COST-BENEFIT ANALYSIS OF FOREST ECOSYSTEM SERVICES

A Quantitative Comparison between Economic Benefits and Opportunity Cost of Payment for Forest Ecosystem Services in Vietnam

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Abstract

Vietnam is one of the Southeast Asia countries which facilitates the Payment for Ecosystem Services (PES) scheme in national scale. In spite of legal framework to encourage the PES scheme, the government has constantly faced difficulties from inadequate assessment of service priority region and insufficient amount of monetary compensation. To absolve current problems, this study aims to diagnose three major ecosystem service's priority region and compare them with potential opportunity cost which current forest landowner can expect to get when they convert forests into agricultural purpose. It was intended to examine current PES compensation extent in administrational boundaries. The result showed that three of forest ecosystem services showed different spatial priority in providing services. Also their overall PES compensation ratio was averagely 3.4% of potential agricultural income. It implies that many forest landowners can decide to alter their lands to pursue additional revenue. In conclusion, it is needed to increase the extent of compensation through including more ecosystem services in compulsory legal frame and to raise unit value of current ecosystem services to achieve sustainable forest protection under PFES scheme in Vietnam

Introduction

Globally, forests are under constant threat from human activities. To preserve forests, many attempts were made to deter deforestation and one of them is a Payment for Ecosystem/Environmental Services (PES) scheme. It was regarded as a singular method to protect forests while achieving financial revenue through monetary compensation for ecosystem services which forests provide. Vietnam is one of the most progressive countries for adopting PES scheme in Asia, and the government has launched national decree called Payment for Forest Environmental Services (PFES) in 2010. Vietnamese PFES scheme specifies several ecosystem services that can be transacted and the scheme includes ecosystem services' unit values for ecosystem services to be exchanged. The scheme intended to encourage landowners who owned

Figure 1 Map of study area

forestlands to be subsidized with certain amount of money as a compensation of preserving forest and providing ecosystem services consistently.

However, it is insufficient to prevent landowners from converting their forests into cultivated lands to pursue profits. Currently, involvement of PFES scheme is based on voluntary participation rather than from nationwide ecosystem services assessment. Also lacking spatial information on deciding where to launch a regional PFES scheme intensively is one of major reasons causing inefficient forest management. Additionally, current compensation through PFES is unconducive to support local livelihood. It might lead to additional deforestation because of unsatisfied financial compensations.

In this study, we adopted quantitative methods to analyze production amount of forest ecosystem services in spatially explicit way and to examine financial obstacle in current PFES scheme in Vietnam. By comparing three PFES compensation in forests and their opportunity cost of preserving forest lands (e.g. not converting them into agricultural areas), we aim to estimate the sustainability of forest conservation within PFES scheme in Vietnam.

Method

The study area was the Socialist Republic of Vietnam, located in the Indochina Peninsula in Southeast Asia. Covering a wide range of latitude (from 8 to 24°) and altitude (from 0m to 3000m), climate conditions differ to regions resulting in various environmental status and agricultural activities. In this study, we assumed that most critical factor to guarantee the sustainable forest protection is financial satisfaction from PFES scheme implying that landowners would voluntarily participate in forest conservation only if the PFES compensation meets certain extent of the opportunity cost. Therefore, our analysis focused on examining current extent of compensation compared to landowners' opportunity cost. Prior to the assessment, we made assumptions that cannot be considered in this study; 1) all forestlands are capable of being cultivated when the land uses are converted, and 2) landowners only consider cost-benefit tradeoff to decide whether to keep or convert forests and exclude costs from land conversion or protection activities.

For a method, we compared the amount of compensation through the PFES scheme and landowners' potential agricultural income (PAI) as a case of converting forests into agricultural land. Under cost-benefit analysis, PFES compensation was benefit and PAI was opportunity cost.

Among copious forest ecosystem services, we adopted three services that are specified in Vietnamese PFES decree in 2010; 1) Non-Timber Forest Production, 2) Water Yield, and 3) Carbon Sequestration services in a state of 2010. Three services were assessed exclusively for forest areas based on global land cover map (GlobCover 2009). In case of NTFP, total NTFP revenue in each province in 2012 (GSO Vietnam, 2012) was divided into regional forest area to calculate a NTFP revenue per unit forest area (100㎢) in land cover map. Water yield was estimated by adopting water balance theory that subtracting actual evapotranspiration (MODIS ET) from rainfall (GPCC) in 2010, to estimate residual water quantity. The residual water was multiplied by unit price of PFES scheme (40VND/㎥). Also we estimated CS, in spite of pilot status of REDD+ in Vietnam, to estimate potential compensation in the near future. We adopted MODIS net primary production (NPP) in 2010 and multiplied $5/TonC as conservative amount estimated in Vietnam (Gibbon et al., 2009).

