



Implementation of payment for forest environmental services and its influence on the livelihood of ethnic minorities in Thua Thien Hue Province, Vietnam

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ABSTRACT

Payment for Forest Environmental Services (PFES) is considered a major breakthrough in socializing the forestry sector by transferring money from forest resource users to the local communities in charge of forest protection activities. This paper aims to elucidate the PFES implementation in Thua Thien Hue Province, and to assess the influence of the PFES on the livelihood of forest protectors, especially ethnic minorities. We interviewed 133 out of 397 households in two villages in Hong Kim commune, divided into two different groups: Forest protection groups (FPG) and Non-forest protection groups (NFPG). Our study indicated that the success in negotiating and expanding the number of service users has increased the forest area covered by the PFES for seven years. Nonetheless, revenue from PFES still fluctuates from year to year due to their great dependence on a limited number of service users. PFES payment (only 2%) did not contribute significantly to the total income of forest protector households. Interestingly, both monetary and non-monetary values seem to encourage local people to join the forest protection group. To better implement PFES, it is necessary to identify and expand service beneficiaries. Remote sensing technology improved PFES in TTH by aiding forest patrols, but there is a lack of maintaining forest quality during degradation, needing commitments to restore degraded forests and raise patrol accountability.

1. Introduction

Payment for environmental services (PES) schemes are becoming increasingly common around the world to create, conserve, and restore natural resources for public benefit (Alix-Garcia et al., 2009). PES is a new approach to actively support activities outside the environment through the transfer of financial resources from ES beneficiaries to those who provide these services or are subsidiaries of environmental resources (Mayrand and Paquin, 2004). The root idea of PES is that landowners and local land users will be paid directly by external ES beneficiaries on the condition that they adopt practices that ensure ecosystem conservation and restoration (Wunder, 2005). Even though the term “payment for environmental services” is fairly new, such schemes have existed for quite some time (Alix-Garcia et al., 2009). Developed countries in Latin America used the earliest PES payment models, and there is an increasing interest in rehabilitating degraded places by establishing plantations of native and alien tree species in

many regions of the continent (Montagnini and Finney, 2011). The possibility of “win-win” scenarios is part of the reason why PES has become so appealing, especially for conservationists and policymakers in developing countries (Alix-Garcia et al., 2009; Miles and Kapos, 2008). Over 300 PES schemes were recorded in 2002 (Mayrand and Paquin, 2004). Some developing nations such as Costa Rica, Mexico, and Ecuador have already introduced PES in national policy (Wunder, 2008). In Vietnam, the Payment for Forest Environmental Services (PFES) is a new policy launched nationwide since January 1st, 2011 (now replaced by Decree No. 147/2016/ND-CP) to socialize the forestry sector and contribute to strengthening the role of local communities in forest management and protection (Pham, 2018). Vietnam is the first country in Southeast Asia to kick off the nationwide PFES scheme (McElwee, 2012; Pham et al., 2013). The aspirations of performing the PFES policy in Vietnam is to put into practice the contents of the state’s laws and policies on forestry and socializing forestry activities, and raise the sense of responsibility and obligations of all organizations and

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individuals for forest protection and development (Nguyen, 2008). This policy plays a crucial role in improving income for 500,000 households living in nearby forests, most of whom are ethnic minorities (Pham, 2018; VNFF and MONRE, 2017). The initiative on PFES is seen as reciprocation for people participating in community forest management and being motivated by those who participate in forest protection and management (Nguyen and Nguyen, 2019b).

Although this policy is considered to contribute to the reduction of the state budget invested in the forestry sector and poverty reduction (Pham, 2018; VNFF and MONRE, 2017), the implementation of this policy still has many shortcomings. To et al. (2012) highlighted that payments acquired from PFES services may administer a strong incentive for state entities to seize on to the land, catching the benefit streams allied with PES, while poor households find it difficult to approach such benefits when faced with stronger constraints on resource access. In many cases, income from PES programs does not grasp the poor because of economic and political constraints. Suhardiman et al. (2013) also emphasized that the PES program implemented in Vietnam does not resemble the basic principles of PES program design following Wunder's definition in 2005. This is mainly because the government outlines the payment mechanisms and valuation. There was no negotiation between the fund providers and service providers regarding the amount of payments and state coerces participation from both sides (Suhardiman et al., 2013). The benefit-sharing mechanism of PFES is still unclear, local inhabitants have little voice in making benefit-sharing decisions and monitoring the distribution of funds from the PFES (Truong, 2022). The government discourse on the 'success' of PES has served as an effective tool of diverting consideration to the weakness of the forestry sector, creating new capital for the pre-existing sector in the context of prolonged budget shortage, and expanding of state power concerning forest resources (To and Dressler, 2019). A few recent studies (Pham et al., 2020a, 2021) have attempted to better understand the impact of the PFES on the livelihoods of households participating in the PFES. PFES payments contribute 16% to 18% of the total household income in villages with PFES in Cat Tien National Park (Pham et al., 2021). Income in places where PFES is implemented is significantly higher than that in places where PFES has not been introduced (Pham et al., 2021). The contribution of PFES income in Son La is controversial and depends on who collects the data and what data are used to assess PFES impacts (Pham et al., 2020b). In addition, there are many existing weaknesses in the current monitoring and evaluation system and the lack of reliable data to measure the impact of PFES (Pham et al., 2021). PFES in Vietnam has evolved into 'something else' for different participants. For households, PES has become a form of livelihood subsidy provided by the state, while for local officials, it has become a new source of locally controlled monies that they can manage with minimal interference from higher-ups (McElwee et al., 2020). The adoption of PFES in Vietnam has been affected by both rural history and forest institutions (McElwee et al., 2020). Although collective PES models in Vietnam were designed to suit local contexts, none has exceeded expectations in promoting positive collective action, and each model faces unique challenges that undermine the group's efforts, exacerbate underlying issues, or even lead new conflicts (Nguyen et al., 2022). The need to re-evaluate PFES performance to determine if it is working as intended and to adjust related policies to meet community needs.

Thua Thien Hue province (TTH) was selected as a study site to evaluate PFES implementation in Vietnam for several reasons. TTH is one of the provinces with the largest forest cover in the country (57.38%) in 2020 (MARD, 2021). The province is also a pioneer province to implement the PFES since 2011. In TTH province, PFES is not heavily reliant on foreign donors, which enables a closer evaluation of its implementation and effects of a domestically-funded PFES program (Hoang et al., 2021a). The Forest Protection and Development Fund of TTH province (TTH-FPDF) is the only intermediary organization and has pushed a number of initiatives such as the use of remote sensing technology and various policies to ensure the efficient, transparent, and

equitable implementation of PFES (Hoang et al., 2021b). According to a report from the TTH-FPDF, PFES is considered a breathtaking policy for the provincial forestry sector. It supports the protection of 156,000 ha/283,000 ha of forest area in the region, contributes to maintaining the province's forest cover, creating more jobs, and providing additional income for 4682 households, with 65% being ethnic minorities in mountainous areas (Tran, 2019). From the lens of the state, the PFES in TTH seems to be very successful and attains its purpose. Thus, our study focused on re-evaluating the implementation of PFES within a decade to verify whether or not the PFES implementation process has been successful as expected. The PES program in Vietnam is more focused on mobilizing new sources and funds for state and local forest co-management activities and supporting household livelihoods (McElwee et al., 2020). We wanted to thoroughly analyze the current status of community forest management through PFES support and its contribution to the livelihoods of forest protectors by applying quantitative methods and statistical analysis to make the assessment results more trustworthy. Re-assessing the PFES implementation's progress in a typical province like TTH would help to gain experience and provide significant recommendations for better PFES implementation at the national level.

2. Materials and methods

2.1. Study area

2.1.1. Thua Thien Hue province

TTH is located in the north coast central region of Vietnam, which is 654 km from Hanoi Capital to the north and 1071 km from Ho Chi Minh city to the south. TTH is one of five provinces in the central key economic region, with geographical coordinates from N 15°59'30" to N 16°44'30", and from E 107°00'56" to E 108°15'7". It borders to Quang Tri province to the north, Da Nang city and Quang Nam province to the south, Laos country from the west, and the East Sea in the east (TTHPPC, 2014) (Fig. 1).

