

Using a Biogas Scheme to Control Soil Erosion on Sloping Lands in North Vietnam



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This paper discusses the design of an incentive based framework for the promotion and possible upscaling of a biogas-based pilot scheme to manage soil fertility and erosion control on sloping lands, with a focus on policy implications. The study is based on research conducted in 2007 within a small agricultural village of the Hoa Binh Province in Northern Vietnam.

Introduction

The challenge facing agriculture in Southeast Asia is how to produce more food, more sustainably in the context of rapid change. In the case of Vietnam, agricultural output in mountainous areas will be critical in meeting future food

demands, particularly in the context of reduced production in the deltas. Since 1990, production in most commodity groups has more than doubled, mainly due to intensification and increases in yield. This increase has not come without environmental cost: soil and water degradations affect between 10 and 40% of land area in each country in Southeast Asia (Valentin et al. 2008). High rates of deforestation, soil erosion, declining soil quality and changes in water quantity and quality are all directly attributable to unsustainable agricultural practices.

Whilst farmers are concerned about environmental and resource management, this is often not in itself sufficient to motivate the adoption of sustainable land and water management practices (George et al. 2009). Our research has shown that indirect methods, in this case introducing new technology to facilitate intensive livestock production and enhance smallholder income, can incentivise delivery of environmental services (Orange et al. 2008). Based on these results and through dialogue with local farmers, in 2007 two biodigesters were built within two farming systems in Dong Cao Village as pilots to inform the design of a PES framework.

Context

The Hoa Binh Province is located 50 km southwest of Hanoi. The entire province is surrounded by hills with an average slope of 40%, but sometimes reaching more than 100% for agricultural lands with an elevation of 100 to 700m. The annual rainfall ranges from 1500-1800 mm; the air humidity is always high and the air temperature can be below 10°C in winter. The areas are mainly cultivated with cassava with some areas of *Eucalyptus* and *Acacia mangium*. From 2002, agricultural practices have changed very quickly because of

soil erosion, decreases in soil fertility and enhanced access to the economic market.

In Northern Vietnam, animal solid wastes (from pigs, cows and buffalos) mixed with human faeces are typically used as fresh organic matter to fertilise the soils, whilst liquid waste, mainly from pig husbandry, is delivered directly to the natural water network or used in part to water the vegetables. These processes contribute to bad odours and water and air pollution (Yajima et al. 2008), which has made the increasing quantity of animal waste a concern for decision makers as well as the farming community.

Biodigester technology: environmental services and livelihoods

Biodigesters use methane (CH₄) producing bacteria to convert organic wastes into a) biogas, a renewable energy available for cooking, heating and lighting, and b) nutrient rich fertiliser for crops. Their installation is now common even in remote villages in many parts of Asia, especially India, China and Vietnam. By trapping methane, biogas technology prevents its release into the atmosphere and therefore contributes to reductions in greenhouse gas emissions from agriculture; significantly reduces pathogenic germs (e.g. E-coli), and prevents run-off from animal pens. From the farmers' perspective, biogas technology not only provides cheap fuel as an alternative to, for example, labour-intensive firewood, but also reduces odour from manure and compost and supports crop production. Studies have shown that the slurry produced by the biodigester provides readily absorbed and efficient nutrients (nitrogen, potassium and phosphorus) and also removes seeds of weeds in the feedstock (Schiere et al. 2001).



Farmers under contract for biodigester purchase by the Total Company. Photo: Didier Orange.

Piloting the biodigester: responding to individual and social concerns

Considering only biogas implementation and disregarding the two weeks needed to install the biodigester, it has been evaluated that in the pilot around 12% of total annual worktime has been saved for the smallholder farmer. The cost of constructing a biodigester with its outbuildings (adaptation of cowsheds for pigs and cows, building of latrines) is around 20 million VND (approx. US \$1100), where the annual household income averages around 10 million VND (US \$550). It is estimated that 75% less household wood is required with biogas installation, worth 4 million VND (US \$225) per household per year and saving more than two hours per day for wood collection, a task usually performed by the women. The additional free time has allowed women in the pilots to participate in social and support groups of farmers and/or to develop small shops. This gives biogas implementation high indirect benefits.

