Vietnam Journal of Agricultural Sciences

ISSN 2588-1299

VJAS 2021; 5(1): 1345-1358
https://doi.org/10.31817/vjas.2021.5.1.04

The Importance of Socio-economic Development to Sustainable Natural Resources Management in Rural Areas: A Case Study of Sustainable Livelihoods and Forest Management in Xuan Nha Nature Reserve in Northwestern Vietnam

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Abstract

Sustainable forest management is facing threats such as deforestation, forest degradation, and biodiversity loss due to socio-economic conditions, a weak governance capacity, and lack of public participation. In Xuan Nha Nature Reserve, about 50% of the total population are living below the poverty level and their livelihoods are depending on forest. The community's activities have been creating pressures on the forest by reducing the forest area, increasing forest land degradation, and through illegal logging. The objectives of the study were to (i) identify sustainable livelihood options; (ii) the most suitable livelihood practices with the purpose of reducing poverty for local communities and their dependency on forest resources; and (iii) recommend suitable policies to reduce the conflict between socio-economic development and forest management. In order to achieve these objectives, we used the LIFE (livelihood, income, forest condition, and equity); the Sustainable Livelihood Framework; and the Advocacy Coalition Framework. The results showed that fruit orchards and beekeeping were two suitable livelihood options for the buffer areas since there were more convenient assets such as roads, markets, and human knowledge, while fruit orchards and local pig farming were suggested for the ERA (ecological restoration area) and SPA (strictly protected area) to solve the problem of land degradation and maintain the traditional habits of the local community. Regarding policy changes, support for livelihood practices and improvement of the community's and authorities' awareness on forest protection was necessary for all the sub-areas for reducing poverty and the pressures on forest resources of the community.

Received: August 23, 2021
Accepted: February 25, 2022

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Keywords

Sustainable forest management, fruit orchard, beekeeping, local pig farming, forest policy

Introduction

Forest resources in both protected areas and non-protected areas have important roles in maintaining and enhancing local livelihoods, and alleviating poverty via supplying timber, non-timber forest products (NTFPs), and environmental services. NTFPs are the main source for providing food and income for the local poor whose livelihoods highly depend on forests, particularly in protected areas where timber products are strictly protected. According to FAO & UNEP (2020), there are 1.6 billion people who depend on forest resources for their livelihoods, where the degree of their dependency varies. Among them, about 60 million local people are wholly dependent on forest resources and 350 million people living in or adjacent to dense forests depend on forest resources to a high degree for their subsistence and income. In Asia, there are around 350 million people living at the forest edges and in the forest cores, and 90 million people living in mosaic forests (RECOFTC, 2009; Phuong & Son, 2017). Despite the high poverty rate of these populations and the lack of economic alternatives, most of the products from protected areas are restricted. Therefore, there is a need to find sustainable livelihood options to reduce the poverty of local communities and find alternate sources of income from forest resources.

Furthermore, sustainable forest management also faces various threats due to socio-economic conditions, governance capacity, and forest policy implementation/arrangement as well as a lack of public participation and interactions with actors/stakeholders (Gossum *et al.*, 2011; Ochieng *et al.*, 2016; Son *et al*., 2022). As a result, there is often a gap between forest policy documents and actual implementation in the field (Clement & Amezaga, 2009; Ayana *et al.*, 2018). The gap in forest policy not only affects the success of these policies and the forest status, but also affects the trust of people in governments. Trust is an important factor affecting sustainable forest management (Gossum *et al.*, 2011).

Xuan Nha Nature Reserve (XNNR) is in category IV according to the IUCN protected area classification (ICEM, 2003). This category of protected areas was established to assure the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perpetuation. Controlled harvesting of some resources may be permitted (Roland, 2011). Poverty is widespread among the residing population. About 50% of the total population living there are below the poverty level, and their dependency on the forest for their livelihoods is high due to illiteracy, lags in technology, and a lack of knowledge (VCF, 2009). Hence, deforestation and forest degradation have continued because of poverty together with the weak management and enforcement of rules.

The establishment of the Xuan Nha Nature Reserve has led to restrictions of the local people's access to forest products while there is a lack of alternative livelihood options. Therefore, there has recently been conflict between economic development and reserve protection since the local people have less access to land area expansions for agricultural production. People who settled in the nature reserve before its establishment have agricultural land but they cannot expand their land now following the regulations of the nature reserve even though the population has increased leading to an increase in land demand. According to the Son La Scientific and Technology Association (SUSTA), the average rate of population increase in Son La province is 1.49% per year (SUSTA, 2019).

Is it possible to reduce poverty for the community together with protecting the reserve? – A big question that this study aimed to deal with. There have been a number of research projects conducted in this area, for example, research on the assessment of flora biodiversity conducted in 2016 (Dang Thi Hoa & Hoang Van

Sam, 2016), and on the assessment of community forestry in Son La, which included Moc Chau district, conducted in 2019 (Do Van Anh, 2019). There is limited research about livelihoods and forest policies. The objectives of this study were: (1) to assess the pressure of the local communities on forest resources, (2) to examine the possibility of conducting alternative livelihood options to reduce poverty for the local people and their negative effects on the forest, and (3) to analyze the effects of forest policies on the socio-economic development and forest management, and to recommend essential policy modifications to reduce the conflict between development and resource management.

