PES in Upper-catchments of Vietnam: Expected Differential Impact for Contrasted Farmers

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Abstract

In most upper-catchments of the Northern provinces of Vietnam current land uses are producing negative externalities that affect downstream areas. Slash-and-burn is often blamed as the main cause for the problem.

Land uses that would bring about environmental benefits include tree-based land use alternatives and agro-ecological practices (e.g. direct-seeded mulching cropping systems). However, the environmental services these alternative land uses would provide are un-rewarded. Payments for Environmental Services (PES) schemes present a new approach that focuses on creating a conditional benefit transfer between the upland providers of environmental services and the downstream beneficiaries.

Agricultural households in upper-catchments have unequal access to natural resources, inducing contrasted farming practices and livelihood strategies. Our main objective was to evaluate the response of contrasted households to PES schemes that would reward them when they set aside some land for forestry projects. We looked at the specificity of PES schemes targeted at agricultural households of the upper-catchments in Northern Vietnam.

Based on farm typologies developed earlier and using a simplified farm model, we analyzed how households with different endowments would respond to such PES schemes.

MEDIA GRAB
Access to irrigated land instrumental for reducing poverty and erosion for poor farmers of Northern provinces of Vietnam

Introduction

In most upper-catchments of the Northern provinces of Vietnam current land uses are producing negative externalities that affect downstream areas. Slash-and-burn is often blamed as the main cause for the problem. New land uses that would bring about environmental benefits include tree-based land use alternatives and agro-ecological practices (e.g. direct-seeded mulching cropping systems). However, the environmental services these alternative land uses would provide are un-rewarded. Payments for Environmental Services (PES) schemes present a new approach that focuses on creating a conditional benefit transfer between the upland providers of environmental services and the downstream beneficiaries (Pagiola and Platais 2002; Wunder 2005).

The past few years have witnessed a surge of interest in the development of PES schemes in Asia. In Vietnam, while some projects using the conceptual framework of PES are being initiated in the central and southern part of the country (e.g. WWF 2007), no PES schemes are currently being implemented in the upper catchment areas of Northern Vietnam (Wunder, Bui Dung The, and Ibarra 2005). However, the Vietnamese Government expressed recently its interest in starting such a scheme to protect fragile upper-catchments whose degradations are causing problems, among others, on hydro-electric infrastructures.

Agricultural households in upper-catchments have unequal access to natural resources, inducing contrasted farming practices and livelihood strategies (Do Anh Tai et al. 2007). Our main objective was to evaluate the response of contrasted households to PES schemes that would reward them when they set aside some land for forestry projects. While some analytical work has already given general results (Zilberman, Lipper, and McCarthy 2006), we looked at the specificity of PES schemes targeted at agricultural households of the upper-catchments in Northern Vietnam.

A large diversity of situations in the upper-catchments of Vietnam

Mountainous provinces of Vietnam contain huge ecological and economic heterogeneity. In upper-catchments areas, household livelihoods are influenced by major driving forces such as the type of land they have access to, the amount of water they can capture for irrigation, and the markets they have access to. Household surveys conducted in Yen Bai province in 2006 and 2007 were used to build a generic typology of upland farmers to relate the differences in resource endowments and their livelihood strategies.

The first and main differentiating factor was the combined access to land and water. Results showed that land well-suited for growing paddies was unevenly distributed between households. For the typology construction, two types of access to land and water were defined: (1) households with sloping rainfed land only, (2) households with sloping rainfed land and access to water flows allowing the production of one or two paddy crops per year. The second differentiating factor is the household access to markets (inputs, outputs, and off-farm). Large differences were found between the communities access to markets. Distance to main markets gives one explanation. Many households were also excluded from markets because of previous bad experiences such as defaults on previous credits. On the latter, participation to input/output markets were also found to be highly variable between households of the same community.

