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Assessment of Erosion Control in Farming Systems in Northwestern Vietnam

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1. Abstract

In northern Vietnam a high share of agricultural production occurs on hillside sloping fields. It is mainly rainfed upland cultivation and prone to erosion. This problem is already recognized by farmers, government officials and foreign development agencies and efforts to introduce erosion control measures thus have been undertaken for several years already. Still, erosion control is not an integral part of the farming systems. The most commonly promoted erosion control measure is the planting of legume tree hedgerows along contourlines. This technique was found to be effective in soil retention, but not attractive enough for farmers, so that bigger scale adoption would occur. The development of adapted and economically viable soil conservation measures and innovative methods of technology transfer is needed in order to enable farmers to cultivate their upland fields sustainably.

Keywords: Erosion control, Farmers' assessment, Farming systems, Vietnam

2. Problem statement

The pressure on land in north Vietnam is rising, mostly due to three factors:
1. Rapid population growth
2. Land allocation
3. Reforestation

Vietnam's northern mountainous region faced a 300% population increase between 1960 and 1984, and it is assumed that it will double again within the next 20 years (Jamieson, 1998). As a consequence, in the study region Yen Chau, agricultural land available per person decreased from 0.5 ha/person in 1980 to 0.2 ha/person in 1998 (Statistical Department Yen Chau 1999). Besides the main factor of population growth, also the ongoing process of land allocation to farming households limits their area available for cultivation. Furthermore, land considered unsuitable for agriculture is being reforested again.

More than half the surface area of the northern mountain region has slopes of over 20 degrees (Jamieson, 1998). Upland cultivation is an important part of the farming systems in the study area. In many villages where no paddy area is available, rainfed upland cultivation is the only option for crop production. In Yen Chau, "the main problem for farmers, villages and the district as a whole, is the current unsustainable upland cultivation" (SFDP working paper No.2). Cropping intensity is increasing, fallow periods are shortened and often steep fields are cultivated, thus erosion and declining soil fertility are major problems in this context. To stop or reverse the processes of resource degradation, innovation in upland production systems is needed.

Two international development agencies are active in the study region and both of them work on the development of sustainable upland cultivation with the introduction and promotion of erosion control measures (ECMs). Since 1993 the Vietnamese-German technical cooperation has been at work in Yen Chau with a Social Forestry Development Project (SFDP). Action

Aid Vietnam (AAV), a British Non-Governmental-Organization has been promoting the implementation of hedgerows (Hrs) since 1992 in the neighboring district of Mai Son. Efforts jointly made by development agencies and the state extension service to introduce Erosion Control Measures (ECMs) are facing problems with farmers' acceptance and abandonment.

3. Scope and aim of this study

This study was conducted during a three month stay in Vietnam from March to May 1999. The author participated in the "Interdisciplinary Study Project 1999" named "Rural Transformation in Northern Vietnam" which was organized in cooperation between Hohenheim University, Germany, Hanoi Agricultural University No.1, Vietnam and Chiang Mai University, Thailand.
As erosion is a threat primarily for upland cultivation this is the main focus of the study. Farming systems are diverse in the study region. Different environmental and socioeconomic situations are reflected in the farming systems. The various ethnic groups living in the region also show differing preferences for cultivated crops and farming practices. These differences are highlighted as a basis for adapting ECMs in the future.
ECM adopters and non-adopters are compared in order to understand motivating factors for ECM adoption or its rejection. Farmers' preferences, their assessment of erosion, soil degradation and ECMs are described to facilitate the future development of ECMs matching farmers' interests and needs better.

