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Livelihood strategies

Potential of cattle rearing by improved fodder production to increase households` income and to decrease soil erosion in rural communities in Northwest Vietnam

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“Let every individual and institution now think and act as a responsible trustee of Earth, seeking choices in ecology, economics and ethnics that will provide a sustainable future, eliminate pollution, poverty and violence, awaken the wonder of life and foster peaceful progress in the human adventure.”

John McConnell – founder of International Earth Day

Abstract

With the steadily growing population and the increasing demand on food, more and more forests are converted into farmland. Vulnerable lands on steep slopes or areas prone to desertification processes are overused and polluted by the application of more and more chemicals. According to the FAO (2008), more than 20% of all cultivated land, 30% of all forests and 10% of all grasslands worldwide are already degraded and affect one fourth of the world`s population negatively. Most of the people living in developing countries depend on agriculture. It is therefore obvious that the productivity of their farmland must be maintained in order to ensure their source of food and to combat poverty.

Food insecurity has become a fundamental topic in international meetings, a fact which must be taken as an alert how badly research is needed to find better ways for an alternative and sustainable land use. The University of Hohenheim is involved in a long-term research program in Vietnam in the framework of the Uplands Program, which is funded by EnBW Rainforest Foundation. Its aims are to contribute to the conservation of natural resources as well as to improve rural living conditions in remote mountainous areas by transferring know-how and technical innovations.

The study site is characterized by very steep slopes on which mainly maize is cultivated. For maize as animal feed is from the economic point of view very attractive to the farmers, subsistence-oriented agriculture is being replaced by market-oriented agriculture. Maize is a very erosion-prone crop, especially in the beginning of the rainy season when the maize plant is still fragile and the soil is not yet covered by vegetative residues. During this period, erosion processes occur quite frequently and deteriorate the ecosystem by sediment translocation to lower areas and siltation of water bodies.

This diploma thesis has been accomplished in the framework of subproject **C4** “Impact of intensification on land use dynamics and environmental services of tropical mountainous watersheds” funded by the German Research Foundation (DFG).

As the title of this thesis points out, poverty is to be reduced by the implementation of soil conservation techniques in order to maintain the fertility of soil and thus, to raise productivity. Furthermore, the idea is to establish conservation plants that could be used as animal feed in order to promote cattle keeping and thereby to diversify the

farming systems. Animal husbandry could create a supplementary income source and provide stability to vulnerable and marginal households. Livestock can be considered as an optimal means of storing and saving money for emergency cases.

So the objective of this thesis is to evaluate the adoption of soil conservation techniques and the potential of animal husbandry as possibilities to reduce poverty in two communes in Son La province in the Northwest of Vietnam.

The two communes in question differ concerning remoteness from the next district center and infrastructural access as well as in the ethnicity of their population. This survey tries to find out whether remoteness and the extent of social integration of the different ethnic groups play a crucial part in the adoption of new technologies.

The results of this comparison reveal that the adoption rates of the two communes are – despite their differences – quite similar. In fact, Black Thai living in lower altitudes and with better infrastructural and social integration proved to be more open to innovation than Hmong in very remote areas and with little contact to the Vietnamese population. Nevertheless, in both communes examined, a whole range of constraints that hinder the implementation of agricultural innovations could be observed. There is for example the farmers' fear that the conservation plants and maize might compete for the fertilizer used and that this might lead to decreased maize yields. Further on, the farmers' poor financial situation to buy seeds for cover crops or grass stripes plays an essential role. Lack of knowledge about methods of soil conservation is also a decisive factor in the adoption of new techniques.

To make sense, the analysis of these constraints should eventually lead to adequate recommendations. Though most of the farmers are not altogether unaware of the erosion problem in their region, still a great effort of educational promotion has to be made. Without additional technical or financial support, the farmers will be unable to realize sustainability in agriculture. The precondition of primary concern for the solution of the existing problems is a pro-poor political and institutional framework.

Keywords:

Erosion, soil conservation techniques, animal husbandry, sustainable agriculture, constraints, political and institutional framework

Acknowledgements

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I want to address dear thanks to the ENBW Rainforest Foundation, too. Taking part in the Uplands Program, I had the chance to make not only a lot of new experiences but also many new friends.

I am particularly grateful to all participants of the Uplands Program. A warm “thank you” to Gerhard Clemens, who coordinated my stay in Vietnam and to Tuan Vu Dinh, who was my contact person in Yen Chau and who helped me with words and deeds! I thankfully think of all my colleagues in Yen Chau, especially Erisa Shiraishi, Nadja Reinhardt, Johannes Pucher and Julian Kofler, and, of course, my assistant Hien Do, who patiently translated for me and answered all my questions about the culture and the way of life in the mountainous regions of Northwest Vietnam. Thanks so much to you all for sharing your ideas and knowledge and for making my stay in Vietnam unforgettable.

I also owe many thanks to the village headmen for endorsing my interviews in their villages, and of course, to all farmers and experts who took their time going through my questionnaires.

Last but not least, I sincerely thank my parents for their support during my studies and their encouragement in all my decisions. I thankfully remember my German and Greek grandparents, the ones who awakened my interests for different cultures, the others who made me appreciate the gifts of nature.

Dorothea Kalliopi Mavrakis, University of Tübingen, 2012

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List of abbreviations

a.o.	and others
BSE	Bovine Spongiform Encephalopathy
C	Carbon
CH	Chieng Hac
CK	Chieng Khoi
DFG	Deutsche Forschungsgemeinschaft (German Research Foundation)
EnBW	Energie Baden-Württemberg
FAO	Food and Agriculture Organization
G8	Group of Eight; Forum of governments of eight large economies
GDP	Gross Domestic Product
HDI	Human Development Index
HIV/ AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HYV	High Yielding Varieties
LAI	Leaf Area Index
a.m.s.l.	above mean sea level
MDG`s	Millennium Development Goals
N	Nitrogen
NGO	Non-Governmental Organization
NMR	Northern Mountainous Region
NW	Northwest
P	Phosphorus
PRA	Participatory Rural Appraisal
SARS	Severe Acute Respiratory Syndrome
SCT	Soil conservation techniques
SFB	Sonderforschungsbereich
T	Treatment
UNDP	United Nation Development Programme
US	United States
USD	United States Dollars
WRB	World Reference Base

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1 Purpose and concept of the thesis

1.1 Preface

Coming first to the Northwest of Vietnam, one is overwhelmed by the diversity and abundance of nature in general and simultaneously deeply shocked by the barrenness of the steep hills in the mountainous regions and about the impoverished circumstances of the farmers living there. Automatically, the question arises what are the roots of this deplorable situation.

Because of the rapid increase in population and the economic growth in Vietnam and consequently the rising food demand, the agricultural area per person has considerably decreased in the last years. Farmers started to clear more and more forest area in order to use it as farmland. The overexploitation of natural resources and the intensification of land have led to immense soil degradation so that according to CLEMENS et al. (2010: 87), already half of the Vietnamese land area can be considered by now as "barren lands" with low soil fertility and therefore, low level of productivity. This process has notably aggravated the situation in the Northwest, the study site of this thesis. In this region, which is characterized by steep mountains, deforestation and cultivation of annual crops, soil erosion is a frequent phenomenon. In the beginning of the rainy season, the soil is not yet covered, thus entailing nutrient depletion which impedes long-term production. In consequence, farmers started to use more and more fertilizer to raise the productivity of their already degraded soils. The increasing use of chemical fertilizer and pesticides pollute the ecosystem of the whole watershed. Through the clearing of new forest area also the biological diversity is seriously endangered.

Picture 1: „Barren lands"
(Source: own picture taken in May 2011)

But land degradation is not only an ecological problem. Like in all developing countries, most of the people in Vietnam live from agriculture. Soils are the basis of their livelihood and therefore degradation of soils raises the vulnerability of farmers to live in poverty.

1.2 Objectives of the study and placement of this topic into the geographical context

This study shows that development can only happen in a sustainable way if all dimensions and all stakeholders are involved and if value chains are built up that contribute to a better living standard in the long-run.
It tries to point out how poverty on small-scale level can be reduced

- by the conservation of soils to provide a basis of farmers` livelihood and to maintain productivity and yields,
- by the support of small-scale farmers to make them independent of market prices by promoting a sustained subsistence farming system,
- by building up value chains to diversify their income sources and
- by promoting cattle keeping to ensure stability in emergency cases such as natural hazards.

All these factors shall be investigated more closely in this thesis. The intention of this research work is to find out what measures are apt to fight hunger and poverty. Quite seemingly, long-term productivity of farmers in the northwestern region of Vietnam can be increased by the introduction of soil conservation techniques and the improvement of their feed production for cattle rearing. Food security and the reduction of poverty would lead to an improved livelihood in the economically marginalized and ecologically extreme fragile mountainous region of Northwest Vietnam. However, the putting into practice of these ideas turns out to be difficult if preconditions of the implementation of new techniques are unfavorable.

Therefore, the objectives of this study are

- to identify the small-scale farmers' restraints concerning the implementation of soil conservation techniques,
- to analyze the institutional and political framework on different administrative levels in terms of technical and financial support for local farmers,
- to evaluate the constraints and preconditions,
- to give an outlook on possible options for sustainable cultivation systems in a fragile and vulnerable ecosystem and
- to establish concepts for the improvement of the institutional framework.

All these deliberations must keep in mind the involvement of the local stakeholders.

As this topic deals with the relationship between humans and environment as well as with the interaction of economic and cultural linkages such as the globalization process, it is highly relevant in the context of geography. Especially in the sector *Geography of developing countries,* the problems of the so-called third world, such as poverty and food insecurity, are subjects of burning interest. Geography is a discipline that discusses topics on different scales and from various viewpoints and all these characteristics are taken into consideration in this thesis.

1.3 Structure of the thesis

The **first chapter** presents the concept and purpose of this thesis and clarifies the question why this topic is of great importance in the context of geography. Furthermore, the objectives of this study are explained.

In the **second chapter** general background information about the study site illustrate the main problems of the local agriculture and the reasons for these problems.

Chapter three is the theoretical part of this thesis and includes the state of the art. It explains the ideas of sustainability and sustainable agriculture. Three soil conservation techniques that have already been tested in the study site are presented in detail.

Then a hypothesis is put forward about the adoption rate and its preconditions.

Chapter four describes the methods and the materials such as the different questionnaires used for the conduction of the research. Problems arising during the research are discussed, too.

In the **fifth chapter** follows the empirical part that contains the analysis and interpretation of all data collected during the fieldwork. The constraints of the adoption of soil conservation techniques and of cattle rearing from the farmers` viewpoint are exemplified. The two communes in question are compared in regard of their adoption of soil conservation techniques and of the potential of cattle rearing.

In **chapter six** the hypothesis posed before is reflected again in the light of the new gained findings.

Chapter seven tries to make recommendations for a better dissemination of SCT in the region.

Chapter eight describes future scenarios in case agriculture does not return to sustainable methods in Northwest Vietnam.

Finally, the references are listed up in **chapter nine.**

In the Appendix, the questionnaires used and an additional Figure that can elucidate some earlier statements are attached.

2 The initial situation and inherent problems of agriculture of the study site

2.1 General information about the research sites

Vietnam is situated in the tropics of South East Asia. It has borders to Laos in the West, China in the North and Cambodia in the South. Vietnam is divided into eight economic regions (THE et al., 2004: 13). The research sites are located in the Northern Mountain Region (NMR), the Northwest. This region consists of 13 provinces (FRIEDERICHSEN, 2006: 38). The province this survey was conducted in is called Son La. It is further subdivided into ten districts, each of them having several communes. In Yen Chau district where the research work was pursued (see Figure 1 above), two communes Chieng Khoi and Chieng Hac were chosen as two representative sites with differing physical and infrastructural conditions. In order to understand these differences, one has to look more closely at the physical and climatic, socioeconomic and agricultural situation.

Figure 1: Location of Yen Chau district
(Source: QUANG et al., 2008 : 7)

2.1.1 Physical and climatic conditions

Vietnam`s total land area amounts to around 330´000 km², three fourths of which consist of mountainous relief with very steep slopes. That is why the arable land area per capita is with 0.1 ha the lowest in the world (THE et al., 2004: 13). The study area is located in the Northern Mountainous Region (NMR) in the Northwest of Vietnam near the Laotian border. As its name already suggests, this region is dominated by high mountains. The uplands of Son La province, where the survey was conducted, reach from 300 to 1´000 a.m.s.l. (see Figure 2 below), the highest altitudes being characterized by steep slopes of up to 35° (UNIVERSITY OF HOHENHEIM, 2012). Between the steep hills – mostly limestone – there are large, flat intermountain basins or river valleys.
The study area is situated in the Black River watershed (THE et al., 2004: 17).

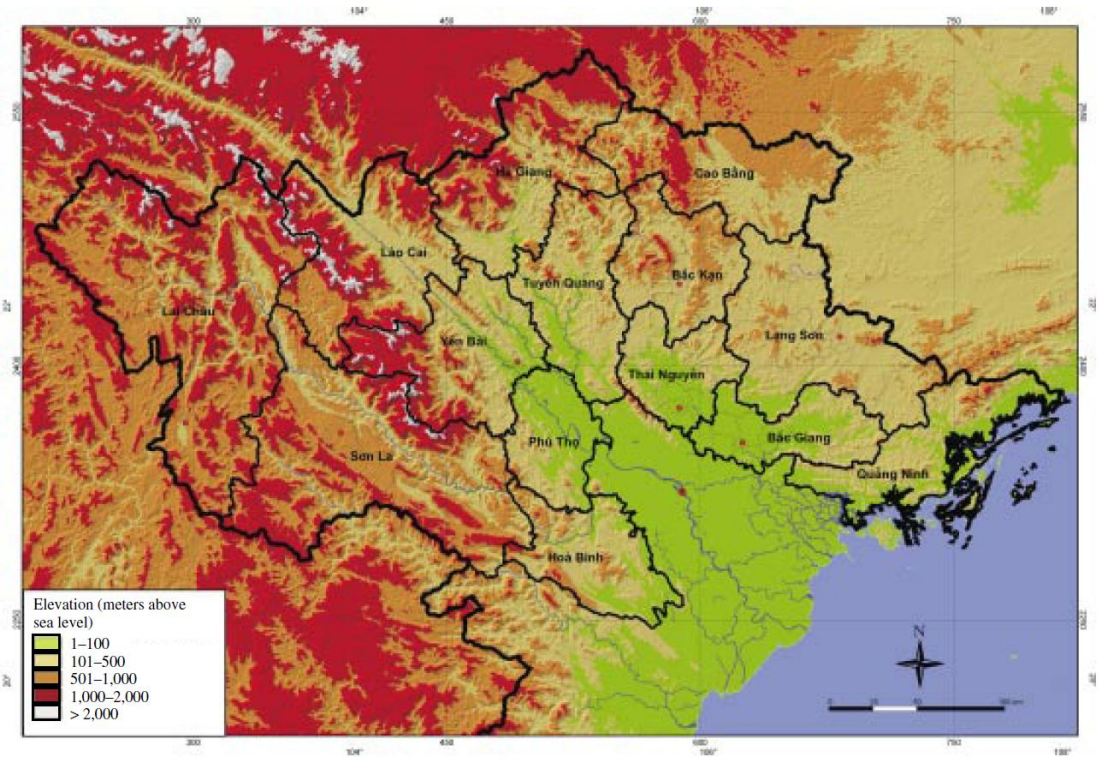


Figure 2: Elevations in the northern uplands
(Source: Elevation data from USGS GTOPO30 (2003). In: MINOT et al., 2006: 31)

Northwest Vietnam has two seasons: between April and September it is quite hot with temperatures ranging between 23 and 29°C. During this period, the monsoon brings 80% of the annual rainfall. The precipitation distribution depends on the slopes and the elevation, but the average precipitation amounts to 1´800 mm per year. The dry season

begins in October and lasts until March. In this space of time, the average temperature is 18°C, but can even fall as low as 0°C (THE et al., 2004: 18). This sub-tropical climate causes deep weathered soils, which are poor in nutrients. There is a great variety of soil types according to the location and depending on the parent materials, but the most typical soils found in this region are gray ferrallits or yellow-red ferrallitic soils, which are suitable for fruit trees (THE et al., 2004: 17).

The northern mountainous region has a great ecological diversity containing 90% of the country`s forests, 70% of the total fauna and 90% of domestic flora species. They represent the main source of water, mineral resources and medical plants (THE et al., 2004: 25).

The uplands can be subdivided into areas of higher and lower altitudes. The higher altitudes (most parts of Chieng Hac) are characterized by very steep slopes and hill tops whereas the lower altitudes (most parts of Chieng Khoi) are more diversified with steep slopes, bottom of the hills and valleys.

The two sites have not the same history of settlement and are therefore inhabited by different ethnic groups.

2.1.2 History of settlement and agriculture

The Vietnamese population comes to 80 million people (THE et al., 2004: 13). According to official information, Vietnam has 53 different ethnic groups, 30 of which live in the northern uplands. The biggest minority group having immigrated from southern China about 800 years ago is the Tai people, including the Tay as well as the Thai. This dominant group used to organize itself in principalities with a strict hierarchical class structure and has lived in the federation of twelve Tai cantons in the upper valley of the Black River since the 17th century. In the 1880s, the Tai were ruled by the French colonialists and then by the Vietnamese (FRIEDERICHSEN, 2006: 22-23).

Although it was officially forbidden to settle at higher and more isolated parts of the highlands, another minority group, the Hmong, set up their villages in these regions in the mid of the 19th century (FRIEDERICHSEN, 2006: 25-26). For example, Bo Kieng, one of the settlements in the high altitudes of Chieng Hac, where one part of the survey was conducted, was founded in 1970, and Co Say, another village, where interviews were

made, has only existed since 1994 (FRIEDERICHSEN, 2004: 67). The settlement of ethnic minorities played an important role in the following years, when the Vietnamese finally managed to gain their national independence in the battle against the French with the help of the ethnic population. Thanks to this fact, the area mainly populated by minorities became autonomous in 1955. But for fear of separatism, the autonomy lasted only until 1959 (FRIEDERICHSEN, 2006: 25-26).

Yen Chau district, where the research of this thesis took place, is populated by twelve ethnic groups, the Thai people representing the greatest part with 53%. The Kinh people follow with 18%; the Sinh Mun and Hmong people are on the third and fourth position with 13% and 12% (FRIEDERICHSEN, 2006: 27).

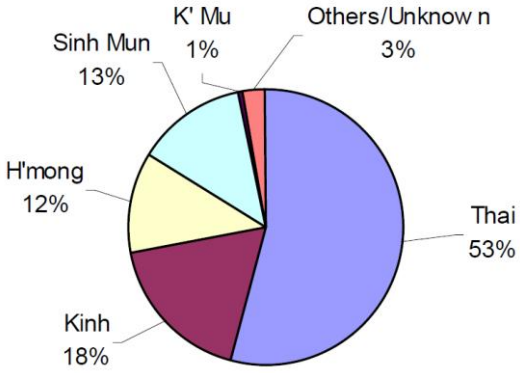


Figure 3: Ethnic groups of Yen Chau District
(Source: FRIEDERICHSEN, 2006: 27)

Since the year 1960, there has been an enormous increase of population in the whole country of Vietnam – not only because of naturally rising birth rates but also due to migration processes. In NMR, the augmentation rate is as high as 300% by now. To cope with the high population density, the government attempted to exploit the economically unused terrain in the sparsely populated higher altitudes of the Northwest by resettlement policies. Kinh people were promised cash incentives or good positions if they left the densely populated lowlands to build up new villages and agricultural or forest companies along the main roads in the uplands (FRIEDERICHSEN, 2006: 25-26). The purpose was to establish new economic zones. Road infrastructure was extended to improve the lowlands-uplands commodity and information flow (FRIEDERICHSEN, 2007: 9). According to FRIEDERICHSEN (2007) citing the Asian Development Bank, around 3,8 million people were resettled until 1998. With the construction of a new hydropower plant near Son La, even more people will migrate to the uplands in the near future (FRIEDERICHSEN, 2007: 7).

Apart from that, a sedentarization program was pursued in 1968 in order to settle down the nomadic farmers and to reduce their mobility. This “Fixed cultivation, fixed settlement”-program is particularly aimed at stopping their swidden farming systems (FRIEDERICHSEN, 2007: 7). The traditional cultivation method that has been applied for hundreds of years is *shifting cultivation or “composite swidden farming”* (AYANU, 2009:

2). This is an agricultural system in which farmers first convert the primary forest into annual crops through slash and burn. After a cropping period of 2-3 years, the plots are left fallow until the soil is regenerated with nutrients again and a secondary forest can emerge. During this time, another part of the forest is cleared in order to plant crops there. Farmers cultivate on steep hills as well as on fields in the valleys (paddy rice). This is an optimal and integrated cultivation system in the tropics as long as the fallow periods are maintained.