Based on these factors, we classified the households in four categories (Table 1). Of the four groups identified, types 1 and 3 households are the poorest in terms of income generation and also the most vulnerable over time. Both have a limited access to markets, but they are contrasted by their access to irrigated land. For the remaining of this paper, we will therefore concentrate on the impact of the PES scheme on these two groups. Type 1 farmers do not have land suitable for growing paddy rice. Hence they cultivate only more fragile sloping lands for their food needs. Shifting-cultivation rice based systems are used. With low availability of land per capita, shifting cultivation is practiced with short fallow periods, and the overall land fertility is progressively decreasing. Without access to input, output markets, food demand can only be met through traditional cultivation techniques (no fertilizers) and through food produced from their own land (no purchase of rice). Type 3 farmers have access to water for irrigation, but have limited access to markets. Most of the activities are concentrated on the production of paddy rice. Sloping areas are only cropped when the rice paddy production is not sufficient for household needs. In particular, when farmers can grow two rice crops per year, the remaining upland is usually left idle for soil fertility recovery. The fourth group does have access to water for irrigation and to markets.

Table 1 : Simplified typology of households in upper-catchments

		Access to land and water	
		Upland mainly (no water)	Paddy land mainly (water for 2 rice crops)
Access to markets	No	① Subsistence rainfed rice farming (18%)	③Subsistence paddy farming (21%)
	Yes	② Diversified upland growers (15%)	④ Diversified production (46%)

A simple model of type 1 and 3 production systems was developed and simulations were conducted to analyze their potential reactions to different types of PES schemes. However, modeling shifting cultivators is not straightforward since the model has to reproduce systems with discontinuous behavior over time, and cannot rely on the traditional hypotheses of income maximizing behavior and market integration.

The specificities of our modeling approach

Shifting cultivation systems are characterized by the use of long fallow periods alternating with short cultivation periods and the absence of use of external inputs. The rationale of discontinuing cultivation is double. First, fragile sloping soils are degrading fast and crop yields tend to fall rapidly. Second, invasion of weeds after few years of cultivation are causing a sharp reduction of labor productivity. For these subsistence oriented shifting cultivation systems, we hypothesized that a field cultivated in the preceding season, is given up if two conditions are fulfilled: (1) the discounted projected benefit stream of continued cultivation is less than the one associated with the alternative options of concentrating efforts on the other opened fields, or by opening a new field, and (2) the expected food production stream will not fall below the household minimum requirements.

Since the two types of farmers modeled do not have access to markets, it was assumed that modeled farmers are only interested basic consumption needs. When these are met they prefer more leisure to higher consumption. Hence, the households' objective is to reach a food sufficiency target with the minimum of labor effort, implying that consumption beyond that level has no real value (e.g. Dvorak 1992; Angelsen 1999; Rasmussen and Møller-Jensen 1999).

Most conservation decisions involve inter-temporal trade-offs. Nevertheless, most farmers with pressing subsistence needs have high discount rates resulting in very short planning horizons. Still, decisions taken at one point of time will influence future outputs and decisions. Hence, we used a recursive model, where households take decision annually with short-term planning horizon, but have to bear the consequences of their previous choices.

Model structure and dynamics

The model simulates private decisions of a farmer that has been allocated a given area of sloping land for individual management. It focused on three interlinked mechanisms: nutrient dynamics, cropping and fallow periods, and labor allocation decisions. The model is recursive dynamic and deterministic. It is recursive dynamic because farmers make annual decisions based on expectations over their planning horizons and on the actual state of the system. However, the state of the system depends only on the previous decisions. The following assumptions were also made: only one crop is grown, land available to the household is fixed, household population is constant over time, and fertility status of each field can be described by only one parameter.

Nutrient dynamics is influenced by household decisions at each period, i.e. cropping versus fallowing, and labor input in each cropped plot. In return, those decisions will be conditioned by the status of each available fields, and household food requirements and labor constraints. Household land is divided into a fixed number of fields of equal size, among which a variable number is cultivated at any time. Fertility equations ensured that plot fertility increase at a decreasing rate during fallow periods, and decrease proportionally to yields during cultivation periods. Yield obtained in each plot will depend on its actual fertility and the labor investment. The production function ensured that yields increase at a decreasing rate with plot fertility and labor input. The modeled households have no access to markets, so it was assumed that households chose the number of fields cultivated or fallowed and allocated labor among cultivated lands in order to produce enough food and minimize labor input. The household planning horizon is one year.