4. Design and Methods of the study

Interviews by means of standardized questionnaires held with farmers are the main source of the presented information. A total of 78 questionnaires were performed with the help of a Vietnamese interpreter, each taking 30-60 minutes. Purposive sampling to select the interviewees was chosen. Interviewees were selected together with village headmen. It was intended to reach a high share of ECM-adopters because of their experience with practising ECMs. The quality of the obtained information varies within the sample. In general, the data presented for the Black Thai ethnic group are expected to be more precise. This is due to easier communication, and better education levels of Thai villagers. Interviews were also held with farmers belonging to the H'mong, Sinh Mun and Kh'mu ethnic groups, where communication turned out to be more complicated due to language barriers. In addition, sometimes shyness and an uncomfortable feeling of the farmers when interviewed were obvious. Interviews were performed in 11 villages in two districts in Son La province. Development agencies are active in 9 out of the 11 villages and promoting ECMs. Besides those structured interviews, open conversation with farmers was sought on different occasions. PRA-tools (e.g. seasonal calendars and various rankings) were repeatedly used. Visually supported communication when discussing farmers' preferences and their assessment of production constraints was mostly accepted by farmers and helpful.
State representatives, extension workers and staff of development agencies (GTZ, Yen Chau and Action Aid Vietnam, Mai Son) were consulted for background information. Field visits together with farmers were realized for getting direct insight in farming practices of the season and documenting plot conditions especially on plots where ECMs are applied.

5. Study Area and division of village groups

This study was conducted in two districts of Son La province: Yen Chau and Mai Son. A total of six Black Thai villages, three H'mong villages, one village of the Sinh Mun and one of Kh'Mu ethnic group were visited. The villages were divided into two groups: village group one (VG 1) and village group two (VG 2), each group covered by 39 interviews. VG 1 comprises the Black Thai villages, which have better access to markets and government

services, such as schools, health care, state extension service, credit and in some cases electricity. Their cropping pattern mostly includes paddy terraces, and is more dynamic. In VG 2 all other ethnic groups are included. VG 2 villages normally have less access to the above named government services, to markets and their cropping pattern mostly is limited to rainfed upland crops and more static.

6. Results

6.1. Ecological aspects

Warm Sub-Humid Subtropic climate predominates in the region. Erratic weather (i.e. frost in higher altitudes and dry years, e.g. 1998) are important constraint factors for both crops and Hr-species in question. As 1998 was a dry year, many farmers reported zero-harvests of upland rice in that year. Therefore, 1998-yields are not seen to represent an average value. Ferralitic soils developed from limestone with pH KCl in the topsoil between 5-7 make up for most of the area (N. Hirth, 1999). Upland cultivation occurs on slopes up to 100% inclined, inevitably causing erosion despite soil characteristics (e.g. organic matter, soil texture, aggregate stability) indicating mostly low to middle erosion risk (N. Hirth, 1999).

6.2. Farming systems

All farmers visited were practicing sedentary cultivation, with VG 1 farmers being already sedentary for a longer period than VG 2 farmers.
A Permanent Upland Farming System with two subsystems as described by Ludwig (1997) with occasional fallows is found:
1. Smallholder Mixed Permanent Farming (including terrace cultivation) mostly in VG 1
2. Smallholder Rainfed Upland Farming mostly in VG 2
Forestry, animal husbandry, fisheries, agroforestry and rainfed slope cultivation are found in subsystem 1 and 2 with intensities varying between and within the village groups. Farms in VG 1 are more oriented towards market production (maize, fruits); whereas they are more subsistence oriented in VG 2 (upland rice).

6.3. Characterization of interviewed households

Mean household size in VG 1 is found to be 6.7 persons per household, whereas in VG 2 it is 7.0. Respondents in VG 1 claimed to have school education of 5.5 years (mean value), farmers in VG 2: 1.6 years. Years of education refers mostly to men as only 3 interviewees were women. Women were more difficult to contact, also because of difficulties in speaking Vietnamese. Possessions chosen as wealth indicators were: Brick roof, motorbike and Television set. All three categories indicate VG 1 farmers to be the wealthier.

6.4. Land endowment of VG 1 and VG 2 households

Table 1. Cultivated land

	VG 1	VG 2
Mean Paddy area (ha/hh)	0.16	0.02
Mean upland area (ha/hh)	1.3	2.9
Mean upland area per hh-member (ha/pers.)	0.2	0.4

The hypothesis of land being especially scarce in VG 1 is supported by the numbers of farmers claiming fodder for ruminants (i.e. pasture land, especially during dry season) to be lacking.

