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Chapter

Integrated Effect of the Payment for Forest Environmental Services (PFES) in Vietnam

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Abstract

Payment for forest environmental services (PFES) has become an effective management tool for forest resources in the world, especially in developing countries such as Vietnam. The Vietnamese PFES policy has been institutionalized and implemented since 2010, contributing to forest protection and improving the livelihoods of people who depend on forests. In this chapter, the PFES policy was analyzed, followed by the evaluation of the effectiveness of a PFES program applied in the Ba Be district, Bac Kan province, Vietnam in three aspects: environment, economy, and society. Finally, we synthesize the combined effectiveness of the PFES program in Vietnam and offer solutions to improve and promote the PFES policy in Vietnam and developing countries around the world.

Keywords: babe district, evaluation, integrated effect, payment for forest environmental services (PFES), policy

1. Introduction

Payment for environmental services is understood as a mechanism to convert external/nonmarket values of the environment into actual funding to motivate those providing these ecosystem services (ES). In other words, payment for environmental services applies the benefit pays principle (BPP) to mobilize funds for environmental protection activities. Currently, payment for environmental services is being widely applied globally because this tool effectively protects environment and brings economic benefits to people.

In Vietnam, the program of payment for forest environmental services (PFES) was officially institutionalized through Decree No. 99/2010/ND-CP on “Payment for forest environmental services”. After being promulgated, this policy has received great consensus from stakeholders and brought positive environmental and socio-economic effects. However, whether this policy has really become a new driving force for the protection and sustainable development of forests requires detailed evaluation. At the Conference summarizing Vietnam’s PFES program after ten years of implementation,

scientists and managers all agreed that Vietnam currently lacks an effective evaluation mechanism for the national program of PFES [1].

According to experts in the field of assessment of environmental services payment programs, there are three main terms used: “*Evaluate the results of the implementation of the policy*” and “*evaluate the implementation process of the policy*” and “*evaluate the effectiveness of the policy*”. Which, the reviews of the program of payment for forest environmental services in Vietnam mainly focus on the first two aspects, while the third aspect has not been given due attention [2]. Sharing the same view, Ngai [3] said that Vietnam’s state agencies mainly focus on the evaluation process of “Evaluating the implementation process” of PFES programs. In contrast, evaluations of the effectiveness and actual impacts of PFES programs on people’s lives (social efficiency), benefits of economic (economic efficiency), and the effectiveness of forest protection (environmental efficiency) in fact have not been noticed. Faced with that situation, scientists and managers in Vietnam all agree that it is necessary to develop a method to evaluate the effectiveness of PFES programs in Vietnam. In this chapter, we introduce a method to evaluate the combined effectiveness of PFES programs based on a sustainable development approach (considering the program’s sustainability based on three aspects of economy, society, and environment) with a case study in Ba Be district, Bac Kan province, Vietnam.

2. Overview of PFES policy in Vietnam

2.1 The process of developing PFES policy in Vietnam

In 2004, the revised Law on Forest Protection and Development was approved by the National Assembly of Vietnam, which affirmed the important role of forests in providing environmental services such as limiting soil erosion, regulating water sources and climate, biodiversity conservation, and landscape preservation for tourism and recreational activities. Then, in 2007, Vietnam’s Forestry Development Strategy for the period 2006–2020 was approved. The important task was identified as “*mobilizing revenue from PFES payments for forest protection and development activities and improving people’s livelihoods*”. On the other hand, the Strategy also set out the important task of fully assessing the economic values of forest environmental services. These were considered two important legal documents laying the foundation for the development and implementation of the policy on PFES in Vietnam.

In 2008, the Government of Vietnam established the National Forest Protection and Development Fund (According to Decree No. 05/2008/ND-CP). The main task of the Fund is to act as an intermediary connecting forest environmental services suppliers and users in Vietnam. In addition, on April 10, 2008, the Prime Minister of Vietnam signed Decision No. 380/QD-TTg on the pilot implementation of the PFES policy in two provinces, Son La and Lam Dong. After only two years of implementing pilot projects on PFES, in 2010, the Government of Vietnam issued Decree No. 99/2010/ND-CP on implementation of PFES nationwide. This was considered an important event in the process of implementing payment for forest environmental services in Vietnam. With this Decree, Vietnam became one of the first countries in Asia to institutionalize the implementation of PFES on a national scale [4]. In the process of implementation due to the identification of payers for environmental services, payment levels, and beneficiaries. The Government of Vietnam has issued Decree 147/2016/ND-CP to amend a number of provisions in Decree No. 99/2010/ND-CP to be

more appropriate. The process of amending Vietnam's forest protection policy continues with the promulgation of the Law on Forest Protection and Development 2017 on November 15, 2017, and Decree No. 158/2018 on November 16, 2018, guiding the implementation of the Law on Forest Protection and Development 2017. Both of these documents continue to specify the contents of PFES to solidify the legal basis for the implementation of PFES in Vietnam. Besides, Vietnam's Law on Environmental Protection 2020 also stipulates to encourage the implementation of payment for environmental services as an economic tool to protect the environment.

Presently, Vietnam has basically completed the legal basis for implementing payment programs for forest environment services nationwide.

2.2 Review of past PFES experiences in Vietnam

In 2008–2010, USAID and the German Development Agency (GIZ) assisted the Ministry of Agriculture and Rural Development to develop a pilot project on PFES in Vietnam and suggest potential buyers and providers of ES [5, 6]. Lam Dong and Son La provinces hosted the pilot projects. The main buyers included primarily hydropower plants, and it was intended that local farmers should protect the forests as service providers or receivers. With one exception [7], we selected peer-reviewed articles or CIFOR publications released in 2010 or later to gain insights into how scholars evaluate PFES achievements in Vietnam.

Scholars agree that the pilot phase's process was seemingly hasty because of the lack of rigorous evaluation and highly optimistic in forecasting an increase in revenues to \$ 2 billion in 2020 [8]. Several studies before the issuance of the final Decree 99 were not reflected in the final decision [9].

A fundamental question is, therefore, whether the Vietnamese PFES experience appears to be a success. The answer probably depends on the criteria applied (environmental, economic, or social) and mainly on the conceived 'purity' of the Vietnamese version according to economic principles.

Vien et al. [10] refer to two fundamental weaknesses in a PFES scheme from Bac Kan province: the ES receivers are not the services' direct users. The payment differs from the social cost or opportunity cost of forest protection. Wunder et al. [7] mentioned to rename the PES experience a nonstarter in Vietnam because few environmental services are provided (they emphasize hydropower plants and watershed protection). Few entities buy the services and there is an absence of private land ownership. Despite the pessimistic forecasting and, as pointed out by McElwee et al. [5], Wunder et al. [7] were proven wrong because PFES became a relative success in Vietnam, with a cumulative annual user fee of US\$100 million. Suppose the scenario in which PFES ultimately serves to collect taxes and subsidize forest authorities [8]. In that case, Wunder et al. [7] 's criticism conveys more an intellectual claim that the Vietnamese PFES falls short of adhering to theoretical economic principles. The reality is that PES schemes transfer funds to the state outside the regular government budget, and the amount is not negligible.