The TTH province has a natural land area of 5025.30 km², with an average population of 1129,505 people in 2019 (TTHSO, 2020). According to the statistics in 2019, the population density is 230 people/km², which is lower than the national population density (291 people/km²) and higher than the average population density of the provinces in the North Central and Central coastal areas (211 people/km²) (GSO, 2020).

Three-quarters of the TTH terrain is covered by hills and mountains, with a forest cover of 57.38%, which is higher than the forest cover of the whole country (42.01%) (MARD, 2021). The total forest land area (311,284.88 ha) accounts for the majority of the entire land use structure of TTH, with 288,401.82 ha of forest area with volumes. In 2011, TTH was also one of the first provinces to implement the policy on PFES according to Decree 99/2010 of the government. By 2020, about 620 state and non-state forest owners have committed to implementing the PFES policy with a total area of 153,202.42 ha (TTH FPDF, 2021).

2.1.2. Hong Kim commune

The survey at the community level was conducted in Hong Kim commune (HK commune), which is 74 km from Hue city to the southwest. The geographic coordinates from E 107°11'42" to E 107°16'11" and from N 16°16'28" to N 16°22'53". HK commune borders to Phong Dien Nature Reserve to the north, adjacent to A Luoi town to the south, is contiguous to Hong Ha commune to the East, abutting the Trung Son commune and Hong Bac commune in the west (Fig. 2). There are 553 households with 2062 people in the HK commune in 2020 divided into four villages: A Tia 1, A Tia 2, Dut 1, and Dut 2.

Although the total land of the commune is not as large as 4086.46 ha (HKCO, 2019, 2020), the forest cover accounted for 89.8%, which was by far the most compared to the remaining communes in A Luoi district (A Luoi district FPD, 2019). Classified by origin, the total area of forest

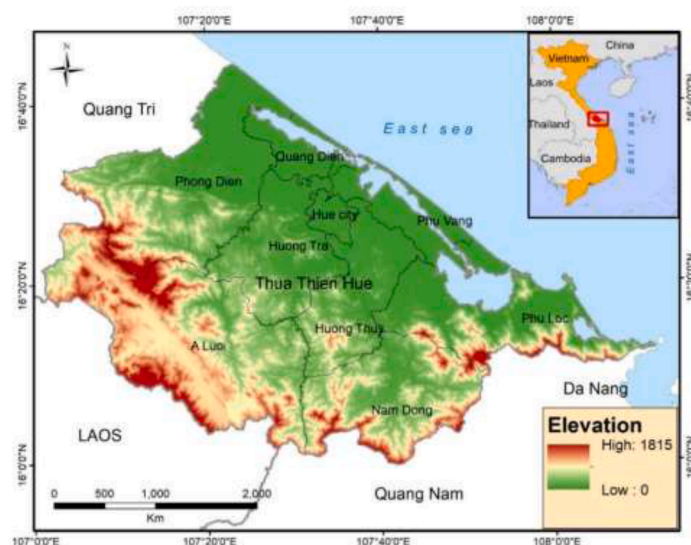


Fig. 1. Topography of Thua Thien Hue province. Source: (AW3D30, 2021).

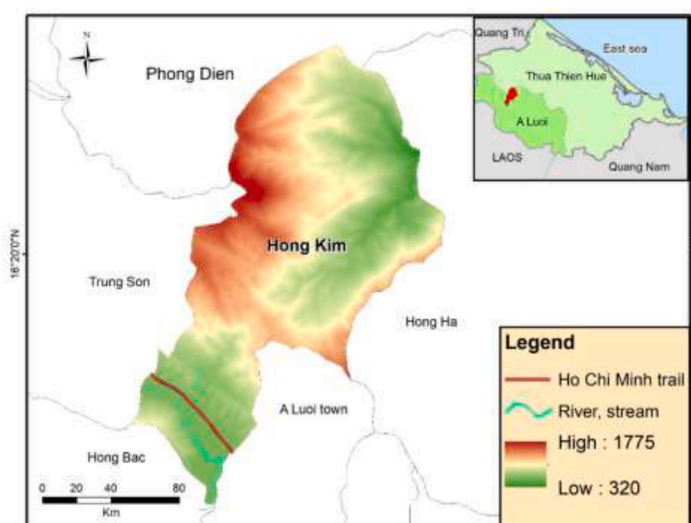


Fig. 2. Topography of Hong Kim commune. Source: (AW3D30, 2021).

land is 3736.1 ha, of which 3442.5 ha (92%) is natural forest, and 293.6 ha is plantation forest (A Luoi district FPD, 2019). Classified by use function, there are 3016.3 ha special-use forest, 225.5 ha protection forest, and 380.3 ha production forest (A Luoi district FPD, 2019).

2.2. Data collection

2.2.1. Secondary data collection

Secondary data were collected from Thua Thien Hue Forest Protection and Development Fund (TTH-FPDF), and Thua Thien Hue Forest Protection Department (TTH-FPD) (annual reports, project reports, provincial statistical data, etc.) related to the PFES and forestry sector at the provincial level. Basic information and data on the natural and

socioeconomic conditions of research sites were collected from local authorities of the HK commune, A Luoi district, and TTH province.

2.2.2. Primary data collection

Primary data collection in this study combined several methods, such as key informant interviews, focus group discussions, semi-structured interviews, and participatory observations.

For key informant interviews, respondents were officials of the TTH-FPDF, TTH-FPD other officer groups (comprising staff of Forest Protection Department Office of A Luoi District (ALFPDO), A Luoi District's People Committee (ALDPC), and village leader groups (comprising Village Head, Women's Union Head, Farmer Association, Youth Union, and Elderly with Sanding Peerage, FPG Head) to collect information on

the situation, progress, and results of PFES implementation at the research site.

Focus group discussions (FGDs) were implemented through unstructured interviews to acquire fundamental issues to identify relevant factors and design a questionnaire for the household survey. Ten participants were selected and categorized into two groups: forest protection groups (FPG) and non-forest protection groups (NFPG).

Semi-structured interviews were conducted for the household surveys. The questionnaire was built to obtain information related to the profile of households, the livelihood activities of households, rights of withdrawal of forest resources between forest protection groups and non-forest protection groups, reasons for participating and non-participating in forest protection management activities among interviewed households, expectations of people regarding policies to improve their livelihoods, and attitudes towards sustainable forest management. Two villages were selected for the survey in four villages of HK commune, namely A Tia 2 and Dut 1, with a total of 185 households and 212 households, respectively. The survey sample size was defined based on the formula of Slovin (1960) (Maina et al., 2018):

$n = N / (1 + Ne^2)$, where N is the total population, n is the number of survey samples, and e is the margin of error (usually taken as 10%).

Then, a simple random sampling technique was used to select household interviewees based on the list of households provided by the local government.

A Tia 2 should be 65 interviewees and Dut 1 should be 68 interviewees, divided into two different groups: forest protection group (FPG, $n = 67$) and non-forest protection group (NFPG, $n = 66$) (Table 1). The total number of household interviewees was 133 households. Interview surveys were conducted between February and March 2020 (a total of 30 days). The household surveys focused on collecting information relating to the socio-demographic characteristics of respondents, their livelihood activities from agriculture, forestry, and other fields, the impact of PFES on livelihoods, and the local perception of the role of the forest in their lives.

Participatory observations are used to gain insights into the daily activities of forest protection patrols, thereby verifying and comparing it

with the initial information gathered through the interview process.

2.3. Data analysis

Quantitative analysis was conducted using SPSS 20 and Excel software. Descriptive statistics were used to introduce the demographic data of the interviewees. The Mann-Whitney U test was used to compare differences between two independent groups (FPG and NFPG) when the dependent variable was either ordinal or continuous, but not normally distributed. The chi-squared test was used for independent variables in a contingency table to determine whether they were related or not. Multiple regression analysis was applied to identify the relationship between the dependent variable (total income) and other independent variables.

