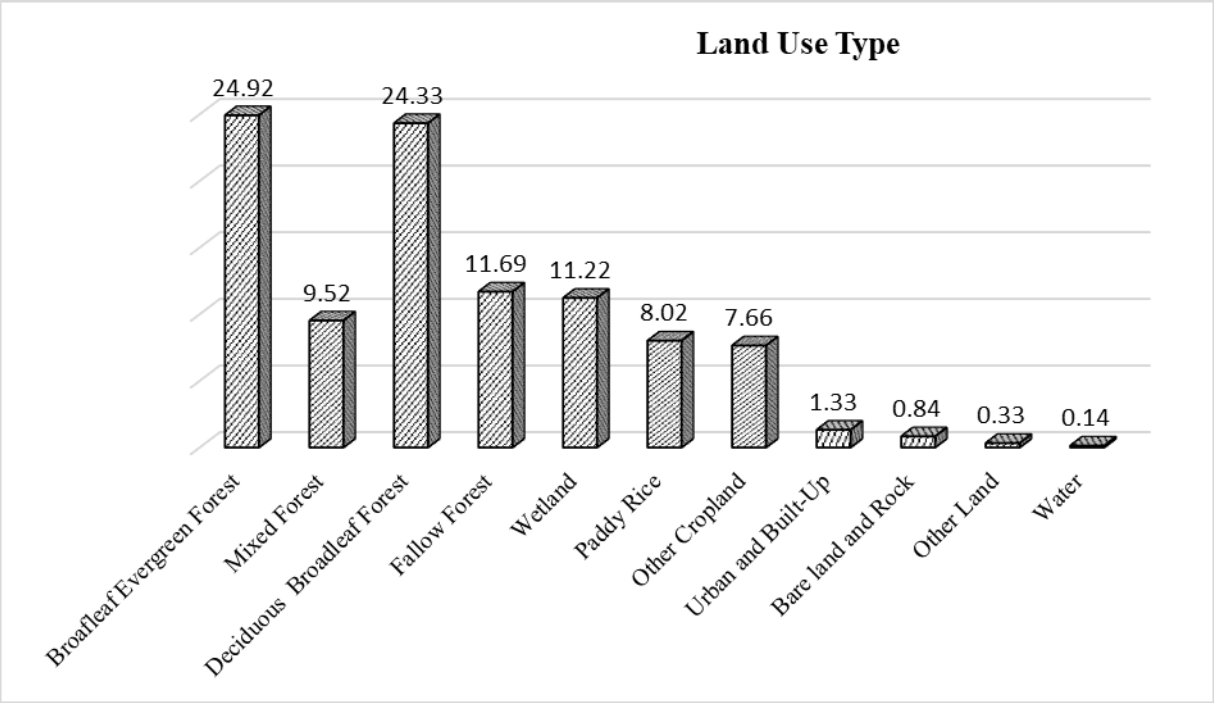

Figure 2. Land Use Type within BKN catchment area (in %), 2021.

3.2 Family status

People from two villages claim that rice is the main food and source of income for the family. Then raise livestock and others. Poor families earn as laborers and collect food from forests and from wetlands for family and sell. Such as fish, water snails, and small shrimps. Based on the interview, snails are a good source of income for the community and household, as they can be found all year round. It might be in the dry season, but the price is higher than selling in the rainy season. Although the apple snail is recognized as an alien invasive species and harmed rice plants, most farmers want to destroy them; in contrast, it is an urgent source of income for their families in the community. On average, in the dry season of 2021, poor families earn around 15 US dollars/day from cooked snails.