One of the social objectives of the PES is to contribute to poverty alleviation. Households with limited access to the forest should participate in the program with the broader purpose of poverty reduction [11].

In an earlier evaluation of the Vietnamese PFES experience, Pham et al. [4] conclude that each household receives only a small amount, which is counter to increasing efficiency. Simultaneously, the system does not account for resource quality and thus lacks incentives to protect the forest. Despite data paucity, To et al. [8] followed the same line of argument by stating that no agency has produced data to show that

poorer households received a higher share of total PFES payments. In support of this argument, Doung and De Groot [12] state that the direct contribution of PFES to poverty alleviation is small compared with the average household income, based on estimations from samples in three provinces. In contrast, Phan et al. [13] studied two groups of households in Lam Dong province, one participating in a PFES scheme and the other not, concluding a significant difference in 2008, with nonparticipating households reporting income levels twice as high. Later, the difference in income disappeared (2014).

Furthermore, households considered payments to be too low relative to their living costs. In certain villages, income opportunities other than PFES payments are limited. McElwee et al. [5] refer to many contradictory cases, making an overall conclusion on social objectivity at the national level virtually impossible.

The economic aspects of PFES encompass different angles, as either significant financial support to the forest sector or support for poor households (see above). If the Vietnamese government envisaged PFES payments to reach a \$ 2 billion level in 2020, the PFES experience was a disappointment. Nevertheless, the current annual level of \$ 100 million from PFES schemes appears significant compared with the forestry sector's central government budget. According to data from the Vietnam Administration of Forestry [14], the total payment for forest environmental services in the 2008–2018 period in Vietnam was VND 10,000 billion (an average of VND 1300 billion/ \$56,000/year). This amount accounts for 16% of Vietnam's total forest protection budget.

Did PFES assist in saving the forest cover or at least slow the transformation of the primary forest into plantations? [15] Decree 99 refers to an 'improved forest, 'but falls short of specifying what the condition implies and how to monitor progress [16].

In light of this, forest protection is one of PFES's primary objectives; surprisingly, few studies have been conducted to bring evidence to the environmental debate. Two studies represent an exception. Phan et al. [17], using a district-based satellite image interpretation of Lam Dong province, showed an increase in forest cover from 2010 to 2014. Arriving at a similar conclusion, Duong and De Groot [12] find that forest protection has become more effective due to the implementation of a PES scheme in three different provinces. However, only this single study from Lam Dong used forest cover data from satellite images and then one district. A national-level conclusion is not possible at this stage. The last study by Duong and De Groot [12] argued that forest protection had been very successful due to PES as a result of regular official visits to forest areas and threats of severe consequences in case of noncompliant behavior. Even if this statement is correct, the risk of leakage has not vanished. Farmers can clear forests in one area for agricultural production and receive PFES money for another protected forest area [18].

Fairness and transparency are essential in PFES schemes, and, usually, studies on this topic should be abundant. However, only two studies in our sample concentrate on these aspects, while others briefly refer to the discussion. Perceived fairness of payment distribution is at the core of Loft et al.'s [19] analysis. Households preferred an equal share with only a minority in favor of payments based on work efforts (Dien Bien province). Local people rejected the initial idea of differentiation of payments according to forest conditions (primary, secondary, and degraded forest) using a weighting system (K1–K3 coefficients) and opted for a flat rate.

In a study of three different PFES schemes in Thua Thien-Hue province, Hass et al. [20] found considerable differences. Households entered lucrative contracts with the national park, whereas other PFES schemes involved low payment. The authors focused more on the lack of transparency in selecting households than on the

difference between the degrees of voluntarism among PFES schemes (our theme in this article). The government must ensure clarity in all PFES payment steps, from verification of forest area to payments to receivers [4]. Whether fairness in terms of payments based on performance equals equity is the concern of Pham et al. [21]. The authors conclude that ‘equal distribution’ among all villagers discourages any attempt to reach efficient local forest management.

Although the present literature review helped us situate the debate, we are unable to present an ultimate answer for Vietnamese ventures in regard to environmental payments, partly because any assessment depends on the criteria (ecological, social, or economic objectives) and partly because even within a limited scope and focusing on one of the requirements only, scholars seem to disagree. Most observers support the view that PFES programs in Vietnam differ from basic payment principles because authorities define mechanisms and compel service providers’ participation. Scholars agree that payments appear inferior to opportunity costs or previous forest protection programs (Program 661) [21–23].

3. Study area

Study based on Ba Be District, Bac Kan province, a mountainous area located in the northern of Vietnam. Ba Be has 68,412 hectares in total, mean annual temperature ranges from 21.98 to 23.61°C, total sunshine hours in a year is around 1283–1577 hours, annual precipitation is from 1151.3 to 1699.2 mm, and the annual humidity is 85–86%. In 2019, the total population of this district was 47,415 persons, with an approximate