3. Results

3.1. The evolution of PFES in TTH province

After the reunification of Vietnam in 1975, forests and agricultural lands throughout the country were nationalized, and State Forest Enterprises (SFEs) were established to manage the nationalized forests (McElwee, 2012). However, those who have been living in the vicinity of the forests for generations have been marginalized and deprived of any benefits from the SFEs (McElwee, 2012), leading to disputes over land rights and exploitation areas between villages and SFEs (Hoang, 2006; McElwee, 2004).

The TTH province was a pioneer in establishing community-based forest management, which shares resource management between the government and locals. Numerous forestry policies have been implemented since 1991 to decentralize forest management to various forest owners. In 2000, TTH province was among the first localities to allocate forest land and forests to communities and groups of households (Hoang, 2006; Tran et al., 2010). To further promote the socialization of the forestry sector, TTH province issued Decision 430 in 2010, which focused on forest allocation and leasing from 2010 to 2014. According to the TTH-FDPF, in 2020, non-state forest owners, including households, household groups, communities, and Commune People's Committee, were allotted roughly 103,856.24 hectares of natural forest areas. Despite many efforts, TTH province's forestry sector still has many challenges in managing forest resources and combating illegal logging due to the vast forest cover, distribution of resources in various regions with complex terrain, and limited budget. Although forestry is one of the sectors that TTH province is extremely interested in, the state budget for forest protection and development is still inadequate. These financing sources are modest in size, and are primarily focused on the improvement of social welfare and education (roads, schools, hospitals, etc.) [Interview staff of TTH-FPDF and TTH-FDF, 2023].

As a result, following the successful implementation of the PFES pilot program in Son La and Lam Dong provinces from 2008 to 2010, with substantial international donor funding from the US Agency for International Development (USAID) and the German development agency, and the national PFES policy issuance in 2010, the People's Committee of TTH province established the provincial-level FPDF under Decision No. 1632/QD-UBND on August 10, 2011. The foundation of PFES is socialized revenue; particularly, consumers of clean water and electricity who pay for environmental services through their electricity and water bills, which are collected by water supply companies and hydro-electric plants (referred to as intermediaries or ES buyers). The TTH-FPDF, a newly established state agency, is in charge of distributing the funds to forest owners or those who participated in forest patrolling in order to ensure that forested areas continue the potential to provide

Table 1
The basic information of interviewees in Hong Kim commune.

| | Current village name | Previous village name | Group name | The number of households |
|----------|----------------------------------|-----------------------|--|--------------------------|
| Hong Kim | A Tia 2 ($N = 185$; $n = 65$) | Village 2 | Forest protection group ($N = 22$; $n = 18$) | 18 |
| | | | Non-forest protection group | 18 |
| | | Village 3 | Forest protection group ($N = 16$; $n = 14$) | 14 |
| | | | Non-forest protection group | 15 |
| | Dut 1 ($N = 212$; $n = 68$) | Village 4 | Forest protection group ($N = 21$; $n = 17$) | 17 |
| | | | Non-forest protection group | 17 |
| | | Village 5 | Forest protection groups ($N = 22$; $n = 18$) | 18 |
| | | | Non-forest protection group | 16 |
| Total | | | | 133 |

environmental services. Moreover, TTH province has been piloting various environmental services from other service users. Revenue from environmental services provided by tourism activities has been piloted at Bach Ma National Park, with an amount of over 100 million VND per year directly paid. The TTH-FPDF also planned to collect the environmental service payments from aquaculture activities, but it had to halt due to the Formosa marine incident's impact on the locals' livelihoods. The COVID-19 pandemic has delayed the plan of collecting environmental service payments from large industrial power plants, including cement mills, with an estimated sum of about 6 billion VND. Additionally, TTH is one of six provinces piloting carbon sequestration payments in the period 2023–2025.

The provincial government has created a PFES management system by utilizing existing state forest management mechanisms, outlining regulations and compliance based on a national PFES policy. The PFES aimed to lessen reliance on governmental financial sources while assisting forest rangers in managing and safeguarding forests. They assist the provincial FPD in identifying violations and enhancing forest management, but they lack the authority to deal with transgressions on their own. The TTH-FPDF initially received cooperation from forestry organizations including the province and district forest ranger offices in conducting surveys to identify forest areas qualified to offer forest environmental services. Then, in several watersheds, they mapped up the eligible forest areas. TTH is one of the few provinces in the country where PFES recipients are clearly identified from state forest owners to the communities, group households, and individual houses. Service users (water and hydropower firms) are thus able to precisely determine who should be paid, how much should be paid, and for how many regions. Additionally, the TTH-FPDF has implemented various initiatives utilizing remote sensing technology and policies to monitor and ensure effective, transparent, and fair PFES implementation. Using satellite imagery, the TTH-FPDF will give forest owners and rangers information on locations where forests have been lost or encroached upon. They can cooperate to look into the root reasons and take prompt action to address the issue. In addition, the TTH-FPDF supports local people in using GIS technology in forest patrol activities to monitor and evaluate the efficiency of their work.

Despite being one of the first provinces to pilot community-based forest management, TTH has been under a lot of pressure from little families encroaching on forest land for acacia plantations (Nguyen et al., 2022). The establishment of PFES intends to offer financial help for maintaining and protecting forests in accordance with traditional collective forest management models from previous policies. In the traditional society of ethnic minorities living near forests, the land and forests are either common property (ghost forests, spiritual forests, watershed areas, etc.) or private property (land for shifting cultivation and gardens; and resident land). They managed them according to customary laws with open access for their villagers. Village patriarchs establish strict guidelines for the management and usage of natural resources within and between villages. Ownership conflicts are rare because ownership is clearly defined (Hoang, 2006). TTH-FPDF is trying to help these communities rebuild their traditional customary laws to align with current state forest laws, facilitating strong relations among the community. Besides, they supports them in monitoring, patrolling, and building forest protection agreements among local and forest rangers. Communities are allowed to access non-timber forest products and commit to protecting large timber resources in their natural forest areas. Additionally, PFES supports local inhabitants in planting non-timber forest products (medicinal plants) under forest canopies to develop livelihoods. To more quickly identify instances of encroachment on natural forests for the planting of acacia trees, PFES in TTH also employs remote sensing methods. By mandating families encroaching on forests to replant with native species to prevent forest loss and restore forests, they will work in conjunction with forest rangers and local authorities to address infractions.

3.2. How to distribute the fund to the service providers in TTH province

The mechanism for allocating payments from PFES in TTH province is basically under the General Regulations on Payment for Forest Environmental Services Nationwide (Decree No. 99/2010/ND-CP, 2010; Decree No.147/2016/ND-CP, 2016). Service users (hydropower plants, clean water supply companies) collect monthly bills from people using electricity and clean water, including the PFES fee (GSO, 2020). The average selling price of clean water in 2018 was 10,155 VND/m³ (excluding 10% of VAT, 5% of environmental protection fee for domestic wastewater, and PFES fee with 52 VND/m³ for commercial water use) (Decision No. 54/2016/QĐ-UBND, 2016). The average retail price of electricity was 1,864.44 VND/kWh in 2019 (including a PFES fee of 36 VND/kWh for commercial electricity, excluding 10% of VAT) (Decision No. 648/QĐ-BCT 2019). This means that both electricity and water users have to pay their monthly bills based on their actual use and retail price, including VAT, environmental fees, and PFES fees. One hundred percent of the revenue is directly transferred to the TTH-FPDF every three months. FPDF spends 10% of the total revenue from service users for administration and 5% for contingency funds. The remaining 85% is distributed to service providers, which are forest owners or those that sign a contract in forest protection and management. Forest owners and forest protectors receive a payment amount based on the forest area they are assigned to manage and protect. In terms of the state forest owners, the payment is directly transferred into their organization bank account. They can use 100% of the money received from the FPDF for the forest area directly managed and protected. If the state forest owners assign their forest area to local communities to support management and protection activities, 90% of the money received from provincial FPDF will be transferred directly to those who participate in forest patrolling activities. Virtually, households or household groups of forest owners are ethnic minorities, most of whom do not have bank accounts. Hence, it is difficult to pay through bank accounts, and direct payment in cash to these forest owners is still preferred. Community forest owners receive money via the community's bank account under the representation of the leader and accountant. The community will use 100% of the money they receive from the FPDF according to the agreement of the entire community. Most of the money received from the PFES will be distributed to those who are directly involved in forest protection according to their patrol days (Fig. 3).

