

Impact of Payments for Forest Environmental Services on households' livelihood: a case study in the Central Highlands of Vietnam

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ONLINE APPENDIX

Appendix A. Tables and figures

Table A1. Synthesis of PES impacts on livelihood

Case study (source)	Method	Key findings
PFES program in the Central Highlands of Vietnam (Pham <i>et al.</i> 2021)	PSM	PFES improved on income sources, total income, income per labor
Ecuador's national forest conservation incentives program (Jones <i>et al.</i> 2020)	PSM, DID	The program improved perceived tenure security and did not increase land conflicts.
Payments for hydrological services programs in Veracruz State, Mexico (Jones <i>et al.</i> 2019)	PSM	PES influenced positively the living quality of households and communities.
PFES program in buffer zones of protected areas in Vietnam (Do & NaRanong 2019)	PSM	PFES positively affected income sources, consumption expenditure, and loan access to poor households.
Mexico's federal conservation payments program (Alix-Garcia <i>et al.</i> 2018)	Regression discontinuity	PES enhanced land management and improved community social capital
PES program in Northern Cambodia (Beauchamp <i>et al.</i> 2018)	DID	Participants in PES projects had more livelihood activities, higher agricultural productivity, and economic status compared to non-participants.
PES program in western Fujian province of Southeast China (Wang <i>et al.</i> 2017)	Tests of difference	PES empowered participants to access natural resources; non-participants were prohibited from accessing natural resources; increased net income.
Equitable payments for watershed services program in Morogoro, Tanzania (Kwayu <i>et al.</i> 2017)	PSM	PES increased crop yields, investment in housing, furniture, employment opportunities, improved knowledge and skills, expanded social network.
Payments for hydrological services program in Mexico (Alix-Garcia <i>et al.</i> 2015)	Matching and panel regressions	PES affected small but positively on poverty alleviation.
PES program in northern Cambodia (Clements & Milner-Gulland 2014)	Matching, tests of difference	PES improved household well-being, decreased household poverty, and improved agricultural productivity.
China's largest payment for ecosystem services program (Yin <i>et al.</i> 2014)	Multivariate linear regression	PES led to a 250% increase in total income, reduction of rural poverty; increased non-farm employment.
PES program in the Ecuadorian Andes (Bremer <i>et al.</i> 2014)	Descriptive statistics	PES increased the sustainability of conservation efforts, provided the potential for improving natural, financial, and social resources between community participants.

PES program in Wolong Nature Reserve, China (Yang <i>et al.</i> 2013)	Descriptive statistics and tests of difference	PES provided more benefits than costs; positively impact: income, tourism activities, prevention of water and soil erosion; negative impact: economic losses because of crop-raiding by wildlife.
Paddy Land-to-Dry Land program in Beijing, China (Zheng <i>et al.</i> 2013)	DID with matching	PES generated more benefits, e.g., improved water quantity and quality than losses, reduced agricultural output.
PES project in Mozambique (Hegde & Bull 2011)	PSM	PES increased income and revenue streams; incurred more consumption expenditure; harvested lower agriculture products.
China's Large-Scale Ecological Restoration Program (Cao 2011)	Discussion from document	Loss of income due to logging and grazing bans is greater than program payments.
Payments for watershed management in Cidanau watershed, West Java, Indonesia (Leimona <i>et al.</i> 2010)	Focus group discussion	PES contributed household income but could reduce income from wood harvesting.
PES program in China (Uchida <i>et al.</i> 2009)	DID	PES increased non-farm employment for participants.
PES project in Nicaragua (Pagiola <i>et al.</i> 2008)	Descriptive statistics	PES affected poor households because they could participate in PFES and receive payment for PES.
PES program in northern Costa Rica (Locatelli <i>et al.</i> 2008)	Multi-criteria analysis, t-tests for difference	PES improved the relationship between landowners and institutions; strengthened the forestry sector institutions; and had negative impact on short-term, medium-term, and long-term income of small farmers but positive impact on others.
Land conservation program in China (Uchida <i>et al.</i> 2007)	PSM, DID	PES increased assets and income from breeding activities and contributed to poverty reduction.
PES in Costa Rica (Miranda <i>et al.</i> 2003)	Descriptive statistics	PES contributed household income and provided economic means and technical assistance for households.

Note: Although some papers in the table were mentioned by Pham *et al.* (2021) to synthesize PES impact on income, they continue to be mentioned here to synthesize the effect on other aspects of livelihood, i.e., income, expenditure, asset, loan or well-being.