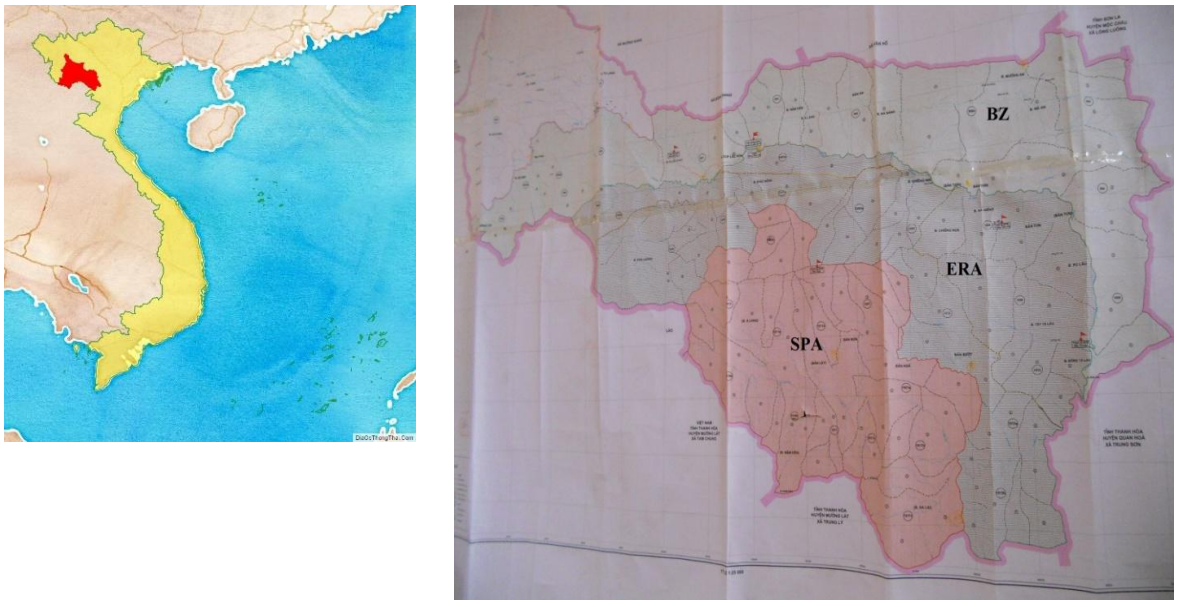
Methodology

Study area

Xuan Nha Nature Reserve is located in the Northwestern mountainous area of Vietnam and covers 16,000ha of natural forest. The reserve is divided into three sub-areas (**Figure 1**).

The buffer zone (BZ) is the land at the edge of the reserve and has a role in reducing the impacts of people on the reserve by economic production, the ecological restoration area (ERA) is strictly managed for natural restoration of forest, and the strictly protected area (SPA) is strictly and fully protected.

XNNR has coordinates estimated as 20°34' – 20°54'N latitude and 104°28' – 104°50'E longitude. XNNR has an average altitude of 900 meters, and the highest mountain is Pha Luong with a height of 1970 meters above sea level. XNNR is characterized by a mountainous area with a strongly divided terrain, and has rugged mountains and small valleys. The average slope in the XNNR is about 20-25°, particularly more than 35° in some areas. Because of the high altitude, XNNR has specific climate characteristics besides the common climate of Northwest Vietnam. It has a subtropical monsoon climate with an average precipitation of approximately 1,800mm per year, and around 90% of rainfall occurs from May to October. Compared with other regions in Northern Vietnam, the average annual temperature in XNNR is about 18.5°C, less than neighboring areas such as Hoa Binh province (23°C) and Son La city (21.1°C). In terms of socio-economic characteristics, the population lives in the core areas, buffer zone, and adjacent areas of XNNR,



(a) (b)

Figure 1. Detailed maps of the study area showing (a) the location of Xuan Nha Nature Reserve and (b) the three areas within the Reserve
Source: Xuan Nha Nature Reserve Management Board

and totals around 22,000 people with five ethnic groups (H'Mong, Thai, Muong, Kinh, and Tho) of which H'Mong is the majority group.

Analytical and Conceptual Frameworks

This study used LIFE indicators (i.e. livelihood, income, forest condition, and equity) developed by CIFOR-RRI (Center for International Forestry Research-Resource Rights Initiative) via a research project on "Improving livelihood and equity in community forestry" in the Philippines (Pulhin, 2008) to represent the interactions between livelihood activities and forest resources. For this study, the LIFE indicators, which are concerned with essential information for identifying the sustainable livelihood options to reduce impacts on the Nature Reserve, are presented in **Figure 2** and **Figure 3**.

The sustainable livelihood options were suggested based on the following requirements: match the available livelihood assets, minimize the negative impacts on the reserve, are based on market demand on products of livelihood options, provide potential benefit to the local community (ability to get higher income), and create an equal chance to develop economic opportunities for the community.

For policy analysis, the Advocacy Coalition Framework (ACF) developed by Sabatier & Weible (2019) was used. **Figure 4** describes the details of the ACF. First, the major coalitions (stakeholders) and outputs of the current policy were examined based on the conditions of resources in the reserve, socio-economic conditions, and policy beliefs of the coalitions. After that, policy changes were recommended according to the degree of consensus of the coalitions.