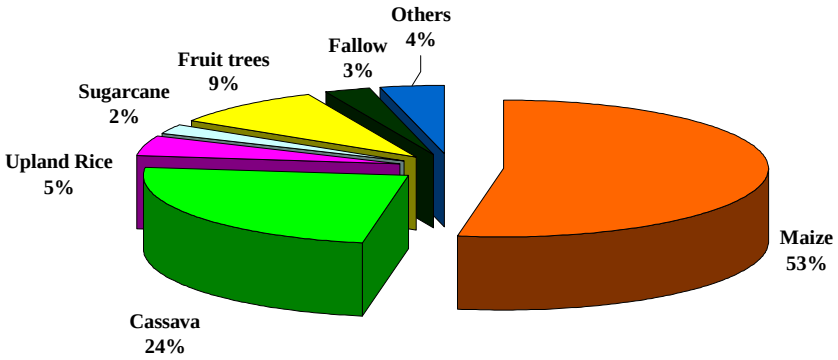
Table 2. Fodder availabilty, Number of cattle

	VG 1	VG 2
Farmers claiming fodder to be lacking (%)	90	69
Mean No. of cattle (No./hh)	1.6	1.0

6.5. Division of the upland area

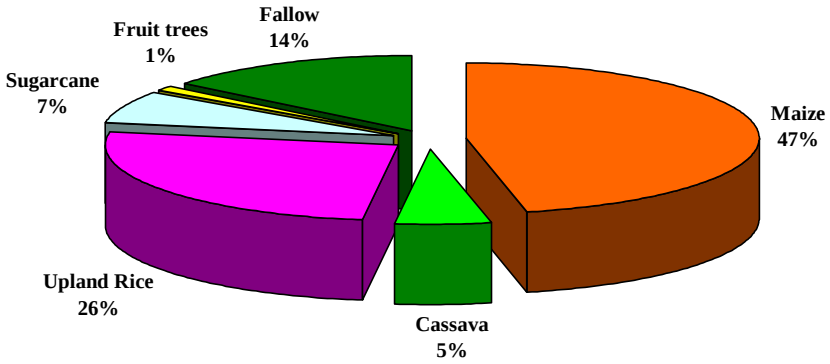
Figure 1. Division of the upland area

VG 1



- 93% of the upland rice share is grown in one village (Hong San), which has no paddy area and is thus explained by a wish to ensure food subsistence
- “Others” consists of cotton and tamarind trees within forest

VG 2



- The whole sugarcane share derives from one village (Keo Bo)
- Illegal poppy cultivation was not treated in the interviews but may be part of the cropping pattern in some villages

6.6. Discussion of the data concerning area size

The data describe the average division of a household's upland area. These data contain a considerable margin of uncertainty and should be interpreted rather by their relative values than their absolute values. As many farmers especially in VG 2 often could not tell the size of their plots, area size had to be extrapolated. Respondents' answers concerning the size of cultivated land and the mandays needed for different tasks (ploughing, hoeing) is the basis for the extrapolation. The numbers of workdays necessary for a certain task vary strongly and it was not distinguished between men's, women's and children/young adult's workforce. Also differing soil properties and distances of plots which have an influence on productivity could not be taken into consideration.

6.7. Maize production and Inputs

Available inputs are preferably applied to paddy rice (e.g. animal manure, mineral fertilizer, pesticides) and sugarcane (e.g. mineral fertilizer) where cultivated. As maize is the upland crop with the highest area share it is treated in more detail. 43% of farmers in VG1 and 18% in VG2 apply mineral fertilizer (i.e. Urea- Nitrogen and Phosphorus) to their maize plots. Farmers who don't use mineral fertilizer on upland fields most frequently named lacking purchasing power as the reason.

Reduction of the workload and more efficient and deeper tillage by means of animal traction was frequently mentioned as desired. 38% of farmers named buffalo and cattle as their first investment choice when asked in what they would invest or did invest in the past.

Maize production is named in 97- 95% (VG 1 -VG 2 respectively) of the interviews as the most important source for cash income, in many cases as the only one. Production patterns of maize vary considerably between the village groups and are used to highlight differences in access to and acceptance of innovations. Table 5. illustrates differences in maize production.