The opportunity cost in each province was calculated as multiplying total forest area and the averaged total agricultural income by unit hectare from Census data (GSO Vietnam 2012) in each administrative region. In this approach, it was assumed that forest landowner can expect potential agricultural income as much as averaged outcome per unit area of its province. Overall analysis units were 64 provincial administrative boundaries and they were to illustrate the spatial differences of agricultural productivity and forest ecosystem services in the long-stretched territory of Vietnam.

Table 1 Data description in this study

Ecosystem Service Category (MA 2005)	Ecosystem Services included in this study	Data	Source
Current Forest Ecosystem Services (Quantity of forest ecosystem service flux)			
Provisioning Service	Non-Timber Forest Products (NTFP) (limited to foraging, collecting activities)	NTFP income in 2012	GSO Vietnam, 2012
Provisioning Service	Water yield (WY)	Precipitation in 2010	GPCC precipitation (DWD; Schnider et al.,2011)
		Actual Evapotranspiration in 2010	MODIS16 AET
Regulating Service	Carbon Sequestration (CS)	Net Primary Production in 2010	MODIS17 NPP
Economic Value of Forest Ecosystem Services (Monetary value of forest ecosystem service flux)			
Provisioning Service	Non-Timber Forest Products (NTFP)	Gross output of collected forest products without timber and other forest products (PV level) in 2010	GSO Vietnam, 2012
Provisioning Service	Water yield (WY)	PFES unit value in 99/2010	Government of Vietnam Decree 99/2010
Regulating Service	Carbon Sequestration (CS)	Carbon market unit value	Gibbon et al., 2009
Economic Value of Agricultural Products (Potential opportunity cost)			
-	Total output product values in agricultural lands	Output value per 1ha of cultivated land (Provincially specified data)	Rural, agricultural and fishery census (GSO Vietnam, 2012)

Results

The results show that three forest ecosystem services had different distribution to regions.

While the highest values in NTFP was identified at northern mountainous regions, WY was abundant in southern highland regions. CS values was ample in both northern areas and central coast regions. On the other hand, opportunity cost was high at central highland regions where industrial plantations (e.g. coffee) were prevailed. According to the comparison, averaged proportion of PES compensation compared to its opportunity cost was around 3.4% that barely meets landowners' expectation to support their livelihood. Exceptionally, the most prominent compensation ratio was 15.9% in Lai Chau province due to its rich forest ecosystem services and relatively low agricultural income due to high elevation and remoteness from settlements.

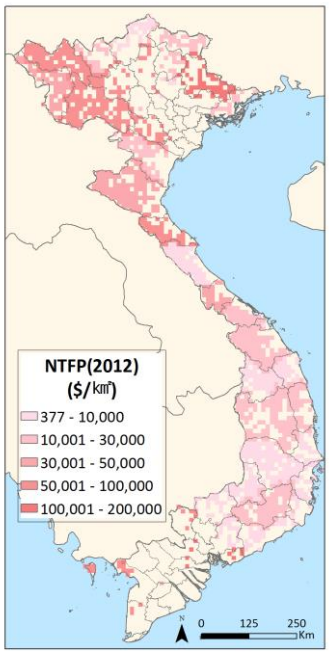

Figure 2 PFES from NTFP

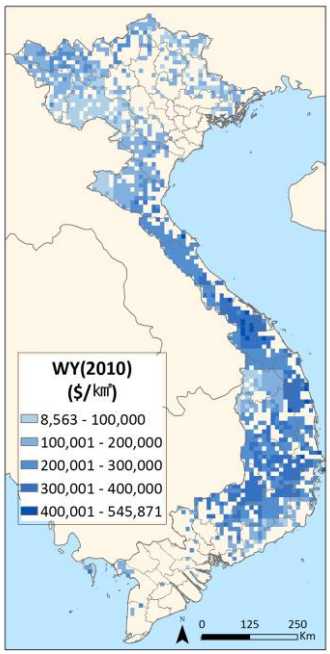

Figure 3 PFES from Water Yield

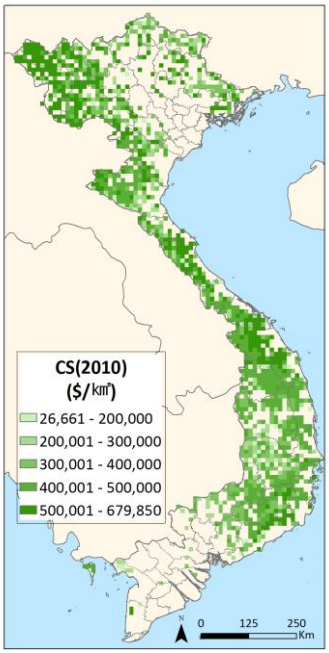

Figure 4 PFES from CS

As a result, no region satisfied the landowners' potential agricultural income by preserving their forests by receiving the PES compensation only. In addition, economic gap between the cost and benefit were even worse at Vietnam's main forest areas such as central highlands, where industrial plantations keep threatening rich forests. Due to the fact that the locations of intensively forested areas share the place where cash-crops prevail as well, it would be harder to protect the rich forests from land conversion without suitable PFES compensation.