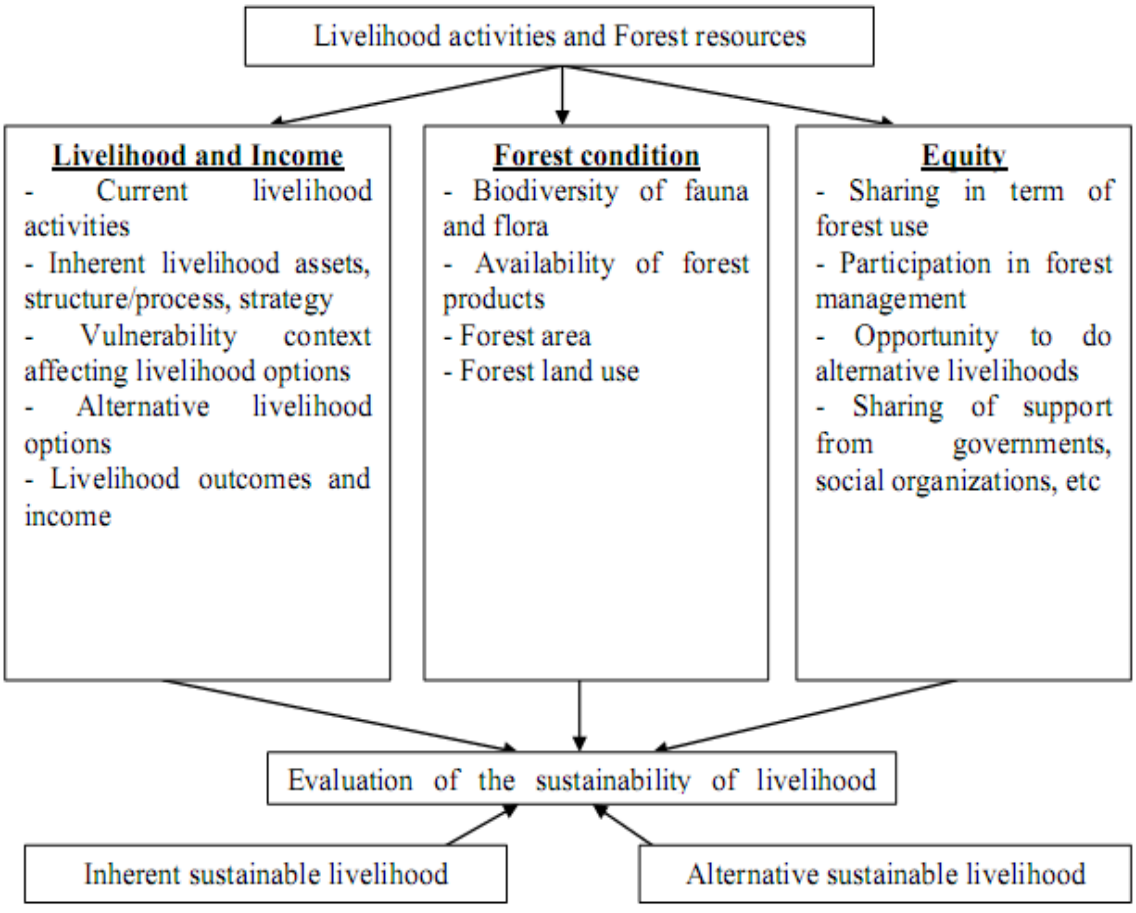


Figure 2. Framework for sustainable livelihood evaluation in interacting with forest resources

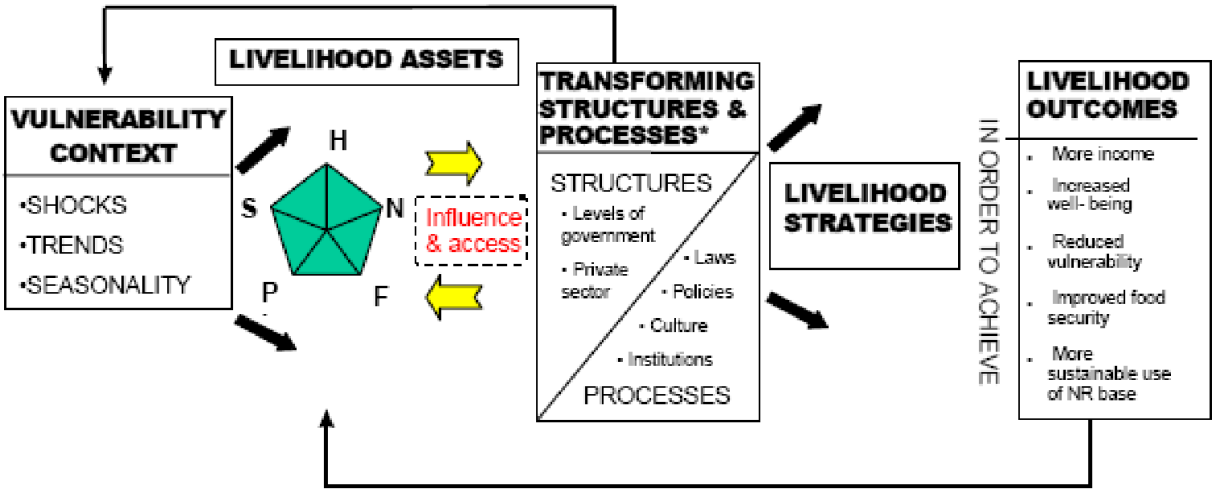


Figure 3. Sustainable Livelihood Framework of DFID

Source: Carney (1998, p5)