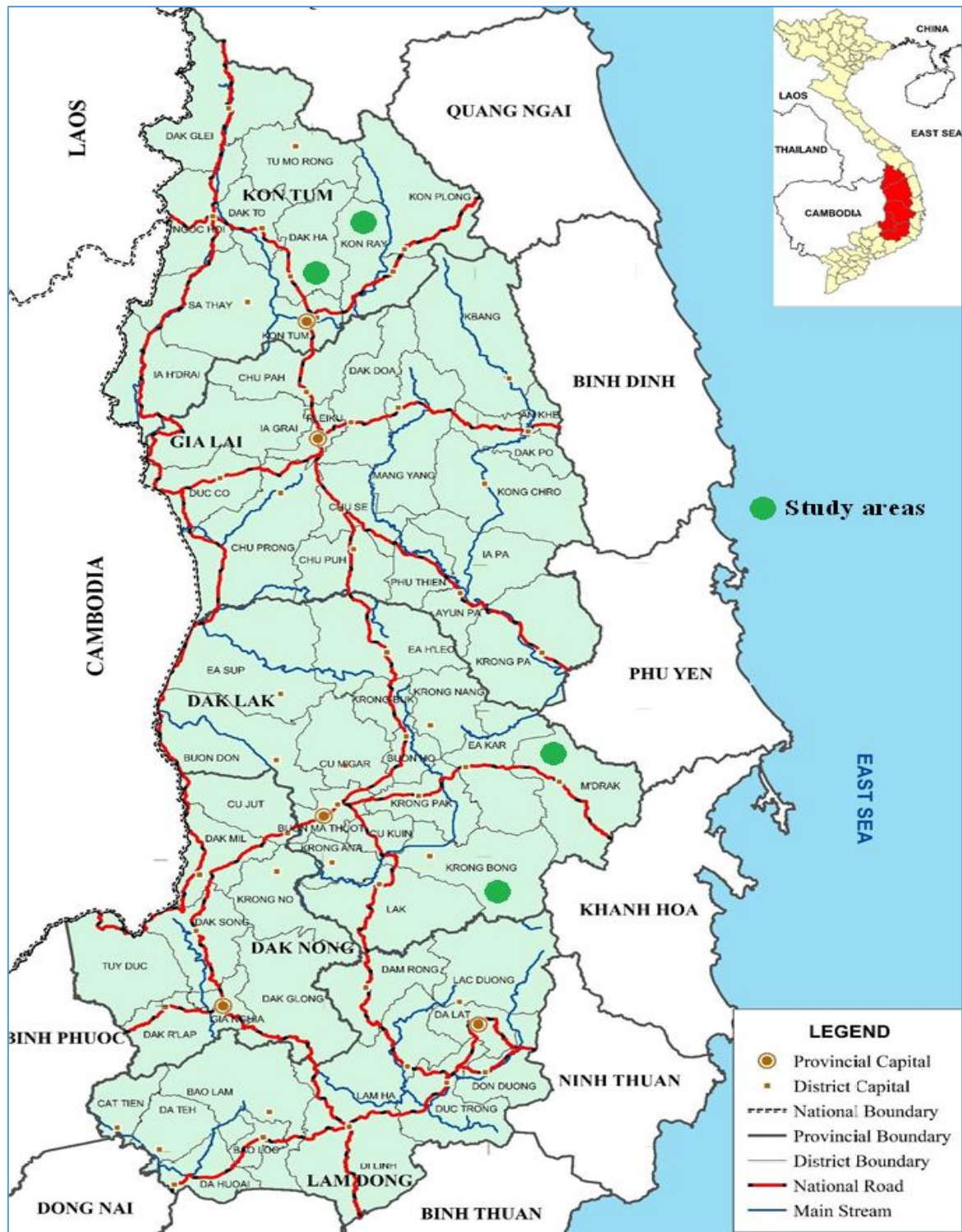


Figure A1. Location map of the Central Highlands of Vietnam.

Source: Adapted from JICA, 2018.

Table A2. Results of the participation model

Variables	Coef	Std. Error	P > z
Intercept	-0.214996	0.560107	0.70109
Age of the household head	-0.025779	0.008786	0.00335
Male-headed household	0.719026	0.330378	0.02953
Household size	0.189238	0.064607	0.00340
Households often participate in seasonal works	-0.502695	0.229804	0.02871
Households regularly receive assistance	0.388327	0.225715	0.08535
Prob > chi2		0.0001787	

Note: The logit model for participation in PFES was estimated for the entire independent variables related to household characteristics, and, then in consideration of the PFES mechanism, we identified variables that need to be removed from the selection model..