3.3. PFES implementation in Thua Thien Hue province over 10 years

3.3.1. Total area receiving payment from PFES

In TTH province, the total area of forested land in 2014 was 297,802.4 ha, of which the natural forest area for PFES was 103,963.38 ha (accounting for 35% of total forest area) and those for the plantation forest area was 5,285.39 ha (accounting for 2% of total forest area) (Fig. 4). Since 2016, the area of natural forests receiving PFES has increased to 44% (125,774.86 ha), whereas the corresponding figures for plantation forest area have remained unchanged. From 2018 to 2020, the area of natural forests eligible to provide PFES has increased to 51%, while only 2% of plantation forest areas provide forest environmental services. In general, within seven years of implementing the PFES, the total forest area eligible for service provision increased from 37% to 53% of the total forest area. This is because, in the early years, negotiations with environmental service users faced many difficulties, and only four organizations agreed to sign a commitment to pay for forest environmental services. The forest area to be paid must be within the basins of these hydropower plants. Only forest areas located in three basins, A Luoi, Binh Dien, and Huong Dien implemented PFES in 2014. In 2016, after the issuance of Decree No. 147/2016/ND-CP on amendments and supplements to the PFES, the provincial FPDF signed with seven additional organizations using forest environmental services. By 2020, 13 service users were defined, which contributed to an increase in the forest area eligible for the provision of PFES.

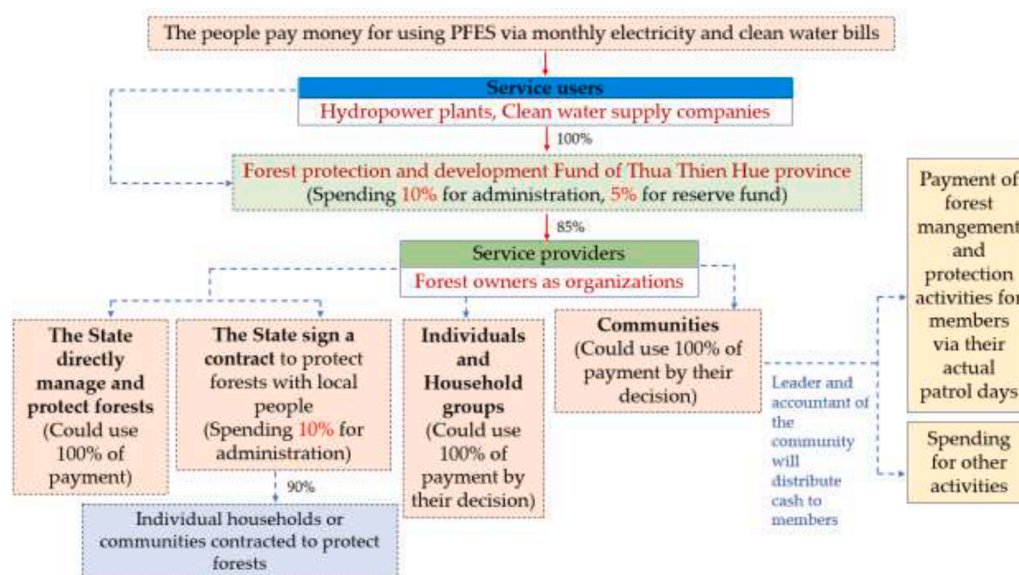


Fig. 3. How forest owners and forest protectors receive the payment from service users in Thua Thien Hue province. Source: The percent and the flow of payment that based on Decree 99 and Decree 147.

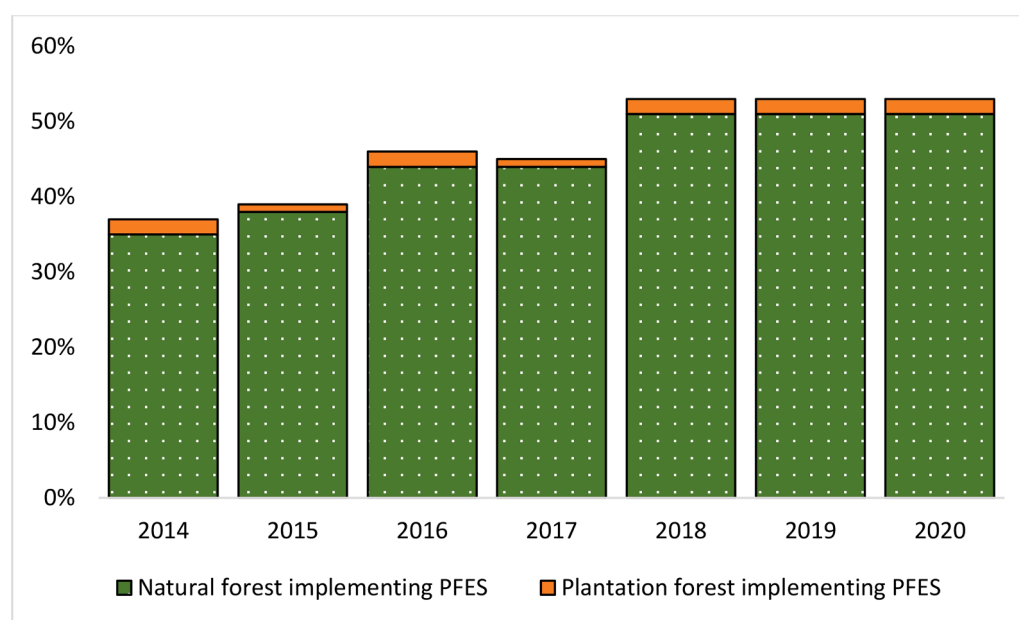


Fig. 4. Percentage of the forest area implementing PFES in Thua Thien Hue province. Source: TTH-FPDF, 2020.

Table 2

Unit price converted for 1 ha received payment from PFES in different hydropower basin in Thua Thien Hue province.

| VND | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|-----------------------------|---------|---------|---------|---------|---------|---------|---------|
| A Luoi Hydropower basin | 574,722 | 646,165 | 738,543 | 450,000 | 600,000 | 600,000 | 400,000 |
| Huong Dien Hydropower basin | 86,336 | 44,615 | 122,632 | 297,728 | 400,000 | 400,000 | 230,000 |
| Binh Dien Hydropower basin | 53,000 | 55,680 | 60,038 | 297,728 | 400,000 | 400,000 | 230,000 |
| Water source basin | 100,000 | 158,800 | 165,132 | 297,728 | 400,000 | 400,000 | 230,000 |
| Thuong Lo Hydropower basin | – | – | 7,842 | 297,278 | 235,000 | 235,000 | 180,000 |

Source: TTH-FPDF, 2020.