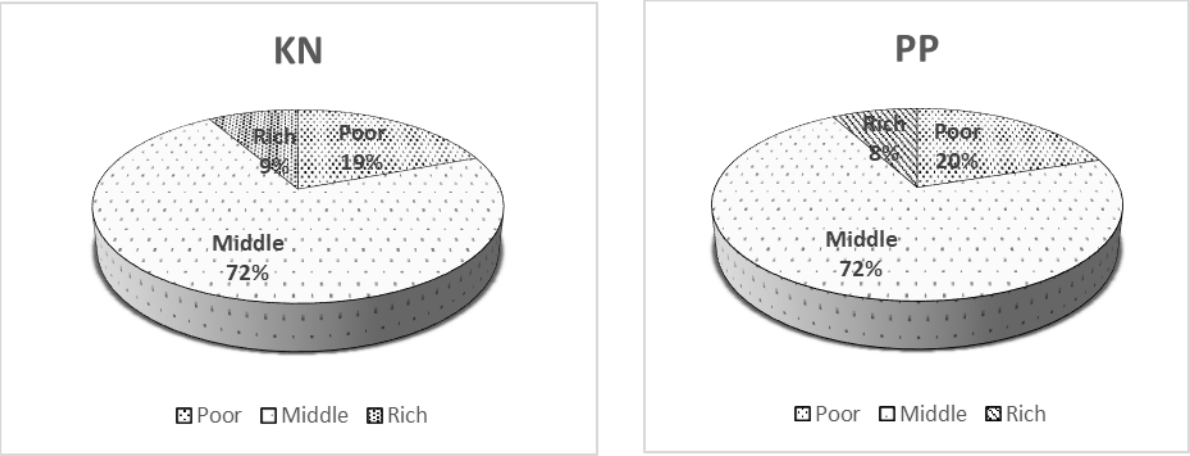

Figure 3. Economic status of people in Phapho and Kiat Ngong villages.

From the in-depth information, explain: the meaning of poverty for this study is based on the income and expenditure of the family, and also the family is so poor that they will not have land for farming, gardens, and livestock; farming every year is to rent other people's fields or have to find resources from nature to sell to buy rice and food to feed the family. In addition, men or young people go out to sell labor in big cities or cross to Thailand.

Figure 3 shows the family economic status of people in two villages, PP and KN. The majority of people in the two villages consider themselves middle-income, accounting for 72% of the total population. While poor families remain at 19% in KN and 20% in PP. The family status is based on the total income and expenses of the family/month/year, similarly to Khamlibounthavi, 2008.

Table 1. source of income for both villages

Items	Price	Income a year per household
Rice	2.8 million kip/ton (254.55$)	-
Casava	- 1,200 (wet) kip/kg (0.11$) - 2,300 (dry) kip/kg (0.21$)	From 30 million – 250 million kip (at first 2 years and large field)
Cow	1,800,000kip/cow (163.64$)	-
Fish	-	3,000,000kip – 10,000,000kip (273-909)
Apple Snail (Pomacea)	8,000 (0.73$) -15,000kip (1.36$)/kg	15,000,000kip
Labour	- 60,000kip/day/person	

Note: rate exchange 1 USD = 11,330 Kip, January 2022.

Table 1. shows sources of income for a household in both villages. List from rice, cassava, cow, fish, selling golden apple snail, some are merchants and use labor, and others. People claim that rice is the main food for families and source of income. However, PP village has more paddy than KN, as KN is located in the upper part of the main wetland and next to Xe Pain NPA, so most of the paddy area is inundated during the rainy season. Farmers can only grow rice in the dry season. While PP area is flatter, has a larger area of paddy, and people can grow rice in the rainy season, some families can do both seasons. Capacity in this catchment is approximately 3.5 tons/ha in the dry season.

Cassava planting became interesting to the community in 2020 when the price got higher and higher from 2019 to 2021. Most people sell wet cassava right after harvest. Especially in KN, the family who lives in this region for a long time, wealthy families may have old fallow land in Xepain NPA. Cassava plantations in PP are very rare.

Golden apple snails become the first choice of income generation for poor families. Mainly low-income families will collect snails for sale and cook at home. The price varies in the rainy season and dry season.

Livestock is considered a capital source of income for a family, or “family savings.” People will sell out one or more cows per year or once they need urgent money. New/young families mostly be livestock keepers for others. The main expenditure is for health problems, then, sending children to school. 5% of the population in the village is running businesses, trading, or being

merchants. And mostly it is wealthy people from PP. Apart from income for family, the big expenditures of the family are different families with cassava fields that spent a lot to prepare the land, clean grass, and harvest time. Which requires much time and labor. Some families plant cassava for the first time in rice fields. Other expenses are for food and health care. Some family pawned a tractor after selling cassava.

Fish and aquatic resources are also the main food for families and income. A part of the farmer does fishing every day from BKN. People dug holes in their own field to trap fish in the rainy season. Size is about 0.5 meter (width) x 1 meter (depth). Collect fish and sell them in the dry season. Another option for earning is labor. The rate for daily labor working in the field is 55,000 kip ($5)/person; occasionally, and especially low-income families, get paid by harvesting cassava for others in the community and village nearby. The poor and newlywed families normally do not have land for farming, so they rent it from others in the village or share it with their parents.

