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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 9 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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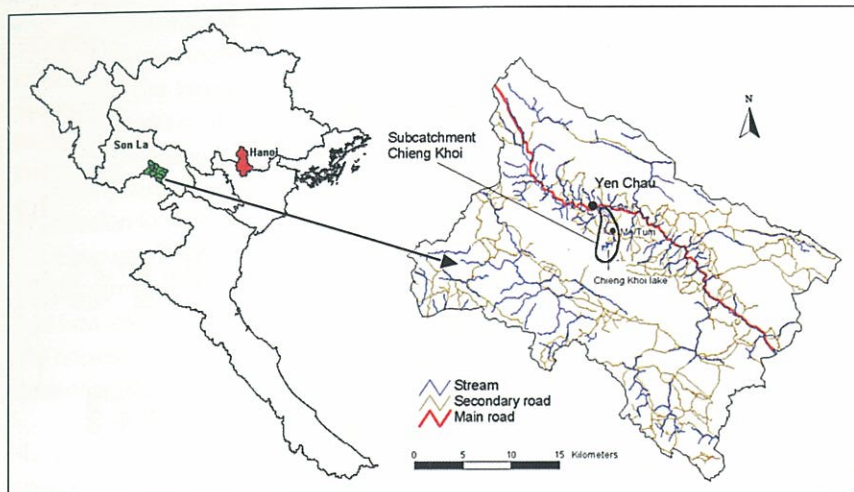
The Sustainability Of Agricultural Innovations – A Case Study From North Vietnam

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Vietnam, like most developing countries across Southeast Asia, has boosted farm outputs by introducing new crops, production methods and other agricultural innovations. Unfortunately, this process has increased soil erosion and water pollution and caused many other environmental problems. Now a new EEPSEA study has assessed this situation. It looks at the environmental trade offs that are involved in →

A summary of EEPSEA Research Report No. 2010-RR4: 'Innovations And Sustainability Strategies In The Upland Agriculture Of Northern Vietnam: An Agent-Based Modeling Approach' by Mr. Dang Viet Quang, Department of Land Use Economics in the Tropics and Subtropics, University of Hohenheim (490d), Fruwirthstr. 12, 70593 Stuttgart, Germany. Tel: +49 711 459 23204; Fax: +49 711 459 24248 Email: danguhoh@uni-hohenheim.de

"a land tax policy could ...



The selected study sub-catchment

→ upgrading people's livelihoods through agricultural improvement. It also investigates how the negative impacts of such changes can be mitigated.

The study is the work of Dang Viet Quang from the University of Hohenheim, Germany. It provides details of how agricultural innovations have harmed the environment. It shows that a land tax policy could be used to reduce these environmental problems. Such a tax, however, will have a negative impact on farmers' livelihoods. Hence, this policy will be strongly resisted given that the North West Region has the highest poverty rate in Vietnam. The study therefore recommends that farmers should be helped to implement sustainable animal husbandry innovations so that their standard of living is not unduly affected.

Are Agricultural Innovations Sustainable?

Rapid population growth in Vietnam has put pressure on forests and agricultural land. Between 1943 and 1993, the forest area of Vietnam

decreased from 19 million ha to 9 million ha: an average annual loss of 200 thousand ha. Over time, cropland has been more intensively cultivated and fallow periods have shortened. As a result, the fertility of topsoil has significantly reduced.

In an effort to protect the forest and reduce poverty, the government of Vietnam, together with international organizations, has helped communities take up various agriculture innovations since the 1990s. These innovations include the adoption of hybrid varieties of maize and rice, and use modern inputs of production such as fertilizers and pesticides. This strategy has generally benefited farm households economically but resulted in environmental losses as well. In particular, the cultivation of hybrid varieties leads to higher soil erosion while use of chemicals brings about environmental pollution. As such, the sustainability of the approach has been in question for some time. This uncertainty highlighted the need to gauge the sustainability of various agricultural development policies and to help

design more sustainable policies for the future.