The payments to forest owners (or service providers) shall be calculated by multiplying the forest area providing services, the average payment for one hectare of forest, and the K coefficient (the K coefficient is determined based on forest status, forest type, forest origin, location,

etc.) (Decree No. 99/2010/ND-CP, 2010). For the TTH province, the K coefficients of each eligible area were determined in the early years of the PFES implementation. Unit price converted for 1 ha of forest area received payment from PFES is calculated depending on the production

Table 3

PFES revenues and distribution to the services providers in Thua Thien Hue province over 10 years.

| Billion VND | Hydropower plants | Clean water supply facilities | Interest from the bank | Total revenue from PFES | PFES payment distributes to service providers | PFES payment distributed to the State service providers | PFES payment distributed to Non-State service providers |
|--------------|-------------------|-------------------------------|------------------------|-------------------------|---|---|---|
| 2011 | – | – | – | – | – | – | – |
| 2012 | – | 0.791 | 0.003 | 0.795 | – | – | – |
| 2013 | 7.096 | 2.720 | 0.090 | 9.905 | – | – | – |
| 2014 | 22.932 | 1.620 | 0.124 | 24.676 | 11.283 | 7.163 | 4.119 |
| 2015 | 34.054 | 1.727 | 0.374 | 36.155 | 14.637 | 8.478 | 6.159 |
| 2016 | 17.891 | 1.821 | 0.397 | 20.109 | 19.694 | 12.583 | 7.111 |
| 2017 | 36.156 | 2.276 | 0.183 | 38.615 | 34.030 | 27.150 | 6.880 |
| 2018 | 28.763 | 2.494 | 0.108 | 31.366 | 48.712 | 40.100 | 8.612 |
| 2019 | 41.128 | 2.717 | 0.071 | 43.915 | 48.762 | 40.174 | 8.588 |
| 2020 | 31.994 | 1.856 | 0.050 | 33.900 | 30.190 | 24.841 | 5.349 |
| Total | 220.014 | 18.022 | 1.401 | 239.436 | 207.308 | 160.490 | 46.818 |

Source: TTH-FPDF, 2020.

capacity of hydropower plants and clean water supply companies located in each basin. There was a significant difference in the amount converted to pay for one hectare between hydropower basins. Specifically, in 2014, the payment per 1 ha in the A Luoi Hydropower basin was the highest at 574,722 VND, while the remaining basins, such as the Huong Dien Hydropower basin and Binh Dien Hydropower basin received only 86,336 VND and 53,000 VND, respectively. From 2017 to 2020, the unit price converted for 1 ha was balanced to reduce the disparity between the hydropower basins. The converted amount in the A Luoi hydropower basin in 2020 was 400,000 VND, which was lower than in previous years, but still the highest compared to the remaining basins at 230,000 VND and 180,000 VND (Table 2). In general, the unit price converted for 1 ha paid for forest environmental services in the basins varied from year to year because it depends on the productivity and revenue of service providers (hydroelectricity and clean water plants) (Table 2).

3.3.2. Total revenue and distribution payment from PFES over 10 years (2011–2020)

Although PFES has been officially implemented in TTH since 2011, it began to receive payment from service providers in 2012. The total revenues and distribution payments from the PFES between 2012 and 2020 are listed in Table 3. From 2011 to 2020, the total revenue from the PFES payment was 239,436 billion VND, of which 92% was from

hydropower production plants, only 7.5% was from clean water companies, and 0.5% was obtained from bank interest. The revenue from PFES still fluctuates from year to year due to its heavy dependence on two service users, namely hydroelectricity and clean water companies. According to a report from the Fund, the dynamic debt ratio and slow capital recovery from these service users greatly affected the allocation of funds to service providers. Other users of forest environment services such as tourism businesses and industrial and aquaculture production establishments (mentioned in Decree 99/2010) have not been identified in TTH. Ten years after implementing the PFES, 87% of the total revenue from the PFES was transmitted to service providers (207.308 billion VND). State forest owners received 77% of the amount from the PFES, while non-state forest owners received only 23%.

3.4. PFES in Hong Kim commune

3.4.1. History of forest protection groups

In 2005, although forest resources were strictly managed by the state, illegal hunting and logging still occurred frequently. The policy of allocating forests to the community for management according to Decision 430/QĐ-UBND of the TTHPPC in 2010 is considered a fundamental policy for community forestry development in HK. In 2013, six forest management and protection groups were established to manage more than 400 ha of forest allocated to communities. Initially, the

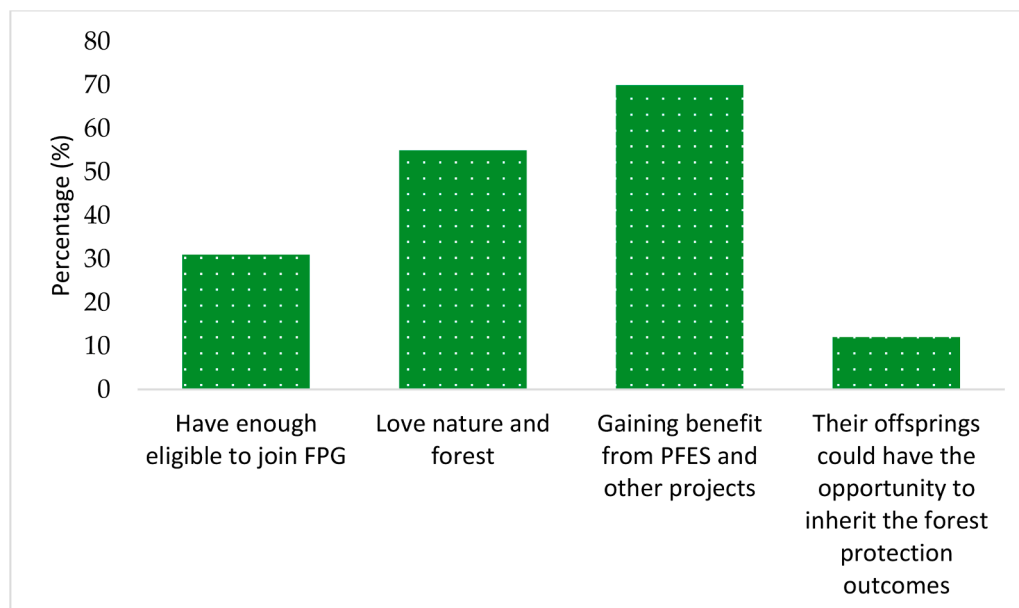


Fig. 5. Reason for becoming a member of FPG (Multiple choices) (n = 67).



Fig. 6. Reason why interviewees did not join FPG (Multiple choices) (n = 66).

selection of FPG members was done by local authorities in collaboration with village heads to call for voluntary participation from households, and the people involved in forest protection had not received any benefits from patrolling activities. Members of the FPG organized patrols with the support of local forest rangers and commune forestry officers, but lacked financial support. Hence, although forest patrols have been put into operation, they have not been effective in limiting illegal logging and encroachment on forest land. In 2014, PFES began to be piloted in the HK commune, with the goal of supporting forest protection and management activities. The former FPG groups have been kept and maintained more methodical patrol activities under the support of PFES. Compared with NFPG, those who are not involved in forest protection, FPG members were trained and guided in forest patrolling methods, had the opportunity to have access to many forestry projects and programs, and received payment from PFES.

3.4.2. The reason why respondents join and do not join the forest protection group

Through group discussions, we asked interviewees of both FPG and NFPG to list the reasons why they participated and did not participate in the forest protection groups. Subsequently, household survey questionnaires were built based on the information gathered from group discussions. Interviewees find it free to choose the reason from a list of multiple choices (Fig. 5 and 6). The interview results (Fig. 5) show that 70% of the interviewees participated in FPG because they gained benefits from PFES and other projects. Since HK is a mountainous commune with a high poverty rate in the A Luoi district, there are many forestry-related livelihood development projects, such as the afforestation program named 147 in 2013, the Greater Mekong Subregion Biodiversity Conservation Corridors Project (BCC project) for the period 2014–2019, and the United States Agency for International Development Green Annamites Project (USAID Green Annamites) to support the development of community-based tourism in 2019. Through household surveys, most of the interviewees at NFPG and FPG said that the criteria for selecting participants in these projects were considered by local authorities. Members of the FPG were also given priority in forestry development programs in the area than NFPG because they were contributors to the management and protection of local forests. Specifically, all members of the FPG agreed to take part in the project to enrich the forest by planting native trees and planting rattan under the forest canopy funded by the BBC project. They gain not only cash benefits, but also training to enhance capacity. In addition, HK started to develop community-based tourism since 2017, and the local authorities defined that members of the PFG were also members of community-based tourism groups. Thus, from respondent aspects, compared to NFPG,

participating in FPG will give them more opportunities to gain monetary and non-monetary benefits (Fig. 5). More than half of the interviewees said that they love nature and forest; therefore, they applied for becoming members. Approximately 12% of respondents believed that if they have an opportunity to act as forest patrols, their offspring can inherit the forest protection outcomes in the future (Fig. 5). During an interview, a member of the FPG said that "Initially, when the community was assigned forest by the state, local residents did not gain any benefits because the allocated forest was poor, and the government firmly forbade the