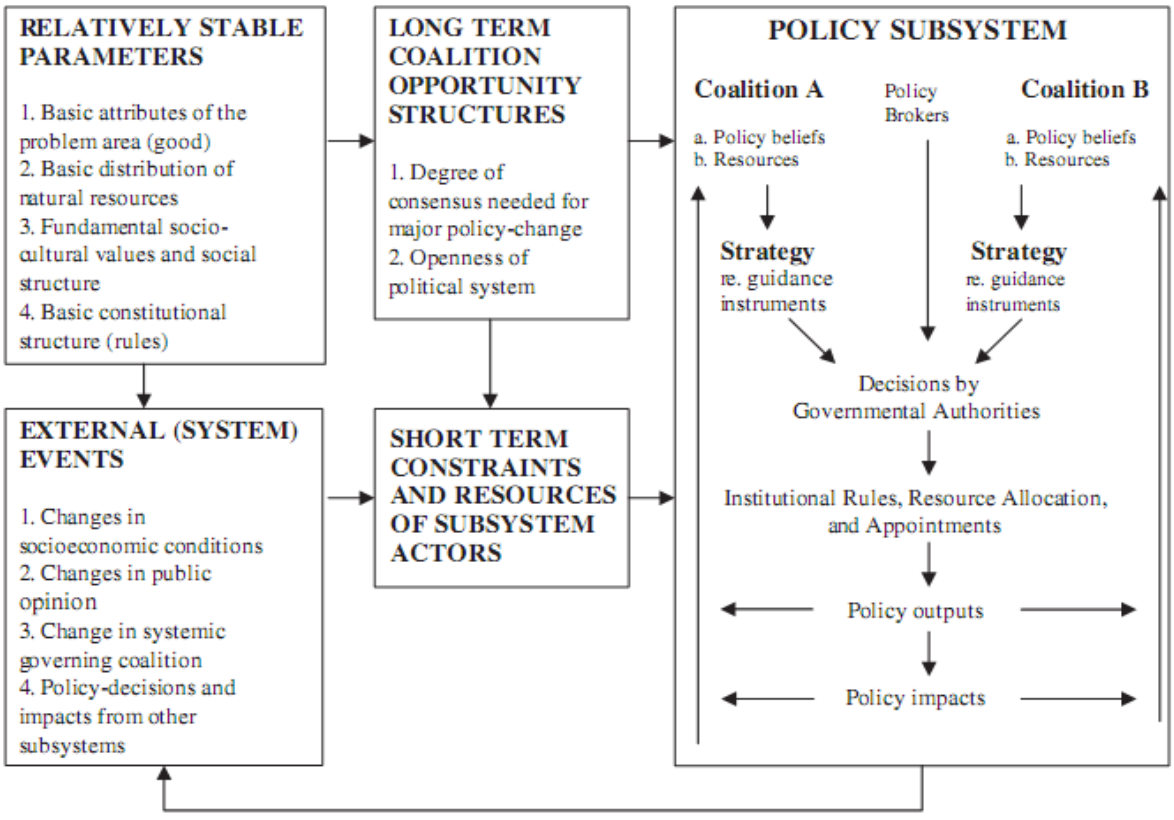


Figure 4. Advocacy Coalition Framework for Policy analysis

Source: Sabatier & Weible (2019)

Data collection

Primary data

Primary data were collected by field observation, key informant interviews, group discussions, and household interviews. Field observations were conducted in 2011 (from October to November) in order to achieve a general view about livelihoods and forest resources as well as more detailed information about the study area. Key informant interviews involved interviews with some heads of local

governments, namely heads of the commune, villages, and Reserve Management Board. Group discussions were done in 15 selected villages, and a household survey was also conducted in these villages with 90 randomly selected households.

Secondary data

Secondary data were collected from books, online resources, and existing materials for the study areas.

Data analysis

Data were coded and entered into a database system using Microsoft Excel. Statistical software (SPSS, Minitab) was used to analyze the data and produce descriptive statistics.

Results and Discussion

The major threats to the forest from current livelihood activities

The dominant livelihood practice of the community in this area was annual crop production in which corn and cassava are the major trees. The expansion of these crops led to deforestation. A key informant interview with the representative of the Reserve Management Board indicated that the area of the nature reserve reduced from 60,000ha (when it was established in 2002) to 16,000ha in 2006 – when the management board was established. The household survey showed that each household was around one hectare of hilly land for agricultural production. This was not usual in an SPA where human activities are prohibited, although deforestation is still happening. The management board recorded 6.5ha of forest area destroyed in 2011, of which 4ha were in the SPA. The main cause of deforestation in this area was the lack of land for cultivation when the population increased and a high demand for expanding new land area due to the poor productivity of the current land area (**Figure 5**). Son & Binh (2020) also indicated that forest conversion to agricultural land contributed significantly to deforestation in Northwestern Vietnam. Furthermore, the trade development of crop products nowadays was another force for agricultural land expansion. Additionally, the forest area in the reserve was also converted to agricultural land by people from a neighboring province and the authorities were not found a solution to prevent this.

In addition, local demands for forest

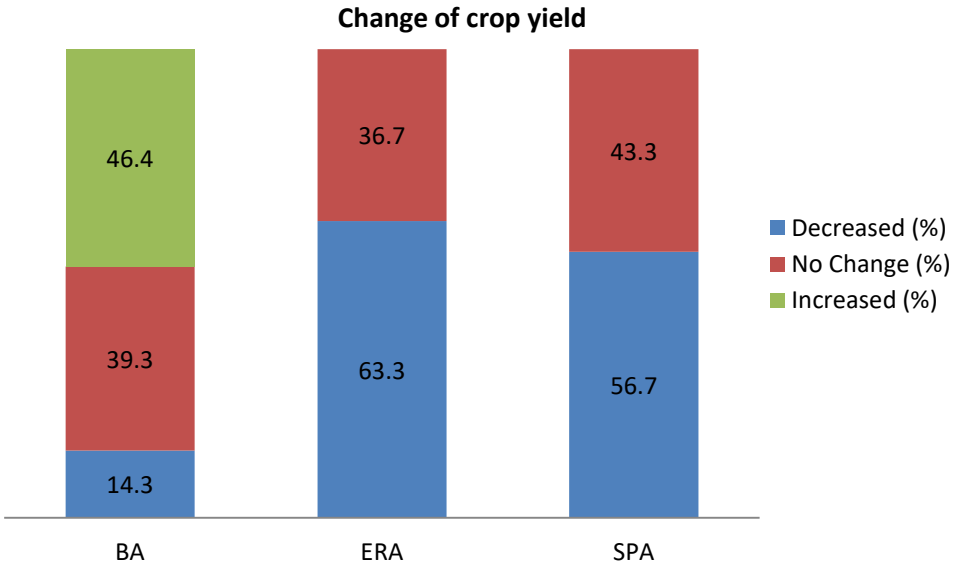


Figure 5. Change of crop yield as an indicator for land productivity

Source: Household Survey (2011)