Table 3. Maize production (N=78)

	VG 1	VG 2
Use of high yielding varieties (%)	92	64
Use of local varieties (also mixed with HYV) (%)	8	74
HYV seeds purchased from extension (%)	79	46
Yield per ha in 1998 (t/ha seeds)	5.1	3.1

Average gross revenues from Maize cultivation are higher in VG1 compared to VG2 (~6.5Mio. VND/ha for VG1, VG2: ~3.2Mio. VND/ha), but also entail higher input costs for HYV seeds and mineral fertilizer. Yields measured in VG 1 villages in 1998 by N. Hirth resulted in an average yield of 4.1 t/ha. The higher data presented above (5.1 t/ha) is explained by tendencially too small area data, as these are based on red book data, which tend to be 10-50% understating (A. Luibrand, personal communication).
Most of the farmers who adopted the new varieties (79% in VG1 and VG2 together) cultivate HYV-maize only since 1997. Commonly, both HYV and local maize varieties are cultivated in VG 2 farms. In VG 2 the share of local Maize varieties is higher and the mean date of HYV-adoption is 8 months later. Furthermore, the share of farmers buying seeds from the private market is higher, because extension and cooperatives are less present and active. VG 2 farmers thus profit less from existing HYV seed-subsidies.

6.8. Hedgerow (Hr) adoption
Hr adopters were interviewed because the planting of Hrs is the main ECM jointly promoted by the state extension service and development agencies. The share of the 18 interviewed Hr-adopters in the sample of 78 interviews is higher than their normal share of a village's population. The share of households that plant Hrs (ca. 38) in all 11 villages that were visited is ~3% , even though Hrs are promoted in 9 of the villages.

Table 4. Hedgerow adopters

	All interviews (N=78)	VG 1 (N=39)	VG 2 (N=39)
Hedgerow adopters (% of households interviewed)	23	33	13
Hedgerow adopters (total number)	18	13	5

Comparing hedgerow adopters in both village groups with the non-adopters, holders of official positions (e.g. village head man, head of cooperative) have an overproportionate share. This was repeatedly explained by having to fulfill a role model function, as EC is supported by government policy and local authorities. A tendency can also be observed, that Hr-adopters sell a higher market value of maize.

6.9. The hedgerow technique
Hrs planted consist of *Leucaena* sp., *Tephrosia* sp. and *Cajanus* sp. legume tree species. Hrs are planted in rows (single or double) along contourlines with 3-8 meters distance. Newly installed Hrs are planted at bigger distances as a trade-off between EC effectiveness and farmers' wish to reduce the area loss. Newly established Hrs also consist predominantly of *Leucaena* sp., responding to farmers' preference for longer-living species. AAV Mai Son is conducting trials with *Indigofera* sp. as a hedgerow tree because it is frost resistant. Frosts are

responsible for the dying out of Hrs in higher altitudes. Soil building up above Hrs can be observed and indicates for the Hrs' effectiveness in reducing soil loss due to erosion.

6.10. Hedgerow management

Hedgerow management can be improved. Cuttings are placed besides hedges, therefore organic matter serves as green manure mainly for the hedges and not as is intended for the crops planted in the alleys. Although a lack of ruminant fodder was mentioned by many respondents, edible cuttings of *Leucaena* plants are not being used for fodder. This is partially explained by the Hr plots being situated too distant from farms; often farmers also were not aware of this side-benefit.

6.11. Hedgerows in the farming system

The area share of plots being under cultivation with hedgerows is marginal. Even Hr-adopters do not plant Hrs on more than one plot. The plots where Hrs are installed often show degraded soils, are steep, stony and rather unproductive. In many cases Hrs were installed on plots that thereafter were laid fallow. Repeatedly, it was reported that Hrs were destroyed. Accidentally by uncontrolled fire, or willingly in order to plant more productive crops (e.g. sugarcane) instead. In villages in Mai Son district the Hr technique was found discredited. Repeatedly farmers complained, that when they were given the seeds they were also given the guaranty to sell back the seeds. After harvesting the seeds (mostly *Cajanus* sp.) farmers found that nobody wanted to by them anymore.