Table 4

Characteristic of the interviewees in 2020.

| Categories | Socio-demographic characteristic | | | | | |
|---|----------------------------------|----|---------------|----|------------------|----|
| | Non-FPG n = 66 | | FPG n = 67 | | Total n = 133 | |
| | n | % | n | % | n | % |
| 1. Gender | | | | | | |
| – Men | 36 | 55 | 44 | 66 | 80 | 60 |
| – Women | 30 | 45 | 23 | 34 | 53 | 40 |
| 2. Age group | | | | | | |
| – Under 25 years old | 4 | 6 | 0 | 0 | 4 | 3 |
| – From 25 to 35 | 20 | 30 | 14 | 21 | 34 | 26 |
| – From 36 to 45 | 20 | 30 | 31 | 46 | 51 | 38 |
| – From 46 to 60 | 12 | 18 | 17 | 25 | 29 | 22 |
| – Over 60 years old | 10 | 15 | 5 | 8 | 15 | 11 |
| 3. Occupation | | | | | | |
| – Farmer | 50 | 76 | 49 | 73 | 99 | 74 |
| – Builder/mason | 1 | 2 | 1 | 2 | 2 | 2 |
| – Hired worker | 9 | 14 | 2 | 3 | 11 | 8 |
| – Business | 2 | 3 | 0 | 0 | 2 | 2 |
| – Government officials | 3 | 5 | 13 | 19 | 16 | 12 |
| – Teacher | 1 | 2 | 2 | 3 | 3 | 2 |
| 4. Ethnicity | | | | | | |
| – Paco | 61 | 92 | 64 | 96 | 125 | 94 |
| – Kotu | 0 | 0 | 1 | 2 | 1 | 1 |
| – Kinh | 5 | 8 | 2 | 3 | 7 | 5 |
| 5. Education level | | | | | | |
| – Illiterate | 9 | 14 | 8 | 12 | 17 | 13 |
| – Literate | 14 | 21 | 5 | 8 | 19 | 14 |
| – Primary school | 4 | 6 | 14 | 21 | 18 | 14 |
| – Secondary school | 17 | 26 | 20 | 30 | 37 | 28 |
| – High school | 17 | 26 | 12 | 18 | 29 | 22 |
| – University | 5 | 8 | 8 | 12 | 13 | 10 |
| 6. Type of household | | | | | | |
| – Poor | 27 | 41 | 19 | 28 | 46 | 35 |
| – Near poor | 10 | 15 | 10 | 15 | 20 | 15 |
| – Average | 29 | 44 | 38 | 57 | 67 | 51 |
| 7. Households whose members work away from home | 23 | 32 | 28 | 42 | 51 | 38 |

use of timber and wildlife. I nevertheless offered to take part since I believe that the establishment of FPG will forge close ties among community members, and I also hope that by doing this, my offspring would be able to see the dense forests as I used to see when I was a child”.

On the other hand, after conducting household interviews with the NFPG to find out why they did not join the group, 35% of respondents said that the number of members to join FPG was limited and there was a consideration among the members. Since the forest area allocated to communities in the HK commune was very limited, only about 400 ha, the number of people selected to be FPG members was more than 120 out of 553 households. During the household interviews, the study found that members wishing to join the FPG must apply for and be approved by the management board and local authorities. Others thought that they did not know information about recruiting members (9%). More than a third of the interviewees had to spend time doing other jobs to improve their poverty (Fig. 6). When asked, “if you are agreed to become a new member of the forest protection and management group, do you want to participate in?”, 62% of respondents also wanted to participate in forest patrolling because they would not only profit from PFES cash, but also help protect the future for their next generation.

3.4.3. Characteristic of households interviewed

Table 4 demonstrates that the gender of respondents was moderately balanced in the NFPG. Men (66%) were dominant among the interviewees in FPG. The age of respondents in NFPG from 25 to 45 years old had the highest percentage (60%), while the middle-aged demographic from 36 to 45 years old (46%) was overwhelmingly large in FPG. Young people prefer to do other jobs and are not interested in FPG, and the elderly are not healthy enough to participate in this activity. The occupations of the interviewees in both NFPG and FPG were mainly farmers at 76% and 73%, respectively. Only 3% of interviewees in FPG were hired workers, whereas the number of NFPGs was four times higher. Additionally, approximately a fifth of respondents in FPG had a job as government officials, while only 5% of NFPG had the same occupation. Paco was the dominant ethnic group in both groups while Kinh and Kotu were minor. Regarding the education level of respondents, almost a tenth of the interviewees experienced illiteracy in both groups. Most of them were elderly individuals. The number of respondents with a university level in FPG made 12% which was 4% higher than that of NFPG. At the high school level, NFPG (26%) was higher than that in FPG (18%). Forty-one percent of respondents in NFPG experienced poor conditions while more than a quarter of FPG lived under the poor. In contrast, average households in FPG accounted for 57%, which was 13% higher than that of NFPG. This household classification was based on government standards (Decision No. 59/2015 / QĐ-TTg, 2015). High poverty incidence might have a great influence on the management of natural resources because the dependence of the poor on the sources of goods and services from natural forests is enormous (Sunderlin and Ba, 2005). Currently, job opportunities in this mountainous area are unstable. The households with family members working far from home in both groups were relatively high at

32% and 42%, respectively. Most of them moved to Da Nang City or the South of Vietnam (Binh Duong City, Ho Chi Minh City) to find a job at garment, leather, and wood processing companies to send the money back to support their families. This money was used to pay off previous loans to the bank to build a brick house, buy a motorbike, or invest in agriculture.

3.4.4. Contribution of PFES payment to livelihood income of FPG

Table 5 shows that total income of NFPG was 64.671 ± 41.580 million VND, whereas the corresponding number for FPG was 72.025 ± 40.847 million VND. The on-farm income from crops, livestock, acacia plantations, and collecting non-timber forest products, made up a small part to the total income structure of both FPG and NFPG. Income from nonfarm and hired labor activities contributes remarkable high amounts to total income of both FPG and NFPG. These findings are consistent with (Nguyen et al., 2020a) on income structure of households in HK commune in 2018. Mann Whitney U test revealed that there were no significant differences in the total income and each income sources between the two groups. The average income from PFES per capita per year in TTH province was calculated by dividing the total PFES revenue by the total number of members of FPG in each commune (Fig. 7). Fig. 7 indicates some variation in the income per capita per year from PFES between 2019 and 2020. Specifically, in 2020, each member joining FPG in HK commune received 1,114,000 VND from PFES, which was lower than the average amount from PFES per person in the whole province level (1,606,000 VND). FPG in Huong Phong and Hong Thuong commune received amounts that were two to three times higher, respectively, than those in HK commune.

3.4.5. Identification of factors related to household income in Hong Kim commune

The multiple regression model was applied to all independent variables to examine how they are related to the total income of local villagers in the HK commune. The dependent variable was total income per year, while the independent variables were comprised of (1) age, (2) education (a dummy variable: 0 = lower than high school level, 1 = high school education and higher education), (3) dependence ratio (percentage of dependents in the household), (4) total number of main labor, (5) people working far from home (a dummy variable: 0 = No, 1 = Yes), (6) wet rice area (log), (7) home garden area (log), (8) annual crop area (log), (9) perennial crop area (log), (10) plantation area (log), (11) fish pond area (log), (12) accessing to loan and credits (a dummy variable: 0 = No, 1 = Yes), (13) participating in forest protection group (a dummy variable: 0 = No, 1 = Yes), (14) harvesting NTFPs in community forest (a dummy variable: 0 = No, 1 = Yes).