The two pilot smallholders report high satisfaction with their biodigesters, primarily because of the reduction of odour but also because of increased income and intensification of pig husbandry. However the two farmers have not always maintained or managed the biodigester particularly well due to a lack of knowledge about biodigester processes, and have not adopted the composting of solid waste. It is therefore clear that with upscaling training and technical control is a necessity, but there is also clear potential for a payment for environment services (PES) scheme to profit from farmers' interest in biogas production as a means to control odours, and to increase household income through intensive agricultural production.

PES, an adaptative mechanism

Experiences have shown that, as far as soil conservation is concerned, the biggest challenge is the apparent reluctance of land users to adopt effective conservation practices that have been promoted. Usually it has not been clear why practices that have appeared so promising in trials have not been accepted by land-users, or have been rejected after a short time. We promote the idea that attention has to be turned to the land-users themselves rather than the technology. The importance of fully involving them in the whole process of developing interventions is now generally accepted as a precondition to a programme's success.

The common PES definition emphasises voluntary and conditional transactions. In practice, few if any PES schemes entirely meet this narrow definition, whereas there are lots of "PES-like" initiatives such as the different experiences documented in Vietnam. Based on our two years experiment, we assume with Gutman et Davidson (2007) that PES should have adaptative features in order to meet concrete opportunities and mutual interest.

Financing PES in Vietnam

Since economic liberalisation, rural families have to meet increased financing needs. Many of them have recourse to borrowing (57% in 1997, Le Roy and Robert 1999). Faced with significant demand for credit, the range of sources (the supply) is both diversified and voluminous. As far as microfinance is concerned, Vietnam appears to be a peculiar case: a country which has managed to introduce on a wide scale and in record time a State commercial bank - the Vietnam Bank for Agriculture and Rural Development (VBARD). To complement the VBA, the government has

established formal provision for microfinance through the Vietnam Bank for Social Policies (VBSP) and, at a community-level, People's Credit Funds (PCFs).

The last major concern for implementing a PES mechanism is the possibility of finding a financier. Our study points out three kinds of potential financiers who would be able to ensure independence and sustainability. The simplest seems to be the Vietnamese government, who have recently demonstrated an interest in investing in environmental services and in promoting higher quality agriculture. A second possibility is to seek investment from private firms interested in downstream water quality such as EVN (national provider of electricity), or in contributing to efforts to mitigate Climate Change. Although international backers and other institutions linked to aid or promoting environmental-friendly measures (CDM mechanisms etc.) appeared easiest to convince, there remain concerns about the sustainability of this form of financing. The PES mechanism has to be implemented within a long-term project. Secondly, the idea behind the PES scheme in this context is to create a virtuous loop, independent from external subsidies.

The PES mechanism

Based on these conditions, we propose an incentive based framework (figure 1) centred around the establishment of a management board (Orange et al. 2009). The farmer contracts a bank for a loan to buy a biodigester. The bank enrolls the farmer in a "biodigester PES programme", promoted by a management board and funded by providers looking for environmental control and economic success of the farms. The role of provider could potentially be filled by the Ministry of Agriculture and Rural Development. The management board, directly linked to the Provincial People Committee, regulates the efficiency of the PES framework through the use of a set of indicators that address environmental, economic and social issues and can be used to modulate the amount of monthly repayments by the farmer. The individual refund contract is then fixed to a period of four to eight years to be sure to result in longer

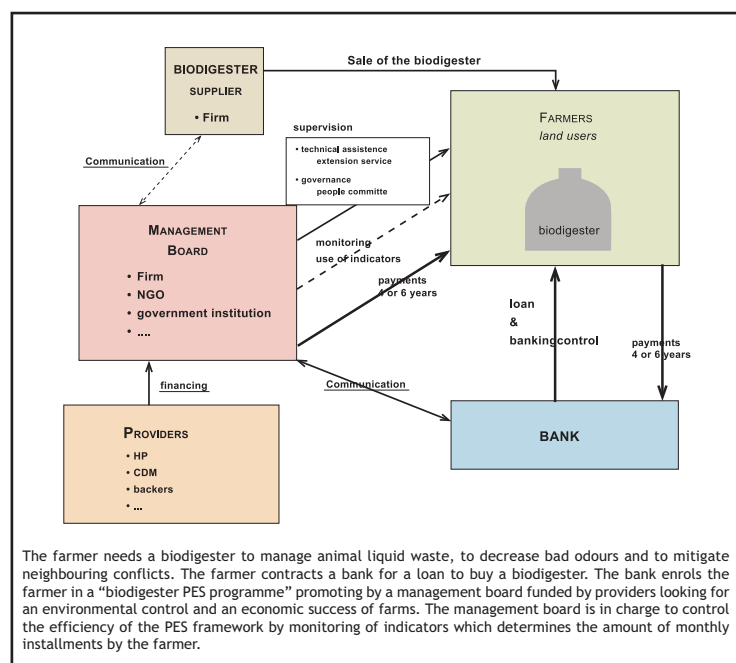


Figure 1: Incentive based framework for PES implementation.