Table A3. The results of “xBalance” test

Matching algorithms	Chi-square	Df	P. value
Before matching	23.4	5	0.000
After matching			
<i>Using the nearest-neighbor with a caliper</i>	<i>1.34</i>	<i>5</i>	<i>0.930</i>
<i>Using the nearest-neighbor without a caliper</i>	<i>1.63</i>	<i>5</i>	<i>0.898</i>
<i>Using the full matching</i>	<i>13.3</i>	<i>5</i>	<i>0.021</i>

Table A4. Estimated impacts of PFES on livelihood when using the Bonferroni correction

Indicators	Caliper matching	Nearest-neighbor matching	Full Matching
Livelihood resources			
Certificated land area (ha)	-0.0499 (1.0000)	-0.0168 (1.0000)	-0.0459 (1.0000)
Value of appliances used in daily living (million VND)	5.3995 (1.0000)	4.9660 (1.0000)	3.2648 (1.0000)
Value of appliances used for production (million VND)	-0.1757 (1.0000)	-0.0450 (1.0000)	-1.4759 (1.0000)
Loan access (million VND)	-6.5220 (0.7536)	-6.8395 (0.5880)	-4.1544 (1.0000)
Households participating in training courses	0.1944 (0.0060)	0.1820 (0.0162)	0.1556 (0.0466)
Households participating in groups of production or job development	0.0088 (1.0000)	0.0060 (1.0000)	-0.0000 (1.0000)
Households participating in traditional community activities	0.2139 (0.0013)	0.1873 (0.0101)	0.1712 (0.0147)
Income and expenditure for living			
Number of livelihood sources (million VND)	0.3300 (<0.001)	0.3381 (<0.001)	0.3286 (<0.001)
Total income of household (million VND)	11.7639 (0.1577)	12.3560 (0.1097)	10.1539 (0.2774)
Income from cultivation activities (million VND)	5.5110 (1.0000)	6.0350 (0.7260)	5.1601 (0.9098)
Income from resources livestock breeding activities (million VND)	-0.7495 (1.0000)	-0.7617 (1.0000)	-0.8059 (1.0000)
Income from activities related to natural forest (million VND)	8.2401 (<0.001)	8.2781 (<0.001)	8.3868 (<0.001)
Income from short-term employment activities (million VND)	-0.9761 (1.0000)	-0.9034 (1.0000)	-0.9934 (1.0000)
Income from other activities (million VND)	-0.2616 (1.0000)	-0.2920 (1.0000)	-1.5936 (1.0000)
Cost for food and drinking of households (million VND per day)	0.0116 (0.0910)	0.0120 (0.0833)	0.0090 (0.0440)
Cost of living of households (million VND per month)	0.5030 (0.0101)	0.4956 (0.0140)	0.4013 (0.0636)
Well-being			
Feeling satisfied with the family's income (score)	0.2450 (0.6480)	0.2628 (0.4296)	0.2291 (0.6768)
Family members had an appropriate job (score)	0.2147 (0.9264)	0.1832 (1.0000)	0.1286 (1.0000)
Feeling satisfied with current life (score)	0.1554 (1.0000)	0.1349 (1.0000)	0.1146 (1.0000)

Land use			
The ability of water source support irrigation (score)	0.0901 (1.0000)	0.0741 (1.0000)	0.0298 (1.0000)
Organic fertilizers were mainly used in agricultural production (score)	0.0909 (1.0000)	0.1017 (1.0000)	0.1016 (1.0000)
Enhancing the use of organic fertilizer to replace chemical fertilizers (score)	0.1716 (1.0000)	0.1281 (1.0000)	0.1672 (1.0000)
Soil fertility was increasingly improved (score)	0.1518 (1.0000)	0.1317 (1.0000)	0.1284 (1.0000)
Land productivity was increasingly improved (score)	0.0847 (1.0000)	0.1400 (1.0000)	0.1222 (1.0000)

Note: The p-values are in parentheses.

Appendix B. Questionnaire

QUESTIONNAIRE

I am Pham Van Truong, a lecturer of Tay Nguyen University. I conduct this interview to collect information to assess the impact of the policy on payment for forest environmental services (PFES) on livelihood and attitude for forest conservation. I hope that you will take some time to answer the questions in this interview. Your participation is voluntary, and the information will be only used for scientific research purposes.