This sedentarization law was associated with collectivization in order to reduce forest destruction and to strengthen the ethnic and community unity. All in all, it was considered as a measure to fight poverty. But sedentarization does not automatically lead to a change of farming practices (FRIEDERICHSEN, 2006: 22-27). The practice of clearing forest around the villages was still continuing.

This collective farming system lasted until 1988. In the 90s, a land allocation was carried through that provided farmers with land use rights and land titles. The allocation started in the lowlands. Later on, allocation had the purpose to combine scattered small plots in order to increase productivity. Besides, land use plans were established. According to family size and soil quality, households got land use certificates (defined in the so-called "Red Book") for 20 years (for annual crops) and up to 25 years (for perennial crops). Though farmers have long-term land use rights, the government has still control over the land use plans (SAINT-MACARY et al., 2008: 3). With sedentary farming, the government originally aimed at the reduction of the annual forest losses. However, the planned resettlement and the sedentarization of nomadic farmers again caused higher population density and pressure on arable land, a process entailing immense environmental damages, as the chapter 2.2.2 will show.

Agriculture in the lower altitudes of the uplands

Although agriculture became increasingly cash-oriented in the lower altitudes and valley bottoms inhabited by Kinh and Black Thai, cultivation there is still subsistence-oriented and more diversified than in the higher altitudes. Thanks to water-richness, one of the main crops still consists in irrigated paddy rice, which is planted once or twice per year in the lower plains. Maize and cassava is mainly cultivated for export. Easier access to markets enables the farmers to cultivate a variety of trees (banana, lychee, mangos, plums, a.o.) and to raise animals like buffalos, pigs, chicken or fish for home consumption and sale (FRIEDERICHSEN, 2006: 25). Cattle rearing is seen as a

complementary income source and as an integral part of the so-called VAC-system (in Vietnamese ***v****uon* – ***a****o* – ***c****huong*; FAO, 2001), an integrated crop-animal-system that comprises gardens with crops (horticulture), fishponds (aquaculture) and stables (animals) for pigs or cattle (MANH, 2010: 14-15).

The agricultural subsystems (see picture below) in Chieng Khoi, one of the study sites, are:

hill tops

- forest
- maize and cassava
- paddy rice
- fish pond

valley bottoms

Picture 2: Agricultural subsystems
(Source: own picture taken in June 2011)

Agriculture in the higher altitudes of the uplands

Quite in contrast, Hmong people live in high altitudes with an insufficient infrastructure what makes marketing of perishable crops difficult. Because of poor yields, the traditional upland rice has been almost totally replaced by maize and cassava (FRIEDERICHSEN, 2006: 25). Here, aquaculture, cattle keeping and cultivation of fruit trees has never played a major role.

As in higher altitudes it is impossible to cultivate paddy rice, the farmers there are highly dependent on maize production for selling and buying rice on the market in exchange. In consequence, the arable land for maize cultivation expanded by 100% between the years 1999 and 2003 (FRIEDERICHSEN, 2004: 67). Private traders or companies invested capital into road construction for the transportation of the heavy harvest. They also gave incentives to farmers such as high-yielding hybrid maize seeds, cash, chemical fertilizers or pesticides in order to raise the productivity in this region. As in the eyes of Hmong farmers, private traders improve the living conditions in remote areas, they have more confidence in them than in the government (FRIEDERICHSEN, 2007: 9, 10).

Along with the economic growth in Vietnam as a consequence of the liberalization reform *Doi Moi* in 1986, also the demand of meat has considerably increased so that maize produced for animal feed is now the most profitable cash crop in Vietnam (see Figure 4 below).

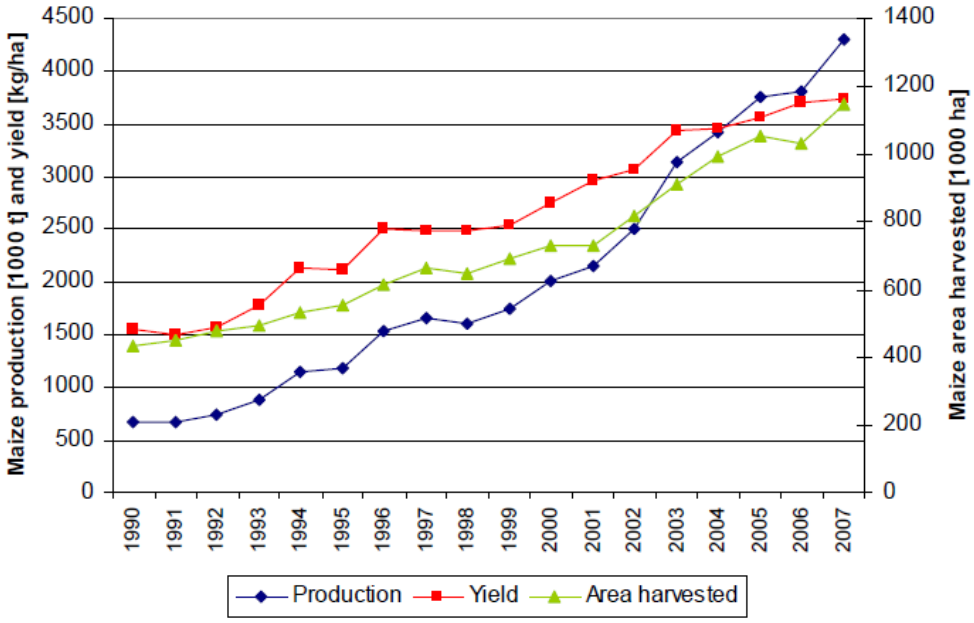


Figure 4: The development of maize production in Vietnam
(Source: KEIL et al., 2008: 3)

So, maize production has become an additional income source for the formerly subsistence-oriented small-scale farmers in the uplands and is, at present, the dominant rainfed uplands crop.

2.1.3 Socio-economic conditions and institutional framework

2.1.3.1 Socio-economy and poverty in rural areas

Although Vietnam`s economy has improved during the last decades, 11% of Vietnam`s population is still undernourished (FAO, 2012 a). In relation to other countries, Vietnam falls back on rank 113, based on human development indices. This Human Development Index (HDI) is a measurement to analyze the degree of poverty in a country by combining indicators like life expectancy, educational attainment and income.

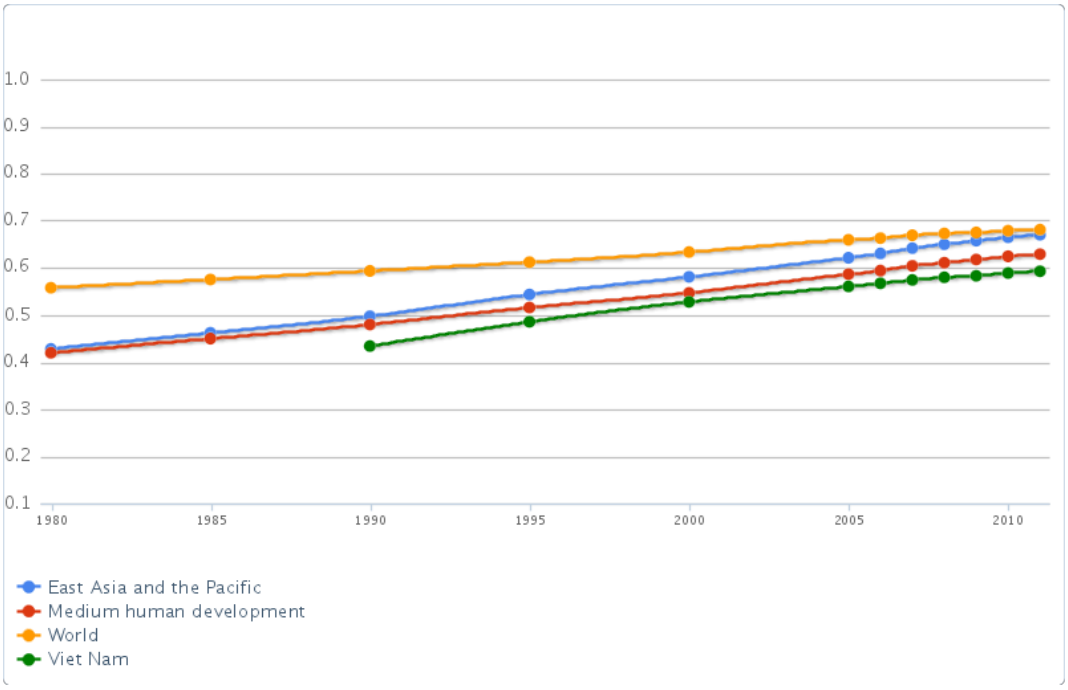


Figure 5: HDI trends 1990 to present
(Source: UNITED NATIONS DEVELOPMENT PROGRAMME)

The HDI sets goalposts – a minimum and a maximum – between 0 and 1 to compare countries. According to a country report of the UNDP, the value for Vietnam was 0.572 in the year 2010 (UNITED NATIONS DEVELOPMENT PROGRAMME**).**

According to the World Bank, poverty is defined as the

> „pronounced deprivation in well-being, and comprises many dimensions. It includes low incomes and the inability to acquire the basic goods and services necessary for survival with dignity. Poverty also encompasses low levels of health and education, poor access to clean water and sanitation, inadequate physical security, lack of voice, and insufficient capacity and opportunity to better one's life" (THE WORLDBANK GROUP, 2011).

Agriculture is – like in most of the developing countries – with 18% of the GDP the major sector of Vietnam`s economy. Around 62% of the population earn their living by agricultural production, poverty being a widely spread rural phenomenon in Vietnam (FAO, 2012 a). This means, 90% of the poor live in rural areas as for instance in the uplands (THE et al., 2004: 14). Living in out-of-the-way districts in an inhospitable physical environment with an underdeveloped infrastructure and a difficult access to information and market, socially isolated and relying on a traditionally subsistence agriculture as the main economic sector, farmers in the northern upland area are rather limited in their participation in economic growth.

One can even say that the northern uplands count among the poorest and least developed regions in Vietnam. Although the poverty rate in NMR decreased from 81% in 1993 to 68% in 2002 (THE et al., 2004: 16), many people still live in misery there. 80% of Vietnam`s poor are farmers (THE et al., 2004: 16). The reasons are low professional or business skills, little access to capital, know-how and technology, problems in marketing or processing their products, low quality of their products and small product diversity as well as an irregular income and high vulnerability to unexpected calamities. Besides, one can observe that most of the poor farmers belong to ethnic minorities. In the year 2002, 69.3% of the ethnic minorities lived in poverty (THE et al., 2004: 16). They are geographically, culturally and socially isolated, have little access to information (due to language barriers, communication assets and illiteracy) and to social services (like education and health care) Female farmers, especially unmarried women are the most deprived group with a very low income and extremely long working hours. They have almost no access to the benefits of development programs brought under way by governmental decisions.

Picture 3: Ethnic woman working on the field and at home
(Source: own picture taken in June 2011)

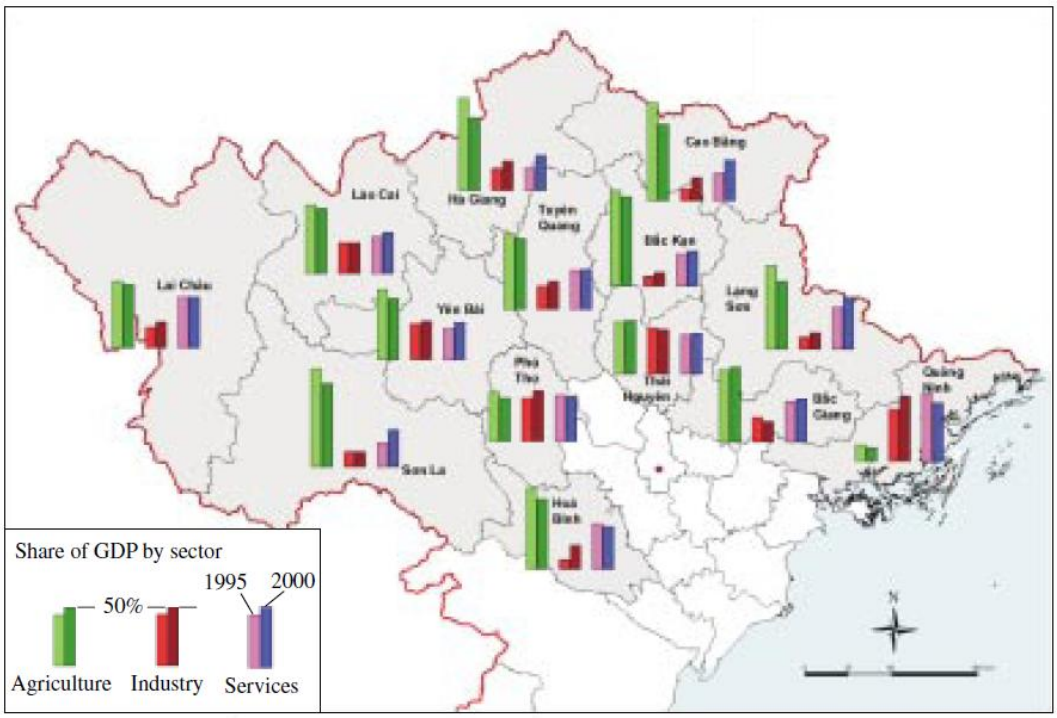


Figure 6: Composition of GDP in 1995 and 2000
(Source: Calculations based on data from GSO (2001). In: MINOT et al., 2006: 33)

As already mentioned, the agricultural sector playing the most important role in the uplands (see Figure 6 above), there is a big gap in living standards between rural and urban regions. In the NMR, the GDP is less than 1´000 USD – sometimes it lays only at 550 USD – while the average national GDP is around 1´860 USD (THE et al., 2004: 19). There are not only great disparities between rural and urban areas, but also between mountainous and flat regions. People living in very steep landscapes do not manage to produce enough rice and therefore suffer from food insecurity. Another reason for distress and hunger in the NMR is the pressure on land. The NMR has an annual population growth of 3%, what is relatively high in comparison to the rest of the country (1.7%) (THE et al., 2004: 18). The mortality rate could be reduced in the last decades (over 40% of the population is younger than 14 years). In the space of about twenty years, the population will probably have doubled (FRIEDERICHSEN, 2006: 26). Furthermore, the immigration rate exceeds the rate of out-migration (due to governmental policies establishing new economic zones in the uplands) so that the population density on the whole rises. Pressure on land and the exploitation of other natural resources are the consequences, a fact that will be discussed later in chapter 2.2.2. Although a large number of upland development programs for the improvement of this situation have

been implemented in which many international NGOs were involved, the living standard is still very low in the NMR (THE et al., 2004: 13-16, 18-19). Figure 7 below shows the percentage rates of population living below the poverty line in the northern uplands.

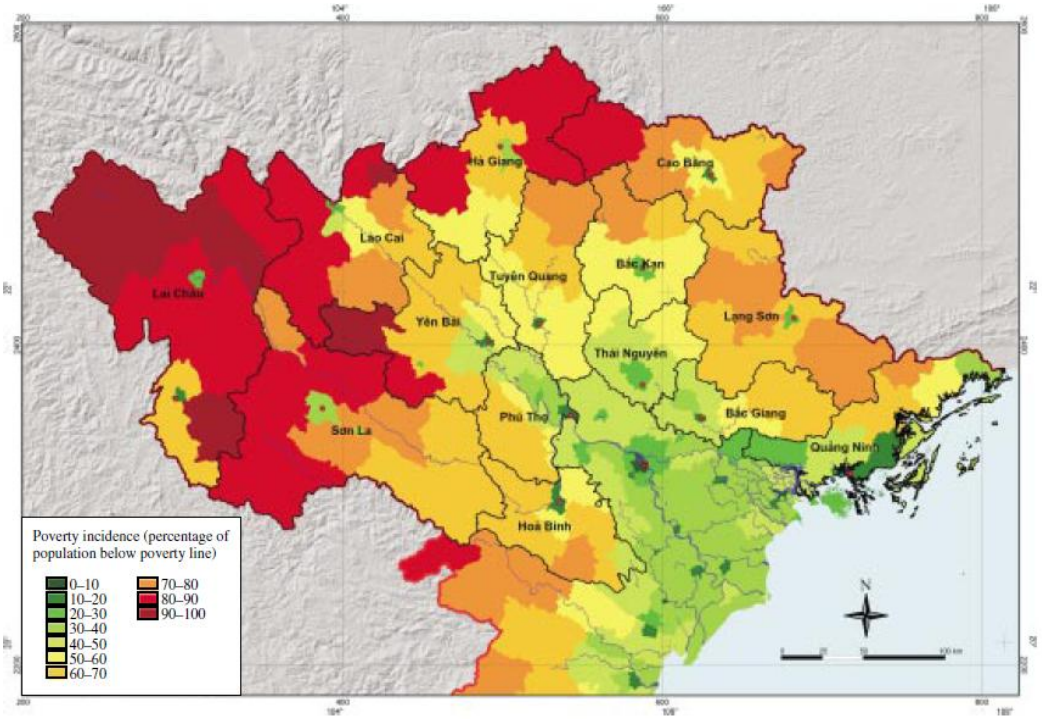


Figure 7: Indices of poverty at district level in the northern uplands
(Source: Analysis of the 1999 Population and Housing Census and the 1998 VLSS. In: MINOT et al., 2006: 34)

2.1.3.2 The role of agricultural institutions

There are a number of institutions directed to the development of agriculture but the promotion of sustainability is still neglected. These institutions include some universities or higher-education departments like the *Hanoi Agricultural University (HAU)* and *Thai Nguyen University of Agriculture and Forestry (TUAF).* Their main responsibility lies on teaching rather than on research. In addition to that, there are national institutions like the *National Center for Science and Technology* or the *National Center for Social Science and Humanities*. These national institutions are not directly subordinate to the government. Their main research focus is laid on lowland areas. Upland areas with their ethnic minorities, however, are regarded as an anthropological topic and are excluded from agricultural research. On the other hand, the *Vietnam Agricultural Science Institute (VASI)* and the *National Institute for Animal Husbandry (NIAH)* conduct research under the Ministry of Agriculture and pay increasingly attention to the upland regions. Therefore, a new center, the *Northern Mountain Research Center (NOMARC)* has been established at *VASI*. For around 15 years now, the uplands as a challenging region are getting more and more important and interesting for foreign research organizations. Among them is the French-Vietnamese Mountain Agrarian System Program (SAM) or the Uplands Program under which this study is conducted.

Despite all efforts to develop the agricultural sector, agricultural research remains less important than the development of information technology, biotechnology, new materials and automation. And else, the extent and the quality of research are restricted for the following reasons: firstly because of the high average age of 57 years of the employed staff and secondly because of the graduation of the researchers in former socialist countries like China or the USSR with different technical education and practical knowledge.

In summary, Vietnam is a developing country and lacks money for good research, which always depends on funds and access to a wide variety of literature and on the collaboration between researchers. Here, the publications of a final thesis or of another paper for a further career leap are not as important as in western countries. Personal contacts weigh far more (FRIEDERICHSEN, 2006: 17-21).

2.2 Land use change and its environmental impact

2.2.1 Political decisions on land use change – The concept of *Political Ecology*

This thesis tries to point out that environmental destruction cannot be explained merely by natural-scientific approaches, but has also to be analyzed from a socio-scientific point of view. The growing importance of the new discipline in contemporary geography, namely the "Political Ecology" is reflecting this fundamental insight. According to WALKER (2005) citing Blaickie and Brookfield, "Political Ecology" is the combination between ecology and political economy, which together "encompasses the constantly shifting dialect between society and land-based resources and also within classes and groups within society itself" (WALKER, 2005: 74). In particular rural land users in developing countries are politically, economically and ecologically marginalized. The participation of developing countries in global markets may lead to unbalanced powers which force rural land users "to degrade their environment in acts of ´desperate ecocide`" (WALKER, 2005: 74).

This also applies to the situation of Northwest Vietnam:

In order to cope with the fast growing population, governmental policies in Vietnam during the past decades have aimed at the improvement of infrastructure, communication facilities and the market situation (AYUNU, 2009: 3), but together with the increase of productivity, these efforts have led to an extreme overexploitation of natural resources. The agrarian reform in the 80s and the change from subsistence to commercial production (encouraged by privatization policies of the government) cause a great expansion of agricultural farmland and a loss of forest area that once ranged from the lowlands in the valley bottoms to the steep slopes on the hill tops.