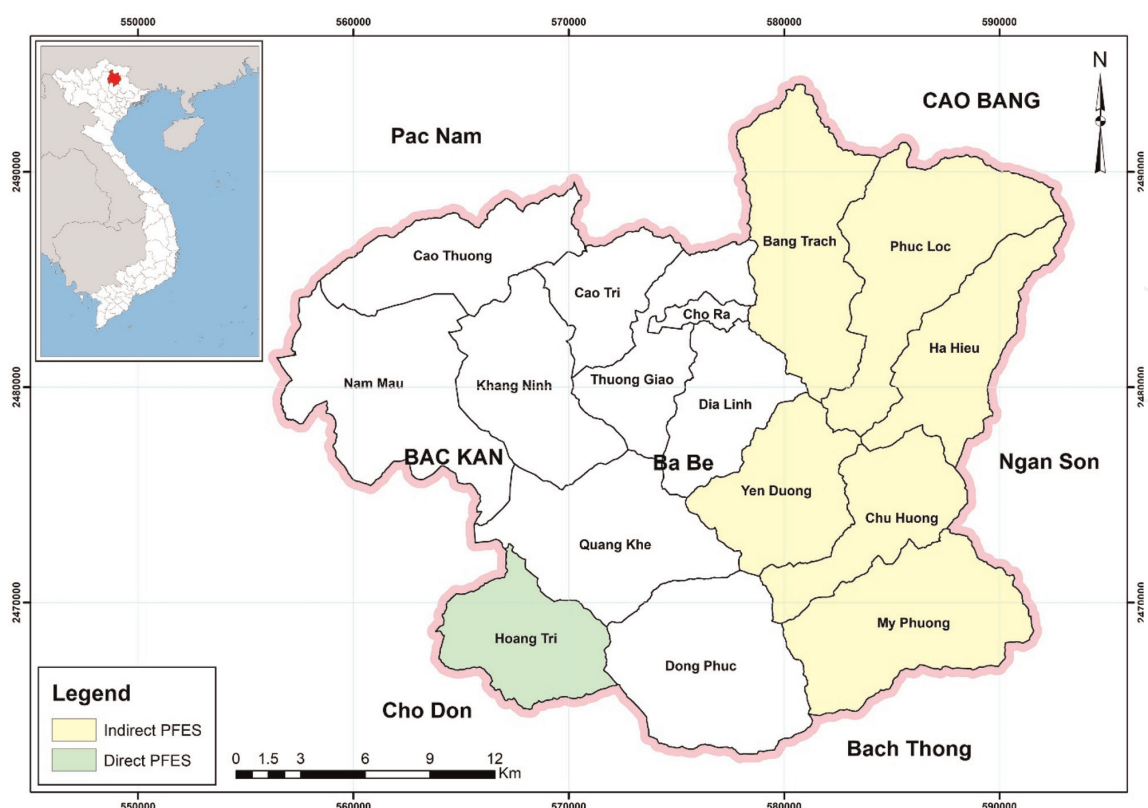


Figure 1.
Ba Be district— The area covered in this study shown on a map of Vietnam.

population density of 70 persons per km². There are four main ethnic groups living in this district: Tay, Dao, Kinh, and H'Mong groups. In comparison to other districts, Ba Be has slow economic growth, depends deeply on the agroforestry sector (taking 50% of total GDP), has a low annual income per capita (10 million VND per person), and high rate of poverty in comparison to the average rate of Vietnam (18.04% poor households in total) (**Figure 1**) [24].

Ba Be district has a large forest area of 68,412 hectares with forest coverage reaching 65%, especially in the district with Ba Be National Park which has high biodiversity and conservation value, so Ba Be receives interest and support from the State and many NGOs for forest conservation and development. Currently, in the district, there are many projects being implemented such as 3PAD, REDD+, UN-REDD, and so on. Since 2013, the PFES program has been implemented in Bac Kan province in general and in Ba Be district between Na Hang and Chiem Hoa hydro-power plants and forest owners in Ba Be district. With the above conditions, it can be seen that the Ba Be district is an appropriate place to conduct research to evaluate the actual effectiveness of the PFES program in Vietnam.

4. Study methods

4.1 Study data sources

The data used to evaluate the integrated effectiveness and analyze the actual impacts of the PFES program in Ba Be were collected from two specific sources as follows:

- Statistical data on the operation of the PFES program in the period 2013–2018 collected from the authorities in Ba Be district, Bac Kan province.
- Data from the questionnaire survey in 2016 and 2017 of 259 households in the study area, including 117 households participating and 142 households not participating in the PFES program.

4.2 Criteria for evaluating the effectiveness of the PFES program

Vietnam's PFES policy toward sustainable development of three pillars in the forestry sector: economic, social and environmental fields [25]. On that basis, we have built a set of criteria to evaluate the combined effectiveness of PFES program with 15 indicators. In which the economic aspect was evaluated based on four indicators (symbols Ec1, Ec2, Ec3, and Ec4), the social aspect was evaluated through six indicators (symbols So1, So2, So3, So4, So5, and So6) and the environmental aspect was assessed in five indicators (symbol En1, En2, En3, En4, and En5) (**Table 1**).

All these 15 criteria were synthesized and selected from the reality of the evaluation of PFES programs in the world and Vietnam. Specifically, four economic criteria (Ec1, Ec2, Ec3, and Ec4), 5 environmental criteria (En1, En2, En3, En4, and En5), and three social criteria (So1, So2, and So4) were used by the Vietnam Administration of Forestry during the evaluation of PFES programs [25]. Meanwhile, the remaining three social criteria (So3, So5, and So6) have been mentioned by scientists around the world when considering and evaluating PFES programs [26–28].

Aspect	Symbols	Indicator	Indicator description
Economic	Ec1	Average price paid (Million VND/ha/year)	Total amount received from PFES program for one hectare of forest in a year
	Ec2	Percentage of funds contributed to the local environmental protection budget (%).	Ratio between the total amount of PFES received/total annual environmental protection budget. In which, the environmental protection budget was calculated at 1% of the Babe's GDP.
	Ec3	Percentage of funds contributed to the forestry sector (%)	Ratio between the total amount of PFES received/total income of the forestry sector in Ba Be district.
	Ec4	Percentage of funds contributed to forest protection activities (%)	% of money directly used for forest protection activities from the total amount received in PFES program.
Social	So1	Percentage of poor households participating in the PFES program	Ratio of the poor to the total number of participants in the PFES program.
	So2	Percentage of ethnic minorities participating in the PFES program	Ratio of ethnic minorities to the total number of participants in the PFES program.
	So3	Social conflict	The change in the relationship between members of the community and between communities in the same locality when there was a PFES program.
	So4	Awareness of forest protection	People's awareness of the importance of forests, forest protection activities and environmental services of forests.
	So5	Fairness in PFES program	Ensure fairness among members, groups of people/communities in participating in activities of the PFES program.
	So6	Transparency in PFES program	The disclosure of activities, information, rights and responsibilities of stakeholders in the PFES program.
Environment	En1	Proportion of forest area protected under the PFES program (%)	Ratio of forest area participating in the PFES program to the total forest area of Ba Be district.
	En2	Forest quality	Divided by forest classification of Vietnam Administration of Forestry (Rich forest, medium forest, poor forest, depleted forest, restored forest)
	En3	Forest cover	The ratio of total forest area participating in the PFES program/total natural land area of Ba Be district.
	En4	Quality of forest protection activities	The quality of forest protection activities was determined based on criteria such as forest protection organization, forest patrol frequency; number of people participating in forest protection
	En5	Number of illegal deforestation cases	The increase and decrease in illegal logging cases before and after the PFES program

Table 1.
Criteria for evaluating the effectiveness of PFES program.

4.3 Evaluation of the integrated effectiveness the of PFES program

4.3.1 Scoring method

The combined effectiveness of the PFES program was evaluated by the weighted scoring method. The efficiency of the PFES program will be divided into seven levels according to a 10-point scale, specifically as shown in **Table 2**.

The Integrated Effectiveness Score (IES) was calculated on the basis of three economic, social, and environmental dimensions according to the following formula:

$$IES = EcS * W_{Ec} + SoS * W_{So} + EnS * W_{En} \quad (1)$$

In which:

- IES = The Integrated Effectiveness Score of PFES
- EcS = Economic Effectiveness Score of PFES; SoS = Social Effectiveness Score of PFES; EnS = Environmental Effectiveness Score of PFES.
- W_{Ec} , W_{So} , and W_{En} are the weights of economic, social, and environmental aspects, respectively.