For each time step, we implemented the following decision process. Four strategies with respect to opening and abandonment of fields were defined: (1) no changes made compare to previous season, (2) one new field is opened and no fields abandoned, (3) one field is abandoned, (4) one new field is opened, and one field is abandoned. If a field is to be opened, the field with the highest fertility is chosen. Besides, field clearing time is added to the labor needs of this plot. If a field is to be abandoned, the cultivated field with the lowest fertility value is chosen. For each strategy, a decision model, using non-linear programming, is applied that minimize household's labor input, while producing the required food and respecting the family labor constraints. If a strategy is impossible at a particular time, it is discarded during that loop. Farmers with access to water can also allocate labor to their paddy fields. Paddy fields are producing food according a specific production function. The strategy giving the lowest forecasted value of household labor required is retained. State variables are re-calculated for the next time step using the chosen strategy. This model was implemented using GAMS with the non-linear programming solver CONOPT2 (Drud 2006).

Simulations and discussion

Many of the mechanisms required by the model were difficult to extract from available empirical data. Hence, they are based on generalized empirical findings in terms of yields decrease over cultivation years in shifting cultivation systems and are as far as possible based on a household survey done in the Van Chan district, Yen Bai province in 2007.

We first ran the model for base scenarios (Scenarios 1 and 3 of table 2) to reproduce the main phenomena observed over time in the shifting cultivation systems. In all cases, households were composed of 3 working adults that provided food for a total of 5 household members. The models were able to reproduce a cropping/fallow system quite realistically. Figure 1 shows the fertility index of one farm plots over the years under the different scenarios. The upward sloping part of the curves correspond to fallow periods, the downward sloping part of the curves correspond to cultivation periods. Farms without access to irrigated land (scenario 1) have a shorter cropping/fallow period of around 16 years, with a cultivation period of 6 to 7 years. Farms with access to irrigated land (scenario 3) have a longer cropping/fallow cycle of 20 years, with around 5 years of cultivation and the remaining time for fallow. Given the high productivity of paddy fields, fertility can be maintained over time in the sloping land. Different coefficients taken for the yield and fertility equations provided slightly different cycle length, but the same fundamental cycle was obtained, which suggests that the most fundamental mechanisms are represented in the model, even though real empirical coefficients could not be obtained.

Table 2 : Land and water access under the different scenarios.

Scenarios	Paddy area (ha)	Upland area (ha)	Upldand area under cultivation after 15 years (ha)*
1 (Base, Group 1)	0	3.5	1.31
2 (Protected zone, Group 1)	0	2.62	1.31 (0%)
3 (Base, Group 3)	0.2	3.5	0.87
4 (Protected zone, Group 3)	0.2	2.62	0.82 (-6%)

* *Results of the simulations*

For the simulated farms with access to water, the average land fertility is decreasing only slightly over time suggesting that shifting-cultivation systems could be sustainable over time since enough time is given for soil fertility recovery. Fertility is decreasing faster for the farm without access to irrigated land since they have shorter fallow periods.