term behavioural change. The main target is not only to monitor the environmental, economic and social performance of the system, but also to manage the dialogue between farmers and other external agents (i.e. the People's Committee, the bank and the biodigester suppliers).

Conclusion

Global awareness of climate change has resulted in enhanced awareness of the fragility of natural systems and a new longer-term perspective for national and regional planning, which presents an opportunity to radically rethink approaches to agricultural production. In Northern Vietnam, the concrete and mutual interest in an attractive technology such as the biodigester creates the opportunity to mobilise the entrepreneurial arena. Here, the PES mechanism is adaptable; the management board matches supply and demand to answer both individual and social concerns, and economic opportunities.

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References

- Clement F., Amezcaga J.M., 2008. Linking reforestation policies with land use change in Northern Vietnam: Why local factors matter. *Geoforum*, Elsevier, 39(1): 265-277.
- George A., Pierret A., Boonsaner A., Valentin C., Orange D., Planchon O., 2009. Potential and limitations of Payments for Environmental Services (PES) as a means to manage watershed services in mainland Southeast Asia. *Int. Journal of Commons*, 3(1) : 16-40. Mountain Forum Online Library and is available at <http://www.mtnforum.org/rs/ol/browse.cfm?tp=vd&docid=4270>.
- Gutman P., Davidson S., 2007. The Global Environmental Facility and Payments for Ecosystem Services. A Review of current initiatives and recommendations for future PES support by GEF and FAO programs. WWF Report, Macroeconomic for Sustainable Development Programme Office.
- Le Roy P., Robert M., 1999. The micro-economic impact of rural credit in northern Vietnam. *Collection Etudes et Travaux*, Ed. GRET, Paris.
- Orange D., Tran Duc Toan, Nguyen Duy Phuong, Nguyen Van Thiet, Salgado P., Clement F., Le Hoa Binh, 2008. Different interests, common concerns and shared benefits. *LEISA Magazine*, 24(2): 12-13. + Chinese version
- Orange D., Geier P., Dardenne L., Courret J., Grandidier E., Rodriguez C., Plumère T., Leblond N., Medoc J.M., Pham Van Vinh, Doan Thu Thuy, Nguyen Duy Phuong, Henry des Tureaux T., Jouquet P., Tran Duc Toan, 2009. Biogas and PES for watershed management in Southeast Asian Mountains. AFD

Final Report, AFD grant, MSEC project, IWMI-IRD-SFRI, Hanoi, Vietnam.

Schiere, H., Kater, L., Mixed Crop Livestock Farming, 2001, FAO Animal Production and Health Papers 152, New York.

Valentin C., Agus F., Alamban R., Boosaner A., Bricquet J.P., Chaplot V., de Guzman T., de Rouw A., Janeau J.L., Orange D., Phai Do Duy, Podwojewski P., Ribolzi O., Silvera N., Subagyo K., Thiébaux J.P., Toan Tran Duc, 2008. Runoff and sediment losses from 27 upland catchments in Southeast Asia: Impact of rapid land use changes and conservation practices. *Agriculture, Ecosystems and Environment*, 128: 225-238.

Yajima A., Jouquet P., Dung Do Trung, Thach Dang Thi Cam, Tran Cong Dai, Orange D., Montresor A., 2009. High latrine coverage is not reducing the prevalence of soil-transmitted helminthiasis in Hoa Binh province, Vietnam. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 103(3): 237-241.

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¹ In a typical reforestation project in the Philippines, the cost for tree plantation establishment and maintenance in three years could reach US\$ 1000 per hectare, making reforestation projects very expensive. Taking the current price of carbon (\$15 per tonne C), this would not be enough to cover the costs of project development.