In the beginning, it was possible to raise productivity enormously while the ecosystem was suffering more and more from the overuse of land and the degradation of soils. Rural poverty and scarcity of land forced farmers either to minimize fallow periods with the consequence of rapidly decreasing soil fertility, or, due to food insecurity, to migrate to less populated regions where they had to clear more forest area.

With the expansion of agricultural area, farming systems have changed from a relatively sustainable and "integrated" (AYUNU, 2009: 2) agriculture to a system that causes land degradation.

2.2.2. Environmental repercussions

The Northwest of Vietnam is characterized by high rainfall events and steep slopes. This chapter points out why the cultivation of maize in a monocropping system, which is very common in this region, shows a strong environmental impact. This monocropping system can therefore be defined as a highly unsustainable form of land use:

Because of modified soil texture, water cannot infiltrate easily so that the water storage capability is reduced and a dramatic erosion of the surface can occur. Water as surface flow, soil particles and important plant nutrients such as nitrogen and organic carbon get lost. Especially on less vegetated upland areas, run-off is high and the water stock for plant growth is reduced. In the establishment and juvenile stages of plant growth, the erosion rates are the highest.

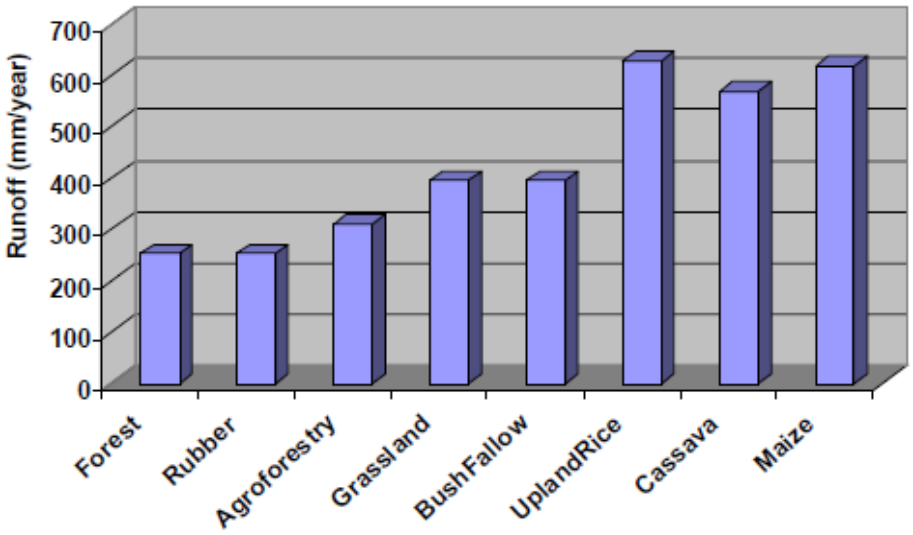


Figure 8: Simulated annual run-off under different land uses in 2002
(Source: AYUNU, 2009: 48)

While on perennial fields (agroforestry or forests) run-off is very low due to a higher leaf area index (LAI; reduced direct soil contact of rainfall by canopy closure), on annual fields, with maize or cassava, run-off is much higher due to uncovered soil layer after the harvest (AYUNU, 2009: 47-48).

According to AYUNU only 10% of a total annual rainfall of 2.595 mm (in 2002) got lost as run-off under forest, while 23% got lost under maize (AYUNU, 2009: 48). Since 1960,

1.5 cm of topsoil was washed away per year (THE et al., 2004: 24). This means an amount of up to 68 tons of soil per ha annually. The infertile reddish subsoil comes up to the

surface. Soil loses its productivity and crop yields decline. The longer the fields are exposed to soil erosion processes, the less productive is their yield and they must be abandoned after a few years. In order to maintain soil fertility, more and more mineral fertilizer has to be applied, what leads to an environmental contamination. Soil erosion in the uplands can lead to high sedimentation rates or to severe landslides with fatal economic consequences in the lowlands. The lowlands could also benefit from nutrient flows from the uplands, but the deposits of sediments in lower parts of the watershed can also hamper the crop production: The fertile soil in lower parts is buried by sediments of low quality. These sediments can alter the hydrological characteristics, cover and damage cultivated plants and silt up water reservoirs or contaminate the environment by pesticides or other chemicals. In Chieng Khoi lake, for instance, the most important water reservoir in the Chieng Khoi commune, there is a sedimentation rate of 2.5 to 4.6 cm per year, which influences negatively for example the production of hydropower (UNIVERSITY OF HOHENHEIM, 2012). Drinking water supply is therefore seriously endangered in that region. A loss of important nutrients out of the whole watershed through river flows is likely so that even neighbored watersheds and landscapes can be affected in a negative way. In that respect, uplands and lowlands are interlinked; all changes in agricultural practices can have harmful effects on landscapes in the lowlands. The nutrient balance is disturbed by the transportation of essential nutrients contained in sediments and irrigation water from the top to the lowland. The unequal distribution – or rather the lack – of nutrients is highly detrimental to productivity of the land on the top and in the valleys.

Other factors that deteriorate the soil quality are some farmers` practices like deep ploughing and burning organic matter after harvesting the maize. Deep ploughing destroys the soil structure so that erosion processes happen frequently. When burning organic residues, the soil is neither covered, nor is it rendered its required nutrients by organic matter. The result is lack of soil fertility and thus, productivity (Vu Dinh Tuan; personal communication).

Because of the growing demand on meat and therefore on animal feed, market opportunities for maize sales are rising. It is expected that all farmers in the study area will tend to produce exclusively maize. This is going to have extremely destructive ecological consequences. The forest cover has already declined considerably during the last years. Between 1975 and 1990, there was an estimated annual loss of 190´000 ha

(THE et al., 2004: 23). It was in this period that the forest loss and degradation was very high because of deforestation and agricultural expansion but also because of *Agent Orange* (herbicide with very toxic dioxin, which was used by the US-Americans to weaken the Vietnamese in the Vietnam War; NGUYEN, 2005). This herbicide had disastrous repercussions on the vegetative development (THE et al., 2004: 23). Especially in higher altitudes, in Hmong villages, forest extraction has proceeded very quickly. Until 1975, agricultural production lay in the hands of the government (FRIEDERICHSEN, 2007: 6). Inter-village cooperatives were founded, in which all agricultural tools were common properties. In rather remote areas, like in the villages of Chieng Hac, collectivization could not be regulated that well with the consequence that forest clearing was carried out individually and therefore, to a very large extent.

Several programs were set up to prevent the extraction of forest. Between 1993 and 1998, the government tried to put into practice *program 327* to reforest the hill tops and to protect the forests by giving incentives to farmers (establishment and maintenance costs for the next three years). Another project was the so-called *5 Million Hectare Forest Program,* which aimed at reforesting 5 million ha until 2010. Individuals and several organizations were involved in the program by giving them land tenure certificates for the protection of the forest. These programs included incentives for farmers to protect the natural resources. But the interest conflicts between the long-term and sustainable conservation of forests and the short-term, daily needs of farmers could not be eradicated. Furthermore, the compensation costs for farmers to maintain the forest instead of using the area for agricultural purposes were not really high, so that the *natural* forest cover in Son La province is still only 12%. As mentioned before, some organizations got land tenure certificates when they reforested hilltops. However, they often used plants that brought an economic value instead of indigenous plants (THE et al. 2004: 20-23). In view of the fact that still very few farmers practice soil conservation on their fields and 60-65% of land area is degraded, the northern uplands have to be referred to as “barren lands” (FRIEDERICHSEN, 2007: 7).

3 Sustainable agriculture

3.1 The origins of sustainable agriculture as a concept and the implementation of soil conservation techniques

Due to many cases of soil loss in the US and later on, of soil degradation caused by the overuse of natural resources resulting from the growth of population and pressure on land, the awareness of the need of soil conservation measures arose in the US in the 1930s. Soil conservation was later exported into developing countries and became an important aspect in international development policies. However, it was only in the 80s that soil erosion as a severe problem was formulated in an official document, the World Soil Charta of the FAO. Subsequently, increasing attention was paid to environmental issues also by the World Bank (YOUNG, 1990: 17, 19) and sustainability has become an important aspect in international conventions about development.

According to the Brundtland Report "Our common future" from 1987, sustainable development is described in Chapter 2 "Towards sustainable Development" as a

> "development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
> 1. The concept of needs, in particular the essential needs of the world`s poor, to which overriding priority should be given; and
> 2. The idea of limitations imposed by the state of technology and social organizations on the environment`s ability to meet present and future needs" (UNITED NATIONS, 1987).

Applied to agriculture, sustainability can be achieved when the natural resources the production depends on are conserved without reducing productivity. For example, clearing forest must not exceed the rates of regrowth of the forest. Production should be maintained over a long time without affecting the environment in a negative way (YOUNG, 1990: 10).

3.2 The *Sustainable Livelihoods Approach*

In order to act in a sustainable way, the protection of soils and of the whole ecosystem has become a major issue in international conventions in their struggle against poverty. A growing number of researchers are engaged in exploring alternative land use systems. Yet, it is all but easy to just implement new techniques in order to maintain soil fertility. As this thesis will reflect in the following, numerous constraints may prevent the adoption by local farmers. Therefore, sustainable ways of natural resource management need to be found and their putting into practice must occur in a participatory, *bottom-up*-approach.

As the processes of environmental damage are caused first and foremost by *political* decisions, *political* approaches are inevitable to solve the problems, not without the inclusion of all stakeholders. The so-called "*Sustainable Livelihoods Approach"* tries to incorporate especially poor livelihoods of developing countries in rural development activities by considering their capabilities such as skills and social networks as well as their assets such as physical and financial resources. Poor households as a vulnerable group in the society depend very much on external powers and political decisions. Therefore, policies and institutions, which are important factors in the sustainable livelihood concept, must be oriented pro-poor (SERRAT, 2008: 1-2).

By

- people-centered
- responsive and participatory
- multilevel
- dynamic and
- sustainable

livelihood strategies, which are conducted in partnership with the public and private sectors, adequate livelihood outcomes (see Figure 9 below) are to be achieved (SERRAT, 2008: 1-2).

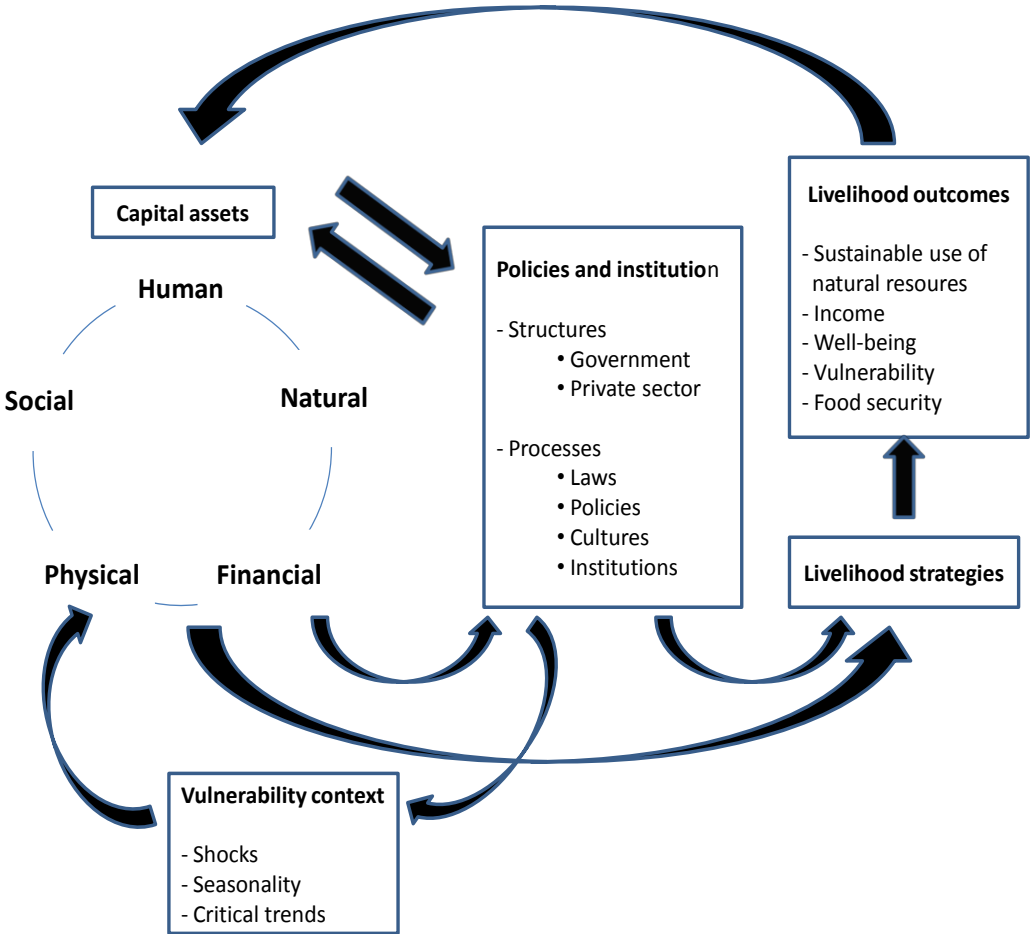


Figure 9: The sustainable livelihood framework
(Source: modified figure on the base of the Department for International Development of the United Kingdom. In: SERRAT, 2008: 2)

3.3 Integrated agriculture

The combination of agriculture, gardening, livestock keeping and aquaculture is a traditional and sustainable form of farming in the uplands of Vietnam. This integrated form of agriculture (VAC-system, see chapter 2.1.2) was introduced by the late Vietnamese president Ho Chi Minh in the last years of the 60s in order to improve the nutritional conditions of the rural population living in the mountains of the uplands (FAO, 2001).

The fishpond and the livestock pen (including buffaloes, pigs, ducks or chicken) are located next to the family`s house because kitchen wastes are used as animal feed. Ruminants are fed or graze around the farm. The garden contains perennial and annual vegetable plants and fruit trees fertilized by the manure of the livestock. The livestock`s manure is also applied to the fishpond (FAO, 2001).

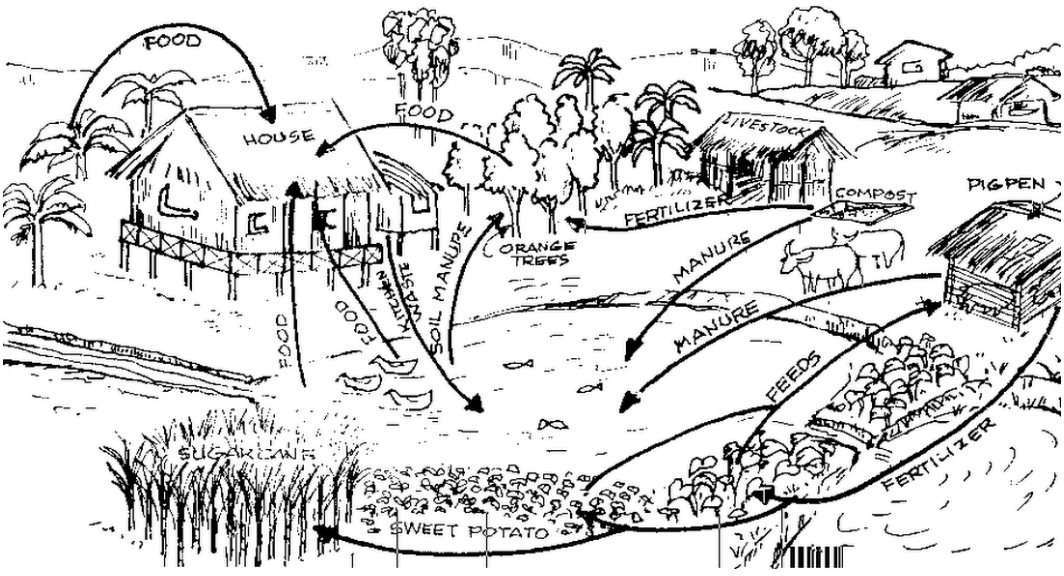


Figure 10: Upland integrated farming system
(Source: FAO, 2001)

The linkage between all farm components makes these farming systems sustainable and the farmers more or less independent of external inputs and market forces.
That is why this thesis considers the integration of animal keeping in sustained conservation agriculture.

3.4 The livestock sub-sector as a means of alleviating poverty and a measure to contribute to integrated agriculture

As one main purpose of this thesis is to underline the role of livestock and cattle rearing in reducing poverty and improving living conditions, the positive effects of livestock production shall be highlighted in this chapter:

At first sight, it seems very doubtful how livestock production might contribute to a better living standard. The negative impacts of cattle rearing seem all too obvious: causing greenhouse gases, environmental damages (deforestation, desertification, soil degradation), zoonotic diseases e.g. BSE, public health hazards (SARS) or diet disorders linked to heart diseases – all these problems are burning topics in international conferences for saving our globe (ROTA et al., 2009: 10-11).

From the economic viewpoint, livestock accounts for more than a third of the agriculture gross domestic products in developing countries and is the fastest growing agricultural sub-sector. 880 million rural people worldwide that live from less than two USD per day are estimated to be dependent on livestock production (ROTA et al., 2009: 8). The share of income in rural households from livestock is definitely higher than from cropping. In Vietnam, livestock's share has increased by 110% between 1992 and 1998 (JOHNSON, 2009: 13).

Yet, livestock is often neglected when it comes to development cooperation; the focus is mainly laid on introducing new production techniques, breed development or animal health. The role of small-scale cattle breeding is still underestimated because of the interests of professionals for agricultural development and because of governmental decisions having in mind the promotion of large-scale animal production (mainly for export) (ROTA et al., 2009: 9).

However, livestock production can very well contribute to a sustainable and integrating development. At a closer look, livestock serves all eight Millennium Development Goals to reduce poverty (see UNITED NATIONS, 2010):

MDG 1: *"Eradicate extreme poverty and hunger" by "achieving full and productive employment and decent work for women, men and young people*" and "*halving the proportion of people who suffer from hunger"*

Picture 4: Draft animal
(Source: own picture taken in July 2011)

Income can be secured by livestock and by all livestock-related activities such as processing animal products (milk, meat, wool, hides), creating off-farm jobs. According to the FAO, the sale of 100 l milk provides one to five jobs (ROTA et al., 2009: 9). The rising demand of meat and other animal products has already generated a lot of jobs all around the world and along the value chain from input sales to animal production to trading and to processing. Livestock can be considered as "piggy banks" (JOHNSON, 2009: 14). It can store and save money to meet cash needs throughout the year and can cope with droughts or other emergencies. By climbing up the "livestock ladder" (JOHNSON, 2009: 13) from chicken to goats to cattle, even the poorest can evade misery.

Livestock production and the consumption of an appropriate amount of meat can contribute to the reduction of malnutrition. Meat raises the amount of calorie intake, which is one criterion in the measurement of hunger and provides proteins and micronutrients. In times of agricultural distress or during critical seasonal food gaps, livestock can be considered as a store or source of income to buy food and to help the families to survive (JOHNSON, 2009: 14-15).

MDG 2: "*Achieve universal primary education"*

Livestock production with its preconditions of profound knowledge and skills (ROTA et al., 2009: 9) is prone to foster primary education by generating on the one hand household food, income and employment, on the other the desire to learn.

MDG 3: "*Promote gender equality and empower women"*

Due to economic laws or cultural restrictions, it may be difficult for women to possess their own piece of land or to participate in financial markets. Raising animals can offer women jobs such as selling livestock, livestock feed or manure (JOHNSON, 2009: 15).

MDG 4: "*Reduce child mortality rates",* **MDG 5:** "*Improve maternal health*" and **MDG 6:** "*Combat HIV/ AIDS, malaria and other diseases"*

Poor people in developing countries can only afford cheap, low quality food, being mainly nourished on starchy diets such as potatoes and rice. Meat or animal products like eggs or milk are very rarely part of the daily meals. As is proved, people living in pastoral areas are far better nourished. Meat supplies proteins and micronutrients like iron, which is very important for children, pregnant women or immune-suppressed people (JOHNSON, 2009: 14-15).

MDG 7: *"Ensure environmental sustainability"*

By depositing organic manure of goats or cattle, quality of soils and thus, productivity of small-scale farmers can be considerably improved. Moreover, the wildlife ecosystem can be enriched by supporting livestock herders (JOHNSON, 2009: 15).

MDG 8: "*Develop a global partnership for development"*

With the growing awareness of these facts, a number of international organizations started to focus their work on the cooperation with livestock keepers to improve living conditions in rural areas. Networks for knowledge exchange are founded, where local stakeholders, specialists and policy-makers are involved. By now, policies and institutional frameworks are regarded as far more important than new technologies. That is the reason why the FAO, for instance, started the "Pro-poor livestock policy initiative" in 2001 (DIJKMAN, 2009: 16) in order to support farmers with the implementation of policies and institutional changes.