Discussion

According to the result, there was positive correlations between the regions in which providing high forest ecosystem services (Figure 6) and taking high opportunity cost as agricultural production (Figure 7) in each provincial level. It implies that major forest areas acting as abundant ecosystem service suppliers are vulnerable to deforestation except for remote

mountainous provinces for their low accessibility to cultivate. In addition, compensation in current ecosystem services was tenuous to meet opportunity cost in every province. Especially, Central Highland regions, in which possesses large amount of forestlands and high productivity of industrial plants, showed more opportunity cost than other regions. It indicated that the lack of proper compensation might result in severe threats deterring sustainable forest preservation. In summary, current forests in Vietnam are facing high vulnerability in forest ecosystem conservation through PFES scheme. Although current PFES scheme is under compulsory regulation by the government, it is further necessary to improve current compensation scheme of PFES to persuade landowners to take part in PFES scheme in more satisfactory conditions. Because precondition on successful PES implementation includes voluntary participation and transaction between service seller and buyer (Wunder, 2005). If the compensation keeps below the opportunity cost to landowners, it would be impossible to expect sustainable forest and ecosystem services conservation in Vietnam. In addition to the current five forest ecosystem services to be paid, the government is in need to include other services in compensation system to increase revenue.

As a matter of fact, the problem is not limited to the Vietnam. According to previous studies, most PES-based compensation shares only 0.36% of total rural household income in worldwide (Angelsen et al., 2014) and PES scheme compensates only about 0.02 to 21.8% of minimum living condition in Latin America (Kosoy et al., 2007). However Kosoy et al. (2007) suggested that willingness to participate in the PES scheme can be lower than the opportunity cost for landowners with specific local conditions, implying that PES scheme might be successfully implemented without full-compensation of the opportunity cost. For this reason, it would be required to estimate what extent of compensation would be enough to include local landowners to get involved in PES scheme. As a result, current PFES scheme in Vietnam needs to be estimated based on realistic monetary valuation, inclusion of other forest ecosystem services as well as participation of local people to accomplish sustainable PFES scheme to efficiently deter further deforestation.

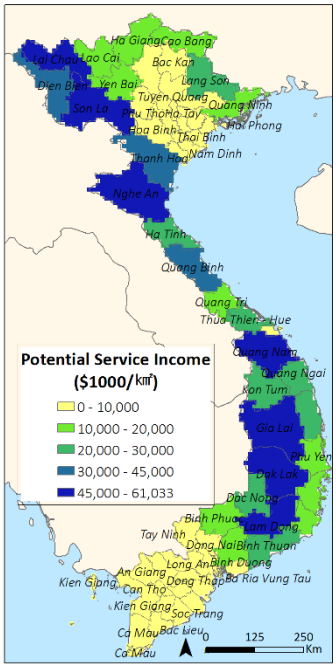

Figure 5 PFES Compensation in each administrative distri

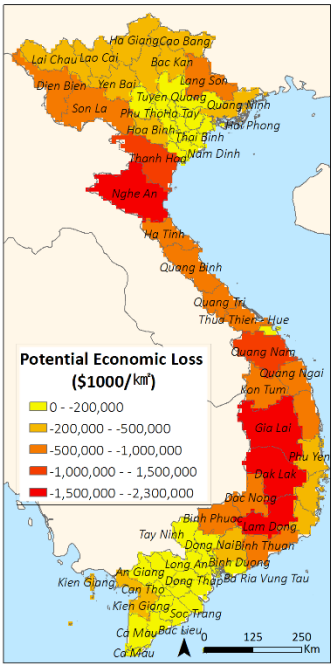

Figure 6 Opportunity cost in ach administrative district

Reference

Angelsen. A., P. Jagger, R. Babigumira, B. Belcher, N. J. Hogarth, S. Bauch, J. Borner, C. Smith-hall, and S. Wunder. 2014. Environmental income and rural livelihoods: a global comparative analysis. World Development in press.

Kosoy, N., Martinez-Tuna, M., Muradian, R., Martinez-Alier, J. 2007. Payment for environmental services in watersheds: Insights from a comparative study of three cases in Central America. Ecological Economics 61 446-455.

Wunder. S. 2005. Payments for environmental services: some nuts and bolts. CIFOR: Bogor.

General Statistics Office Vietnam. 2012. Rural, Agricultural and Fishery Census

Gibbon. A, C. Sloth and S. Schrader. 2009. Forest carbon project feasibility study. Rainforest Alliance.

Schneider Udo, A. Becker, P. Finger, A. Meyer-Christoffer, B. Rudolf and M. Ziese. 2011. GPCC Full Data Reanalysis Version 6.0 at 0.5°: Monthly Land-Surface Precipitation from Rain-Gauges built on GTS-based and Historic Data.

MODIS16A2: http://www.ntsg.umt.edu/project/mod16, MODIS17A3 : http://www.ntsg.umt.edu/project/mod17, GlobCover 2009 : http://due.esrin.esa.int/globcover/