Table 6 to rank predictor variables based on their contribution (irrespective of positive or negative sign) in elucidating the outcome indicates that the model explained 31.9% of the variation in total household income per year. As expected, some coefficients were statistically significant ($p < 0.01$, $p < 0.05$, $p < 0.1$) with their signs, as expected. The results in Table 6 reveal that multicollinearity did not exist in the model because the VIF for all variables was < 5 (Jim, 2020). The

Table 5
Cash income sources per household per year in Hong Kim commune.

| Categories | | Non- FPG (n = 66) | | | FPG (n = 67) | | | Mann whitney U test |
|---------------------------|---|-------------------|--------|--------|--------------|--------|--------|---------------------|
| Cash income (million VND) | | n | Mean | Std. D | n | Mean | Std. D | p-value |
| On-farm income | – Crops | 21 | 2.238 | 4.277 | 45 | 1.884 | 1.884 | 0.593 |
| | – Animal husbandry | 35 | 6.560 | 7.541 | 46 | 7.880 | 7.598 | 0.176 |
| | – Acacia plantation | 24 | 1.738 | 1.932 | 38 | 3.195 | 9.996 | 0.856 |
| | – Non timber forest products | 9 | 5.811 | 9.349 | 9 | 10.689 | 9.996 | 0.145 |
| Off-farm income | – Hired agriculture labor | 38 | 27.134 | 15.691 | 26 | 28.331 | 12.186 | 0.424 |
| Non-farm income | – Officers, freelance business, hired non-agriculture | 59 | 48.586 | 48.773 | 62 | 53.984 | 43.324 | 0.269 |
| | – PFES | 0 | 0 | 0 | 67 | 1.152 | 0.303 | |
| Total income per year | | 66 | 64.671 | 41.580 | 67 | 72.025 | 40.847 | 0.215 |

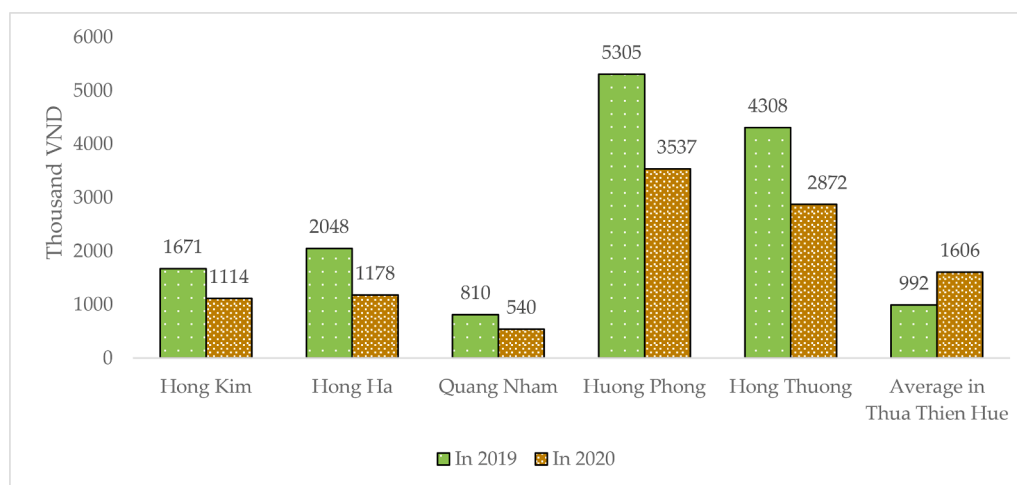


Fig. 7. Average income from PFES per capita per year in Hong Kim commune and the other communes in Thua Thien Hue province. Source: TTH-FPDF.

Table 6

Factors associated with total household income in Hong Kim.

| Explanatory variables | Total income per year of both groups p-value | Coefficients Beta | VIF |
|--|---|-------------------|-------|
| (Constant) | 0.000 | | |
| Age | 0.553 | 0.058 | 1.471 |
| Education level | 0.006** | 0.232 | 1.184 |
| Dependency ratio | 0.027** | -0.221 | 1.685 |
| Main labor in the household | 0.307 | 0.100 | 1.650 |
| People working far from home | 0.542 | 0.054 | 1.343 |
| Wet rice land area (log) | 0.000*** | -0.323 | 1.236 |
| Home garden area (log) | 0.365 | -0.073 | 1.130 |
| Annual crop area (log) | 0.105 | 0.134 | 1.176 |
| Perennial crop area (log) | 0.316 | -0.081 | 1.121 |
| Plantation land area (log) | 0.051* | 0.170 | 1.300 |
| Fish pond area (log) | 0.344 | 0.080 | 1.244 |
| Access to the credit | 0.682 | -0.034 | 1.205 |
| Access to the natural forest | 0.128 | -0.131 | 1.264 |
| Participate in forest protection group | 0.119 | 0.132 | 1.225 |
| R squared | 0.319 | | |
| Observations | 133 | | |

beta weight (coefficients beta) measures how much the outcome variable increases (in standard deviations) when the predictor variable is raised by one standard deviation, assuming that other variables in the model are kept constant. It is a useful measure variable (Dhakal, 2018). Notably, the value of beta coefficients (Table 6) shows that the education level of the household head (0.232) plays a larger role in the total household income compared to the remaining associated factors.

4. Discussion

4.1. PFES implementation at the provincial level

The area of forest receiving payments from forest environmental services has increased over the past seven years (Fig. 4), which opens up opportunities for communities living near forests, especially those involved in forest management and protection activities benefit from this policy (Clements and Milner-Gulland, 2015; Suhardiman et al., 2013). In reality, the difference in unit price converted per 1 ha receiving payment among hydropower basins in the whole province (Table 2) rose comparisons related to PFES payments among forest protectors. This is because the amount of money that forest protectors receive depended on the allocated forest area and the unit price paid for one hectare. Fig. 7 shows that there is a difference in the average income from PFES per year per capita in each commune. Although they perform forest protection patrols with the same roles and responsibilities, their

incomes are very different. This might create conflicts among people living in the same area but located in different hydropower basins or neighboring areas, especially minor ethnic minorities. Notably, income disparity from forest patrols might greatly affect people's awareness and effectiveness of forest protection and management such as the number of times to patrol the forest, the number of people participating in a patrol, and the work done during the patrol. Therefore, it is necessary to adjust and balance the source of money from the PFES so that it can contribute to the income structure of forest protectors. In addition, revenue from PFES is not stable over the years owing to the limitation of service users. Hence, to create motivation and incentives for forest patrolling activities, other service users benefit from PFES should be identified (according to Decree 99) (tourism business, industrial and aquaculture production establishment). The provincial government and TTH-FPDF should review and negotiate to expand the beneficiaries of forest environmental services to create a stable source of income, and reduce dependence on the two current beneficiaries (hydropower plants and clean water supply companies). In addition, it is essential to properly balance the unit cost and the source of payment, so that the income from PFES for people participating in forest protection is increased commensurate with their efforts and responsibilities. It is vital to develop stricter legal provisions on the responsibilities of the parties involved. Although FPG are in charge of making sure that their allotted forest area is kept in good condition, any loss of forest cover just reduces their PFES payment without subjecting them to additional duty (Nguyen et al., 2022). Additionally, there has been a lack of attention given to maintaining forest quality in the event of forest degradation during the province's adoption of PFES. While remote sensing technology has effectively monitored forest patrols, there is a need to establish additional commitments between forest owners or those involve in forest patrols and TTH-FPDF to restore degraded forests increase responsibility in forest patrols. For service users, payment regulations and reasonable payment deadlines should be introduced to limit late payments and outstanding debt. This will solidly bind the participation of stakeholders.