To summarize, two completely different scenarios concerning livestock can be observed:

The so-called "Livestock Revolution" (ROTA et al., 2009: 10), which means the rapid growth and transformation of the livestock sector in large parts of the world, mainly in rich, developed countries, but also in Brazil, Russia or China, leads to economic polarization and a deep gap in society. On the one hand, there is a large-scale, purely commercially oriented production, based on high technological progress. On the other hand, there is a small-scale, traditional and mainly subsistence-based production in developing countries. The private-profit oriented way of cattle rearing (overproduction and mistreatment of animals during breeding and transport) in developed countries,

which extremely offends sustainability ought to be restrained by cutting down public subsidies for the livestock industry and by reducing the consumption of animal products. But this is by no means a promising option for developing countries: quite on the reverse, livestock can there be a chance to get out of misery and to reduce vulnerability of the poorest. First of all, livestock and all aspects of the value chain can be a possibility for small-scale farmers to participate in markets. Furthermore, livestock can contribute to environmental management if animal keepers are encouraged to preserve biodiversity (ROTA et al., 2009: 8-11). Consequently, promotion of livestock in remote areas like the Northwest of Vietnam reveals to be of great importance for sustainability.

3.5 Soil conservation techniques

Sustainable land use can be realized by implementing soil conservation measures. Soil conservation is understood as the maintenance of soil fertility along with its physical, chemical and biological properties by controlling soil erosion and the nutrient status (YOUNG, 1990: 9).

Conservation measures can be seen as "a way […] to make cultivation environmentally acceptable" (YOUNG, 1990: 24).

3.5.1 Research background

In 2000, the University of Hohenheim, in collaboration with seven universities and research institutes in Vietnam and Thailand, got a special research program under way. The Uplands Program (SFB 564) – "Sustainable Land use and rural development in mountainous regions in southeast Asia" is an interdisciplinary, long-term research program, which aims to conserve natural resources and to improve the living conditions of the local farmers. The program is divided into several subprojects.

The project sections are

- soil and water,
- fruit production,
- livestock systems,
- processing and marketing,
- socioeconomics and
- integrated modeling.

This thesis is written in the framework of the subproject **C4** "Impact of intensification on land use dynamics and environmental services of tropical mountainous watersheds" under the direction of Prof. Dr. Georg Cadisch and Dr. agr. Thomas H. Hilger.

In a first step, **C4** evaluates the impact of land use changes in the last years from subsistence to market-oriented farming systems. The next objective of this subproject is to model various scenarios of resource availability in the future under certain land uses

and under alternative land use options. In the following, the experiences with these options are discussed in workshops; the results are supposed to lead to recommendations for farmers in their decisions of crop management and cultivation systems. The biophysical, socioeconomic and political framework conditions are fundamental factors in the deliberations (UNIVERSITY OF HOHENHEIM, 2012).

This study gives a survey of the applied conservation techniques and analyzes the arising technical, institutional, political and socioeconomic constraints in the adoption of these techniques by farmers.

3.5.2 Experiments on soil conservation techniques in Northwest Vietnam

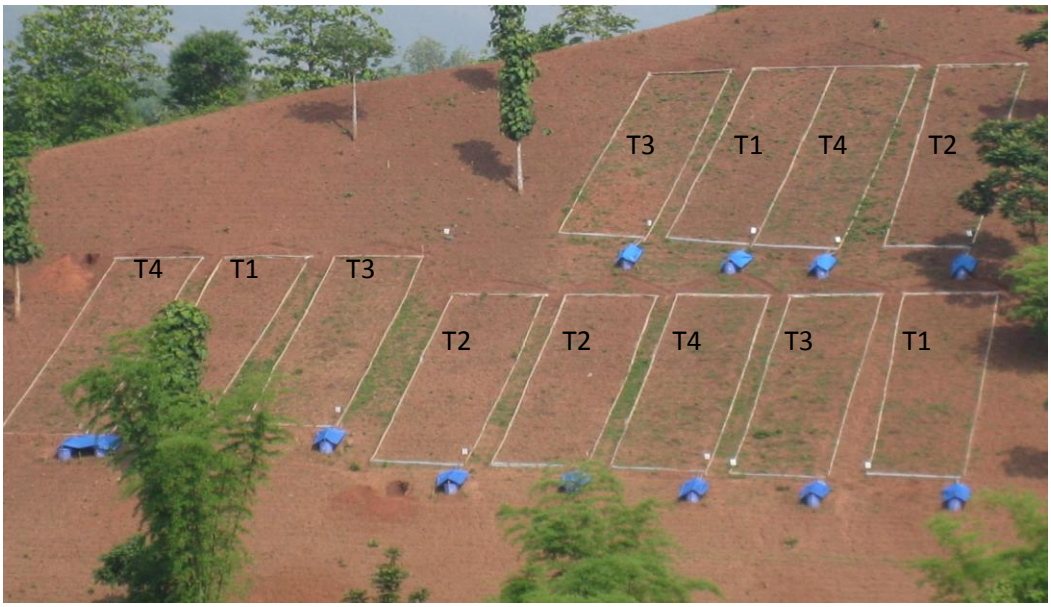
The severe impacts of soil erosion must be decreased by an efficient use of nutrients through sustainable cultivation measures. Within the framework of the SFB 564 Uplands Program "Sustainable land use and rural development in the mountainous regions of south-east Asia" of the EnBW Rainforest Foundation, where the University of Hohenheim is involved, three different conservation techniques have been tested during the last four years on demonstration plots (Wischmeier plots) in both communes, Chieng Hac and Chieng Khoi.

Each treatment is repeated three times on each experimental site.

The trial site in Chieng Khoi has an elevation of 516 m a.m.s.l. and a slope of 24-28°. The elevation in Chieng Hac is 296 m a.m.s.l. and the slope is a little steeper with 27-34°. The application of fertilizer is the same in both experimental sites (158 kg N per ha, 17.5 kg P per ha, 58.6 kg K per ha) (TUAN et al., 2011: 3-5).

The four treatments are (see Picture 5):

- maize in a monocropping system (current farmers` practice) (**T1**)
- maize with grass barriers (**T2**)
- maize under minimum tillage and cover crop (**T3**)
- maize under minimum tillage and relay cropping with a legume (**T4**)



Picture 5: Wischmeier plots in Chieng Khoi
(Source: TUAN et al., 2011: 5)

Run-off is collected in buckets (see blue buckets on the picture above). After each rainfall event, the sediments are measured. It has been proved that the erosion rate is highest on the onset of the rainy season when the soil is not yet covered by plants and famers prepare the plot by tillage (May to June) (TUAN et al., 2011: 3-7).

According to soil scientist Dr. Gerhard Clemens (explanation during the EnBW-workshop held in September 2011; see chapter 4.4) run-off occurs when the amount of rainfall is higher than the amount of water that can infiltrate into the soil. On the other hand, the infiltration rate depends on the stability of soil aggregates. In turn, soil aggregates are related with the amount of humus, soil texture and the activities of soil organisms.

All these influencing factors can be worsened by adverse field management such as burning plant residues (a practice that destroys humus and living organisms) and deep ploughing (which destroys the soil`s aggregates).

3.5.2.1 Maize cultivation on farmer`s practice plot

By establishing a plot in the habitual manner of the farmers (**T1**), the erosion rate can be compared between the plots under conservation measures and the plots under current cultivation practice. Before beginning the maize cultivation, farmers usually burn the stems and residues from the last cropping season. Then weeds are cut and burnt, too.

Picture 6: Burning residues after harvest
(Source: picture taken by Julian Kofler)

After that, contour lines are dug with a hoe and a seedbed is formed. During planting and some weeks after planting it is common to apply fertilizer.

It must be noted that in former times, according to Mr. Diên, the head of the Department of Agriculture, farmers had a better cultivation method. They just used the hoe and a stick to sow instead of ploughing and burning so that there was less risk of erosion (interview on the 15 of May 2011).

3.5.2.2 Maize with grass barriers (*Panicum maximum*)

Picture 7: Grass barriers with *Panicum maximum*
(Source: own picture taken in May 2011)

The first treatment for soil conservation (**T2**) is to plant some grass barriers on the plot. This measure keeps sediments to a great extent from being washed out from the plot. This kind of treatment has been tested for several years now and the loss of top soil material on the plot could clearly be reduced. It turned out that *Panicum maximum* can grow on altitudes up to 2´000 a.m.s.l. and is more resistant to droughts than to floods. Although it can develop on poor soils, this grass type grows better on loams with high fertility. Once sown, It spreads widely and has a high tolerance limit

to herbicides. *Panicum maximum* gets well along with other crops and needs not more than six weeks to recover before the next grazing (FAO, 2012 c). As *panicum maximum* has a high nutritive value, it is an optimal feed source for ruminants.

3.5.2.3 Maize under minimum tillage with cover crop *Arachis pintoi*

Picture 8: *Arachis pintoi* as cover crop
(Source: own picture taken in May 2011)

The second treatment for soil conservation (**T3**) on the Wischmeier plot consists in the combination of maize with *Arachis pintoi* as cover crop on the ground to maintain the soil covered before planting and during the juvenile stage of the maize. *Arachis pintoi* or pinto peanut is a forage legume of hot and wet climate, but it is also well adapted to droughts and extreme weather conditions (frosts or floods). It can also grow in higher altitudes (up to 1´400 a.m.s.l.) and on soils poor in phosphorus. Through its easy spreading, the ground can be covered very fast. The seeds remain for longer than one season so that pinto peanut does not have to be sown again. Due to its fast growing and wide spreading qualities, it is very resistant on farmlands with heavy grazing and even has a high feeding value. *Arachis pintoi* is quite resilient against diseases or pests (FAO, 2012 b). Before planting the maize, *Arachis pintoi* needs to be cut very carefully. Otherwise it gets too big and competes with the maize for light, nutrients and water. In 2010, *Arachis pintoi* was cut once and given to animals as feed. Maize stover and natural weeds were applied as mulch (Vu Dinh Tuan; personal communication).

3.5.2.4 Maize under minimum tillage and relay cropping with *Phaseolus calcaratus*

Picture 9: Relay cropping with *Phaseolus calcaratus*
(Source: own picture taken in September 2011)

The third treatment applying soil conservation techniques (**T4**) is to relay cropping with *Phaseolus calcaratus* (rice bean). Maize is planted in May, beans are planted one month later before harvesting. Farmers are obliged to weed carefully in order to minimize competition for light, water and nutrients and to improve the development of the young maize. Bean seedlings are set between the maize plants. Maize is harvested in September and beans in December. The aim of this method is firstly, to cover the soil for a longer period (by the bean plants) and secondly, to improve the soil by plant residues as mulch proving organic matter to the soil and thus, to raise soil fertility. Another advantage of this measure is that beans can use the maize stems to climb up after the maize has been harvested (Vu Dinh Tuan; personal communication).

Phaseolus calcaratus is a fast-maturing plant. It needs a lot of water but is also quite resistant to droughts. Rice bean can also develop on poor soils. In many cases, *Phaseolus calcaratus* is used as green manure and as cover crop to protect the soil against erosion, but it can also serve for home consumption. It has to be harvested manually (SCHUSTER et al., 1998). Legumes may produce an enormous biomass and have a high protein content. Owing to their good digestibility and palatability, legumes offer a good feed source for cattle (MANH, 2010: 19).

All these measures have been tested now for four cropping seasons and show positive results (Vu Dinh Tuan; personal communication). As the erosion rate is normally highest in the beginning of the rainy season when the soil is not yet covered by the canopy of plants, the results of the second year of the practice of these treatments revealed that erosion could be reduced to a certain degree (TUAN et al., 2011: 6, 8). Minimum tillage and the avoidance of burning residues has raised the amount of humus, what contributes to a higher activity of micro-organisms and therefore, a higher stability of

the soil`s aggregates (explanation of Dr. Gerhard Clemens during the EnBW-workshop in September 2011).

AS you can see in Figure 11 below, in the two experimental sites of the chosen communes, the amount of soil loss was highest on the famers` practice plot (**T1**), followed by the plot with grass barriers (**T2**) and then the plot under relay cropping with *Phaseolus calcaratus* (**T4**). Soil loss has almost been zeroed in both demonstration sites alike under treatment three (**T3**) (TUAN et al., 2011: 6, 8).

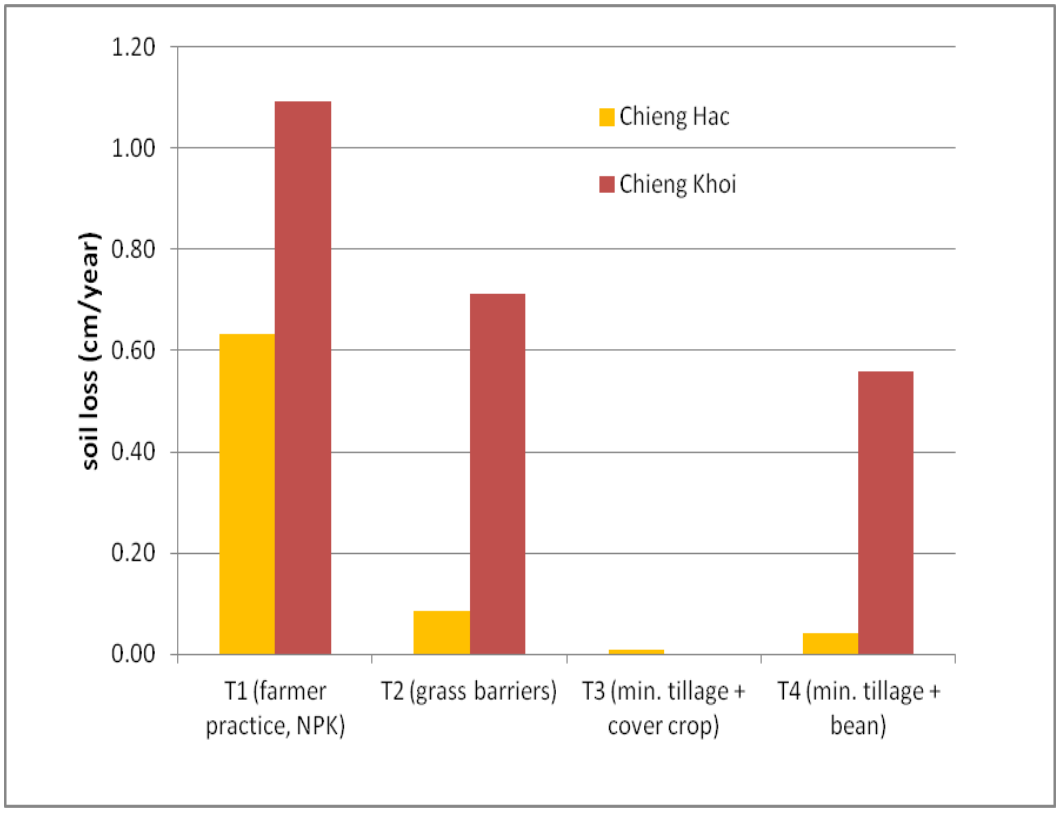


Figure 11: Soil loss in both demonstration sites
(Source: TUAN et al., 2011: 8)

In addition to that, it became obvious that *Panicum maximum* and *Arachis pintoi* can yield a high biomass amount by being cut several times per year and can therefore serve as animal feed (Vu Dinh Tuan; personal communication).

According to Dr. Clemens` explanation during the workshop, cover crops protect apart from that the soil from splash erosion, an erosion process in which aggregates are destroyed by the impact of raindrops. But cover crops must be cut properly in the beginning of the planting phase of maize, otherwise the competition with maize for growth factors is too high (TUAN et al., 2011: 10).

3.5.3 Further measures for soil conservation

Picture 10: Hedgerows against erosion (Source: own picture taken in May 2011 in Yen Son)

Numerous other conservation techniques have been tested with the goal to establish them in the tropics and subtropics in order to maintain soil fertility. The techniques already mentioned are hedgerows, vegetation strips (such as pineapple or King Grass) or intercropping with peanuts, cassava or beans. These measures do not only protect the soil from erosion and maintain soil fertility but also provide feed sources for animals and grains for human consumption and are therefore multi-purpose measures. During the EnBW-workshop in September 2011, Mr. Minh from NOMAFSI highlighted the positive effects of mulching (leaving the maize stalks or other organic matter on the field instead of burning them) and terracing the terrain on very steep slopes so that sediments are prevented from being washed out. Digging ditches or channeling surface water are practices to be applied to control runoff.

A further very important measure to protect soil from erosion is the reforestation of hill -tops in order to recover the soil (UNIVERSITY OF HOHENHEIM, 2012). Forests are vital for the ecosystem because they regulate the climate, mitigate flood risks and droughts and reduce air pollution. Demonstrably, forests help to maintain soil fertility and stability and thus, prevent the soils from erosion. Soils under forests having a better infiltration have an important filter function and so they help to preserve groundwater and to provide good drinking water (THE et al., 2004: 23).

Picture 11: Agroforestry system (Source: SMALL GRANTS PROGRAMME 2006)

Another measure is called agroforestry. This land use system combines agriculture (herbaceous plants such as crops) with forestry (woody perennials such as trees or shrubs) and/ or livestock in a spatial arrangement or rotation (YOUNG, 1990: 11) (see picture on the right). Beside the already mentioned positive aspects of trees, agroforestry aises soil fertility by providing litter, (for example by fruit trees), increases the soil cover (higher LAI) and stabilizes the soil by the tree root system (YOUNG, 1990: 60), and by this way reduces soil erosion.

3.6 Hypothesis

Son La province in the northern mountainous region (NMR) is the home of many ethnic groups. Most of them live in more remote regions than the Vietnamese (Kinh) people. This study compares two communes, one populated mainly by Hmong people, the other by a majority of Black Thai. The two communes differ concerning remoteness from the district center of Yen Chau and in consequence, their integration into markets and access to information and social services are quite dissimilar.

Hmong people live in higher altitudes (Chieng Hac) where the infrastructural conditions are poor and information transfer is low. Their villages being farer away from the educational center and market, it is harder for them to trade their products. However, due to the sparsely populated area there, more arable land is available to cultivate (FRIEDERICHSEN, 2006: 25-26).

On the other hand, Black Thai settlements are closer to the main roads and to the central market of Yen Chau district center (Chieng Khoi). Despite the poor availability of land due to denser population, the above mentioned factors lead to a favorable educational integration and market access.

Certainly, the assumption is not wrong that the more remote people live from the center the lower is the adoption rate of soil conservation techniques. But quite obviously, it is not only the negative infrastructural conditions that make Hmong people more marginal. The Hmong have a more conservative way of living and deliberately isolate themselves from the Black Thai and Kinh, disliking to mix with other ethnic groups. On the reverse, the Thai culture is closer to the Kinh, the Vietnamese people. That`s why the relationship of these two people is better and thus, Black Thai are privileged among the other ethnic groups. Settling in valley bottoms, they have considerable economic advantages. Besides, Black Thai are often involved in the dissemination of information by working for the governmental extension service. And what is more, two demonstration plots where three different soil conservation methods are tested on lie nearer to their villages and some Black Thai farmers are even involved in the establishment of the cultivation techniques on these plots.

Having in mind these facts, this survey can be based on the hypothesis “Adoption of soil conservation techniques is higher in Black Thai villages of Chieng Khoi than in Hmong villages of Chieng Hac”.

4 Materials and methods

4.1 Participatory Rural Appraisal (PRA)

This survey is a Participatory Rural Appraisal (PRA), applying an iterative, innovative, interactive and informal method (BISHNU, 2003: 11), which is conducted directly in the investigated community. Some of the techniques used during the survey are secondary data reviews such as reports and articles, own observations on the study site, semi-structured interviews with individual farmers or households and key persons along with local history portraits, maps, seasonal calendars, time lines and photos and, last but not least, workshops where the participants had the opportunity to discuss ideas and solutions to any problem.

The PRA is a methodology for action research involving local people in order to share information and learn from indigenous wisdom. That is why a stay of several months in Yen Chau district was indispensable to gather first hand experiences, to combine theory (gathered beforehand in Germany by secondary literature) and practice by face-to-face contacts and to learn from local knowledge.

4.2 Multidimensional Approach

As a sustainable development can only be achieved by involving all stakeholders (farmers, farmers` union, traders, professors at the regional university, specialists of the extension service, members of the Department of Agriculture and all other governmental staff) on all administrative levels and by creating appropriate framework conditions to follow the central ideas of sustainable agriculture, this research was conducted on different administrative levels (multidimensional approach).