products, including timber for making houses, grass for feeding animals in the cold season and New Year time, and bamboo, were threats to forest resources in the reserve. The quantity of timber consumption domestically was 15-40 cubic meters per household (Household Survey, 2011). One-hundred percent of the interviewed households had houses made of wood. Illegal timber logging recorded by the management board in 2011 was 169 cubic meters. High timber demand from adjacent areas was also a reason for illegal logging in the reserve since timber resources were less available outside the protected forest.

Animal grazing in the forest was also affecting forest land quality and cover canopy. Domestic animals such as cows and buffalo were kept by every household that did agricultural cultivation as important equipment for production. Importantly, all these animals were grazing freely in the forest (Household Survey, 2011). Animal grazing was one of the important actors for forest degradation in Moc Chau district, Son La province (Do Van Anh, 2019).

The sustainable livelihood options

Fruit orchards

Besides the argument of several researchers about the environmental benefits of fruit orchards, local experience also underlined the advantages of fruit orchards. Group discussions illustrated that all communities realized there were decreases in crop yield after cultivating some years due to land degradation, but fruit yield had not suffered from this matter. Hence, fruit orchard production was a better option than annual crops in terms of sustainable land use because it reduced the threats on the reserve when local people did need the new land area for replacing the degraded ones.

Nowadays, there was an increase in food demand while the population was increasing but agricultural land in plain areas was being replaced by urban and industrial land. The potential of agricultural land in mountainous areas was much higher. In Moc Chau district, plum was a traditional fruit and is produced popularly in many areas as well as in two villages in the BZ of XNNR. Every year, hundreds of business people came to buy plums and distributed them to the capital and many other provinces. For one plum tree, a gardener could get 100 kilograms of fruit and normally could earn 500 thousand VND (around US$25). Also, there was a local company producing plum wine to export to France, China, and Lao PDR. This was the strength of plum production. Another traditional fruit tree growing in Moc Chau district was peach. Peach orchards were growing for both fruit and flower branches. In preparation for the Lunar New Year, most households in Northern Vietnam displayed a peach flower branch. People now preferred peach branches grown in Moc Chau and they had spent hundreds to thousands of US$ for a peach branch. Due to the high demand for local peach (wild peach) since a few years ago, it was becoming endangered. This would be an opportunity for the community to grow and expand peach orchards that could support flower demand sustainably and protect local peach species. Other fruit trees such as longan, mango, pomelo, orange, and dragon fruit were also produced and shown high economic effectiveness. The results from the household survey recorded the perceptions of the local community on the high demand for fruit products in the three sub-areas. Having fruit orchards could bring higher income for farmers than growing annual crops. For one hectare of corn, farmers could get 10-12 million VND (US$500-600), but with the same land area producing plums, farmers could get 50-60 million VND. Any household having an area of land could have fruit orchards. This livelihood option would not require difficult technology.

Beekeeping

Beekeeping was known as a livelihood practice that requires less space than others so beekeeping could be practiced in a small area. And unlike agriculture, bee farming did not require good soil quality and compete for food with other livelihood activities. Further, bee farming did not create any problems for forest resources; it had positive ecological consequences, as bees played an indispensable role in the pollination of many flowering plants and crops, thus increasing the yields of major food crops. With the restriction of land access,

beekeeping was a suitable option for a protected area.

Vietnam was one of the ten biggest honey exporters in the world and the second-largest one in Asia after China. In Moc Chau, the price of one kilogram of honey was US$6 in 2011. Since tourism had been developing nowadays, honey was considered a product of temperate climates. Every year in the hot season in Northern Vietnam, bee companies from the capital of Ha Noi moved their beehives to Moc Chau. The quality of honey produced in Moc Chau was the preference of many customers. However, bee farming had not been developed in this study area compared to other livestock. Some households in the BZ lent their land to bee companies to keep bees for around 6 months during the hot season.

There was one published example of the economic benefits from beekeeping as an alternative livelihood activity in protected areas (Xuan Thuy National Park). According to CORIN-Asia-Vietnam (2010), with 8 beehives, one household could obtain an average income of VND 7-8 million per year (around US$350-400). They said beekeeping also made their fruit orchards more productive.

Local pig farming

Local pig farming was a traditional activity of the local community for their consumption. Although locals could collect vegetables from the forest to feed the pigs, they also could use any type of vegetables from their gardens, so if local pig farming could be raised at a large scale, input sources could be from the gardens to reduce pressure on the forest.

There were several restaurants in the central town selling food from local pig products, and many locations along the highway (connecting the capital and all provinces in Northwestern Vietnam) selling local pig products to tourists and people from other regions.

The price of local pig products in January 2012 was 150,000 VND (US$7.5) per kilogram, nearly three times higher than a variety pig products (55,000 VND per kilogram). Although it took more time to grow (12 kilograms in 6 months), local pig farming still could provide a high income if a community could produce a large quantity.