The weights of economic, social, and environmental sectors are taken according to the following three scenarios:

- **Scenarios 1:** From a sustainable development point of view, the weights in all three aspects were the same (Not prioritizing any aspect) then:
 $W_{Ec} = W_{So} = W_{En} = 33.33\%$.
- **Scenarios 2:** Prioritizing forest protection activities (prioritizing environmental aspects) then the specific weights are: $W_{Ec} = 25\%$, $W_{En} = 50\%$, $W_{So} = 25\%$.
- **Scenarios 3:** Consulted with forest managers and local authorities (Ba Be district), then: $W_{Ec} = 65\%$, $W_{En} = 20\%$, and $W_{So} = 15\%$.

Rating level	Rank
Very good	9.0–1.0
Good	8.0–8.9
Pretty good	7.0–7.9
Above average	6.0–6.9
Average	5.0–5.9
Weak	4.0–4.9
Poor	0–3.9

Table 2.
Integrated effectiveness rating scale of the PFES program.

Analysis of scenarios contributes to the change in the overall effectiveness of the PFES program. On that basis, to flexibly adjust the activities of the PFES programs to suit the actual situation of the locality. This has important implications when applying the integrated efficiency assessment system of the PFES program in other localities in the future.

4.3.2 Calculation method for the EcS, SoS, and EnS

Scores for each economic, social, and environmental aspect were calculated based on the evaluation indicator. The score of each aspect was divided equally among the evaluation indicators with equal weight. Specifically, the economic aspect has four indicators, so the maximum score for each indicator was 2.5 points; the social aspect has eight indicators so the maximum score of each indicator was 1.25 points; the environmental aspect has five indicators so the maximum score of each indicator was 2.0 points. The scoring of the indicators was based on the classification of the people and the actual results obtained from the PFES program (Table 3).

The basis for evaluating scores for each criterion was described in detail in Table 4.

Aspect	Indicator	Indicator score	Evaluation level of indicator			
			Good	Pretty good	Average	Poor
Economic	Ec1	2.5	2.5 (100% of indicator score)	1.875 (75% of indicator score)	1.75 (50% of indicator score)	0.825 (25% of indicator score)
	Ec2	2.5				
	Ec3	2.5				
	Ec4	2.5				
Total EcS		10	The maximum total score of four indicators			
Environment	En1	2.0	2.0 (100% of indicator score)	1.5 (75% of indicator score)	1.0 (50% of indicator score)	0.5 (25% of indicator score)
	En2	2.0				
	En3	2.0				
	En4	2.0				
	En5	2.0				
Total EnS		10	The maximum total score of five indicators			
Social	So1	1.67	1.67 (100% of indicator score)	1.25 (75% of indicator score)	0.84 (50% of indicator score)	0.42 (25% of indicator score)
	So2	1.67				
	So3	1.67				
	So4	1.67				
	So5	1.67				
	So6	1.67				
Total SoS		10	The maximum total score of five indicators			

Table 3.
 Scoring scale to assess the effectiveness of the PFES program.

Aspect	Indicator	Evaluation level description (Good, Pretty good, Average, and Poor)
Economic	Ec1	Good $\geq 200,000$ VND/ha/year; Pretty good: from 100,000 to 200,000 VND/ha/year; Average: from 50,000 to 100,000 VND/ha/year; Poor $< 50,000$ VND/ha/year (The contract level for forest protection in Vietnam is 200,000 VND/ha/year used as the basis for classification)
	Ec2	Good $> 75\%$ of environmental protection budget; Pretty good: from 50 to 75% of the environmental protection budget; Average: from 25 to 50% of the environmental protection budget; Poor: $< 25\%$ of the environmental protection budget (In which environmental protection budget = 1% of local GDP, calculated according to the proportion of funding for national environmental protection of Vietnam.)
	Ec3	Good $> 75\%$ of the total; Pretty good: from 50 to 75% of the total; Average: from 25 to 50% of the total; Poor $< 25\%$ of the total. (Total = Total amount of payment received in the PFES program)
	Ec4	Good $> 75\%$ of the total; Pretty good: from 50 to 75% of the total; Average: from 25 to 50% of the total; Poor $< 25\%$ of total (Total = Total local forestry budget)
Environment	En1	Good $> 75\%$ of the total; Pretty good: from 50 to 75% of the total; Average: from 25 to 50% of the total; Poor $< 25\%$ of the total. (Total = Total forest area of the locality)
	En2	Good $> 50\%$; Petty good $> 40-50\%$; Average: $> 30-40\%$; Poor $< 30\%$ (Calculated according to the coverage of the paid forest area divided by the total natural area of the locality)
	En3	Rich forest = 5 scores; Medium Forest = 4 scores; Poor forest = 3 scores; Depleted forest = 2 scores; Restored forest = 1 score. Total forest quality score = 5*% rich forest + 4*% medium forest + 3*% Poor forest + 2*% Depleted forest + 1*% Restored forest. Total forest quality score from 1.0 to 2.0 = poor; from 2.1 to 3.0 = Average; 3.1–4.0 = Pretty good; 4.1–5.0 = Good
	En4	According to the results of the people’s classification based on the survey (Good up = 3 Scores; No change = 2 scores; Reducing = 1 score) If evaluation score from 1.0 to 1.5 = Poor; from 1.6 to 2.0 = Average; 2.1–2.5 = Pretty good; 2.6–3.0 = Good
	En5	Good = Do not have; Pretty good = Reducing; Average = No Change; Poor = Increasing
Social	So1	Good $> 15\%$; Pretty good: from 10 to 15%; Average: from 5 to 10%; Poor $< 5\%$ (The poverty rate of Ba Be district was 20%, which was used as a basis to spend the classification levels)
	So2	Good $> 75\%$; Pretty good: from 50 to 75%; Average: from 25 to 50%; Poor $< 25\%$.
	So3	According to the results of the people’s classification based on the survey (Good up = 3 scores; No change = 2 scores; Reduce = 1 score)
	So4	Rating: from 1.0 to 1.5 scores = Poor; from 1.6 to 2.0 score = Average; from 2.1 to 2.5 scores = Pretty good; from 2.6 to 3.0 scores = Good
	So5	Based on people’s assessment of the indicator of fairness and transparency when implementing the payment program according to five evaluation levels.
	So6	If score evaluation at level 1 and 2 = Poor, level 3 = Average, level 4 = Pretty good, and level 5 = Good

Table 4. Detailed description of the basis of classification of evaluation indicator.

5. Results

5.1 PFES program in Ba Be

5.1.1 Formation process

The PFES program started to be implemented in Ba Be district in particular and Bac Kan province in general in 2013 in the spirit of Decree No. 99/ND/CP. However, due to many difficulties in preparing administrative procedures, it was not until 2015 that the payment activity was implemented for the first time. In this payment, the amount received by forest owners is the payment for all 3 years from 2013 to 2015. Since 2015, due to the completion of procedures and necessary conditions, the program has stabilized and paid once a year at the end of the year.