Using Computers to Simulate Agricultural Development

The environmental impacts of agricultural improvements, and the feedback effect of these impacts on the Vietnamese economy, are difficult to quantify directly. This is because they are both long-term processes (e.g. hybrid maize was introduced in the late 1980s). The study therefore uses simulation modeling to assess the situation. The main computer-based tool it employs is the Mathematical Programming-based Multi-Agent Systems (MP-MAS). This allows an assessment of the impact of the agricultural innovations on soil nutrients, nutrient balance and soil erosion. It also allows an assessment of their impact on the income of local farm households.

This approach is not only used to quantify trade-offs between the economic and environmental goals of past policies, it is also used to explore the impact of future conservation policies: to investigate how the negative environmental impact of past policies can best be addressed. Additionally, the study assesses the factors that determine whether farmers adopt agricultural innovations or not. This is done to help extension workers pinpoint 'early adopters' who would be more enthusiastic about implementing effective and sustainable agricultural innovations in the future.

The Study Site - Yen Chau District

The study focuses on the Yen Chau District of Son La Province. This is an area that is considered to be

reduce environmental problems”

representative of the larger North-west region of Vietnam. The Northwest of the country is home to a high share of ethnic minority people. They are farmers who are relatively disadvantaged, with respect to the rest of the country, in terms of access to markets, government institutions and infrastructure. The Northwest of Vietnam also has the highest poverty rate in Vietnam.

Agricultural research in Vietnam has traditionally focused on the highly productive lowland agriculture that provides much of the country with food and supplies the agricultural export trade. Mountainous areas are relatively under-researched. This is one of the reasons why Yen Chau District is the focus for this study.

Within Yen Chau District the study was carried out in one sub-catchment area. The selected sub-catchment is located in the Chieng Khoi commune and is mostly populated by Black Thai people. The watershed in Chieng Khoi comprises of a system of streams and one lake. The selected sub-catchment in Chieng Khoi includes five villages and 471 households.

Data Collection

Information was collected using both semi-structured interviews (SSI) and structured interviews (SI). The SSIs were conducted in the form of group discussions using a checklist. The SIs were conducted with individual households using questionnaires. The sample households were selected at random from lists of households that were provided by each village headman. In each village, about 34% of the households were selected to be interviewed. In total, 159 households took part in

the survey.

The study assesses the impact of the most significant agricultural innovations that have been implemented in the study area. These include the use of chemical fertilizers and the cultivation of hybrid, or improved, maize, cassava and rice – all of which have been adopted at a high rate by users. In 2003, a SFDP (The Social Forestry and Development Project) evaluation report from the province showed that 97.9% of the households grew improved maize, 71.1% grew improved paddy rice and 88.1% used fertilizers in their upland fields.

The use of improved pigs is also assessed in this study. The husbandry of these animals is still at a relatively low level because farmers do not yet know how to raise them properly. These animals are expected to become more popular as farmers learn how to rear them successfully. Raising goats was also

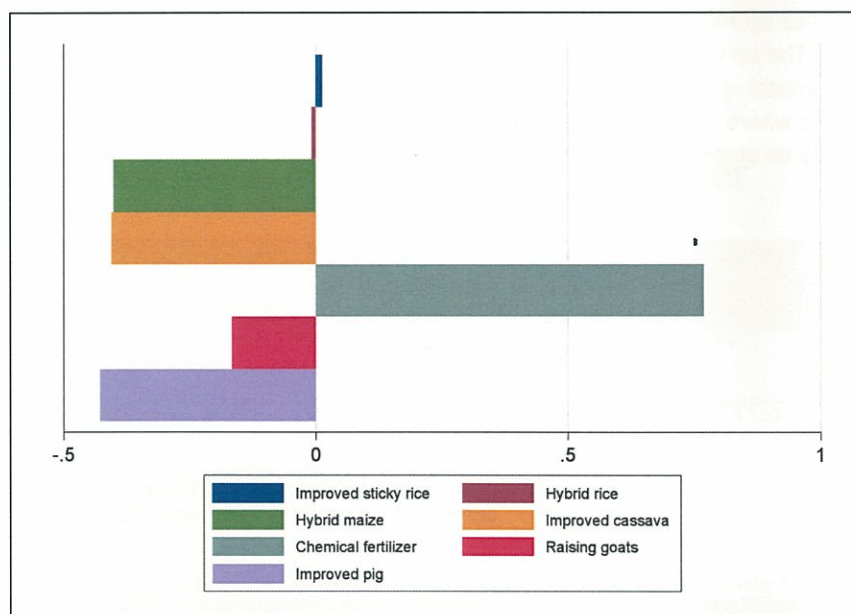
considered as an innovation in the assessment.