I. General information

1. Code:
2. Interview date:
3. Interviewee address:village, commune, District, province

II. Information about household head and family situation

4. Year of Birth:
5. Gender: ① Male ② Female
6. Main occupation:
 ① Agriculture ② Worker ③ Merchant ④ State officer
 ⑤ Student ⑥ Unemployed ⑦ Others
7. Marital status: ① Married ② Single ③ Widow ④ Divorce
8. Education level
 ① None ② Primary school ③ Secondary school ④ High school
 ⑤ Vocational training ⑥ Bachelor degree ⑦ Postgraduate ⑧ Other
9. Health situation: ① For having disease ② For normal
10. Health insurance: ① For yes ② For no
11. Ethnic:
12. Household origin
 ① Born here ② Move from another place
13. Distance from house to the center of commune (km)
14. Household classification ① Poor household ② Non-poor household

III. Information about livelihood

15. Residential land (ha), agricultural land ha, forestry land ha, and abandoned/unused land ha
16. Certificated agricultural land ha, certificate forestry land ha
17. Water sources for needs of irrigation
 ① Very bad (water sources are not enough, this can cause the tree to die, grow slowly or lose all production)
 ② Bad (water sources are insufficient, and this can reduce crop yield)
 ③ Normal (water sources are sufficient, and irrigation cost is reasonable)
 ④ Good (water sources are sufficient, and irrigation cost is low)
 ⑤ Very good (water sources is sufficient without extra cost for irrigation)
18. Water sources for living
 ① Family well, water tank ② Rivers, streams, ponds and lakes ③ Public wells

④ Water company ⑤ Other

19. Household ability to get information from books, news and mass media:

① Very bad ② Bad ③ Normal ④ Good ⑤ Very good

20. Number of family members; Number of employees

21. Information about family members (excluding household heads):

Content	Family member								
	1	2	3	4	5	6	7	8	9
▪ Relationship with head of household: 1 for spouses; 2 for children, 3 for parent, 4 for others									
▪ Gender: 1 for male, 2 for female									
▪ Year of Birth									
▪ Main occupation: 1 for agriculture; 2 for worker, 3 for merchant, 4 for state officer, 5 for student, 6 for unemployed, 7 for other									
▪ Education level: 1 for none; 2 for primary school; 3 for secondary school; 4 for high school; 5 for vocational training; 6 for bachelor degree; 7 for postgraduate; 8 for other									
▪ Health situation in 2019: 1 for having disease; 2 for normal									
▪ Health insurance in 2019: 1 for yes; 2 for no									

22. House condition: square of house: m², estimated value of house..... .. million VND

23. Appliances used in daily living

Items	Quantity	Estimated value (million VND)	Items	Quantity	Estimated value (million VND)
▪ Television			▪ Car or truck		
▪ Laptop, computer			▪ Motorbike		
▪ Washing machine			▪ Bike		
▪ Fridge			▪ Stove		
▪ Radio, cassette			▪ Water pump		
▪ Phone			▪ Cooker		
▪ Flat iron			▪ Fan		
▪ Others			▪		

24. Appliances used for production

Items	Quantity	Estimated value (million VND)	Items	Quantity	Estimated value (million VND)
▪ Agrimotor			▪ Sprayer		
▪ Pump machine, pipe			▪ Chainsaw		
▪ Lawnmower			▪ Others		

25. Building production facilities

Items	Area (m2)	Estimated value (million VND)	Items	Area (m2)	Estimated value (million VND)
▪ Warehouse			▪ Pigsty		
▪ Drying yard			▪ Poultry cages		
▪ Stable			▪ Ponds		
▪ Others			▪		

26. The situation of borrowing capital

Content	Amount of money (million VND)	Rate per year (%)	Purpose (*)	Outstanding amount (million VND)
▪ Bank				
▪ Agent, company				
▪ Project, organizations and unions				
▪ Relatives and friends				
▪ Other				

Note (*): 1 for production; 2 for consumption; 3 for education; 4 for health; 5 for repayment; 6 for others