5.1.2 Stakeholders

5.1.2.1 Forest environmental services suppliers – Forest owners

PFES suppliers are forest owners (households, organizations, and individuals) in Ba Be district. Accordingly, Ba Be district currently has a total of 44,762.20 ha of forest

Number of household	Unit	Rank	Mean ± SD
Number of household members	Person	1–8	4.83 ± 1.60
Household income	million VND/year	2.70–312.75	57.08 ± 53.06
Land ownership			
Total area	Ha	0.11–160.82	4.67 ± 15.12
<i>Agricultural land</i>		<i>0.04–8.00</i>	<i>0.82 ± 1.18</i>
<i>Forest land</i>		<i>0.1–52.00</i>	<i>2.93 ± 5.35</i>
Ethnic composition			
	Kinh	Household	3
		%	2.56
	Tày	Household	61
		%	52.14
	Dao	Household	52
		%	44.44
	Other	Household	1
		%	0.86
Economic sectors			
	Poor	Household	30
		%	25.86
	Nonpoor	Household	86
		%	74.14

Note: The italic value is a part of the vertical value (Smaller item).

Table 5.
 Characteristics of forest owners who are households in the PFES program.

allocated to different forest owners, including Ba Be National Park manages 7478.90 ha (16.71%), Ba Be Forest Enterprise manages 1190.60 ha (2.66%), households/individuals manage 18,783.40 ha (41.96%), village communities manage 6641.90 ha (14.84%) and the remaining 10,667.50 ha (23.83%) has not yet been contracted, so it is temporarily managed by the People's Committees of communes [24]. Forest management forms in Ba Be district are quite diverse, including state management (Ba Be National Park, People's Committees of communes), state enterprises (Ba Be Forest Enterprise), community management (Community/villages), and private management (Households/individuals) (Table 5).

5.1.2.2 Users of Forest environmental services

Tuyen Quang Hydropower Company and Chiem Hoa Hydropower Plant are users of the water source on Nang River basin to produce electricity and are identified as PFES users (Forest environmental services purchasers). However, they do not directly deal with forest owners but entrust the responsibility to the Vietnam Fund for Forest Protection & Development to do the transaction. In this program, neither the forest environmental service provider (Forest Owners) nor the forest environmental service user (Hydropower Plants/Companies) is the one to decide on the price paid, but the government is the one to decide this pay rate.

5.1.3 Payment mechanism

5.1.3.1 Cash flow

Annually, based on the output of electricity produced, Tuyen Quang Hydropower Company and Chiem Hoa Hydropower Plant contributed money to the Fund for Protection and Development of Vietnam with the unit price of 20 VND/KWh (Decision 99/2010/ND-CP), this payment has increased to 36 VND/KWh from 2018 (According to Decree 156/2018/ND-CP). The total amount of contribution was retained by the fund 0.5% as a management fund, and the remaining 99.5% of the amount was transferred to the Bac Kan Forest Protection and Development Fund. The Bac Kan Forest Protection and Development Fund was entitled to 5% of the management fee and 10% of the contingency fund (total of 15%), the remaining 85% of the amount was transferred directly to the forest owners (Figure 2). This form of payment is called indirect because the payment must be through a third party, the Forest Protection and Development Fund, at all levels.

5.1.3.2 Price paid

The rate of payment to forest owners under the PFES program was calculated according to the following formula:

$$\text{Total Payments} = S * P * K \quad (2)$$

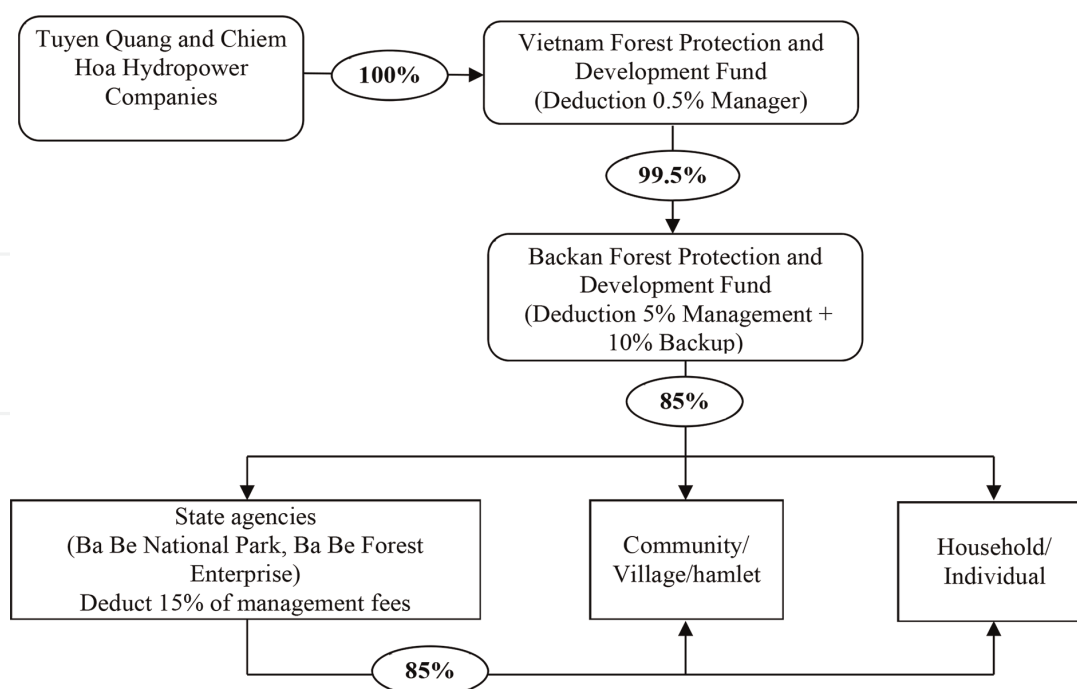


Figure 2.
 Cash flow in the Ba Be PFES program.

In Which:

- S: forest area receiving payment (Ha)
- P: price paid for 1 hectare of forest (VND/ha)
- $K = K1 \cdot K2 \cdot K3 \cdot K4$. The coefficient was determined according to the criteria of forest quality (K1), forest type (plantation/natural forest) (K2), forest origin (K3), and difficulty level in forest protection (K4). However, at the time of the study, the K coefficient in Bac Kan province, in general, and Ba Be district, in particular, is agreed to be $K = 1$ for all forest areas providing environmental services.