Possibility of conducting fruit orchards, beekeeping, and local pig farming

Human assets

A common feature in the human resources of all the sub-areas was the dominance of the young age group (<18 years old). People who were more than 18 years old occupied only 38% of the total population (**Figure 6**). This age structure illustrated the potential and available labor force for various livelihood practices in the future.

Another advantage was the health status of the community. Eighty percent of interviewed households reported that all members had normal

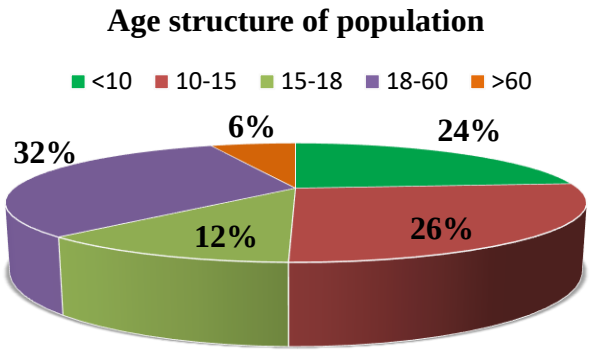


Figure 6. Age structure of the population

health conditions. This data indicated that most people were able to work in the field.

In terms of education level, there were differences among people in the three sub-areas (ANOVA significance was 0.000 – less than 0.05) with the better-educated people in the BZ and the lowest educated ones in the SPA for people in the age group 18-60. This current divide in the labor force demonstrates that residents in the BZ might be more easily familiar with the new livelihood options than people in the ERA and SPA.

For the livelihood options suggested, **Figure 7** describes the general information about the current knowledge of the community about alternative livelihood activities. It can be clearly seen that fruit orchards were better known by locals in the BZ than people in the ERA and SPA (indicated by ANOVA significance 0.000) with 66.7% of respondents being able to do this, while this number in the ERA and SPA was 20% and 0%, respectively. In the SPA, local people were familiar with annual crop production such as corn, cassava, and hilly rice mainly aiming for their consumption. Therefore, they did not know how to work on fruit orchards (50% of respondents), especially for a new seedling generation such as new longan. People had a little bit of knowledge of the traditional fruits, namely peach and plum.

Local pig farming was not a new activity for the community; they had kept local (black) pigs on a small scale mainly for consumption themselves. Most of the interviewees in all the sub-areas had knowledge of local pig farming (76.7% of respondents in the BZ, 70% in the ERA, and 83.3% in the SPA). Doing local pig farming, farmers could graze them freely or keep them in a simple stall. Local pigs easily accepted several types of food such as remaining vegetables from the kitchen, vegetables from the forest, and uncooked corn/cassava, etc. The ANOVA significance was 0.078 indicating that there were no significant differences among local communities in the three sub-areas in terms of knowledge about local pig farming.

In contrast, beekeeping was a new livelihood option for most of the people in all the sub-areas. There were no significant differences among the three areas (ANOVA significance was 0.488). Around 60% of the respondents in all the sub-areas had no knowledge on how to do beekeeping, and others had little knowledge on this option, as beekeeping is a difficult activity for the local community. The community needs to be trained in terms of technology and knowledge to conduct bee farming in the reserve.

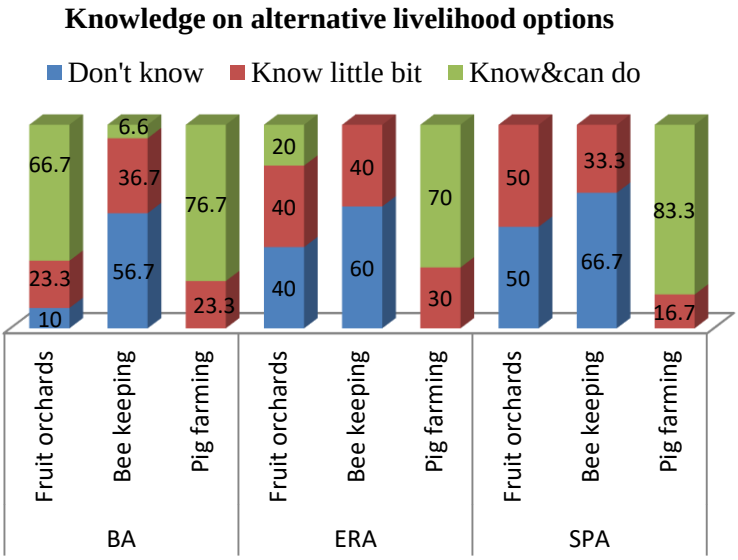


Figure 7. Local knowledge about alternative livelihood options

Physical assets

Since 2000, a road connecting the central town to Laos and crossing the BZ of the reserve was completely constructed. Other road systems connecting communes were built in 2008. These are advantages for socio-economic development not only in the BZ but also in the ERA and SPA. Because of the road facilities, a local community in the SPA can nowadays produce cash crops (e.g. corn, cassava) instead of subsistence crops (e.g. hilly rice, local corn) uniquely. Recently, roads have allowed all types of vehicles to easily enter all the sub-areas of the reserve and commercial activity is developing. However, most of the roads to villages were of low quality and need to be improved.

The development of society somewhat depends on the education level and knowledge of the human factors. Nowadays, the availability of schools brings better conditions for children to have access to education than in previous years. There is a primary school and a secondary school in each commune. Primary schools have also been built in some villages that are far from the central commune.

Social assets

Traditionally, the local people in each village have a close relationship with each other according to the responses from 100% of interviewees. Residents maintained and enhanced their cooperation by helping each other in their important work such as in house constructing and participating in the special occasions of the village/commune. In addition, every household had a member taking part in the social group/association with 72.2% of interviewed households having one person and 26.7% households possessing more than one person joining in a social group.