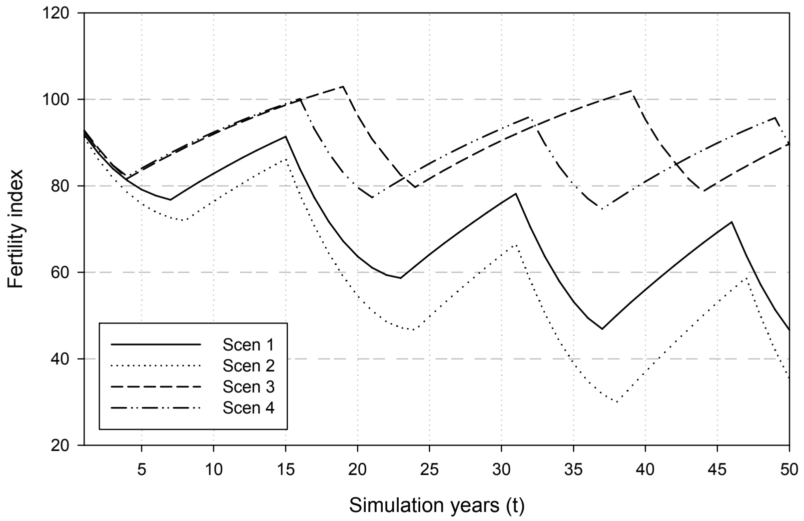

Figure 1: Fertility index over time of one selected plot. Sc 1 and 3 are base scenarios. Sc 2 and 4 correspond to a 25% reduction of cropping area in the sloping compartment of the farm.

Then, we simulated the effects of an hypothetical PES scheme, where participants would receive monetary compensation to set-aside part of their cultivated land for reforestation (Scenario 2 and 4). However, given the high transaction costs these households are facing, monetary payments are unlikely to be easily translatable into real goods. Hence households have no other opportunities than to live with their new constraints, and can only reduce slightly the amount of food they expect from their agricultural land. To illustrate this, we simulated farmers that should reduce their cropping area by 25%, and that would receive monetary compensations that would reduce their food needs from agriculture by 10%. Other alternative PES schemes could be considered, such as monetary compensations for adopters of a set sustainable farming practices and are likely to produce different results, but actual projects of Vietnamese government in the northern part of Vietnam focused so far on forestry projects.

For households without irrigated land, a sharp soil fertility decrease was observed over time in the area left for agriculture (Scenario S2 of figure 1). While protected areas are recovering progressively, increased degradation took place on the remaining cultivated land. With less available land to agriculture, households were forced to reduce the fallow periods, and to cultivate their land for longer periods of time. Simulation results even show that the land under cultivation does not diminish the proposed PES scheme (Table 2). Therefore, the overall effects on erosion transmitted to downstream users and dams would depend on the relative sensitivity of protected and cultivated soils to erosion.

For households with irrigated land, the farmers are decreasing their fallowing period, but are also increasing the labor allocated to irrigated crop (Scenario 4) to be able to produce sufficient food for their needs. Cultivation area in the upland compartment is slightly reduced, and the fertility index in the remaining land is slightly increasing. Therefore, the reduction of available land to agriculture is likely to decrease the erosion created by those upstream farmers.

Conclusions

PES scheme designed to set aside land for forestry programs is likely to have very contrasted effects on farm households without access to markets depending on their access to irrigated land. Farmers with access to irrigation are more likely to participate in such PES schemes because they can compensate the reduction in land availability by increasing the productivity of the lowland compartment. In contrast, farmers without irrigated land are likely to suffer most from land set aside program if only monetary compensations are given. For them, participation in the scheme can only be compensated by cropping more intensively the non-protected zones, hence increasing the likeliness of erosion on these zones.

For farmers without irrigation, having access to new irrigated areas to compensate for their loss in sloping land would be the most favorable reward. For communities that have difficult access to markets, funds transferred to communities in the form of irrigation infrastructure are likely to be more efficient both in terms of soil conservation and livelihood improvement than monetary transfers to individual farms for forestry projects. For example, building-up concrete canals so that more households have access to irrigated land is likely to produce important environmental effects by reducing the pressure on sloping lands. However, this kind of reward would not be conditional.

The results of this simplified model are confirming the information obtained during group discussions with farmers in the communities where this work was conducted. Farmers have often expressed the need for improvement of irrigation infrastructure as a mean to improve their livelihoods, and also tend to see set-aside programs for forestry projects as an additional constraint to their daily life more than an opportunity. In contrast they showed interest in projects that would increase land productivity whether by getting improved access to water or by new sustainable technologies on the sloping lands. In the latter case, new cropping systems such as direct seeded rice or maize with cover mulch are often reducing incomes in the first years of adoption (Affholder et al. 2008). Alternative PES scheme that would provide some compensations conditioned to the adoption of such technologies are also likely to meet interest from farmers.

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