27. Participating in training, project and networking activities of family member

Activity	Participation (1 for yes, 2 for no)	Application or contribution level of activities (*)
▪ Participating in training courses (e.g. production knowledge or vocation), production model after 2015		
▪ Participating in development projects such as poverty reduction after 2015		
▪ Getting preferential loans after 2015		
▪ Receiving help (mental or physical) from organizations inside and outside locality after 2015		
▪ Participating in group of production, consumption, job development or financial groups after 2015		
▪ Participating in groups that are voluntarily formed to strengthen community connection after 2015		
▪ Participating in traditional community activities such as festivals, events or holidays after 2015		
▪ Participating in forestry projects such as afforestation and forest protection in the past		
▪ Participating in current forestry projects related to forest protection		
▪ Participating in state agencies after 2015		

Note (*): (1) very insignificant; (2) insignificant; (3) normal; (4) significant; (5) very significant

28. Role of livelihood activities implementing

....., Cultivating activities, Agroforestry activities
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....., Breeding activities, Worker hired in agriculture
....., Forestry activities, Other non-agricultural activities

Note: write the number into the appropriate options (1 is the most important livelihood strategy, when the number increase, the importance reduces)

29. In comparing to the past, how do livelihood activities changes:

Content	Decreased significantly	Decreased little	No change	Increased little	Increased significantly
Cultivating activities	①	②	③	④	⑤
Breeding activities	①	②	③	④	⑤
Forestry activities	①	②	③	④	⑤
Non-agricultural activities	①	②	③	④	⑤
Agroforestry activities	①	②	③	④	⑤

30. Income from cultivation activities in 2018

Crop	Area (ha)	Yield (ton)	Price (million VNĐ/ton)	Operating cost (million VNĐ)	
				Buying/renting	Family
▪ Rice					
▪ Maize					
▪ Cassava					
▪ Pea					
▪ Pineapple					
▪ Sugarcane					
▪ Vegetable					
▪ Flower					
▪ Coffee					
▪ Pepper					
▪ Cashew					
▪ Rubber					
▪ Fruit tree					
▪ Others					
▪					

31. Income from breeding activities in 2018

Kind of animal	Quantity of animal	Selling yield (ton)	Revenue (triệu đồng)	Operating cost (million VNĐ)	
				Buying/renting	Family
▪ Cow					
▪ Pig					
▪ Goat					
▪ Poultry					
▪ Fish					

▪					
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32. Income from plantation forest in 2018

Plot	Kind of plant	Area (ha)	Year	Cost (million VND)	Estimating revenue from buying wood (million VND)
Plot 1					
Plot 2					
Plot 3					
Plot 4					

33. Other products or activities related to forest in 2018

Product or activity	Exploitation (*)	Purpose (1 for only use, 2 have sale)	Frequency (**)	Estimating value/ income (million VND)
Wood, bamboo				
Firewood				
Vegetable, honey, flower, herbs				
Farming or livestock activities from forest				
Tourism activities				

Note:(*) 1 non exploiting ; 2 only exploiting in past; 3 exploiting from past to now; 4 beginning exploiting this year
 (**) 1 usually; 2 often; 3 occasionally; 4 seldom; 5 rarely

34. Income from other activities in 2018

Field	Income 2018	Field	Income 2018
▪ Employee		▪ Subsidize/ pension	
▪ Self-organizing business in non-agriculture		▪ PFES	
▪ State officials		▪ Rental properties	
▪ Money sent from others		▪ Others	
▪			

35. Comparing income in 2018 and previous years

Content	Decreased significantly	Decreased little	No change	Increased little	Increased significantly
▪ Cultivation activities	①	②	③	④	⑤
▪ Breeding activities	①	②	③	④	⑤
▪ Product from forest activities	①	②	③	④	⑤
▪ Non-agricultural activities	①	②	③	④	⑤
▪ Total income	①	②	③	④	⑤

36. In 2018, your family have to face production-related shocks

- ① Product prices plummeted ② Disease in production ③ Drought, flood
 ④ Products cannot be consumed ⑤ Production output declined ⑥ Other.....

37. Impact severity of these shocks on your family

- ① Very serious ② Serious ③ Normal ④ Less serious ⑤ Not serious

38. How often do these shocks happen

- ① Usually ② Often ③ Occasionally ④ Seldom ⑤ Rarely

39. Cost for food and drinks for all family member in 2018:thousand VND/day

40. Amount of money spent on other living expenses (e.g. electricity, water, phone, education, health, wedding, visit or funeral) in 2018:thousand VND/month

