



# Water for forests to restore environmental services and alleviate poverty in Vietnam: A farm modeling approach to analyze alternative PES programs



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## ABSTRACT

Most forested areas in South East Asia are located in mountainous areas, where they are reservoirs of biodiversity and have important watershed regulating functions. However, the continuing provision of these environmental services may be jeopardized by land use changes.

To re-establish natural or productive forests, programs are being proposed in which participating farmers can set aside some of their cultivated sloping land and receive payment for maintaining the newly forested land. This paper compares two types of payments for ecosystems services (or PES)-type programs designed to favor reforestation by farming households: “Payments for forests” (PFF) and “Terraces for forests” (TFF). Both programs involve setting aside sloping land for reforestation but differ in the type and amount of compensation offered. PFF offers annual payments per area of retired land. TFF offers to cover the cost of converting a certain amount of a farm’s sloping land into terraces, combined with annual payments per unit area of retired land.

The main objective of the paper is to compare the two types of programs in terms of cost-efficiency – can we get the same amount of forest at lower cost? – and equity – will the poorest farmers participate?

Using mathematical programming, we developed a set of farm models corresponding to typical farms in a mountainous district in Northern Vietnam. We simulated participation rates of different types of farms in the two types of PES programs. For each PES, we assessed the amount of land converted into forest, the cost of the program, and its impacts on land use and household revenues, at individual farm and village level.

Results of our simulations showed that increasing access to irrigated terraces as a way of compensating for converting land to forest increased the participation of the poorest farmers and was more cost efficient than pure cash payments. This suggests that existing PFF programs are biased against the smallest landholders in the region whereas they could be transformed into win-win programs likely to increase forested areas and reduce inequalities among farm households. Our paper demonstrates that PES schemes, when fine-tuned to the South East Asian context, could not only be used to restore ecosystem services, but also to alleviate poverty.

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## Introduction

Forested areas in South East Asia, which are mostly located in mountainous regions, serve as biodiversity reservoirs and have important watershed regulating functions. The economic boom, population growth, and the transition from communist to liberal market regulation and land tenure in several countries have driven the expansion of agricultural land and increased cropping intensity (Folving and Christensen, 2007; Pandey, 2006; Tai, 2006). The resulting land use changes threaten the provision of environmental services (ES) (e.g. Bruun et al., 2009; Valentin et al., 2008).

An example of a program to re-establish natural or productive forests can be found in the upper catchments of Vietnam. In the program, farmers can set aside some of their cultivated sloping land and receive payments for maintaining their newly forested land (Hoang Minh Ha et al., 2008; UN-REDD, 2010; Wunder et al., 2005). This program conforms with the principles underlying Payment for Environmental Services, or PES, programs; to minimize transaction and monitoring costs, it pays a flat rate to all types of farmers for all types of retired land. The rationale for these payments is that farmers who retire agricultural land are providing additional ES and should be remunerated for doing so by those who benefit from the ES (Bulte et al., 2008; Lipper et al., 2008). The government serves as intermediary between the actual users – downstream households – and the suppliers – farm households. In such a “government-financed” PES program, all program design decisions are made by intermediaries (Engel et al., 2008; Kronenberg and Hubacek, 2013).

This paper investigates an alternative program tailored to the specific context of farmers in mountainous areas of the Greater-Mekong Sub-region, where a large share of agricultural land has been privately attributed and farmers cannot expand their agricultural land by deforestation of common lands (in contrast with earlier studies such as Angelsen, 1999; Tachibana et al., 2001). While most PES analyses concentrate on pure rain fed agriculture (Engel et al., 2008; Quintero et al., 2009), a large proportion of farmers in mountainous areas in Vietnam practice some form of “composite swiddening” an agro-ecosystem that combines upland rotating crop/fallow plots and downstream permanent wet rice fields into a single household resource system (Lam et al., 2004; Nguyen et al., 2008; Vien et al., 2009). The relative complexity of such system offers an opportunity for an alternative to the standard financial (Bui and Hong, 2006) or food compensations (Gauvin et al., 2010; Uchida et al., 2005) often considered in PES.