5.1.3.3 Dossier appraisal

In order to receive money from the PFES program, forest owners must prepare a forest owner dossier, including a self-declaration of the forest area providing environmental services; commitment to protect and manage forest area providing environmental services; self-declaration of results of protection of forest areas providing environmental services. The forest owner dossier was submitted to the Bac Kan Forest Protection and Development Fund at the end of January every year. The Bac Kan Forest Protection and Development Fund will be responsible for appraising the dossier and conducting the actual acceptance test to accurately determine the area and quality of the forest. Applications that meet the Fund's requirements will receive payments in November or December each year (**Figure 3**).

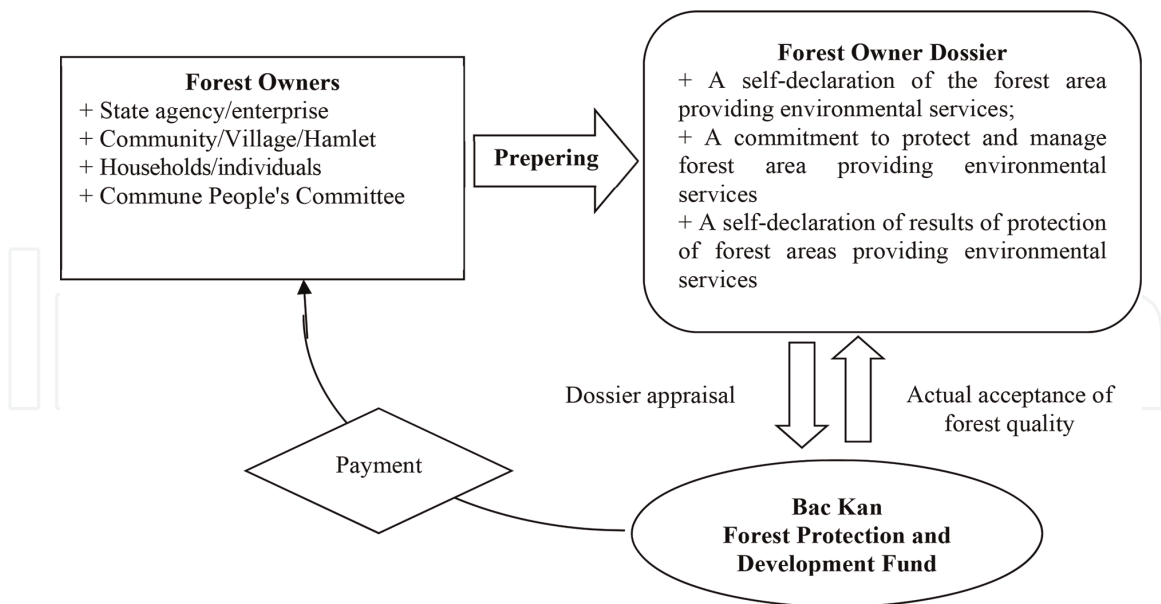


Figure 3.
The process of application assessment and payment in the PFES program.

5.2 Evaluating the effectiveness of the PFES program

5.2.1 Score of the evaluation indicator

Specific scores for each evaluation indicator are shown in **Table 6**. Accordingly, the scores of three economic, social, and environmental aspects were 5.63 points, 7.51 points, and 7.5 points, respectively. Thus, the economic efficiency of the PFES program was only average, while the social and environmental effects were evaluated equally and at a pretty good level.

Indicator	Unit	Evaluation		
		Value	Level	Score
Ec1	1000 VND/ha/year	67	Average	1.25
Ec2	%	44.71	Average	1.25
Ec3	%	2.01	Poor	0.625
Ec4	%	84.58	Good	2.5
Total EcS				5.63
So1	%	29.82	Good	1.67
So2	%	97.42	Good	1.67
So3	Score	2.32 ± 0.62	Pretty good	1.25
So4	Score		Pretty good	1.25
So5	Score	3.29 ± 0.11	Average	0.84
So6	Score	3.34 ± 0.12	Average	0.84

Indicator	Unit	Evaluation		
		Value	Level	Score
Total SoS				7.51
En1	%	80.15	Good	2.00
En2	Score	2.9	Average	1.00
En3	%	52.44	Good	2.00
En4	Score	2.41 ± 0.66	Pretty good	1.50
En5	%	27.59	Average	1.00
Total EnS				7.50

Table 6.
 Score of three economic, social, and environmental aspects of the PFES program.

5.2.2 Integrated effectiveness of the PFES program

The results of calculating the IES of the PFES program under the three scenarios are presented in **Table 7**. The IES of the program achieved the highest score in the second scenario – Sustainable Development Scenario with a score of 7.03 (Pretty Good). In the remaining two scenarios, the IES was only above average with 6.88 points and 6.28 points for the first scenario and third Scenario, respectively.

IES analysis under different scenarios to recommend managers to select/adjust the evaluation weights of three economic, social and environmental aspects in actual situation of the locality or with predefined management objectives. This creates flexibility in the performance assessment of PFES programs. As for the program of Ba Be district is one of the poorest districts of Vietnam. Besides, the local people are mainly ethnic people living in the forest. Therefore, in the selection of scenarios to evaluate the PFES program should pay attention to social issues, especially issues such as poverty reduction, participation of ethnic minorities; sustainable livelihood development; and limit social conflicts. Choosing the first scenario – sustainable development not the most effective because this area was a - special difficult need to be considered very carefully in forest protection and local economic development. On the contrary, if choosing the third scene - Promoting economic efficiency (weighted 65%), reduces environmental efficiency and social efficiency (weights 20% and 15%, respectively) causing to reduce the forest protection efficiency. On the other hand, high economic efficiency but not equal distribution will increase social conflicts, especially between the rich and the poor, ethnic minorities with Kinh people. As a result, the sustainability of the PFES program will be seriously degraded. From the above analysis, it can be seen that the option of

Scenario	Economic		Social		Environment		Integrated effectiveness	
	score	Weight	score	Weight	score	Weight	Score	Rating
First scenario	5.63	33.33	7.51	33.33	7.5	33.33	6.88	Above average
Second scenario		25.0		25.0		50.0	7.03	Pretty good
Third scenario		65.0		15.0		20.0	6.28	Above average

Table 7.
 Analysis of the integrated effectiveness of the PFES program under different scenarios.

evaluating the PFES program according to the second scenario was more feasible for the actual situation of the Ba Be district. This scenario allows the Ba Be district to sustainably protect forest resources and gradually improve local economic and social life. Focusing on forest protection while still considering the livelihoods of forest-based communities, ensuring social security and fairness.

5.3 Actual impact of the PFES program

5.3.1 Socio-economic impact

5.3.1.1 Household income

The PFES program pays forest owners, so households participating in this program will be able to increase their annual income thanks to their forest area. This can make a difference in their income compared to the group of households not participating in the PFES program (**Table 8**).

Table 8 shows that the average income and income from the forest of households participating in the PFES program are significantly higher than that of the group not participating in the program. Specifically, the average income of the group participating in the program was 2.3 million VND/year higher, and the income from the forest was 0.72 million VND/year higher than that of the households not participating in the program. Forest income of the group participating in the PFES program accounted for 6.49% of the total income of the household, while this figure was only 5.02% (1.27% lower) in the group that did not participate in the program. This shows that the PFES program has contributed to improving the average income of households participating in the program. However, this level of income is still modest.