4.2. PFES contribution at the community level

Although this study could not clearly indicate that FPG members were selected by social relationships, more members of the FPG were government officials (Table 4). This might marginalize vulnerable households (low education, poor household, weak social ties, etc.) in competition to become members of the FPG due to limited membership. It is better to openly and transparently select members to ensure fairness and promote the effectiveness of the PFES to involve the entire

commune. FPG was dominated by men (Table 4). Revelo et al. (2011) also indicated that forestry is widely identified in men and that the design of formal forestry policies and management is mostly dominated by men. A prerequisite for members in FPG in the HK commune was to have good health, experience in walking through the forest, a high sense of responsibility, and stable work in the locality. Through a forest transect walk with FPG members, we found that the road to conduct forest patrols is quite far and inaccessible by means of transport. Forest patrollers have to walk on foot through small, narrow, and dangerous roads in the natural forest. Usually, an entire day is required to complete this job. Besides, this is a sensitive job; it is quite tough if the patrol process encounters aggressive illegal logging and hunting. Thus, men are likely to be more suited to this job than women in the HK commune. In fact, local people carry out group forest patrolling (four or five members joining per one-time patrol) to manage the forest and reduce risks so that women with good health and experience could still participate in this work.

Based on the great dependence on forest resources for livelihood development, many changes in livelihood resources were detected in this study, and wet rice cultivation and extraction of resources from natural forests (such as collecting NTFPs) are no longer the core cash income for households (Table 5). Nguyen et al. (2020) also indicated that the impact of a series of forestry policies has changed the land-use history and traditional farming practices of local citizens in the HK commune. In fact, hired labor in the forestry sector such as peeling and transporting acacia timber, and working far away was a new trend to adapt to the difficulties in limiting natural resources and scarcity of job opportunities in remote areas. In particular, the tendency to leave their motherlands to seek jobs in the city is becoming popular (Table 4). Although this transformation helps households improve income, household standards, or even tackle their debt, there is also a need to look at the future of the community. There may be a shortage of young, healthy, and dynamic people that inherit forest patrol activities. Hence, to maintain the sustainability of PFES implementation in the future, more attention should be paid to raising awareness among young people and encouraging them to participate in forest protection patrols so that the next generations are responsible for continuing this work.

One of the aims of the government to implement the PFES policy is to engage crucial stakeholders in protecting forests, improving local livelihoods, and contributing to poverty alleviation (To et al., 2012). Nonetheless, our findings (Table 5) indicate that PFES payment (accounting for 2% of total household income) does not contribute significantly to the income of households engaged in forest management and protection in the HK commune, and it seems that the reflection of fact contradicts the PFES program's purpose. This finding is consistent with (Diswandi, 2017; Pham et al., 2020b; To and Dressler, 2019). Specifically, in Thai Hung village, Moc Chau district, Son La province, the average income from PFES is 509,436 VND/household/year, accounting for only 1% of the total average income (35,000,000 VND/household/year). Similarly, the proportion of income collected from PFES to total household income in other villages such as Ban Lun, Ban Ang I, Ban Bua, and Ban Cang Ty is also very low (2–5%) (Diswandi, 2017; Pham et al., 2020b). A study in West Lombok, Indonesia, applying an econometric model, also indicated that the PES program did not derive the peasant's welfare (Diswandi, 2017). In contrast, the PES contribution for Ban Trong was quite high, accounting for 15% of the total household income. This was because the total household income per year was as low as approximately 15,000,000 VND, and the PFES's income was 2,276,661 VND higher than in other villages (Pham et al., 2020b). Another study in Cat Tien National Park, Dong Nai province in 2019 (Pham et al., 2020a) found that PFES play a key role in household income. Each household received approximately 28 million VNDs/year from the PFES. Because households belonging to the category with good income in the village earn from PFES about 50–70 million/year, PFES contributed up to 50% of the income of better-off households in the village. Tran et al. (2019) estimated the result of multiple log-lin models on factors

influencing income, and also found that PFES significantly contributed to the household's income of farmers in the Da River basin. Do and NaRanong (2019) conducted a research in TTH and Quang Nam province and pointed out that the PFES policy has a positive impact on household income, and there was a significant difference in total income between poor households with and without PFES. As discussed here, the contribution of PFES to household income varies depending on the amount of PFES and household income. However, considering that the PFES income in our study was comparable to its average in TTH province (Fig. 7) and the household income was not as high as the values reported, we could conclude that the contribution of PFES to household income is generally low.

Notably, even though the PFES scheme did not drastically improve the livelihoods of participants, the nexus with external stakeholders began to generate options for participants to diversify or seize greater value from their income sources (Leimona et al., 2010). Similarly, the results of household interviews have revealed that non-monetary benefits are a significant motivator for local inhabitants to be involved in PFES in the HK commune. Nonetheless, it is the fact that PES schemes may not work effectively if poor communities, which are most dependent on land for their livelihoods, are excluded from the systems. Endeavors must therefore be built to integrate these populations and broaden the benefits of PES schemes (Mayrand and Paquin, 2004).

In line with previous studies (Tran, 2015; Vu, 2020), we found that education has a positive effect on household income (Table 6). People with higher level of education earn more money than those with minimal education. As shown in Table 6, the dependence ratio is negatively associated with total income per year. The same finding was also reported in previous studies (Nguyen and Nguyen, 2019a; Tran, 2015; Tran and Nguyen, 2018; Vu, 2020). They found that having more dependent members and more family members, in general, is likely to reduce per capita income. Regarding the role of land assets in total household income, while only forest land had a positive effect on total household income, the remaining types of land were not associated with total household income. Tran and Nguyen (2018) and Tran et al. (2019) also revealed that forest land plays an integral part in the livelihood of local households. Although wet rice land was correlated with total income, the results showed a negative effect. This coincides with the actual survey results in the locality, suggesting that farmers with large paddy fields do not need to earn much cash income because their rice production could meet the demand of their consumption. Notably, there was no correlation between participation in forest protection groups and total household income ($p = 0.119 > 0.05$) (Table 6).

5. Conclusions

The study was set out to elucidate the PFES framework in TTH province and its influence on forest management activities and household income in the HK commune. The research results revealed that the success in negotiating and expanding the number of service beneficiaries increased the forest area receiving PFES from 37% to 53% of the total forest area over seven years. This revenue contributes a very important part in supporting the state budget to invest in forest protection and development in the province. In addition, this revenue also contributes to opening the door to benefit from PFES for forest owners and people participating in forest protection patrols. However, the study also found that revenue from PFES still fluctuates from year to year due to their great dependence on the limited number of service users. This greatly affects the stability of income and the motivation to protect the forest of service providers. In fact, the PFES fund distributed to state-forest owners was dominant, while a smaller amount was transferred to non-state forest owners because the state holds the majority of the nation's forest area. Thanks to the use of remote sensing technology, the implementation of PFES in TTH has substantially improved when compared to other areas in supporting community forest patrols. However, PFES implementation in the province has not paid enough attention to

sustaining forest quality during forest deterioration, highlighting the need for additional commitments between forest owners and TTH-FPDF to restore degraded forests and raise accountability in forest protection activities.

At the community level, total income was correlated with education level, dependence ratio, wet rice land, and forest land. Notably, participation in forest protection groups did not affect the total income. The study concluded that PFES payment (2%) does not contribute significantly to the income of households engaged in forest patrols in the HK commune. The study also found that although many reasons derived the decision of local residents to join the FPG, both monetary and non-monetary benefits from PFES and other projects seem to incentivize for local people to become members of FPG. However, the impact of forestry policies and changes in market mechanisms has affected Paco people to change their livelihoods to adapt to the limitations of natural resources and scarcity of job opportunities in remote areas. PFES's promise seems unclear in the HK commune, and an increasing number of local inhabitants decided to leave their motherland to seek a job in the city to improve their livelihood income.

This study only focused on reflecting the impact of the PFES on community forest owners. More consideration should be paid to non-forest owners (individuals, households, communities) receiving PFES distributed from state forest owners via forest protection contracts to gain insight into the overall impact of PFES on all subjects. The study assessed the implementation of PFES in TTH province within 10 years (2011–2020), analyzing and processing information through inheritance of secondary data is the main method applied. Hence, the research results only focus on the economic aspect that PFES brings to the forestry sector. Future studies should assess forest quality and quantity through forest protection management using PFES support.

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Data availability statement

The data presented in this study are available upon request from the corresponding author.

Declaration of Competing Interest

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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