3.3 Water Resource

Water use is another big issue for people living in the BKN catchment, for household consumption and agricultural purposes. With seriously limited surface water in the dry season, people are not allowed to dig ponds around and inside the Ramsar site for water-saving purposes (IUCN, 2019b). As a result, rainfall is the only source for paddy fields. People in two villages share water from wells with their neighbors; some families store rain for cooking, washing, and boiling for drinking, and 100% of the population in two villages bought drinking water from an outsource, as the area has no pipe water system. They can well be found 4-5 m from the surface in the rainy season and 8 m in the dry season (FAO, 2016). The well's depth is 50 m (Lacombe et al., 2017); one borehole in KN reported a depth down to 70 m, but all drilled boreholes cannot be drunk or cooked. Groundwater in this catchment is contaminated with arsenic at high levels (Meynell et al., 2014). Arsenic contamination found in some boreholes in KN is at 0.09 mg/L, while the national standard for drinking water is below 0.05 mg/L (Phommavong, 2015). The idea of pumping groundwater for gardens or agricultural fields is not practicable due to high-cost gasoline/petrol and electricity. For household use, 70% of agricultural activity comes from wetland and rainfall, 20% of water use comes from wells and rain, and 10% of water used in households for drinking and cooking is from water purification private companies in other districts.

Table 2. Sources of water use in two villages.

Sources	Purpose
Groundwater/boreholes	Gardening, Toilet
Water-well	Washing, Cooking
Rain	Washing, Boiled-Drinking, Agriculture
BKN Ramsar and channels	Agriculture, Rice field, Cassava, Garden, Cattle, Poultry
water purify/company	Drinking water and cooking

3.4 Wetland Resources and Management

The study found that there are a large number of animals, such as fish, snails, shrimps, birds, reptiles, and semi-terrestrial, semi-aquatic animals, that are important to the life of the community, which they lived for a living and sold for income.

By applying the game method to the study, it shows that after playing, mostly, farmers in the poor group relatively lost their capital and were likely to go into debt. While farmers from the group rich gained more income and gained more spare land. People in rich groups (rich families) consider managing land for an alternative purpose. They plan to allocate land for integrated crop and raising cattle, especially for farmers in rich families from Phapho village.

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People in rich groups (rich families) consider managing land for an alternative purpose. They plan to allocate land for integrated crop and raising cattle, especially for farmers in rich families from Phapho village. Comparing between game and real situations, farmers in group C (rich family) show that they have more labor in the family, own larger land, and have more money than middle and poor families, which a few family members have to rent a piece of land for farming; some poor family members are elderly and disabled people. Therefore, poor families are struggling to make income for families.

People in group A (poor families) tend to focus on cassava plantations as a result of the price that is rising every season since late 2021, especially in KN. And prefer to keep cattle as family capital for emergency cases.

People in group C (rich family) consider managing land for an alternative purpose. They plan to allocate land for integrated crop and cattle raising. Especially farmers in group C from Phapho village thought to be a middleman/merchant and to have a larger farmer

Some studies on the benefits of biodiversity of BNK (IUCN, 2008a & Kyophilavong, 2009) with communities living inside and outside BNK concluded that fish and non-fish were at 54%, the highest share of sources of income for families, then tourist activities. Recently, farmers from KN were thinking of ways to prevent flooding and thinking of alternative crops or plants that could grow in the rainy season. Also thinking of ecotourist activities revitalization (Khamlibounthavi, 2008). In both villages and other communities in this region, Phengsisomboon et al. (2022) found that the rich family is the highest user of water resources, using them for both drinking water for household consumption and farming purposes.

4. Conclusion

The study shows people's livelihoods from two villages are heavily reliant on natural resources from the BKN Ramsar site. Growing rice is the main food for families and the first source of income for middle- and poor-class families. Fish and other resources from the BKN catchment remain important for household daily consumption, such as wild vegetables and snails. The source of income, in addition to the sale of livestock and rice, is that the community also finds other resources to sell, such as shellfish, fish, frogs, and other aquatic animals. The income from the sale of shellfish averages 300-400 US dollars in a year. Even though the golden apple snail is reported as an alien species invasion that was harmful and dangerous to rice plants and native biology, people are reluctant to get rid of the snail. Most people in this area eat and earn from it. Since 2020, Casava has gotten people interested in earning more money, especially high-income families in KN. Some old fallows had turned to cassava fields. Water security and supply is a wise issue in this region, as there is no piped water system, no irrigation, and arsenic groundwater cannot be used for cooking, and surface water was available only in the rainy season.

Recently, farmers' curiosity and concern have been about water allocation and management. Due to the new construction dam inside the BKN Ramsar site. The discussion was on flood control in the rainy season; water volume allocation for paddy fields is needed to discuss among target villages, or event ideas are rescheduled to plant rice based on water available.

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