First of all, questionnaires were carried out on household level, village level, district level, commune level and regional level (see Figure 12). Afterwards, a final workshop was held to propagate the advantages of sustainable agriculture and to evaluate the political, institutional, financial and infrastructural preconditions in the study area.

Stakeholders on all levels were invited to discuss solutions together in a participatory way.

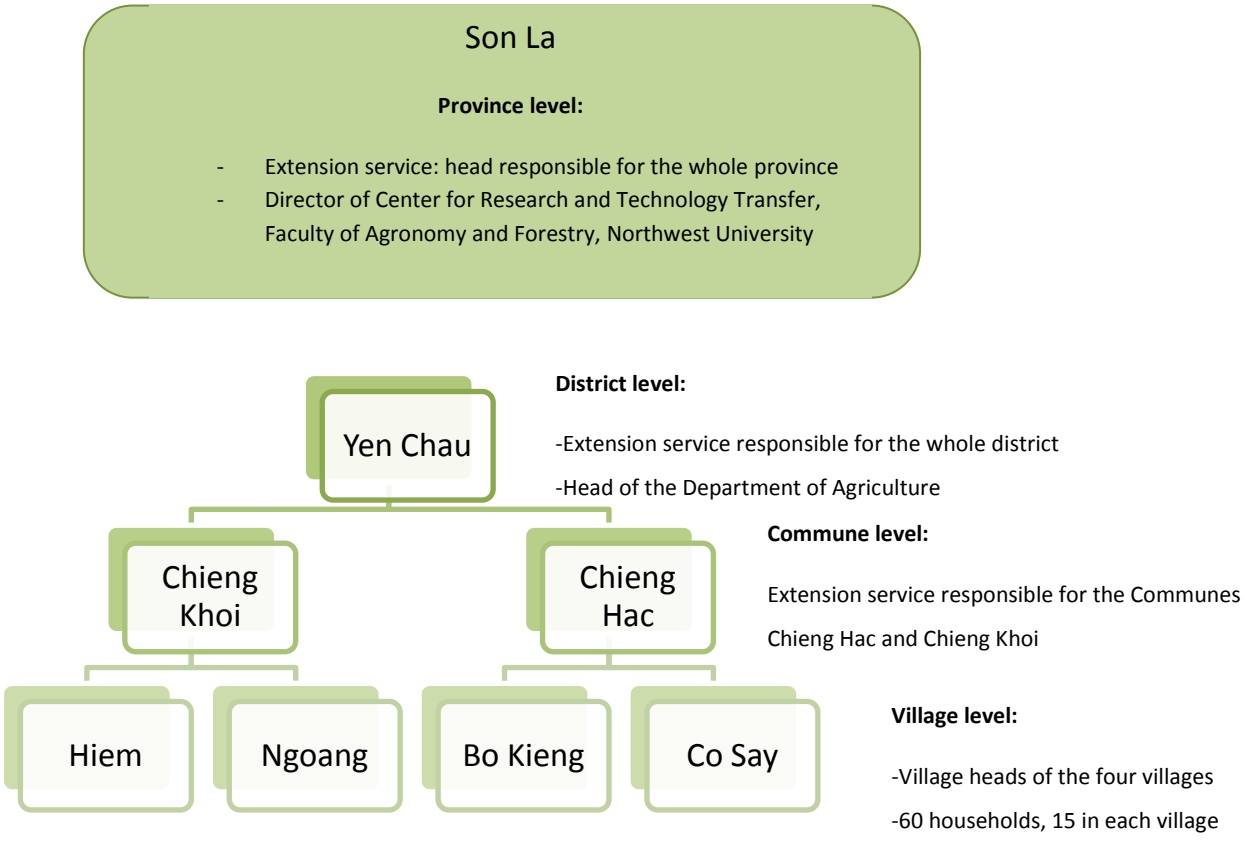


Figure 12: Interviews on different administrative levels
(Source: own draft)

4.3 Interviews with stakeholders

After preparing – still in Germany – the questionnaires for various stakeholder groups and collecting information about the study sites (for this purpose, mainly the internet was used as a source of secondary data), fieldwork on the spot was carried out from May to September 2011 in Northwest Vietnam. As mentioned before, the study sites are located in Son La province, which is subdivided into several districts built up by communes. For this thesis two unequal communes were chosen in Yen Chau district in order to find out whether there is any difference in the adoption of new techniques, Chieng Hac being situated farer away from the district center than Chieng Khoi.

4.3.1 Key person interviews

Key person interviews are intended to serve as additional background information about local characteristics and agricultural systems in the study site. Key persons are representatives of responsible institutions from all administrative levels. The interviews were conducted with qualitative questionnaires. Before starting the interviews, a working permission for each commune had to be obtained from the peoples' committee.

In order to get an overview of the regional agricultural land use and relevant political decisions on land use concerning the study sites, interviews were led with the officer of the extension service responsible for the whole district Yen Chau and with the head of the Department of Agriculture.

Then, to gain a deeper insight into the agriculture and the cultivation methods on the study site, questionnaires about the socioeconomic, biophysical and ethnic conditions were directed at the officers of the extension service who are responsible for the communes Chieng Hac and Chieng Khoi.

In the next step, the village headmen were interviewed to get an idea of the specific characteristics of each village and to clarify the difference between the two communes and all four villages.

Before starting the interviews with farmers, two further expert interview with the head of the extension service of Son La, responsible for the whole district, as well as with the director of the Center of Research and Technology Transfer of the Northwest University, Faculty of Agronomy and Forestry, were accomplished. These interviews were conducted for a better understanding to what extent knowledge about sustainability is transferred to students. For a survey about the educational contents at the provincial University for Agriculture, also some students were interviewed. These interviews did not only comprise questions about education opportunities, but also about the students` future perspectives and professional desires.

The objective of all these interviews on different administrative levels was to clarify the question, what institutional or socioeconomic preconditions were necessary for the local farmers to adopt new soil conservation techniques.

4.3.2 Interviews with farmers of the study site

Interviews with farmers (see Appendix 1) on the study site had the objective to gather information about socioeconomic data as well as about local farming systems and management. They provide for example personal information such as concerning sex and ethnic belonging. Data about household size and the number of people working on the farmland as well as other (off-farm-) jobs were delivered and gave an idea of the living conditions in these communes. Some further questions about land use changes were asked to clarify which agricultural challenges the farmers had to face during the last years. Data about the size of the farmland and about land tenure are important for the adoption of soil conservation techniques.

A time line with the land use history is revealing about the condition of the soil and to what extent the soil is exposed to soil erosion. Farmers were asked when the forest was cut and if they still cleared forest areas in order to convert them into farmland. These questions helped to find out when the shift from subsistence-oriented to market-oriented agriculture began and for what reasons. With the information about past and current cultivation methods (tools and fertilizer for instance) and the shift from the usage of local to hybrid seeds statements can be made about the quality of the soil and about the reasons of these changes.

Knowledge about the further processing of farmers` products illuminates the potential of building up value chains.

Farmers were also asked if they were aware of soil erosion and if they knew any soil conservation techniques. The source of this knowledge shows which institutions play a decisive role in the dissemination of information. For the optimal promotion of soil conservation techniques it is of utter importance to know what external support the farmers need for their application.

Then, various questions about cattle breeding and feed production (illustrated by a seasonal calendar of available feed sources) illuminated the potential of the promotion of cattle rearing in these communes (for example by the provision of cover crops as forage plants).

These questionnaires are quantitative and structured in order to make statements of farmers comparable and to develop a general tendency of the adoption of SCT among

farmers in the study site. Despite the standardized questionnaires, statements of farmers during the interviews were recorded and used as additional information source.

The interviews were conducted in the Vietnamese language with the help of a translator (Vietnamese-English). In one of the villages, the assistance of a second person was needed who translated the local Hmong language into Vietnamese. For the farmers` interviews a farm sketch and a time table on an A0 paper was used to facilitate some of the questions. Because of the patriarchal system most of the respondents were male. As a rule, the households` heads were asked to answer the questions. Only In case the husband had already died, women gave the answers.

The language barrier and the farmers` lack of time in the weeding season were only *some* problems that emerged during the fieldwork and threatened optimal results of this study. That is why the questionnaires were modified several times with the help of some PhD students in Vietnam and numerous pretests were conducted. Further obstacles were the difficult access to the remote villages during the rainy season on the unpaved and muddy streets. Furthermore, some people were illiterate so that more time for one interview had to be taken.

Although the size of samples drawn is relatively limited, this is recompensed by the mix of methods allowing to gather all necessary information to get a general overview of the necessary preconditions for the dissemination of SCT. Moreover, the interviews with key persons opened a further perspective on the main agricultural problems in this region and clarified remaining questions.

The submitted data were interpreted with the help of the statistical program EXCEL.

4.4 Workshop

Capacity building and the empowerment of local people can only be realized if all stakeholders act collectively. To achieve this goal, a final workshop was held end of September 2011, organized by the German ENBW Rainforest Foundation.

The main objectives of this workshop were to improve the awareness of soil erosion, to present some techniques that may control soil erosion, to Figure out what further benefits these techniques can offer to the farmers (such as animal feed) and what kind of constraints keep the farmers from adopting them. Farmers and officials of responsible institutions on different administrative levels were invited to discuss these issues in an interactive way.

In this discussion, 100 participants were taking part. Among them were the heads of people`s committee, the heads of farmer`s union, staff from the extension service and some people from agricultural organizations such as NOMAFSI (Northern Mountainous Agriculture and Forestry Science Institute), as well as selected farmers from 15 communes of Yen Chau district.

Picture 12: Participants of the ENBW workshop in September 2011
(Source: picture taken by Mr. Minh from NOMAFSI in September 2011)

The first day started with presentations by experts about the study site and its high vulnerability to erosion processes. On the one hand, the negative effects of soil erosion in the long-run – both economically and ecologically – were pointed out, on the other hand, the importance of counteractions. Afterwards, the participants had the opportunity to visit one of the demonstration plots (see chapter 3.5.2) in Chieng Hac, where soil science experts informed them about soil properties, soil fertility, soil erosion and soil conservation techniques as well as the equipment and field management.

Picture 13: Infiltration rate experiment on the trial
(Source: picture taken by Dr. Alwin Keil in September 2011)

According to Dr. Gerhard Clemens, a renowned soil scientist, erosion depends on the amount of rainfall and the water that can infiltrate into the soil. Hence, an infiltration experiment was conducted to show the farmers the positive effect of soil conservation techniques such as relay cropping, the avoidance of burning residues and minimum tillage.

On the second day, group discussions were organized. The participants, divided into six groups, had to answer certain questions (see Appendix 3). The first two groups consisted of farmers: of those who live in higher and of those who live in lower altitudes. Officers of the extension service formed the third group. The fourth and fifth groups comprised officials in higher and those in lower altitudes. The last group assembled officials on district and province level.

The members of each group were requested to give their opinion about the techniques presented during the field day, evaluating their benefits and constraints. They were also asked to make suggestions how to overcome the obstacles and to point out alternative soil conservation techniques that would be interesting for the local farmers. The farmers` group was interrogated in particular about their willingness to invest in animal husbandry.

Picture 14: Presentation of the results of the group discussion
(Source: picture taken by Dr. Alwin Keil)

Officials, on the other hand, had to think of adequate measures to disseminate soil conservation techniques.

5 Adoption of livelihood strategies by farmers

5.1 Adoption of soil conservation techniques

The aim of this study is to analyze the willingness of the local farmers in Yen Chau to adopt soil conservation measures in general and to Figure out constraints of the soil conservation techniques that are tested on the trials in both communes in detail.
According to FEDER et al. (1985) the adoption of new technologies depends on economic and physical key parameters such as:

- farm size,
- risk and uncertainty,
- human capital,
- labor availability,
- credit constraints,
- tenure,
- supply constraints, and
- aggregate adoption over time.

The interpretation of the data collected from the interviews with farmers of Chieng Khoi and Chieng Hac suggests that in both unequal communes similar constraints affect the adoption process negatively.

In the final workshop, as described above, constraints and benefits of SCT were discussed among farmers of Yen Chau district and officials, for example officers of the agricultural extension service or staff of the regional university. The adoption barriers figured out here very much resembled the results extracted from the interviews conducted previously.

5.1.1 General constraints of the adoption of soil conservation techniques

Due to the spreading application of mineral fertilizer and the introduction of HYV of maize, maize yields continue to increase and mask the real reduction of soil fertility. This causes a lack of incentives for farmers to change their cultivation methods (UNIVERSITY OF HOHENHEIM, 2012).

Despite several previous attempts to reduce soil erosion in developing countries by the introduction of soil conservation techniques, these techniques have never been widely adopted by farmers due to technical or financial problems. These measures often fail to meet the farmers` needs or mean additional work for the establishment and maintenance. Moreover, soil conservation techniques seem to be economically unattractive for farmers because of the enormous reduction of land area. Due to short-term planning, farmers cannot see any economic advantage. Benefits are only feasible in the long-run. Moreover, farmers can seldom afford the high initial costs for the implementation.

Most of the obstacles to the adoption of soil conservation measures mentioned here were also found on the study site.

5.1.2 Adoption of soil conservation techniques in the study site

Although the majority of the farmers are well aware of the erosion problem (90%), just a few farmers take measures against the erosion processes.

5.1.2.1 Institutional, financial and political constraints

According to the interpretation of the collected data and to the statements of farmers during the workshop, the reason for the farmers' hesitation to implement any kind of soil conservation technique turns out to be above all a problem of unsuitable framework:

Insufficient dissemination of information and technical advice

The main constraint for the adoption of SCT in both communes is the low dissemination of information. More than one third of all interviewed farmers have never received any kind of information about soil conservation methods. Some farmers have already got information from TV or from the village headman but not from official agricultural extension services or agricultural research institutes.

Reforestation and barriers are the methods most commonly known, but none of the interviewed farmers had ever heard about the tested techniques such as minimum tillage, cover crops or relay cropping. So one can record the fact that these tested SCT are completely new in the study sites and the farmers are not at all familiar with them. Farmers remarked that they ignored how to establish barriers or to apply other methods and needed technical instructions or good examples in their region. When they presented the results of the group discussion during the workshop, farmers pointed out that there ought to be local field trials on commune level for testing conservation techniques under local conditions.

Insufficient financial support

Beside the lack of information, another reason why farmers are so reluctant to implement any kind of SCT lies in the lack of financial support (7%): Both, the interviewed farmers and the participants of the workshop, complained that they could

not afford for example the seeds for hedgerows. So for most of the farmers the financial problem is the main obstacle to apply SCT.

Insecure land tenure

Moreover, 32% of the interviewed farmers expressed their fear of reallocation of their fields (see Table 1 below) before the period of land right use ends. A secure land right is an important factor for long-term investments in soil conservation measurement.

Table 1: Constraints of the adoption of soil conservation techniques

	Fear of reallo-cation	No aware-ness of soil erosion	No informa-tion about SCT	No financial support (for inputs)	Way of custom/ tradition	Size of ara-ble land	Extra labor
Total	**32%**	**10%**	**33%**	**7%**	**5%**	**2%**	**2%**
CK	30%	3%	23%	0%	7%	3%	0%
CH	33%	16%	43%	13%	3%	0%	3%

(Source: own data based on interviews in June 2011)

5.1.2.2 Practical constraints

However, not only the insufficient institutional support of farmers hampers the adoption of soil conservation techniques. Also some practical problems were mentioned during the interviews:

As you can find in the Appendix 4, farmers mostly dig water channels (35%) in order to control the water flows on their plots, avoid burning after the harvest (10%) or change the crop after some cropping seasons (8%).

To the question if the farmers could imagine applying one of the tested techniques on the Wischmeier demonstration plots, the following results came up (see also Table 2 below):

Table 2: Main constraints of the adoption of three soil conservation techniques tested on Wischmeier plots

Constraints of these techniques	Panicum Maximum (grass barriers)	Arachis pintoi (cover crop)	Phaseolus calcaratus (bean)
Size of land too small	18%	3%	3%
Fear of reduced yields	15%	8%	15%
Fear of competition with fertilizer	18%	12%	33%
Impede work on field	3%	12%	10%
Extra labor	2%	3%	3%
Fear of cattle devouring it	22%	42%	25%
No seeds	8%	5%	0%
Way of custom/ tradition	3%	7%	7%
No need (for feed, sale,…)	5%	2%	5%
unsuitable weather conditions	0%	0%	8%

(Source: own data based on interviews in June 2011)

Vegetative Barriers

Grass (40%) or legume barriers (25%) seem to be the most attractive measure to the farmers because of their multi-purpose utilization as animal feed and as additional crop for selling on the market. But the farmers' reluctance to plant barriers is still high. Although land use plans exist designing a fixed area for grass in each commune, several reasons keep the farmers from planting grass on their fields. One argument is the fear of cattle without leash grazing on the plots after the maize harvest and that their own or their neighbors` animals might devour the grass (22%). Furthermore, in their opinion barriers take too much land and so their maize yields would decrease. According to Vu Dinh Tuan (personal communication during the workshop), grass barriers for example take around 25% of the plot, which is then not available for maize cultivation.

Some farmers (18%) had doubts that barriers might compete with the maize for fertilizer or sunlight. Moreover, they argued that ploughing and weeding got more difficult with barriers on the field.

Special land use plans by the government prescribed a fixed percentage of land that should be cultivated with grass, yet allowing farmers to plant grass on their poorest plots or even on separate plots. Anyway, according to Mrs. An, the head of the extension service of Yen Chau, the families in Yen Chau district have less than one cattle on average, what means that grass production as animal feed plays just a minor role there (interview on the 13 of May 2011).

Cover crops

Another result of the questionnaires was that 30% of the interviewed households could get familiar with the idea of planting cover crops on their field. Yet here again, farmers fear that cattle brought to the fields would eat away the crops or destroy them by stepping on them. They also thought that the competition with fertilizer or sunlight might be too high. Some farmers explained that they could not afford the additional seeds and that they missed a good example in their commune so that they did not know how to put this technique into practice and whether it was working well. Others were afraid that either mice or the applied herbicides would damage the cover crops. Moreover, the traditional way of burning the residues after harvesting maize would destroy the cover crops.

Minimum tillage

Further it turned out that just 10% of the interviewed farmers were ready to reduce tilling to cultivate their field. The problem is that they lack information about this technique. Apart from that, they fear that the work on the field might become more strenuous and because of the hardened structure of the soil the yields would decrease.

Relay cropping

Relay cropping also appeared to be no attractive technique to the farmers. Not more than 16% of the farmers said they would try this technique on their fields because of its potential as another income source. The constraints again, are fear of competition with fertilizer and sunlight as well as of cattle devouring the plants.

Furthermore, intercropping makes it difficult for farmers to plough, weed and harvest the maize. They might destroy the young plants while the maize is ready to be harvested.

Picture 15: Animal fence
(Source: own picture taken in May 2011)

Some farmers built fences around their plots to protect the crops from cattle, but they complained that fencing required a lot of time and labor. Fencing and burning as traditional cultivation methods are barriers to the implementation of feed stripes. This is also a reason why the techniques tested are not yet put into practice by the farmers.

5.1.3 Comparison of both communes in the adoption of soil conservation techniques

One important factor that influences the adoption of SCT is expected to be the farm size. It is assumed that the bigger the farm size, the higher is the probability to adopt new techniques. Some of the proposed measures take a lot of land and farmers are generally afraid that maize yields are reduced by the implementation of SCT. But, quite on the reverse, the appliance of SCT is lower in Chieng Hac commune (37%) than in Chieng Khoi (47%), despite the fact that Hmong farmers in Chieng Hac have more land area available (30´393 m² on average) than Black Thai farmers in Chieng Khoi (8´649 m² on average). The explanation for this is that Hmong farmers in the higher altitudes still clear forests in an uncontrolled way and share arable land with less people than in the denser populated lower altitudes. All farmers have a Red Book, an official paper where the land size and the land use right is written down. Thus, the Hmong have additional land area at their disposal, which they cultivate unofficially. Nevertheless, this does not lead automatically to a higher application of sustainable land use techniques in the Hmong villages.

There are several reasons for this contradictory phenomenon:

Only 20% of the farmers in Chieng Hac have ever received any information about soil conservation measures. During the interviews, the farmers of Chieng Hac commune explained that the extension service came rather seldom to the remote area to disseminate information. Usually, only one person per family is allowed to participate in an information session. In general, they get information there how to increase maize yields.

Due to the fact that in most of the villages in Chieng Hac there is no electricity and therefore TV or radio do not play any role in the dissemination of information, the extension officers are anyhow the main information source in this region. Being members of the governmental administration, they distribute information the government prefers for Vietnam`s economy. Logically, extension officers tell farmers how to raise productivity of maize (in particular maize for export). In most cases, extension officers are not well paid at all and have therefore few incentives to improve the situation. According to FRIEDERICHSEN (2007: 12), some extension officers also work

for seed suppliers. They tell farmers with what kind of maize varieties they can get the best profit.