41. The income meets the need of basic living standard: ① Sufficiency ② Enough ③ Not enough

42. Your opinion about well-being

Content	Totally disagree	Disagree	Agree	Totally agree	Uncertain
You feel satisfied with your family's income	①	②	③	④	⑤
You feel satisfied with medical and health care services	①	②	③	④	⑤
You feel satisfied with the accommodation and equipment for living	①	②	③	④	⑤
It is easy to access basic education	①	②	③	④	⑤
Family members have an appropriate job	①	②	③	④	⑤
You feel satisfied with environmental quality	①	②	③	④	⑤
You feel satisfied with social connections	①	②	③	④	⑤
You feel satisfied with social safety	①	②	③	④	⑤
You feel satisfied with public services	①	②	③	④	⑤
You feel free to make decisions regarding family economic activities	①	②	③	④	⑤
You feel satisfied with your life	①	②	③	④	⑤

43. Assessing situation of land use

Content	Totally disagree	Disagree	Agree	Totally agree	Uncertain
▪ Organic fertilizers are mainly used in agricultural production	①	②	③	④	⑤
▪ You enhance the use of organic fertilizer to replace chemical fertilizers	①	②	③	④	⑤
▪ You do not remove directly inorganic or hazardous wastes (e.g. pesticide packaging or dead animals) into environment	①	②	③	④	⑤
▪ Your production activities do not harm and pollute the environment	①	②	③	④	⑤
▪ Current farming methods are suitable for quality and type of soil	①	②	③	④	⑤
▪ You regularly test the content of substances in the soil	①	②	③	④	⑤
▪ Soil fertility is increasingly improved	①	②	③	④	⑤

▪ Land productivity is increasingly improved	①	②	③	④	⑤
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IV. Attitude for forest conservation

44. Your opinion about the role of forest protection and activities to conserve the forest

Content	Totally disagree	Disagree	Agree	Totally agree	Uncertain
<i>i. Affective responses/feeling</i>					
▪ You feel pleasure with forest-related activities	①	②	③	④	⑤
▪ You feel discontented with deforestation activities	①	②	③	④	⑤
▪ You feel interested to participate in policies or projects to conserve forest	①	②	③	④	⑤
▪ You are concerned about forest-related information	①	②	③	④	⑤
<i>ii. Cognitive responses /knowledge</i>					
▪ Forests and forest protection play an important role	①	②	③	④	⑤
▪ You know policies related to forest conservation	①	②	③	④	⑤
▪ You know individuals and organizations who are responsible for forest conservation in your locality	①	②	③	④	⑤
▪ You know agroforestry production models	①	②	③	④	⑤
▪ You know local forest situation	①	②	③	④	⑤
<i>iii. Behavioral responses</i>					
▪ You stop activities related to deforestation	①	②	③	④	⑤
▪ You are ready to commit to protect forest	①	②	③	④	⑤
▪ You will inform the relevant agency when you know of illegal activities related to the forest	①	②	③	④	⑤
▪ You have activities or plan for protecting forests or expanding forest areas	①	②	③	④	⑤
▪ You usually advise others not to deforest	①	②	③	④	⑤

V. Opinions and feedbacks of household about PFES

45. Your family knows PFES policy: ① Yes ② No
46. Your family participates and is paid to protect forest (participating PFES)
 ① Yes (if choosing, answering all next questions)
 ② No (if choosing, answering from question 58 onwards if question 45 choose “yes”, and answering only question 59 if question 45 choose “no”)
47. The ways that your family participates in PFES:
 ① Forest owner (community, household) ② Contracted to protect forests ③ Both
48. Types of forest that household protects in PFES
 ① Natural Forest ② Plantation ③ Both
49. The current payment method of PFES money
 ① Cash ② Bankcard ③ In-kind ④ Others
50. Number of payments per year

① 1 ② 2 ③ 4 ④ 12 ⑤ Other

51. Do you know and remember protected forest area by your household (or by community that you participate in):

① Know and remember clearly ② Know and not remember ③ Not know and not remember

52. Income from PFES (million VND): 2018; 2017

53. Family activities involved in implementing PFES (you can choose more than one option)

① Attend the meeting to inform about PFES ② Attend the meeting to comment for implementation
 ③ Attend in training and guidance on PFES ④ Attend in clarifying forest land boundaries
 ⑤ Attend in forest patrolling ⑥ Other