6.12. Other soil conservation measures

AAV in Mai Son promoted cultivation without burning, in order to improve organic matter contents in the soil, but found farmers reluctant to the idea. The burning of fields is a most common practice. It is done before land preparation in order to control weeds and facilitate land preparation. Undersowing of Lablab bean (*Lablab purpureus*) and Rice bean (*Vigna umbellata*, Vietnamese: Nho Nhe) was reported by few farmers. Undersowing of soy bean was tried out by some farmers. Problems with the formation of seedless pods are common. Incorporating more legume intercrops and relay crops in the cropping pattern is desirable for improving Nitrogen contents and coverage of the soil (see R. Bunch, 1997 for a detailed discussion of various soil conservation measures). Land preparation practices (e.g. the building of microterraces) stand for a different approach to soil conservation. Microterraces are promoted by GTZ in Yen Chau since 1998 and find acceptance among the farmers visited. Longer-term effectiveness of the measure still has to be proven. Barriers built of stone and various grass species with potential for vegetative barriers are further options available.

6.13. Farmers' assessment of erosion and soil fertility

Explanations given for the most often observed decline of upland crops' yields were soil degradation because of the long and continuous cultivation of plots ("old soils"), weather and erosion due to inclination and rainfall. For Maize, after the introduction of HYVs (VN 10, 9698, and others) mostly yield increases were reported and explained by the improved varieties, improved land management (deeper tillage) and increased input of mineral fertilizer.

Table 5. Yield tendencies

(% of answers)	Maize-before introduction of HYVs (N=61)	Maize-after introduction of HYVs (N=37)	Upland Rice (N=43)
Stable	30	5	5
Decrease	70	5	91
Increase	0	89	5

6.14. Ranking of production constraints for Maize
Farmers were asked to rank production constraints according to their importance. Own suggestions were first asked for, then six different choices were given:

A: Weeds	C: Pests (Insects)	E: Soil fertility
B: Diseases	D: Rats	F: Erosion

Farmers' own suggestions differing from presented cards were: Weather, water, ants and birds eating seeds. Only the most frequently named three constraints of priority are presented. The three less important constraints were commonly not treated also in the interviews.
Cards with symbols for each constraint were put in an order. The soil fertility symbol was most problematic to be understood, especially in VG 2. Its low ranking is explained by this, as it was frequently named as a constraint factor in other contexts.

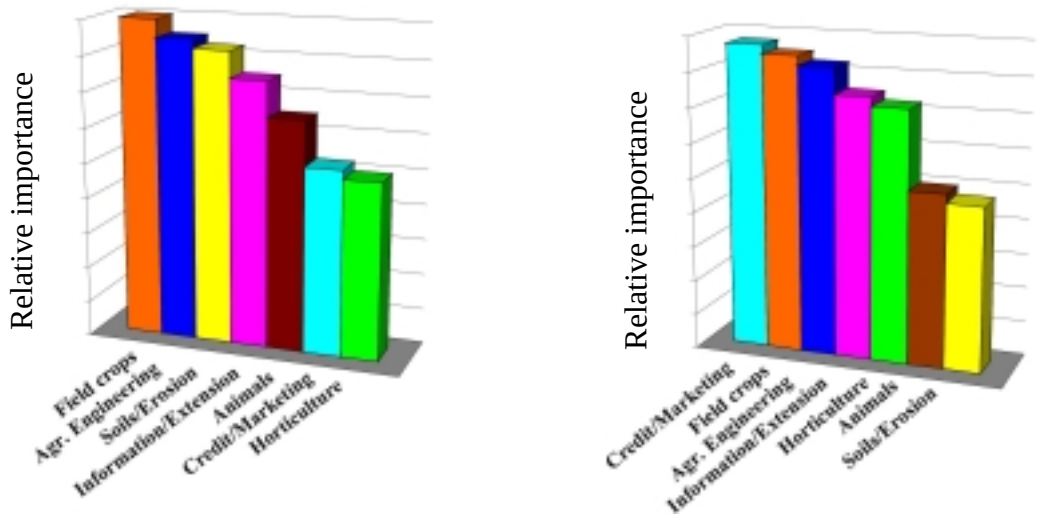
Table 6. Constraint Priority

	VG 1 (N=32)	VG 2 (N=22)
First	Rats, weeds	Rats
Second	Rats, soil fertility	Pests
Third	Erosion	Erosion

Erosion and soil fertility are being perceived as threats to production, but rank lower than other factors. Insofar erosion control measures linked with high costs for farmers cannot be expected to be implemented. In reality, an even lower ranking of the erosion factor has to be expected because of a courtesy bias. Farmers could not always differentiate between GTZ or AAV staff and the author.