Furthermore, meat demand will increase in the near future so that maize production as pig feed gets more and more attractive (FRIEDERICHSEN, 2007: 15). Farmers aspire to expand their cropping area or intensify their cultivation by using even more fertilizer.

Another constraint for the adoption of SCT in Chieng Hac is the fact that farmers are even less aware of the erosion problem than other ethnic groups (see Table 1). This lack of awareness may be because the cultivation of maize in the higher mountains has not yet existed for a very long time (see Appendix 2: Land use history in both communes). Although it is forbidden to clear more forest land, farmers in higher altitudes still convert forests to arable land for maize cultivation. The soils in Chieng Hac are therefore less exposed to erosion processes and the Hmong feel its impacts less painfully.

The difficult situation in the higher altitudes of Chieng Hac can be explained on the following examples:

The main purpose for planting legume barriers, for instance, is home consumption. While in Chieng Khoi, which is closer to the central market of Yen Chau, the farmers see the legumes as an additional income source, in Chieng Hac the farmers would use legumes mainly for home consumption because of the difficult access to the market (see Figure 13 below).

The same applies to relay cropping with *Phaseolus calcaratus*. The villages in Chieng Hac are too far away from the market, so trading in beans is impossible and the bean production would exceed by far the need for home consumption. Anyway, for own requirement, a few bean plants grow already in their gardens. Some of the farmers (27%) had the opinion that the weather was not suitable enough to cultivate *Phaseolus calcaratus.*

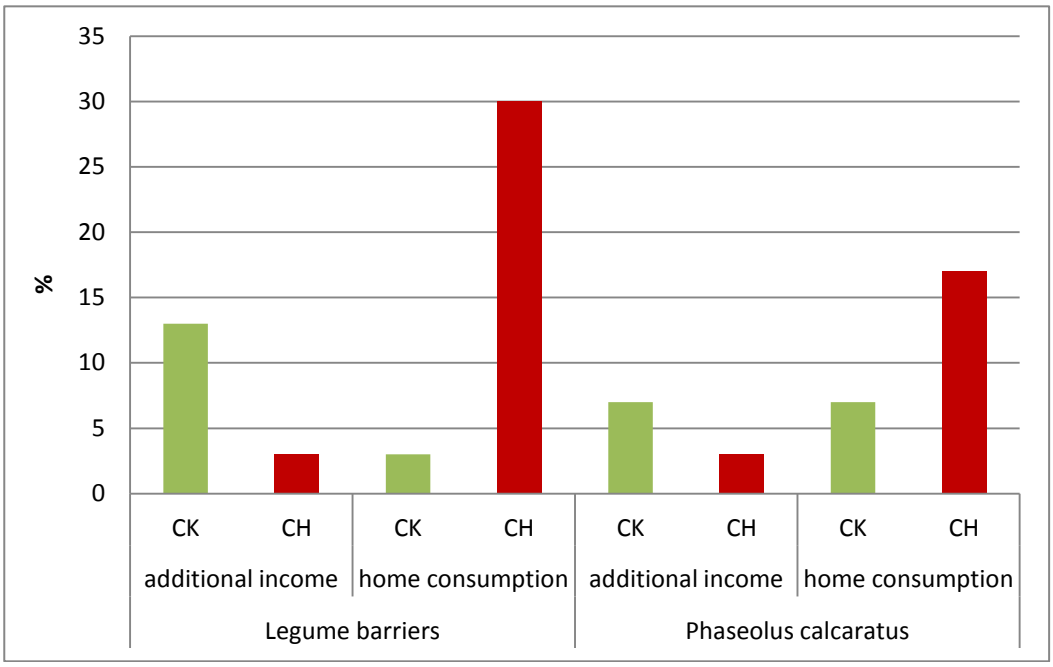


Figure 13: Main purposes of implementing soil conservation techniques
(Source: own data based on interviews in June 2011)

The interviews showed that farmers in Chieng Hac depend more on the sale of maize than farmers in Chieng Khoi do. To the question if the farmers could imagine implementing SCT on their fields, farmers in Chieng Hac mostly answered that they fear that their maize yields would be reduced by implementing SCT (due to competition for fertilizer or sunlight). This answer was quite rare in Chieng Khoi.

The reasons for this are that farmers in Chieng Hac lack a diversified cultivation system. Fish ponds are rarely found, nor is the cultivation of fruit trees very widespread in Chieng Hac. Fruits being a perishable ware, they cannot be transported quickly enough to the next market. As chapter 5.2.2 describes, farmers in Chieng Hac have fewer cattle than farmers in Chieng Khoi who depend on the purchase of beef.

Both village headmen (of Co Say and Bo Kieng) in Chieng Hac emphasized that farmers in their villages were also short of grass seeds. Besides, farmers in Chieng Hac ignored how to establish these barriers.

On the whole, in both communes farmers are poor and avoid running any risks. Uncertainties about yields menace their existence. And else, there is a shortage of additional seeds for other crops and even if they were supplied with enough different kinds of seeds, the farmers would find it too risky to mix up various crops without any demonstration or good example in their region.

One of the main problems is the understanding of long-term methods. Some farmers have already received financial support by the government for planting for example barriers. In practice, however, according to Mrs. An from the extension service of Yen Chau district, farmers take the money and continue to cultivate in a monocropping system when the project period is over. Quite obviously, they are used to think in short-terms and as erosion happens slowly, its results are not yet visible after a short period of time. According to Mr. Diên from the Department of Agriculture, farmers do not mind reallocation and so they just think of their immediate profit in order to support their families without taking any risk.

Modern and science-based technologies are often not adapted to the local and traditional conditions (FRIEDERICHSEN, 2007: 15). Innovations that are not based on successful existing experiments are doomed to failure. If the farmers themselves had a fall-out of harvest trying out new techniques, they would lose both their money and their social prestige. In connection with that, many farmers complained about the missing access to micro-credits or any other governmental support in cases of shortage.

5.2 Potential of cattle rearing in the study site

5.2.1 Constraints of cattle rearing in both communes

The main cattle types in Vietnam are Yellow cattle and Laisind breeds, which are well adapted to the local climate and feed conditions (MANH, 2010: 13). Yet, due to scarcity of feed resources in the dry winter, 50% of the interviewed households have less than three cattle. Keeping cattle is considered as an additional income source and as a guarantee for their own food security and financial security in emergency cases. Beside beef production, farmers use cattle as draft animals. But with the developing economy, cattle are mostly replaced by machinery.

On the other hand, meat demand also in rural regions is increasing.
Vietnam has an extensive meat marketing system. Livestock market infrastructure is not very well organized so that farmers are more likely to sell their meat individually rather than to profit from lower prices with the help of contracts (MANH, 2010: 15).

Investments in cattle rearing are very low, especially in small-scale farms. Indeed, most of the farmers (85%) do have some cattle. Though, 60% of the interviewed farmers have only one to three cattle. 83% of the farmers use their buffalo as a draft animal for ploughing their fields or for transporting their harvest. None of the interviewed farmers use dung as organic fertilizer.
The village headman of Ban Ngoang in Chieng Khoi assumed that farmers in this village would increase the amount of cattle and would promote cattle breeding, but selling meat is difficult in this region due to the low living standard and low meat consumption. Apart from beef production for home consumption, farmers in Chieng Khoi sell meat from time to time on the local market, but only small quantities (interview on the 21 of May 2011).

In contrast to large-scale farms that feed their cattle with an improved feed source, small-scale farmers use mixed feed sources. Feed resources are quite limited, especially in dry winters when farmers feed their animals with rice straw which has poor quality and protein content. The low quality of feed causes a disorder of reproduction and low animal performance (MANH, 2010: 13, 15-16). Farmers of Yen Chau feed their animals with green residues of seasonal plants such as grass in spring, maize leaves after the

harvest in summer, weed in autumn when they leave their maize plots until the next cropping season, and rice straw in winter (see Figure 14 below).

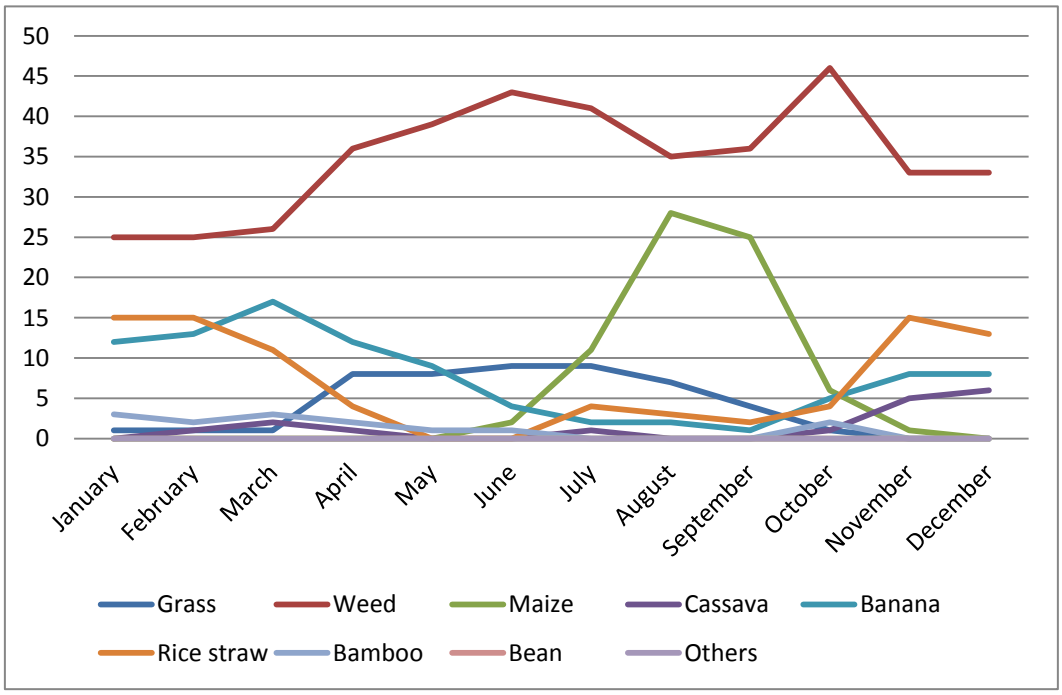


Figure 14: Feed sources during the year
(Source: own data based on interviews in June 2011)

Feed quality plays a decisive role in the promotion of cattle breeding: As this thesis was to analyze if cattle rearing could create value chains to raise households` income, farmers were asked if they could imagine to produce milk and to sell it on the market. But due to the low feed quality and therefore, low protein intake, the quality of milk proved to be too low for trading. Furthermore, there is no gap in the market for milk because there is already a big milk company in Moc Chau, which is situated one hour by car or bus from the district center. Moc Chau is located higher in the mountains, where the weather is suitable to keep other cattle breeds. As farmers have contracts with the milk company, the only feed that animals get is alfalfa imported from the US by the company itself. Due to its very high protein content, the milk quality is suitable for sale (unofficial interview with a farmer in Moc Chau). In Yen Chau district, climate is unfavorable for keeping this kind of cattle breeds.

As demonstrated in the next chapter, the motives for the farmers' reluctance about more intensive cattle rearing are completely different in each commune.

5.2.2 Comparison of the two communes concerning the promotion of cattle rearing

As stated before, farmers in Chieng Khoi dispose of less land than farmers in Chieng Hac, where in higher altitudes uncontrolled forest clearing takes place. For that reason, farmers in Chieng Khoi see the main constraint of promoting cattle in the insufficient feed production on their limited plots (see Table 3). Due to the lack of land and grazing area, they are often obliged to keep their cattle in the cropping areas. As seen in Figure 15 below, besides along roadsides and around fishponds or houses, cattle is often grazing freely and uncontrolled on the fields (especially after the maize harvest), what is regarded as a problem. 17% of the farmers in Chieng Khoi complained that their work did not leave them enough time to take care of the cattle.

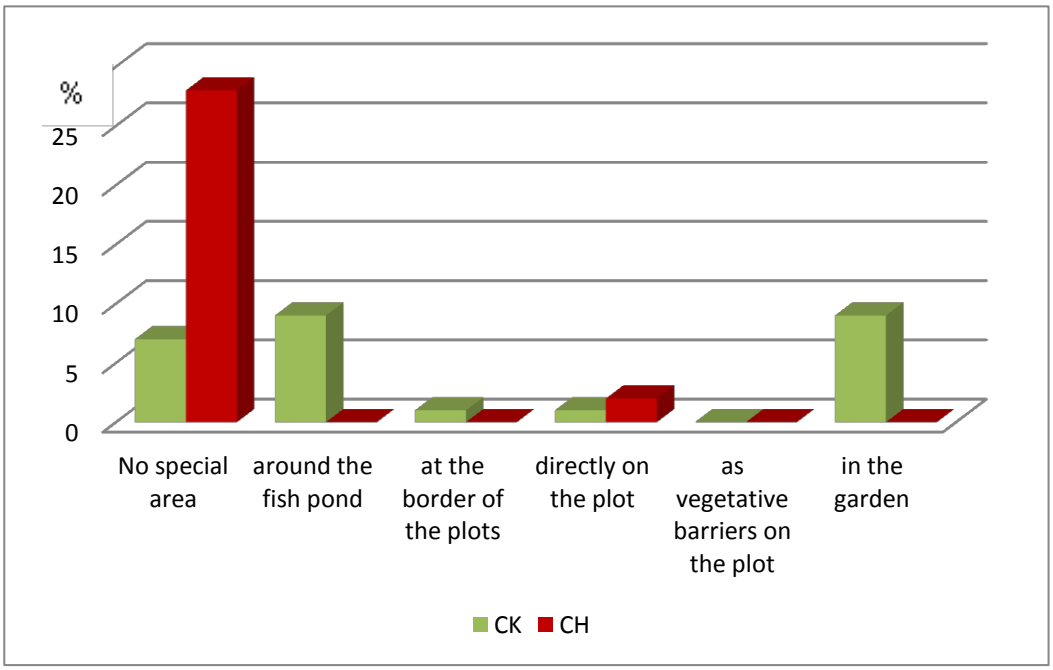


Figure 15: Places of feed production in Chieng Hac and Chieng Khoi
(Source: own data based on interviews in June 2011)

In contrast, for the farmers in Chieng Hac, the main problem is the lack of financial means to buy more buffalos. Owning fewer cattle than farmers in Chieng Khoi (see Table 3), there is no need for them to plant extra feed plants on a special area.

Farmers were asked if they could imagine planting some grass barriers or legume hedgerows on their plot to improve the feed availability. Their answers showed that

their negative view had basically two reasons: beside the fear that with grass barriers and hedgerows the animals might graze freely and destroy the crops, the farmers also expressed their doubts about the competition with the fertilizer. The majority of the farmers in Chieng Hac explained that the few animals they owned could find enough grass and weed growing along the roadside. They preferred to use the arable land exclusively for maize cultivation. Some farmers keep no buffalos at all and just borrow one as draft animal when they prepare their plots before planting maize.

As already mentioned, the farmers in Chieng Hac – quite opposite to those in Chieng Khoi – are very dependent on maize cultivation. Additionally, the government's goal is the promotion of maize. According to the village headman of Bo Kieng in Chieng Hac, the government even "restricts" cattle rearing for that reason. Mr. Diên, the head of the Department of Agriculture, pointed out in an interview (15 of May 2011) that the government supported cattle rearing only along the National Road No. 6 because of the better infrastructural and marketing conditions there.

Finally, the climate also plays a crucial role here. In Chieng Hac more than half of the interviewed farmers (53%) explained that their cattle died the year before because of the cold weather.

Table 3: Constraints of the promotion of cattle rearing

	Number of cattle		**Changes in the last years**		**Reasons for decrease**			
	1 to 3	More than 3	More cattle	Fewer cattle	Cattle died	No money	No time	No feed
Total	**60%**	**32%**	**15%**	**42%**	**27%**	**27%**	**10%**	**33%**
CK	50%	43%	23%	17%	0%	17%	17%	43%
CH	70%	20%	7%	67%	53%	37%	3%	23%

(Source: own data based on interviews in June 2011)

6 Reflection of the hypothesis posed

Quite obviously, the adoption of new techniques depends on the varying local conditions and the different factors such as farm size, human capital, labor and access to credits.

This study took as a starting-point the hypothesis that the probability of the adoption of SCT among Black Thai – living in less remote areas and therefore somehow privileged in view of these factors – is higher than in the Hmong villages which are farer away.

As already illustrated, the Black Thai belonging to the majority of ethnic minorities in Yen Chau district, they often hold positions in local administration institutions. They settle nearer to the district center and are better integrated into the Vietnamese society. Most of the Black Thai can speak Vietnamese beside their ethnic language. Both Black Thai villages in Chieng Khoi commune, Ban Ngoang and Ban Hiem, have electricity and most of households possess communication assets such as TV or radio. So the conclusion can be drawn that because the Black Thai live in the lower altitudes of Chieng Khoi and have better access to information, they are more willing to adapt new soil conservation measures. During the interviews, most of the farmers emphasized the importance for them to have good examples for soil conservation techniques in their region and expressed their wish to get technical support in the establishment of these techniques. Black Thai live closer to the demonstration plots. On both trials of the Uplands Program only Black Thai were involved in the work on these plots and could so directly pass on the information about these techniques in their villages and were the first to adapt them.

The situation observed in the two Hmong villages in Chieng Hac, Ban Co Say and Ban Bo Kieng is totally different. First of all, it is a real challenge to reach the two villages. They are situated high up in the mountains far away from the central market of Yen Chau. The muddy road has plenty of potholes. After the strenuous ascent to conduct the interviews there, it was easy to believe the village headman of Bo Kieng in Chieng Hac who explained that even selling maize can become an insurmountable problem during the rainy season when the truck cannot come up to the villages. This is also a reason why officers of the extension service rarely come to these villages to advise the farmers. Furthermore, Hmong are not familiar with the Vietnamese language so that another

translator (from Hmong language to Vietnamese) has to be engaged. This is also why Hmong are less integrated into the Vietnamese population (Kinh). Moreover, in the war against the US, Hmong fought on the American side and therefore they are not much liked by the Kinh people.
Without electricity and with poor education (most of the farmers are illiterate) their access to information in general is very low.

To summarize, the established hypothesis must be confirmed. As the interviews clearly showed, Black Thai have better access to information and to technical advice through the proximity to the demonstration plots and the lessons by the extension service. Most of them have already heard about soil conservation techniques and are aware of the soil erosion problem. Nonetheless, this means by no way that at present the adoption of SCT is perceptibly higher in Chieng Khoi. The required preconditions, however, already exist to a greater extent there and so new techniques are more likely to be adapted than in the remote villages of Chieng Hac.

According to an interesting statement of Mr. Phương, head of the extension service, who is responsible for Chieng Khoi commune, the educational level of farmers is directly related to the number of cattle they possess (interview on the 16 of May 2011). This underlines clearly the necessity of an adequate information policy.
As the interpretation of the interviews with both the local farmers and the officials shows, the situation for the implementation of SCT in both communes proves to be rather inadequate and must be improved in order to maintain soil fertility and productivity.

7 Recommendations for improving the dissemination of soil conservation techniques

Although one half of the Vietnamese farmland is to be considered as degraded land, only very few farmers practice cultivation methods that conserve soil fertility. As already mentioned the application of mineral fertilizer and the use of high-yielding varieties of plants hide the reduction of soil productivity and hamper the awareness of the soil erosion problem among the farmers. Contour hedgerows and minimum tillage are far from being adopted over wide areas. Farmers urgently need technical support and require more available labor force. Especially small-scale farmers are not ready to accept the reduction of arable land for maize crops by the application of hedgerows.

A great number of projects were carried out in developing countries in order to enhance sustainable agriculture. Most of these approaches were put into effect in a *top-down* process and were not adapted to the local conditions and to the farmers` needs. That is why it is indispensible to provide adequate techniques and to include all stakeholders and institutions into this process.