What the Simulation Showed and What the Farmers Thought

As part of the assessment process, farmers were asked how the key agricultural innovations impacted on soil fertility and their wellbeing. These criteria were quantified into five grades: very bad, bad, no effect, good and very good, corresponding to scores of -2, -1, 0, +1 and +2, respectively.

Using the MP-MAS approach, the impacts of past agricultural innovations on household welfare and the environment were evaluated. Household welfare was indicated by per capita income and revenue, and environmental quality was indicated by soil nutrient content and the degree of soil erosion.

The simulation results show that hybrid maize and improved cassava



Impact of innovations on soil and water quality

negatively affect the quality of soil nutrients and also increase soil erosion. The simulation also finds that the husbandry of improved pigs and goats has no impact on soil quality. In general, the findings of the MP-MAS simulations are relatively close to the qualitative observations of farmers. The farmers indicated that hybrid maize and improved cassava have negative effects on soil quality but make a good contribution to household income and consumption. They also felt that using chemical fertilizers on sloping land had improved both soil quality and household income and consumption.

How to Mitigate the Environmental Impacts of Agricultural Innovation

As described in the previous section, hybrid maize and improved cassava cause a large quantity of soil loss. This is a key problem for society as a whole, because soil erosion not only negatively affects local farmers but also has significant off-site impacts. Because of this, the survey looks at how this problem could be reduced.

According to the polluter pays principle, local farmers should cover the costs of damage caused by the soil erosion they help cause. An eco-tax is one way to make them do this. The survey therefore assesses the impact of such a tax on the areas where farmers grow annual crops on sloping land without soil

conservation measures. Under this proposed policy, farmers would have to pay tax when growing maize, cassava or when intercropping. Farmers would not have to pay tax when they let their land lie fallow or if they grow perennial trees. The key question that this assessment addresses is: how much tax is needed to reduce soil loss and how would this impact on the welfare of farmers?

Using MP-MAS, a simulation of the impact of land taxation on both the environment and household economy was done at different tax levels. The relationship between any reduction in soil loss and income per capita was graphed to depict the trade-offs between sustainability and the economic welfare of farm households. It is clear that a taxation level of 11.65 million VND per ha would reduce soil loss by 48% and decrease farm revenue from regulated activities by 52%. The drop in revenue would be caused by a combination of increased tax levels and resultant changes in crop areas.

Policies to Move Agricultural Development Forward

The study therefore concludes that a land tax policy can be used to reduce the amount of soil loss caused by agricultural innovations such as the cultivation of improved cassava and hybrid maize. However, because this will have a significant

impact on farmers' livelihoods, it also recommends that sustainable innovations in animal husbandry should be identified and disseminated in order to compensate for farmers' loss of household income. It suggests that this should be done if the Vietnamese government applies a strict soil conservation policy.

In addition, the study also identifies the factors that affect whether farmers adopt agricultural innovations. It finds that early adopters tend to be from households with a male head, engaged mainly in farming and with a low dependency ratio. These households are likely to get credit from traders, and have a large area of land. Households who are currently indebted to informal credit sources are not early adopters of innovations in husbandry. The social relations of farm households are also an important factor in the adoption of agricultural innovations. Households who have more frequent contact with extension workers, village headmen, the district center or those who watch television more often, tend to adopt new agricultural practices before others. The study recommends that agricultural extension workers should focus on such households when trying to get people to adopt new agricultural working practices or crops.

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