5.3.1.2 Impact on the economic situation of households

To examine the impacts of the PFES program on people's lives, we compared some socio-economic indicators of two groups of population participating and not participating in the PFES program in Vietnam two times before and after the PFES program taken place. The results of the comparison are shown in **Table 9**. Additionally, the percentage of poor households in the group participating in the program decreased more than in the group not participating in the program. However, the percentage of

Featured		Household participating in the PFES	Household nonparticipating in the PFES	Impact of the PFES
Total household income (1000 VND/year)	Mean	41,105.64	38,755.50	2350.14
	SD	50,860.60	45,542.49	
Household income from the forest (1000 VND/year)	Mean	2668.31	1945.21	723.10
	SD	12,270.38	6438.26	
Ratio of Household in the ratio from the forest/Total household income (%)	6.49	5.02	1.27	

Table 8.

Comparison of total income and income from forests between two groups of households participating and not participating in the PFES program.

Feature	Participating				Nonparticipating			Impact of the PFES $\Delta = \Delta 1 - \Delta 2$
	Before	After	$\Delta 1 = (X2) - (X1)$	Before	After	$\Delta 2 = Y2 - Y1$		
	(X1)	(X2)		(Y1)	(Y2)			
Ratio of poor household (%)	X	Households	26.50	-5.98	44.60	47.52	2.92	-8.90
	SD	0.47	0.44		0.50	0.50		
Percentage of households with savings in Bank (%)	X	12.07	14.53	2.46	2.88**	8.63**	5.75	-3.29
	SD	0.33	0.35		0.17	0.28		
Percentage of households with savings in jewelry (%)	X	3.48	5.17	1.69	3.6	5.04	1.44	0.25
	SD	0.18	0.22		0.19	0.22		
Percentage of households with debt (%)	X	46.76*	54.68*	7.92	39.66*	48.28*	8.62	-0.70
	SD	0.50	0.50		0.49	0.50		

Note: “**” and “***” Statistical difference at the significance level was 0.05 and 0.01, respectively.

Table 9.

Comparison of some socio-economic indicators between two groups of households participating and not participating in the PFES program.

households with savings in money and jewelry of the group participating in the PFES program was lower than that of the nonparticipant group. For the percentage of households with loans in both groups participating and not participating in the PFES program, there was an increasing trend; the growth rate of the participating group was lower than that of the nonparticipating group. This once again affirms that the PFES program has contributed to improving the economic lives of households participating in the program.

5.3.1.3 Impact on people’s awareness of forest protection

The results of comparing the level of awareness of forest functions between the people participating and not participating in the payment for environmental services are shown in **Table 10**.

For the supply and cultural functions, there was no significant difference in awareness between the two groups of participants and nonparticipants in the PFES program. Meanwhile, the ability to recognize the regulatory functions of forests in the forest households participating in the program is always higher than in the group not participating in the program.

In general, it can be seen that the ability to recognize the functions of forests in the participants of the PFES program was much higher than in those who did not. Specifically, the participants recognized up to 9/14 forest functions higher than nonparticipants. In which 100% of the forest’s regulatory functions are recognized higher by the participants than the nonparticipants. This functional group of the forest was often more difficult to identify with the people than the other function groups. This can be explained because when participating in the PFES program, people will be trained and propagated more about the functions and values of forests, especially the regulatory functional group of forests.

Functions of the forest	Participating		Nonparticipating		Impact of the PFES		
	number	Different	number	Ratio (%)	Mean	Level of significance	P-Value
Supply service							
Materials for making houses (Mainly wood)	51	43.59	63	44.37	-0.78		0.90078
Food	26	22.22	36	25.35	-3.13		0.55698
Medicine	20	17.09	15	10.56	6.53		0.13464
Seeds of plants and animals	14	11.97	15	10.56	1.41		0.72438
Firewood	65	55.56	82	58.16	-2.60		0.67617
Regulatory service							
Climate regulation	92	78.63	90	63.38	15.25	**	0.00654
Water regulation	94	80.34	108	76.06	4.28		0.40618
Protect soil and limit erosion	93	79.49	107	75.35	4.14		0.42884
Disease control	26	22.22	26	18.31	3.91		0.43931
Carbon Absorption	43	36.75	48	33.80	2.95		0.62303
Cultural services							
Beliefs/Customs	21	17.95	20	14.08	3.87		0.40304
Culture	10	8.55	13	9.15	-0.6		0.86435
Education	46	39.32	44	30.99	8.33		0.16473
Ecotourism	0	0	4	2.82	-2.82	*	0.04511

Note: “*” and “**” Statistical difference at the significance level was 0.05 and 0.01, respectively.

Table 10.

Comparison of ability to recognize forest functions between two groups of households participating and not participating in the PFES program.

5.3.2 Environmental impact

5.3.2.1 Forest exploitation activities

The results of comparing the frequency of entering the forest to collect forest products of the two groups of participants and nonparticipants in the PFES program are shown in **Table 11**.

Table 11 shows that the frequency of going to the forest of both participants and nonparticipants in the PFES program after the PFES program has taken place tends to decrease. The frequency of going to the forest of the group not participating in the PFES program was always higher than that of the participating group. Reducing the frequency of people entering the forest helps limit the exploitation of forest resources. This was demonstrated more clearly through the data on forest product exploitation of the two groups described in **Table 12**.

Table 12 showed that most of the forest product exploitation activities of people in both participating and nonparticipating groups in the payment program for forest environmental services after 2015 decreased compared to the previous time. However,

Frequency to collect forest products (Times/season)		Participating			Nonparticipating			Impact of the PFES $\Delta = \Delta 1 - \Delta 2$
		Before (X1)	After (X2)	$\Delta 1$ (X2-X1)	Before (Y1)	After (Y2)	$\Delta 2$ (Y2-Y1)	
Dry season	X	8.67	7.74	-0.93	10.4	10.21	-0.19	-0.74
	SD	8.93	8.75		11.3	11.76		
Rainy season	X	5.21*	4.46*	-0.75	5.78*	5.68*	-0.10	-0.65
	SD	6.85	6.19		7.59	7.74		

Note: (*) Statistical difference at the significance level was 0.05.

Table 11.
 Comparing the frequency of collecting forest products of two groups of participants and nonparticipants in the PFES program.