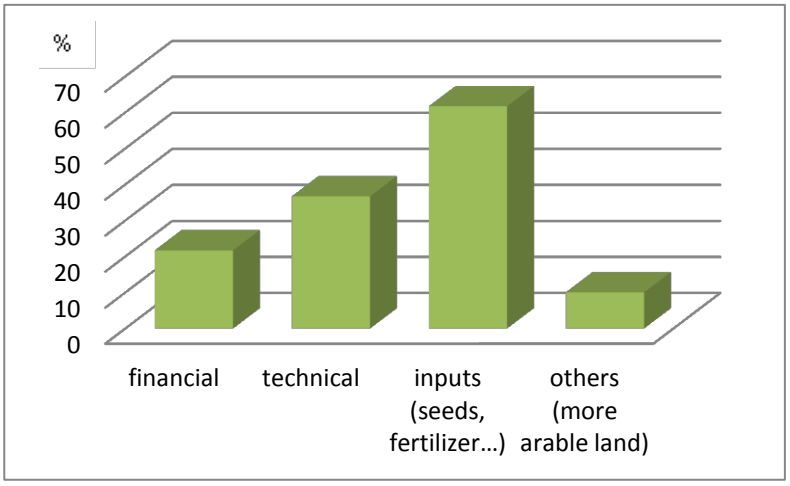


Figure 16: Kind of support desired by farmers
(Source: own data based on interviews in June 2011)

In Yen Chau district, the interviews showed that the low adoption of SCT mainly depends on the unsuitable preconditions. For increasing the adoption rate, the framework must be improved. The adoption of soil conservation techniques is no endogenous problem. Adoption depends more on external factors such as geographical location and farm characteristics as well as socioeconomic conditions and access to inputs and social services such as market situation, information dissemination, the agricultural extension service, social capital and material support; see Figure 16 above).

Opportunity costs such as land and labor, competition of SCT with cash crops) play an essential role in the adoption of SCT. Also short-sightedness in planning due to severe poverty and fear of land reallocations before the land use period ends keep farmers from implementing new techniques with uncertain yields. These constraints reinforce the farmers' inclination not to invest in techniques against erosion processes.

A multi-dimensional approach is needed to enhance sustainable land use:

Political enhancement

There can be no effectiveness of projects and approaches if the political framework is unsuitable. In the case of Vietnam with its emergent economy, the government supports the short-term benefits the farmers achieve on their maize fields. The farmers' belief in government benevolence and their obedience to an autocratic state prevent a long-term development. Hence, first of all the politicians must be convinced to support the institutions concerned and to enact appropriate laws to promote a sustainable development. Corresponding national environmental regulations and land use plans must be put into effect. Other states could give a good example here. In brief, research institutes and government must cooperate closely.

In addition to that, a legal framework is to be created to secure land tenure. According to SAINT-MACARY (2008: 19), the formalization of property rights is a guarantee for land security and can function as an incentive for long-term measures and stop illegal forest conversion.

Institutional amplification

As the extension service is a governmental institution, it is not surprising that its officers inform the farmers about techniques how to increase maize yields instead of promoting a sustainable agriculture. Of course, farmers need to earn money to support themselves. But there should be neutral institutions that advise the farmers how to manage to earn their living in a sustainable way. The problem in NMR is that frequently the employees of the extension service themselves have a poor educational background and having no knowledge about sustainability, they are not aware of the erosion problem. In the examined region, workshops and information sessions ought to take place where everybody can participate in order to initiate an area-wide promotion of long-term land use systems. Advanced trainings for officers of the extension service as well as for staff of the regional university (capacity building) should be offered. The interviewed director

of the Center for Research and Technology Transfer of the Northwestern University explained that diverse courses such as crop science, plant protection and forest management including sustainability as an important topic were held at the university. Until now, the dissemination of this information is restricted to a small and elitist group of people. At present, job opportunities in Vietnam are not automatically awarded to well-trained people with special knowledge, but to people with close relations to the party and decision-makers. In the end, farmers would probably have more confidence in officers with profound knowledge and so the employment of well-trained staff could be a suitable measure to build up trust.

Furthermore, institutions ought to be founded that make available micro-credits for the farmers enabling them to buy seeds (for vegetative barriers or cover crops), improved equipment or just to have an insurance in case of extreme weather situations or mismanagement. Opportunity costs should be covered by expected funds. That would minimize the risk for farmers and lead to a higher probability of the adoption of SCT. Incentives for farmers who are the first to take the risk should be more lucrative. Early adopters could then spread their knowledge. Governmental task is it to strengthen social networks and associations so that all farmers can be innovative and act collectively.

The improvement of educational conditions can lead to a better understanding of sustainability as well as to better practical skills. Hopefully, farmers would continue to produce the additional products and to create a value chain, thus generating a non-farm income. This again, presupposes the creation of a corresponding market.

Infrastructural integration

Marginalized people ought to be integrated into the profiting society. Their situation could be improved by upgrading the infrastructural conditions especially in remote regions so that it would be easier to sell perishable crops. So, farmers could get more independent of the erosion-prone maize. By bringing electricity to the Hmong villages, it would be possible for the inhabitants to receive information by TV or radio. NGOs or private companies could act as funders.

Need for research

Although it is hard to change existing preconditions such as political decisions on land use, it is possible to strengthen the research sector to improve the situation, for instance by building up more research centers, which can discover locally adapted technologies

suiting the biophysical and socioeconomic conditions in these two communes. Researchers can contribute to a sustainable and long-term agriculture by developing methods that help to cover food supply without destroying the environment.

Yet, research work must include the small-scale farmers and all other stakeholders in a participatory "*bottom-up*" approach, taking into account all indigenous knowledge available and especially the farmers` needs. These research institutes should also work together with the local extension service whose task is to spread the information in their commune and explain the techniques on demonstration fields on the spot in these villages so that all farmers get the chance to participate. Only by successful practical demonstration innovations can have a chance to be taken over.

A cost-benefit-analysis must be provided by the research sector. This analysis must include the comparison of net revenues with and without conservation measures on the plot. This can be achieved by estimating the loss of nutrients by erosion processes and calculating the costs of fertilizer that can replace them (YOUNG, 1990: 48-49).

An interdisciplinary approach is needed to identify competitive, acceptable and economically attractive conservation techniques. For a sustainable agriculture, a farming system has to be promoted which combines maize production, cattle keeping and feed production at the same time.

"Bottom-up" approach

For a sustainable development the rural population must be empowered to participate in this process. What weighs most is the farmers' understanding of the value of natural resources and of soil conservation techniques serving finally their own interests. The primary matter is to identify their main problems and prioritize their own needs before a concrete plan is to be established. A range of different institutions have to be involved to support the people in the process of finding possible solutions. Especially grassroots institutions (which are closer to the farmers and know about their needs) should be strengthened by the government helping for example to organize workshops. These workshops should take place in the villages to disseminate information on the spot, letting as many people as possible participate. A contact person should always be at the farmers' disposal to dispel their doubts and to encourage them.

Practical Management

According to YOUNG (1990: 51), conservation methods should not be seen as an isolated measure, but as integrated techniques in the current cultivation system. These

measures must be simple and feasible for the farmers to establish and maintain. According to Mr. Diên from the Department of Agriculture, ideally the application of the techniques should be easy, not very costly and having optimal yields. For a broad implementation, they should show benefits in the shortest space of time possible (interview on the 15 of May 2011).

If I personally had to recommend a special soil conservation technique, I would advise the farmers of Yen Chau to plant various trees, agroforestry having a whole range of advantages, ecologically and economically. As I have already listed the numerousness of ecological pros, I would like to highlight the economic benefits of this multi-purpose technique:

First of all, agroforestry can be adapted to diverse environmental conditions. This system is not land-extensive and does not require costly inputs so that this technique is even for poor or small-scale farmers affordable. Furthermore, no technology transfer is required. Most of the farmers are familiar with managing trees (YOUNG, 1990: 92). The implementation of soil conservation measures must not automatically lead to a decrease in yields due to reduction of land area. On the contrary, trees on the arable land have some positive side-effects: farmers can benefit from the high biomass production, not only to increase soil fertility by N-fixation, but also by using the litter as animal feed. Livestock keeping can be facilitated by controlled grazing on the plot or by cut and carry feed removal. Moreover, farmers benefit from wood production as fuel wood (YOUNG, 1990: 74), as well as from the fruits of the tree (for home consumption or for selling them on the market to generate income). Moreover, erosion prevention is much cheaper than erosion control or reduction or even soil rehabilitation when the soil is already degraded. But even if the soil is so degraded that it is not possible any more to cultivate any crops on this field, farmers can benefit from some trees by the use of grass growing under the trees as feed (YOUNG, 1990: 49).

Farmers should avoid burning the residues after harvesting the maize because the residues can protect the soil from erosion and increase the soil`s fertility (Vu Dinh Tuan; personal communication).

8 Conclusions and future outlook

Like in many countries all over the world, especially in developing countries, a rapid change in land use has taken place in the mountainous uplands of Northwest Vietnam during the past decades. This change could happen because of the following factors:

By agricultural commercializing and by the fact that due to the pressure on land farmers stopped observing fallow periods, the traditional way of farming was destroyed. Before, shifting cultivation was characterized by a high diversity of crops (upland rice, cassava, maize fruits and other vegetables) so that the upper soil was covered by vegetative residues and so erosion risk was minimized. Therefore, this original system can be described as a sustainable, integrated farming system. National land tenure policies appear to be push factors (away from traditional farming systems) and market pressure to the ongoing shift to maize production as a cash crop turn out to be a pull factor to land use intensification without fallow periods but with the application of increasing amounts of mineral fertilizer. These factors have led to widespread land degradation in this region.

Only recently, this problem started to attract international attention. Food security and later soil as its vital basis became issues on top of the agenda in international conferences like the United Nation Conference on Environment and Development in Rio de Janeiro (1992). In the international discussion about fighting hunger in the world, the G8 and many other countries institutions declared *in "L`Aquila" Joint Statement on Global Food Security* that the Millennium Development Goals (MDG`s) could only be achieved by investing in short-, medium- and long-term agricultural development. It further points out that the integration of farmers into markets, especially of small-scale farmers and women, must have priority in the strategies on all administrative levels (ROTA et al., 2009: 10).

Therefore, the Federal Ministry for Economic Cooperation and Development is supporting the international agricultural research by providing 20 million Euros per year (BECKER et al., 2011: 5). This shows that long-term strategies for rural development and food security have become a fundamental target in the development policy of Germany.

Now, many international NGOs and other organizations make great efforts to stop this land degradation in Vietnam. Although most of their work is based on latest research

promoting new technologies, it cannot be successful because farmers are supposed to adopt this "*top-down*"-approach without any adaptation to the local natural or socioeconomic conditions. That is why an integrated approach is inevitable, letting all stakeholders (farmers, policymakers, scientists…) participate in land use decision processes in order to find a suitable way of farming in this vulnerable region.

Above all, a political and institutional change must occur. The government has to make investments such as credits and social services as a buffer against unexpected shocks. Policies must provide long-term environmental stability without neglecting income generation. It is a political challenge to manage interest conflicts. Politicians have to create a legal framework for a transparent and equal development. Definitely, by involving key institutional and economic actors new opportunities could open up. Exchange networks and broadly based partnerships should contribute to this iterative process. According to DIJKMAN (2009: 16-18), sustainable development is an *inclusive* development, which means that poor people must be involved and empowered as producers, consumers, market agents and decision-makers on the local level. Their basic needs must be met by technologies that are locally well adapted by on-farm experiments and by demonstrating feasible alternatives. Therefore, on-site research is indispensible.

Local long-term trials can develop soil conservation techniques, which are adequate to local conditions. But the high spatial variability of soil properties or slopes requires even more research and practical experimentation before any special technique can be recommended. To be true, this is costly and time consuming but worthwhile in the end. Land use decision models can help to identify different land use scenarios and can give recommendations in a relatively fast and cheap way of investigation. One must not forget to check customary rights before in order to achieve the goal to reduce vulnerability and risk.

What the landscape will look like in the future is not only dependent on the farmers` decision on land use but also on the worldwide economic frameworks and the market prices for each crop. Now maize serves as animal feed to satisfy the meat consumption of industrialized countries. Here, consumers could exert great influence on the landscape of the uplands by changing their consumption habits.

9 References

AYANU, Y., Z. (2009): *Simulating Consequences of Land Use Change on Hydrological Landscape Function and Sustainable Crop Production in Northwest Vietnam*. Unpublished Master Thesis. University of Hohenheim.

BECKER, M., KREYE, C., RIPKEN, C., TIELKES, E. (2011): *Tropentag 2011 –Development on the Margin. Book of Abstracts*. International Research on Food Security, Natural Resource Management and Rural Development. Göttingen: Cuvillier Verlag.

BISHNU, B. B. (2003): *Module 4 – Participatory Rural Appraisal (PRA).* Institute for Global Environmental Strategies (IGES). Hayama, Kanagawa, Japan. Retrieved: March 29, 2012, from http://enviroscope.iges.or.jp/contents/eLearning/waterdemo/ bhandari_m4.pdf.

CLEMENS, G., FIEDLER, S., CONG, N. D., DUNG, N. V., SCHULER, U., STAHR, K. (2010): *Soil Fertility Affected by Land Use History, Relief Position and Parent Material under a Tropical Climate in NW-Vietnam.* In: Catena 81, 87-96.

DIJKMAN, J. (2009): *Making Livestock Policy Pro-poor.* In: Rural21 – The International Journal for Rural Development 43 (6), 16-18.

FAO (2001): *The VAC System in Northern Viet Nam*. Retrieved April 13, 2012, from http://www.fao.org/DOCREP/005/Y1187E/y1187e10.htm#l.

FAO (2008): *Newsroom – Land Degradation on the Rise*. Retrieved: January 29, 2012, from http://www.fao.org/newsroom/en/news/2008/1000874/index.html.

FAO (2012 a): *Country Briefs Viet Nam*. Retrieved: April 4, 2012, from http://www.fao.org/countries/55528/en/vnm/.

FAO (2012 b): Grassland Species Profile. Grassland Index – Arachis Pintoi Krap. & Greg. Retrieved: April 4, 2012, from http://www.fao.org/ag/AGP/AGPC/ doc/GBASE/ DATA/pf000463.htm.

FAO (2012 c): Grassland Species Profile. Grassland Index – Panicum Maximum Var. Trichoglume. Retrieved: April 4, 2012, from http://www.fao.org/ag/AGP/AGPC/ doc/Gbase/DATA/ PF000279.HTM.

FEDER, G., JUST, R. E., ZILBERMAN, D. (1985): *Adoption of Agricultural Innovations in Developing Countries: A survey*. In: Economic Development and Cultural Change 33 (2), 255-298.

FRIEDERICHSEN, J.R. (2004): *Participation of Hmong Farmers in Agricultural Research in Upland Northern Vietnam*. In: BATELAAN, O., DUSAR, M., MASSCHELEIN, J., VAN, T. T., TAM, V. T., KHIEN, N. X. (2004): Proceedings in Trans-Karst 2004 – International Transdisciplinary Conference on Development and Conservation of Karst Regions Hanoi, Vietnam 2004.

FRIEDERICHSEN, R. (2006): *Agricultural Sciences in Upland Northern Vietnam: Situating Research in a Dynamic Environment.* Discussion Paper No. 02/ 2006. Department of Agricultural Development Theory and Policy (Ed.). Research in Development Economics and Policy. University of Hohenheim.

FRIEDERICHSEN, R. (2007): *Frayed Margins: A Political Ecology of Farming in the Northern Uplands of Vietnam.* Paper to be Presented at 5th EuroSEAS Conference 2007, Naples. Retrieved: June 11, 2011, from https://www.uni-hohenheim.de/ sfb564/protected/a1_protected/friederichsen_euroseas2007.pdf.

JOHNSON, N. (2009): *Livestock and the MDGs.* In: Rural21 – The International Journal for Rural Development 43 (6), 12-15.

KEIL, A., SAINT-MACARY, C., ZELLER, M. (2008): *Maize Boom in the Uplands of Northern Vietnam: Economic Importance and Environmental Implications*. Discussion Paper No. 4/ 2008. Department of Agricultural Economics and Social Sciences of the Tropics and Subtropics (Ed.). Research in Development Economics and Policy. University of Hohenheim.

MANH, T. C. (2010): *Beef Production Based on Cassava Products and Legume Foliage in Vietnam.* Doctoral Thesis. Faculty of Veterinary Medicine and Animal Science, Department of Animal Nutrition and Management. Swedish University of Agricultural Science, Uppsala. Retrieved: November 2, 2011, from http://pub.epsilon.slu.se/2255/1/che_man_t_100416.pdf.

MINOT, N., EPPRECHT, M., ANH, T. T. T., TRUNG, L.Q. (2006): *Income Diversification and Poverty in the Northern Uplands of Vietnam.* Research Report 45, International Food Policy Research Institute, Washington D.C. Retrieved: October 5, 2011, from http://www.ifpri.org/sites/default/files/ publications/rr145.pdf.

NGUYEN, V. T. (2005): *Agent Orange and the War in Vietnam*. University of New South Wales, Australia. Retrieved: April 4, 2012, from http://www.vn-agentorange.org/edmaterials/ giaodiem_book.html.

QUANG, D. V., SCHREINEMACHERS, P., BERGER, T., VUI, D. K., HIEU, D. T. (2008): *Agricultural Statistics of Two Sub-catchments in Yen Chau District, Son La Province, Vietnam,*

2007. Retrieved: September 30, 2011, from https://www.uni-hohenheim.de/sfb564/public/g1_files/yen_chau_statistics _2007_en.pdf.

ROTA, A., THIEME, O. (2009): *The Livestock Challenge.* In: Rural21 – The International Journal for Rural Development 43 (6), 8-11.

SAINT-MACARY, C., KEIL, A., ZELLER, M., HEIDHUES, F., THI MY DUNG, P. (2008): *Land Titling Policy and Soil Conservation in the Uplands of Northern Vietnam.* Discussion Paper No. 3/ 2008. Department of Agricultural Economics and Social Sciences of the Tropics and Subtropics (Ed.). Research in Development Economics and Policy. University of Hohenheim.

SCHMITTER, P., DERCON, G., HILGER, T., THI LE HA, T., HUU THANH, N., LAM, N., DUC VIEN, T., CADISCH, G. (2010): *Sediment Induced Soil Spatial Variation in Paddy Fields of Northwest Vietnam*. In: Geoderma 155, 298-307.

SCHUSTER, W. H., ALKÄMPER, J., MARQUARD, R., STÄHLIN, A., STÄHLIN, L. (1998): *Leguminosen zur Körnernutzung.* University of Giessen. Retrieved: April 4, 2012, from http://geb.uni-giessen.de/geb/volltexte/2000/320/original/reisbohn.htm#TopOfPage.

SERRAT, O. (2008): *The Sustainable Livelihoods Approach*. Cornell University ILR School. International Publications. Paper 191. In: Knowledge Solutions 2008, 15. Asian Development Bank, Manila.

SMALL GRANTS PROGRAMME (2006): *Agroforestry System*. Retrieved: April 4, 2012, from http://www.sgp.undp.org/web/images/1558/agroforestry_system.html.

THE, B.D., HA, D.T. and CHINH, N.Q. (2004): *Rewarding Upland Farmers for Environmental Services – Experiences, Constraints and Potential in Vietnam*. World Agroforestry Centre (ICRAF), Bogor. Retrieved: September 15, 2011, from http://www.worldagroforestrycentre.org/our_products/publications/advancedresults.

THE WORLD BANK GROUP (2011): *Poverty Reduction and Equity. Basics of Poverty Reduction and Inequality Analysis.* Retrieved: April 4, 2012, from http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/0,,contentMDK:23003423~pagePK:210058~piPK:210062~theSitePK:336992,00.html.

TUAN, V.D., HILGER, T., CLEMENS, G., KEIL, A., CADISCH, G. (2011): *Soil Loss and Nutrient Use Efficiency of Maize Based Cropping Systems – Funded by the EnBW Rainforest Foundation*. Power Point Presentation at the EnBW Workshop in September 2011 in Yen Chau, Vietnam.

TUAN, V.D., TRUONG, N.V., HILGER, T., KEIL, A., CLEMENS, G., ZELLER, M., STAHR, K., CADISCH, G. (2010): *Fostering Rural Development and Environmental Sustainability through Integrated Soil and Water Conservation Systems in the Uplands of Northern Vietnam.* Power Point Presentation on the International Symposium "Sustainable Land Use and Rural Development in Mountainous Regions of Southeast Asia". 21-23 of July 2010. Hanoi.

UNITED NATIONS (1987): *UN Documents*. Gathering a Body of Global Agreements. Report of the World Commission on Environment and Development: Our Common Future. Chapter 2: Towards Sustainable Development. Retrieved: April 4, 2012, from http://www.un-documents.net/ocf-02.htmI.

UNITED NATIONS (2010): *Millennium Development Goals.* Retrieved: April 4, 2012, from http://www.un.org/millenniumgoals.

UNITED NATIONS DEVELOPMENT PROGRAMME: *International Human Development Indicators*. *National Human Development Reports for Viet Nam.* Retrieved: April 4, 2012, from http://hdrstats.undp.org/en/countries/profiles/VNM.html.