The main idea underlying the alternative PES program is to compensate for the loss in production resulting from setting aside land by helping farmers increase the productivity of their remaining agricultural land. In the context of imperfect markets where the farmers' main concern is food security, this type of program could be more attractive than the standard PES using financial rewards. By constructing terraces and linking them to existing water bodies, some sloping lands could be converted into plots that could be irrigated at least part of the year. The literature indicates that this has already happened elsewhere in response to increased population pressure (Boserup, 1981; Krautkraemer, 1994). Yet, while the possibilities of converting land into terraces have not been exhausted, the cost of linking additional terraces to water bodies is prohibitive for individual farmers. In addition, communities face high discount rates because of pressing present needs, and the absence of collective action prevents investment in the construction of terraces. The PES program we propose would help individual farmers and communities overcome these barriers and compensate farmers for converting part of their sloping rainfed land into terraces with access to irrigation.

Smallholders with limited access to irrigation are mainly constrained by their food needs. This is reinforced by the market imperfections that prevail in most of those remote regions. These

farmers are unlikely to participate in a set aside PES scheme if the only benefit is financial compensation. Our alternative PES program fulfills the three requirements laid out by Pagiola et al. (2005) on targeting poor farmers. First, poor farmers generally cultivate land with low agricultural productivity but high potential for ES provision, and are therefore in the ‘right place’ to participate. Second, our program allows farmers to increase (food) production on their remaining land and thus directly compensates them for production losses, which should make the program less biased toward large farmers. There are two ways to overcome these food constraints and ensure the participation of smallholders: (a) compensate for their production loss by directly providing food (Gauvin et al., 2010; Uchida et al., 2005), or (b) increase the productivity of the remaining land. Direct provision of food or payments without other changes in terms of household income generation can create dependency on the program: if payments or food provisions are stopped, farmers are likely to switch back to their former farming systems (Uchida et al., 2005). The program we propose is a modified example of the second category of instruments in the sense that it would provide payments for the maintenance of newly established forests, but would also make some initial investments (financing the construction of terraces) to improve future land productivity and ensure the sustainability of the project. Third, despite differences in size, all the farmers in the study area have long term cultivation rights over land with a potential for ES provision, and are therefore in a position to participate (Bulte et al., 2008). In contrast, set-aside/cash-based PES programs are expected to be mostly attractive to larger landholders who have a lower opportunity cost of land and are more likely to be willing and able to participate. For small landholders, setting land aside means they reduce the already limited land they have available for food production and thus increase their food insecurity and financial instability (e.g. Jourdain et al., 2009).

We compare a cash based program with an irrigated terrace program in terms of cost efficiency – *can we get the same amount of forest at lower cost?* – and equity – *will the poorest farmers participate?* In this way, we contribute to the literature on the possibility of addressing both environmental and poverty issues through PES.

Since the second program we describe here is hypothetical, we used a simulation approach. Using mathematical programming, we developed, calibrated, and validated a set of farm models corresponding to typical farms in a mountainous district of Northern Vietnam where there is currently no PES. We simulated the rate of participation of different types of farms in the two types of PES programs to test their respective economic attractiveness to farmers. For each PES, we analyzed the simulated participation, defined as the area of land converted into forest land, the cost of the program, and its impacts on land use and household income, at the individual farm and village level.

## Study area

The study was carried out in the mountainous part of the district of Van Chan, Yen Bai province, North-Western region, where the slopes in 76% of the district are greater than 15% and agriculture is practiced at altitudes ranging from 200 to 1000 masl. The climate is driven by the monsoon regime. The winter season (January–March) is cold and damp, characterized by low rainfall but persistent drizzle. The summer season (May to October) is hot and rainy with 80% of annual rainfall falling in just five months. The two short inter-seasons (April and November) are characterized by low rainfall, strong sunshine and low humidity.

The majority of the people living in this area belong to one of the Thai, Tay, Dao or Hmong ethnic minorities. Households' current access to land and water is the result of the last redistribution of

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