Forest Products		Participating			Participating			Impact of the PFES $\Delta 2 - \Delta 1$
		Before (X1)	After (X2)	$\Delta 1$ (X2-X1)	Before (Y1)	After (Y2)	$\Delta 2$ (Y2-Y1)	
Wood	X	56.82*	33.33*	-23.49	73.58**	39.21**	-34.37	10.88
	SD	0.50	0.48		0.45	0.49		
Firewood	X	0	0	0	64.81	64.00	-0.81	0.81
	SD	0	0		0.48	0.48		
Vegetables, bamboo shoots	X	95.7	94.62	-1.08	94.44	93.46	-0.98	-0.10
	SD	0.2	0.27		0.23	0.25		
Hunting	X	0	0	0	9.52**	6.25**	-3.27	3.27
	SD	0	0		0.3	0.44		
Honey	X	17.24	7.14	-10.1	16.67	5.26	-11.41	1.31
	SD	0.38	0.26		0.38	0.23		
Rattan	X	41.67	41.67	0	0	0	0	0
	SD	0.20	0.20		0	0		
Medicine	X	25	16.67	-8.33	25	25	0	-8.33
	SD	0.44	0.38		0.44	0.44		
Other	X	66.67	66.67	0	14.28	14.28	0	0
	SD	0.26	0.26		0.36	0.36		

Note: "*" and "**" Statistical difference at the significance level was 0.05 and 0.01, respectively.

Table 12.
 The situation of people's forest product exploitation before and after the PFES program.

whether this was an impact created by the PFES program needs to be considered by the fact that the rate of reduction in harvesting of forest products among those not participating in the program was much higher than that of the group participating in the program.

5.3.2.2 Impact on the forest management plan

The results of comparing forest protection and development plans of two groups of households participating and not participating in the payment program for forest environmental services were quite significant (**Table 13**). The participants in the PFES program had a higher tendency to keep and protect forests than the group of nonparticipants. Specifically, the group participating in the program had higher percentage of planning for forest protection, afforestation, and forest protection to receive payment than the nonparticipants in the group. In contrast, those who did not participate in the PFES program had plans such as transfer of management rights, agroforestry development and forest conversion for other purposes were higher than those participating in the program. Notably, the proportion of households that did not have a forest protection plan in the group of people participating in the PFES was quite low, only 5.98%. In contrast, the number in the group of people who did not participate in the program was nearly 2.5 times higher (13.38%).

In summary, the participants of the PFES program had better forest protection and development plans than those who did not participate in the program. When forest owners actively zoned and protecting forests, it was important for protected forest environmental services because when forest owners changed land use purposes, forest environmental services will also be lost. These cases will lose great social benefits, according to the analysis of Pagiola and Platais [29].

The results of the assessment of the IE of the PFES program in Ba Be have shown that the program has had obvious environmental effects; specifically, the program has contributed to promoting and improving forest protection and development activities. This result has also been shown in Vietnam’s PFES programs in other regions such as Lam Dong, Son La, Hoa Binh and Thua Thien Hue [12, 17, 18, 20, 23]. In addition, the PFES program in Ba Be has contributed to changing people’s perception of forest resources, helping people to be more aware of the value of forests. In the program, the elements of fairness and transparency have been paid attention to, especially ensuring equal access to the program for the poor and ethnic minorities. As a result, there were no major social conflicts or conflicts when implementing PFES programs [10–12]. However, the economic efficiency of the PFES program was not high because the average payment level was still low. As a result, the payment has not really helped people living in the forest to change their livelihood conditions. This was also one of the common weaknesses of most PFES programs in Vietnam [1, 5, 9, 10]. To overcome this,

Forest management plan	Participating		Nonparticipating	
	Participating	Ratio (%)	Number	Ratio (%)
Transfer of forests to others	7	5.98	9	6.34
Forest regeneration zoning	20	17.09	24	16.90
Afforestation	57	48.72	45	31.69
Development of Agroforestry	13	11.11	29	20.42
Protection	24	20.51	14	9.86
Other management plans	4	3.42	10	7.04
Nonmanagement plan	7	5.98	19	13.38

Table 13. Comparison of forest protection plans between participants and nonparticipants in the PFES program.

it is necessary to fully exploit the environmental values of the forest, especially the carbon sequestration service of the forest. Currently, the type of carbon sequestration payment has been regulated by the Government of Vietnam in the Law on Environmental Protection (2020), but the implementation has not been carried out yet [30]. Promoting payment for carbon sequestration services will expand PFES users, which are mainly enterprises and industrial plants. From there, a large source of funding will be mobilized to contribute to raising the price paid per hectare of forest. Besides, the promotion of forest economic development, agroforestry models, planting medicinal plants under the forest canopy, etc., are also solutions that need to be promoted to contribute to raising incomes and improving livelihoods for forest-based communities.

6. Conclusion

The proposed integrated assessment method demonstrates more detail results of payment for forest environmental services in Ba Be district, Bac Kan province, Vietnam. Economic efficiency, if simply measured by the amount of money received by forest owners according to the quality of the forest they contribute, is very small and not commensurate with their efforts [5, 22]. Many researchers recognized the limitations of PFES in Vietnam such as strong state involvement, poor design and monitoring of ecosystem services, less attention on market-driven factors in PFES, and poor livelihood subsidy [5, 22, 26]. However, their evaluations were focused on individual aspects of PFES in Vietnam such as policy factors [6], enhancing forest cover and watershed [6], equality and efficiency of PFES [26], buyer's perspectives [9] or livelihood of local community [4, 12, 19–21]. But if looked at from a social perspective, the evaluation indicators have clearly shown a remarkable change in the awareness, attitude and behavior of forest owners in forest plantation and protection. In our case study, the forest owners are encouraged to participate in forest protection work, go on forest patrols and the community's awareness in forest protection work is clearly raised. This assessment approach focuses on effective exploitation of society according to local characteristics, which has been highly appreciated by researchers [19–21, 28, 29]. Social efficiency has been taken into account in other works on ethnic characteristics, religion, culture and awareness of individuals [9, 10, 26, 27] and communities [12] about the responsibility and obligation to protect forests. Meanwhile, the impacts on the environmental aspect are reflected in the fact that the payment program has protected a large area of forest and promoted forest protection activities such as managing, patrolling, and monitoring forests; reduced indiscriminate logging and deforestation; encouraged local people to protect forests, not to convert forests to other land uses as mentioned by other workers [6, 13, 14, 25].

The proposed method applies ecosystem approaches and is based on three pillars of sustainable development, i.e., economic, social and environmental development, as done by many workers [7, 28, 29]. The use of 15 diverse evaluation criteria has evaluated in detail the effectiveness of payments for forest environmental services in many respects compared with the methods used before.

However, we realize that using 15 evaluation criteria will take a lot of time, and in many cases, the number of evaluation indicators can be reduced to suit the specific conditions of each locality. In addition, our method is still focused on locality context and the upscaling is limited such as national and global dimensions [15]. However, the

simplification has to ensure the evaluation of three aspects of sustainable development such as economy, society and environment, as many workers applied in the world [7, 9, 27–29].

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Conflict of interest

The authors declare no conflict of interest.

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