The social assets illustrated that the local community was willing to share their experiences and knowledge when practicing alternative livelihood options. Also, there were opportunities to educate the local people about fruit orchards, beekeeping, or pig farming via the activities of social groups/associations such as the farmer association, women association, and youth union. Almost every household had members participating in these groups. These groups organized regular meetings so members could share their experiences with each other or discuss any issues they had.

Financial assets

Due to the high poverty rate in all the sub-areas and the current production activities observed, the financial stock of the community was not expected to be high. Every year, the local people were provided inputs for agricultural production by investors/businessmen, including seedlings and fertilizers (if they are used), and interest was charged. When locals harvested the products, the benefit they got after excluding the investment and interest was very low. Many households had to be in debt for their living expenditures from the time after harvesting season till the next season (nearly one year). Therefore, their work during the coming year would pay for the debt of the previous years.

Natural assets and vulnerability

Land resources were available in all the sub-areas. Each household had around 10,000 sq. m (1ha) of hilly land for cultivation. There were a variety of changes among the three areas in terms of land availability. In the BZ there was no change in land area in the last 5 years, while 40% of respondents in the SPA said that their agricultural land had decreased because it became forestry land after some years without cultivation, and this number was 13.3% in the ERA. These changes were creating conflicts between the local community and forest managers.

With climate resources, XNNR has a similar climate as the Moc Chau plateau with colder temperatures than other regions at the same latitude. In some recent years, the development of areas dedicated to growing longan, dragon fruit, and some other fruit types on this plateau indicates the suitability of the land and weather for fruit production. The colder temperatures and availability of various flowers are also the ideal conditions for the growing of bees.

Because agriculture farms lacked irrigation systems and wholly depended on precipitation, annual crop production was suffering from the

high intensity of drought (response from 72.3% of interviewees). With stronger and longer roots, fruit trees could be more resilient to drought than annual crops because they can use water from deeper soil layers. For the impact of diseases, 58.9% of the respondents said diseases occurred at a medium intensity (some livestock have died) but more frequently than drought.

Suggestions about the most suitable livelihood options based on the livelihood assets of each area

Buffer zone

Among the three sub-areas, the BZ was the more convenient area to have fruit orchards, beekeeping, and pig farming than the ERA and SPA. It is easily seen that the human and physical assets in the BZ facilitated these livelihood activities as the BZ had a better educated labor force and better road conditions as well as a closer distance to the central town. Other livelihood components in the BZ did not differ from the ERA and SPA.

The results from the group discussions conducted in five villages in the BZ shows the perceptions and preferences of the local people on each livelihood option. All of the communities were able to perceive the lower negative impacts on the forest of all alternative livelihood options compared to the current livelihood practices. For fruit orchard cultivation, 100% of the local communities said that it required a lower quantity of fertilizers than annual crop production and the potential income is higher (opinion of 80% of the discussed communities) as well as resilience to vulnerability (agreement from 100% of the discussed communities). For bee farming, local communities were worried about the higher investment costs for beginning beehives and its sensitivity to diseases although it could provide higher income. With the local pig farming option, most communities concluded that this option had a lower requirement of inputs (60% of villages), higher potential income (80% of villages), and higher resilience to vulnerability (60% of villages).

ERA and SPA

The livelihood assets and activities of the people did not diverge between the ERA and SPA so the livelihood activities in these areas could be converged.

People in these areas were strictly banned by the regulations from the Reserve Management Board to expand agricultural land area while they were cultivating annual crops without fertilizers and the land quality was degrading. They were producing a larger area of cassava these days, which created a threat to land productivity. Land might not be suitable for any annual crops after some years of people growing cassava.

When conducting group discussions, communities in these areas had no idea how to compare the impacts of the suggested livelihood options and current livelihood activities because they had not worked on these livelihood practices before and they did not invest much in current livelihoods. But all the communities recognized their problem with crop yield-reducing and they were willing to switch to alternative livelihoods if those could bring higher economic effectiveness for them.

As with the BZ, loans were the most difficult for fruit orchards and local pig farming, and knowledge was the most difficult for beekeeping. For local pig farming, since local people were rearing pigs for their consumption now, they could just increase the number of pig heads to ensure the consumption of the community and have products for sale.

Policy analysis

Major coalitions and outputs of policy

The major advocacy coalitions were the economic coalition, environmental coalition, and social concerns coalition. The policy actors, therefore, were divided according to three advocacy coalitions, namely the economic coalition, environmental coalition, and social concerns coalition.

The economic coalition, with its concerns about the potential development for livelihood activities in relation to forest policies and potential poverty reduction, consisted of local communities, investors, and businessmen. Their

livelihood activities were highly affected by forest policies. Also, people from four neighboring communes in Thanh Hoa and Hoa Binh provinces who were poor and planted annual crop production not only in their own land but also in the reserve were part of the economic coalition.

The environmental coalition, with the priorities of forest protection and biodiversity conservation, was composed of government offices, namely the Reserve Management Board, MARD, MONRE, MPI, VCF, and the smaller levels of government offices. They were policymakers and policy implementers, thus, they had an important role in the success of forest policies. The negative actors in the environmental coalition were the people living outside the reserve who had demands on timber and other products.

The social concerns coalition's attentions were the participation/representation of local voices on the policymaking process, the responsibility of officers, and traditional culture protection and development. The actors in the social concerns coalition were local communities who had settled in the reserve before it was established and whose lives were closely linked with the resources in the reserve. Local communities/villagers could share their opinions and expectations with the village heads, the heads then would share with the commune officers as well as to the higher levels of the institution (e.g. district, province, and central). Representatives from the higher institutions would also go to the lower levels to attend the meetings, visit households, and share related information with local communities.