UNIVERSITY OF HOHENHEIM (2012): *The Uplands Program (SFB 564).* Retrieved: April 4, 2012, from https://www.sfb564.uni-hohenheim.de.

WALKER, P. A. (2005): *Political Ecology: Where is the Ecology?* Department of Geography, University of Oregon, Eugene, USA. In: Progress in Human Geography 29 (1), 73-82.

YOUNG, A. (1990): *Agroforestry for Soil Conservation*. CAB International, International Council for Research in Agroforestry. BPCC Wheatons Ltd, Exeter, UK. Retrieved: November 3, 2011, from http://www.worldagroforestrycentre.org/downloads/publications/PDFs/03_Agroforestry_for_soil_conservation.pdf.

Appendices

Appendix 1: Questionnaire for farmers

Livelihood strategies –

Potential of cattle rearing by improved feed production to increase households` income and to decrease soil erosion in rural communities in Northwest Vietnam

EnBW funded project

Date of interview	
Commune name	
Village name	
Household identification number	
Name of the Household head	
Name (and ID) of respondent	
Interviewer name and code	

Personal data:

Sex 1 = male 2 = female	**Age** 1 = < 20 yrs 2 = 21 - 30 yrs 3 = 31 - 50 yrs 4 = > 51 yrs	**Ethnicity** 1 = Black Thai 2 = Hmong 3 = Kinh 4 = Others	**Size of household** 1 = < 4 people 2 = 5 - 7 people 3 = > 8 people	**Is your harvest sufficient for home consumption?** 1 = yes 2 = no		**Other jobs except farming?** 1 = yes 2 = no
				Rice		
				Cassava		
				Sugarcane		
				Bean		
				Others		

Farm type:

Size of farmland	**Ownership** 1 = own property 2 = rented		**Formal land use title** 1 = yes 2 = no	**Afraid of reallocation of land** 1 = yes 2 = no	**Member of farmers` union** 1 = yes 2 = no	**People working on the farmland** 1 = members of my family 2 = neighbors 3 = hired labor	
_____m²	1	m²				1	people
	2	m²				2	people
						3	people

Plot management (use farm sketch on A0 paper to facilitate this question):

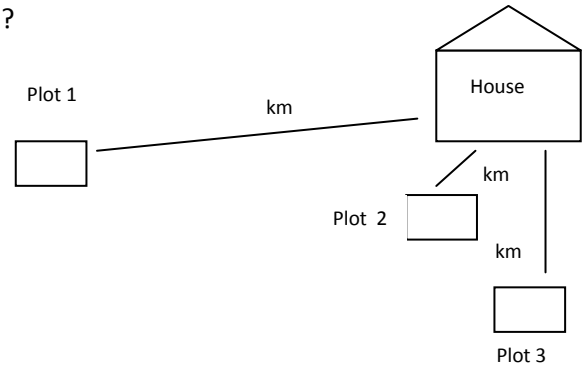
Plot ID	Plot size (m^2)$	Relative distance to farmstead (m)	Inclination *
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

* Use graph to explain farmer
$ Include registered, non-registered and rented land

Farm sketch (use A0 paper for illustration):

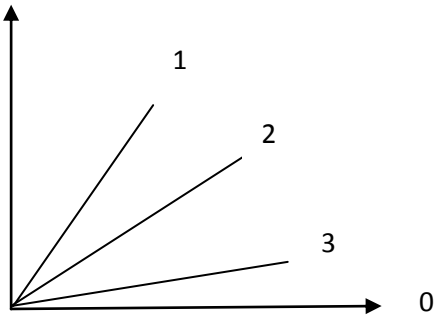
How far are your plots from your house?
How steep are your plots? *

Example:

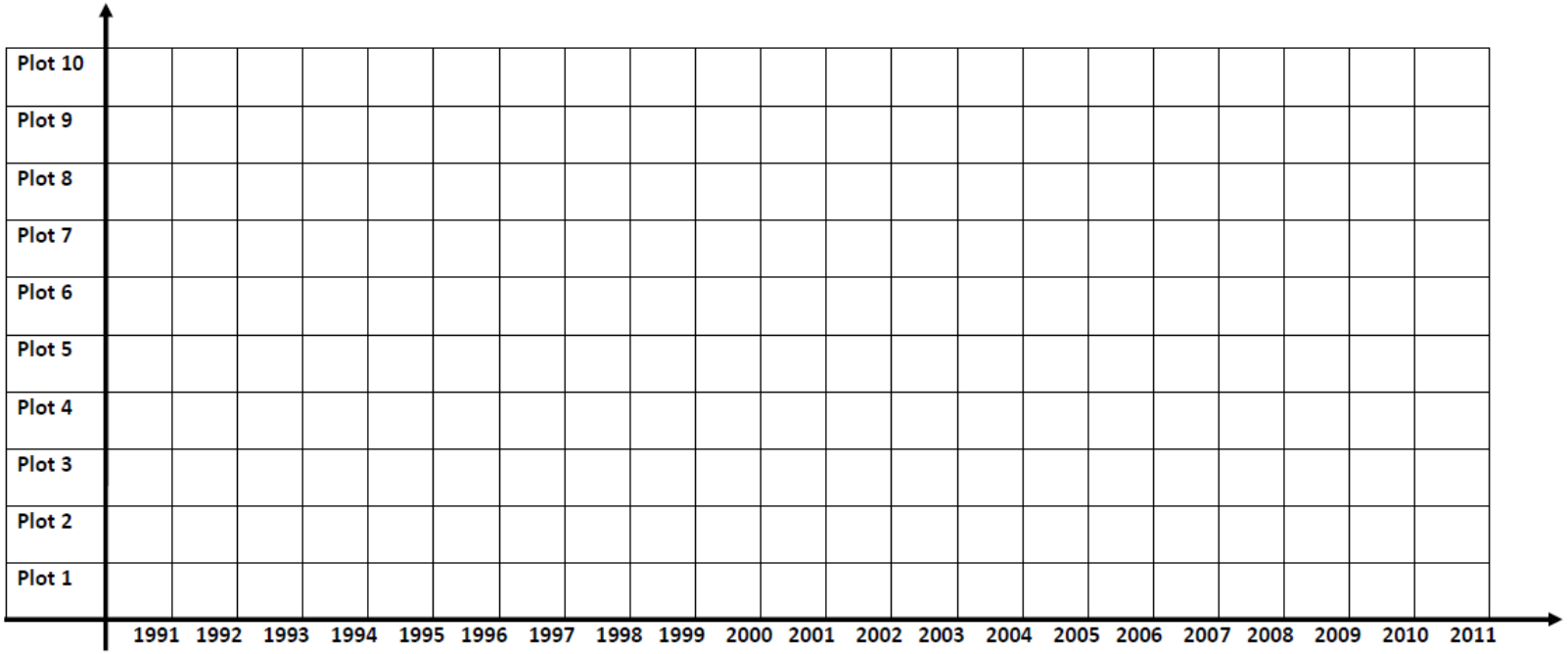


* Inclination of plots:

1 = very steep
2 = steep
3 = not very steep
0 = flat



Land use history and reasons for changes*(use separate paper for facilitation):



x: year when famer has received the field

* Reasons for changes:

1 = adapted to droughts/ pests	7 = soil too poor
2 = higher yield	8 = little land, intensify
3 = 32 J reforestation program	9 = no demand on market
4 = as fodder	10 = hard to cultivate/ no time
5 = for home consumption	11 = just follows others
6 = market price	12 = cattle devour it

Crop management:

Plot ID	Current Crop	How many crops per year? 1 = 1 crop 2 = 2 crops 3 = more than 2 crops	Current cultivation method 1 = mono 2 = mixed 3 = relay 4 = rotation 5 = agroforestry (with fruit trees, teak or others) 6 = others	Changes? Cultivation methods in the last 10 years 1 = yes 2 = no A = mono B = mixed C = relay D = rotation E = agroforestry F = other	Variety in the past (2009) * 1 = local 2 = hybrid/ improved 3 = others	Reasons for changes in variety 1 = price on the market 2 = better adoption to soil 3 = higher yields 4 = recommended by extension service 5 = seed support by the government due to natural disasters 6 = others	Variety in the past (2010)* 1 = local 2 = hybrid/ improved 3 = others	Reasons for changes in variety 1 = price on the market 2 = better adoption to soil 3 = higher yields 4 = recommended by extension service 5 = seed support by the government due to natural disasters 6 = others	Current variety (2011) * 1 = local 2 = hybrid/ improved 3 = others

* Maize varieties:

Local:

Hybrid/ Improved: VM1, LVN 10, CP888/999, NK 54/4300, C919/171, LVN2, 9901

Soil cultivation:

Plot ID	**Tractor** 1 = yes 2 = no	**Plough** 1 = yes 2 = no A = once per cropping season B = twice per cropping season C = three times per cropping season	**Hoe** 1 = yes 2 = no	**Other Equipment** (chọc lỗ bỏ hạt) 1 = yes 2 = no	**Chemical fertilizer** 1 = yes 2 = no	**Organic fertilizer** 1 = yes 2 = no

Further processing:

Do you process your crops any further? 1 = yes 2 = no	**If you process your crops any further, from which crop to which product?**	**Purpose/reason for crop processing?** 1 = home consumption 2 = animal feed 3 = selling 4 = others

Production constraints:

What about the relationship between the input & output of your agriculture: Do you get good returns (exclude your own labor)? 1 = yes 2 = no A = for maize B = for rice C = for cassava D = for sugarcane E = for others	**Which agricultural challenges did you have to face in the last years?** 1 = decreased returns 2 = problems in marketing 3 = price changes for equipment/ seeds/ fertilizer 4 = others	**What might be the reasons for decreased yields?** 1 = high rainfall events 2 = droughts/ shortage of rain 3 = erosion /degraded soils 4 = diseases/ pests 5 = poor soils 6 = others	**Do you observe soil erosion processes on your own field or on other fields in your community?** 1 = yes 2 = no	**Did you already have to abandon any fields due to soil degradation?** 1 = yes 2 = no 3 = I already had to change the purpose of cultivating 4 = I can`t abandon, because I don`t have enough area

Soil conservation techniques:

Have you ever had any information about sustainable agriculture and measures of erosion control and by which institution? 1 = yes 2 = no A = by the extension service B = by the Upland-Program C = by NGO`s D = others	**What kind of information did you get?** 1 = reforestation 2 = grass/ legume barriers 3 = cover crops 4 = relay cropping 5 = mulching 6 = contour ploughing 7 = agroforestry 8 = minimum tillage 9 = fallow periods 10 = change crop/ variety 11 = water channels 12 = others	**Do you take any measures for soil conservation? Which one?** 1 = yes 2 = no A = reforestation B = grass/ legume barriers C = cover crops D = relay cropping E = mulching F = contour ploughing G = agroforestry H = minimum tillage I = fallow periods J = change crop/ variety K = water channels L = others	**If you take any measures, what could be the reasons, why your neighbors or other people in your commune don´t follow you?** 1 = don`t have any problem 2 = don`t have any information 3 = not aware of erosion problem 4 = no financial support 5 = not enough farm land 6 = afraid of competition for fertilizer 7 = not enough labor 8 = others	**If you don`t take any measures, what is the reason?** 1 = don`t have any problem 2 = don`t have any information 3 = not aware of erosion problem 4 = no financial support 5 = not enough farm land 6 = afraid of competition for fertilizer 7 = not enough labor 8 = others

Do you know any government projects/ other institutions which support the agriculture in your region? Which? 1 = yes 2 = no	**If yes, what kind of support is it?** 1 = financial support 2 = technical support 3 = seeds/ fertilizer 4 = others	**What would be necessary to increase the adaption of soil conservation techniques in your village?** 1 = financial support (microcredits) 2 = technical support (knowledge transfer by university courses/ extension service/ workshops/ demonstrations and clear instructions) 3 = seeds/ fertilizer 4 = others

Cattle rearing:

Have you got any cattle? How many? 1 = yes 2 = no A = 1 - 3 B = 4 - 6 C = 7- 10	**For what purposes do you use the cattle?** 1 = draft animal 2 = breeding 3 = milk production 4 = meat production 5 = fertilizer 6 = others	**Changes in the amount of cattle in comparison to the last years?** 1 = no change 2 = more 3 = less	**Reason for these changes?** 1 = cow gave birth 2 = not enough feed 3 = not enough time 4 = other reasons	**Would you like to have (more) cattle?** 1 = yes 2 = no	**If yes: For what purposes would you like to use the cattle?** 1 = draft animal 2 = breeding 3 = milk production 4 = meat production 5 = fertilizer 6 = others	**If no: Why not?** 1 = no money to buy 2 = no time 3 = not enough feed 4 = don`t need (more) 5 = others

Feed production for cattle:

Does feed production play a role for your cattle rearing? 1 = yes 2 = no	**How many m² are at your disposal for pastoral purposes?**	**Where do you plant forage crops?** 1 = around fish ponds 2 = border of fields 3 = on the field (worst piece) 4 = on the field (as barriers) 5 = in the garden 6 = along the streets/ rivers 7 = other place
	m²	

Would you like to improve/increase feed production by implementing*:

	1 = yes **2 = no**	**If yes, why?** 1 = increase feed production 2 = increase soil fertility 3 = protect soil from erosion 4 = additional income from bean 5 = others	**If no, why not?** 1 = not enough area 2 = less yield 3 = competition for fertilizer 4 = hard to plough 5 = not enough labor to establish 6 = other cattle would eat it 7 = others
Grass barriers			
Legume barriers or hedgerow			
Cover crops + minimum tillage			
Relay cropping (with bean)			

*use pictures for illustration

Availability and importance of fodder plants in each month:

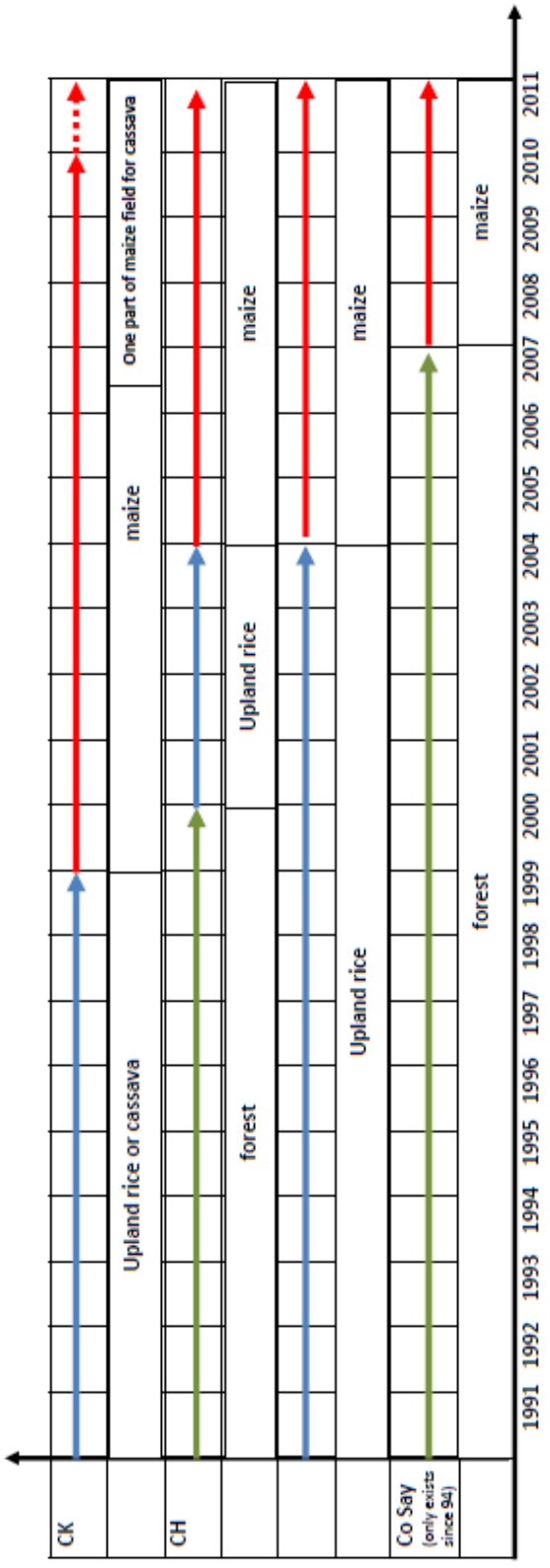
Month	January	February	March	April	May	June	July	August	September	October	November	December
Grass												
Weeds												
Maize leaves/stems												
Cassava leaves/ stems												
Banana leaves/ stems												
Rice straw												
Bamboo leaves												
Bean leaves												
Peanut												
others												

Importance of fodder plant in comparison to other plants in this month:

1 = very important in this month
2 = important in this month
3 = less important in this month

Appendix 2: Land use history

(Source: own creation on the base of interviews)



Appendix 3: Questions for group discussions during the workshop

Guideline for farmers' group

1. Opinions about the technologies presented, which benefits and constraints do you see?
2. What could be done to alleviate these constraints?
3. What would be alternative SCT that would be of interest?
4. What outside support would be necessary to get engaged in testing/practicing SCTs?
5. Do you have access to information on SCTs? Which kind of information source?
6. What do you think the quality of your soils will be like in 10 years/20 years time?
7. What do you think which crops you are going to grow in 10 years/20 years time?
8. Do you think investing in animal husbandry would be an attractive option for the future?

Guideline for extenionist group

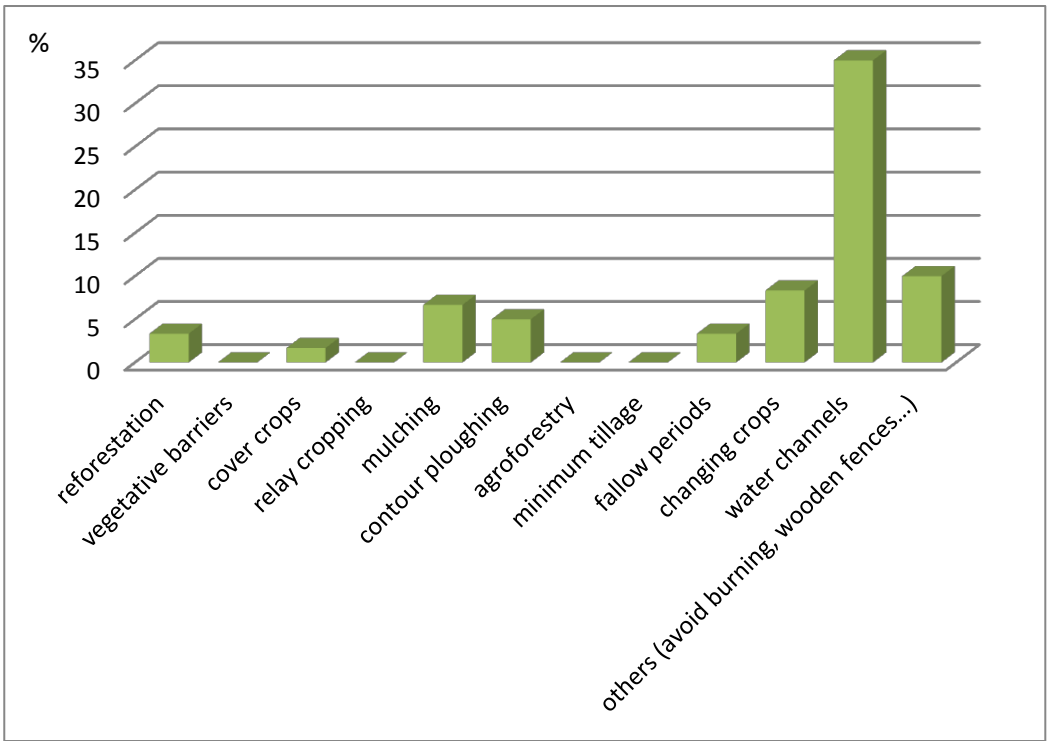
1. Opinions about the technologies presented, which benefits and constraints do you see?
2. What could be done to alleviate these constraints?
3. What would be alternative SCT that would be of interest?
4. What outside support would be necessary to get engaged in testing and disseminating SCTs?
5. What is your vision for future land use in Son La province (in 10 years/20 years)?
6. How do you assess the potential of animal husbandry in Son La province today and in the future?

Guideline for officials' groups

1. Ideas/constraints for an effective dissemination of SCTs
2. What outside support would be necessary to disseminate SCTs?
3. What is your vision for future land use in Son La province (in 10 years/20 years)?
4. How do you assess the potential of animal husbandry in Son La province today and in the future?

(Source: unofficial report on the workshop written by Dr. Alwin Keil)

Appendix 4: Soil conservation techniques applied by farmers



(Source: own data based on interviews)