54. Modality of patrolling forest

① Patrol by individual household ② Patrol by group of households ③ Other

55. How many times do you patrol per year; How many days do you spend per time.....

56. Opinions of participating households in PFES

Content	Totally disagree	Disagree	Agree	Totally agree	Uncertain
▪ You participate voluntarily in PFES	①	②	③	④	⑤
▪ You understand clearly the objectives of the PFES and regulations when participating in PFES	①	②	③	④	⑤
▪ You understand clearly the terms of the contract and forest protection commitment when participating in PFES	①	②	③	④	⑤
▪ You can easily access information about PFES	①	②	③	④	⑤
▪ The process of participating in PFES is simple and is clearly guided	①	②	③	④	⑤
▪ Conditions of participation in PFES are fair	①	②	③	④	⑤
▪ The attitude of the staff in PFES is friendly and enthusiastic	①	②	③	④	⑤
▪ There are many activities/training that help you understand about PFES	①	②	③	④	⑤
▪ The activities of forest inspection and statistics are conducted regularly	①	②	③	④	⑤
▪ PFES money is paid fully and on time	①	②	③	④	⑤
▪ The process of receiving money for PFES is simple	①	②	③	④	⑤
▪ Money from PFES is too low to encourage participation	①	②	③	④	⑤
▪ Money from PFES is appropriate to offset the opportunity cost of participating in PFES	①	②	③	④	⑤
▪ You are satisfied with the documents and regulations relating to PFES	①	②	③	④	⑤
▪ You are satisfied with the attitude of the staff who guide and implement PFES	①	②	③	④	⑤
▪ You are satisfied with the payment method of PFES	①	②	③	④	⑤
▪ You are satisfied with the amount of money received when participating in PFES	①	②	③	④	⑤
▪ You are satisfied with the support when participating in PFES	①	②	③	④	⑤

▪ You are satisfied when participating in PFES	①	②	③	④	⑤
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57. Opinions of participating households about the impact of PFES on their livelihood and attitude for forest conservation (comparing to those before participating PFES)

Content	Totally disagree	Disagree	Agree	Totally agree	Uncertain
▪ Livelihood resources have been improved	①	②	③	④	⑤
▪ Number of activities creating income has increased	①	②	③	④	⑤
▪ Income has been improved	①	②	③	④	⑤
▪ Well-being of family has been improved	①	②	③	④	⑤
▪ Frequency and severity of shocks has decreased	①	②	③	④	⑤
▪ Quantity and quality of meals has been improved	①	②	③	④	⑤
▪ Sustainable land use activities increased	①	②	③	④	⑤
▪ Income from the forest has increased	①	②	③	④	⑤
▪ Income from the forest has become more important	①	②	③	④	⑤
▪ You feel more pleased with forest protection activities	①	②	③	④	⑤
▪ Awareness and responsibility about the role of forest are improved	①	②	③	④	⑤
▪ You have more efforts for forest protection or expanding forest area	①	②	③	④	⑤
▪ Pressure in forest protection increased	①	②	③	④	⑤

58. Assessing the impact of PFES to the community

Content	Totally disagree	Disagree	Agree	Totally agree	Uncertain
▪ PFES helps people to understand and comply with forest protection regulations	①	②	③	④	⑤
▪ PFES enhances cohesion in the community	①	②	③	④	⑤
▪ PFES helps improve income for poor people	①	②	③	④	⑤
▪ PFES helps improve community resources	①	②	③	④	⑤
▪ PFES helps improve forest area	①	②	③	④	⑤
▪ PFES helps improved ES (reducing soil erosion, enhancing water for irrigation or conserving biodiversity)	①	②	③	④	⑤
▪ PFES helps increase well-being for the community	①	②	③	④	⑤
▪ PFES is better than other forestry policies in the past	①	②	③	④	⑤
▪ Deforestation activities are still common	①	②	③	④	⑤

59. If you do not participate in PFES, the income per day for patrolling and protecting forest that you are willing to accept to participate in PFES is (or if you have participated in PFES, in your opinion, the appropriate payment should be): over thousand VND