The support from the government for the remote areas, such as Program 167 (support for house construction) and Program 135 (socio-economic development for remote areas), gave priority for constructing roads, schools, and other infrastructures in the reserve. These programs had a crucial significance in improving basic conditions for social development. Sustainable forest management based on the local community was mentioned in policies at the central level (i.e. Decision No. 106/2006 of MARD) but no program had been specified by local governments. The 5 million hectares reforestation program (Decision No. 661/1998 of Prime Minister) aimed to increase forest cover and improve local livelihoods via support for working on reforestation and forest protection. While many provinces, as well as protected areas, were successful, this program was not implemented in XNNR. Besides, the PES could be used as financial aid to reduce poverty for forest resident dependents who were living close to the forest and who had important roles in forest protection. In the reserve, the ERA and SPA had larger forest areas with better quality than the forests in the BZ, and all the forest areas aimed to protect the watershed and ensure the water supply for the hydropower plant. However, the PES was not been applied. Crucially, the lack of research to identify suitable economic alternatives and support for economic development was another gap in forest policy.

The output of policy affected the belief system of the coalitions, and as such, the three coalitions had different beliefs/conflicts in policy results. The economic coalition had the belief that the reserve's establishment negatively impacts the livelihood activities in the ERA and SPA. The environmental coalition believed there had been an increase of forest area (0.5% per year from 2002 to 2007), and biodiversity was better conserved in established protected areas (VCF, 2009). Besides, this coalition also recognized the loss of natural forests and the increase in the illegal exploitation of natural resources. The Reserve Management Board undecided about how to reduce the pressures of people and timber logging in the reserve. The social concerns coalition had the belief that they had been excluded from their roles and participation in the policymaking process. The local community in the SPA had a conflict with the environmental coalition when the reserve established without any consultations. After the reserve's establishment, local communities were asked to shift to another area but they refused. Also, the participation of the local community was not included in policy making.

Policy recommendations

For the BZ: the poverty rate in the BZ was lower than in the ERA and SPA but still high

(>50%) compared to the general rate of Son La province (22%). So the capacity of the local community for economic development needs to improve. It can be done via training and education to increase knowledge, and support for doing livelihood practices. The biggest difficulties for people are loans and knowledge. To conduct alternative livelihood practices, loans and training are essential. Almost 57% of the respondents were not willing to use other materials (brick, tile, plastic, etc.) instead of timber for making houses and other furniture. Support for reducing the prices of alternative materials should be done together with increasing the tax for timber houses. In addition, it is important to increase awareness of people living on protected forest lands to promote their willingness to use alternative materials instead of wood products. Establishing projects to increase forest cover in denuded land areas with the preferred timber species is also recommended so that the pressure on natural forests can be reduced while timber products are still provided for human needs.

For the ERA and SPA: there is a need to improve the awareness of each coalition on the concerns of other coalitions. In the ERA and SPA, people are living close to the protected forest so their activities are sensitive to the forest. Local people as representatives of the economic coalition should be aware of the environmental aspects of the reserve, including the benefits of forest protection for the reserve through their regular interactions in the social groups/associations (Farmer's Union, Women's Union, and Youth Union). Government officers as key actors of the environmental coalition should be aware of the importance of economic development and the social concerns of people about sustainable forest management, especially when most people are poor. The governments can support local people to establish Agricultural Cooperatives that can support people in production, market searching, and making connections with consumers. The governments can also organize events at different levels to introduce agricultural products that can support local people in the agricultural value chain. Increased economic support should be offered because local people cannot do what they want freely since the land is strictly banned from expansion. The PES could be applied in these areas because the main forest of the district is located in these areas and providing environmental services is one of the objectives of the reserve. The PES should be paid directly to the community to reduce administration costs. For example, the PES could be applied via reducing utility costs for people and they should be trained so that they can use electricity at a lower price than others because they are protecting the forest to ensure the water supply for the dam. Improving the knowledge of people and providing loans to conduct alternative livelihood options are urgently needed.

Conclusions and Recommendations

There is a possibility for increased product consumption in this area. The demand for fruits, peach flowers, honey, and local pig products is increasing. This is an advantage for switching to fruit orchards, beekeeping, and local pig farming.

Fruit orchards and bee farming are two potential sustainable livelihood options for the BZ to provide higher incomes for the local people than annual crop production and have lower negative effects on the reserve. The BZ has more facilities for transition to the alternative livelihood options than the SPA and ERA.

Fruit orchards are also suitable for the SPA and ERA since people cannot expand their land area for agricultural production while the current land area is degrading. To ensure the equity of economic development and maintain a long time tradition, local pig farming is suggested in these areas.

Support from the government can make important contributions to socio-economic development by improving infrastructure, which can help local people access better services and contribute to the livelihood value chain. The government should also maintain support to the poor to ensure social equity. However, there are no economic alternative activities for local people since they have less rights to access to resources when XNNR was established. These gaps are affecting the beliefs of other coalitions

on forest managers and affecting the socio-economic development and forest management in the reserve because the livelihoods of local communities are still vulnerable. For the BZ, the policies should encourage economic development to reduce poverty so that the dependence of locals on forests could be decreased, and there should be a policy to encourage people to use alternative materials instead of timber to minimize the pressure on timber species. For the ERA and SPA, support for switching to alternative livelihood options is urgently needed.

Acknowledgements

The authors would like to thank the Ford Foundation for their support to conduct this research. Great gratitude is also given to the communities and authorities in Xuan Nha Nature Reserve for their cooperation during data collection.

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