6.15. Ranking of future importance of farming system components
Each ranking was conducted with farmer groups of 4-7 persons, and 4 times repeated. The values presented in figure 2 are mean values. They are derived from numbers of seeds placed on each of the cards (each representing a component) by farmers according to the component's importance. In figure 2. a better problem consciousness of VG 1 farmers concerning erosion can be observed. Technical options for better tillage were most referred to as agricultural engineering. VG 2 farmers often mentioned an urgent need for credit, which is reflected in the diagram.

Figure 2. Future importance of farming system components



7. Conclusions and outlook

Erosion control measures have been adopted only by few farmers so far. Reasons for this can be found in the techniques offered, the way of introducing the techniques and differing assessments of erosion as a threat to production between outsiders and farmers. This difference in perception may lead to overestimating farmers' will to make sacrifices for erosion control. The Hr-technique was criticized most often for reducing the area available for crop production and demanding too much labor at times of labor peaks. In addition, erosion as a threat to upland production ranks relatively low in farmers' perception compared to other production constraints. As Maize yields continue to rise, production is not considered unsustainable by farmers in contrast to the outsiders' perspective. Positive side effects (e.g. green manure, fodder) are rarely made use of, due to lack of knowledge and practicability. To improve the acceptance of the Hr-technique, the cost-benefit relation should be improved. On the cost side this can be through e.g. increasing the distances between hedges, which also results in less labor demand for Hr-management. On the benefit side, improving farmers' knowledge about Hr-management, e.g. to make better use of side benefits can be an option. Tax reduction (as is being discussed for Chieng Dong commune) for plots where ECMs are applied would provide an additional incentive for adoption, and should be taken into consideration especially for VG2 farmers, given their stronger dependency on upland production and lower wealth levels. Other Hr-species, which produce marketable products or fodder (e.g. pineapple, sugarcane) may also be a possibility to make erosion control more attractive to farmers.

A top down approach for the implementation of the Hr-technique was observed. In one case the farmer, on whose plot Hrs were planted did not agree, but just let it happen. If farmers would be more integrated already in technology development, better acceptance and easier tailoring of ECMs to their needs and preferences could be expected. Existing informal farmers' experiments with undersowing provide possibilities for adding documentation, scientific evaluation and further development and thus to enrich both sides.

When thinking about future development in the two village groups, their differences have to be taken into account. The more remote Non -Thai villages (VG 2) are much less integrated in the process of innovation transfer. Also their cropping patterns differ considerably from those found in Thai villages, with a higher share of fallow area. Improving fallow through legumes may in their case be one viable means of protecting the soil. Especially in VG1 cropping

patterns are changing rapidly with fruit trees and sugarcane being the most obvious. Fruit production is increasing also on uplands, thus there is an opportunity to promote cover crops (e.g. *Arachis pintoi*) as a part of the extension's advise.

List of Abbreviations

HYV	High Yielding Varieties. The most common hybrid variety used by farmers is the VN10 hybrid. Second most used is Hybrid 9698.
ECM	Erosion Control Measure
Hr(s)	Hedgerow(s). Legume trees planted along contourlines to stop erosion
VG 1	Village Group 1
VG 2	Village Group 2
ha	Hectare. 1hectare equals 10,000 m^2
VND	Vietnamese Dong. Vietnamese currency, at the time of the study 1US$ was equivalent to ~ 13,000 VND.
AAV	Action Aid Vietnam. British Non-governmental-organization, also active in Mai Son district, Son La province.
GTZ	Gesellschaft für Technische Zusammenarbeit. German state-owned development agency. Active in Son La province with the Social Forestry Development program (SFDP).

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