Thanks for your support and cooperation

References

- Alix-Garcia JM, Sims KRE, Orozco-Olvera VH, Costica LE, Fernández Medina JD and Monroy SR** (2018) Payments for environmental services supported social capital while increasing land management. *PNAS* **115**, 7016–7021.
- Alix-Garcia JM, Sims KR and Yanez-Pagans P** (2015) Only one tree from each seed? Environmental effectiveness and poverty alleviation in Mexico's Payments for Ecosystem Services Program. *American Economic Journal: Economic Policy* **7**, 1–40.
- Beauchamp E, Clements T and Milner-Gulland E** (2018) Assessing medium-term impacts of conservation interventions on local livelihoods in Northern Cambodia. *World Development* **101**, 202–218.
- Bremer LL, Farley KA, Lopez-Carr D and Romero J** Conservation and livelihood outcomes of payment for ecosystem services in the Ecuadorian Andes: what is the potential for 'win-win'? *Ecosystem Services* **8**, 148–165.
- Cao S** (2011) Impact of China's large-scale ecological restoration program on the environment and society in arid and semiarid area's of china: achievements, problems, synthesis, and applications. *Critical Reviews in Environmental Science and Technology* **41**, 317–335.
- Clements T and Milner-Gulland E** (2014) Impact of payment for environmental services and protected areas local livelihoods and forest conservation in northern Cambodia. *Conservation Biology* **29**, 78–87.
- Do TD and NaRanong A** (2019) Livelihood and environmental impacts of payments for forest environmental services: a case study in Vietnam. *Sustainability* **11**, 1–22.
- Hegde R and Bull GQ** (2011) Performance of an agro-forestry based payments for environmental services project in Mozambique: a household level analysis. *Ecological Economics* **71**, 122–130.
- JICA** (2018) Data collection survey on water resources management in Central Highlands.

- Jones KW, Etchart N, Holland M, Naughton-Treves L and Arriagada R** (2020) The impact of paying for forest conservation on perceived tenure security in Ecuador. *Conservation Letters* **13**, e12710.
- Jones KW, Foucat SA, Pischke EC, Salcone J, Torrez D, Selfa T and Halvorsen KE** (2019) Exploring the connections between participation in and benefits from payments for hydrological services programs in Veracruz State, Mexico. *Ecosystem Services* **35**, 32–42.
- Kwayu EJ, Paavola J and Sallu SM** (2017) The livelihood impact of the equitable payments for watershed services (EPWS) program in Morogoro, Tanzania. *Environment and Development Economics* **22**, 328–349.
- Leimona B, Pasha R and Rahadian N** (2010) The livelihood impacts of incentive payments for watershed management in Cidanau watershed, West Java, Indonesia. In Tacconi L, Mahanty S and Suich H (eds), *Payments for environmental Services, Forest Conservation and Climate Change: Livelihoods in the REDD?* Cheltenham, UK: Edward Elgar Publishing, pp. 106–129.
- Locatelli B, Rojas V and Salinas Z** (2008) Impacts of payments for environmental services on local development in northern Costa Rica: a fuzzy multi-criteria analysis. *Forest Policy and Economics* **10**, 275–285.
- Miranda M, Porras IT and Moreno ML** (2003) The social impacts of payments for environmental services in Costa Rica. A quantitative field survey and analysis of the Virilla watershed. International Institute for Environment and Development (IIED), London.
- Pagiola S, Rios AR and Arcenas A** (2008) Can the poor participate in Payments for Environmental Services? Lessons from the Silvopastoral Project in Nicaragua. *Environment and Development Economics* **13**, 299–325.

- Pham VT, Roongtawanreongsri S, Ho,TQ and Tran PHN** (2021) Can payments for forest environmental services help improve income and attitudes toward forest conservation? Household-level evaluation in the Central Highlands of Vietnam. *Forest Policy and Economics* **132**, 102578.
- Uchida E, Rozelle S and Xu J** (2009) Conservation payments, liquidity constraints and off-farm labor: impact of the Grain for Green Program on rural households in China. *American Journal of Agricultural Economics* **91**, 70–86.
- Uchida E, Xu J, Xu Z and Rozelle S** (2007) Are the poor benefiting from China’s land conservation program? *Environment and Development Economics* **12**, 593–620.
- Wang C, Pang W and Hong J** (2017) Impact of a regional payment for ecosystem service program on the livelihoods of different rural households. *Cleaner Production* **164**, 1058–1067.
- Yang W, Liu W, Viña A, Luo J, He G and Ouyang Z** (2013) Performance and prospects of payments for ecosystem services programs: evidence from China. *Environmental Management* **127**, 86–95.
- Yin R, Liu C, Zhao M, Yao S and Liu H** (2014) The implementation and impacts of China’s largest payment for ecosystem services program as revealed by longitudinal household data. *Land Use Policy* **40**, 45–55.
- Zheng H, Robinson BE, Liang YC, Polasky S, Ma, DC, Wang FC, Ruckelshaus M, Ouyang ZY and Daily GC** (2013) Benefits, costs, and livelihood implications of a regional payment for ecosystem service program. *PNAS* **110**, 16681–16686.