FARMERS' TRAINING AND THE ADOPTION OF UPLAND AGRICULTURAL TECHNOLOGIES IN THE BLACK RIVER WATERSHED, NORTHWEST OF VIETNAM

by

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A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

2000

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona.

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ACKNOWLEDGEMENTS

As the thesis signifies graduation, it is time to thank people who helped me through time to the completion of the study in the University of Arizona.

My first thanks go to Dr. Mark Langworthy, who spent an enormous amount of time to guide me from the beginning to the end of this thesis. Without his help, I would not be able to complete my thesis. My thanks are also to Dr. Satheesh Aradhyula and Dr. George Frisvold for their invaluable advice and comments on the thesis. Extended thanks to all professors in the Department of Agricultural and Resource Economics, who gave me great academic experience during my study in the University of Arizona.

Special thank to Dr. Elke Förster, who granted me the permission to use the data from the Social Forestry Development Project (SFDP) Song Da for this thesis, without which I cannot make this thesis possible. Thanks to friends and colleagues in and outside of the SFDP Song Da, who through emails and phone contacts gave me invaluable information, data and advice to help me complete this thesis.

The most special thanks go to my parents and in-laws, who always advice and encourage me to pursuit academic goals. Friends and relatives who helped me and my family during my study in the University of Arizona also deserve my appreciation.

Extended thanks to staff and friends in and outside of the Department of Agricultural and Resource Economics, who made my life and study here an interesting and unforgettable experience.

Finally, I want to thank my dearest wife, Van Anh, for her love and support. Special thanks also to my son, Vinh. Although his habit of sitting on my lap and playing with my computer when I was studying made me go to the computer lab more often in the evening, his presence in my life and in Tucson with me made my life and my study much more meaningful.

Thank you all.

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LIST OF ABBREVIATIONS

AFES	Agricultural and Forestry Extension Station (extension agency at district level in Vietnam)
ASEAN	Association of South East Asia Nations
CAFE	Center of Agricultural and Rural Extension (extension agency at province level in Vietnam)
CTA	Chief Technical Adviser
DAFE	Department of Agricultural and Rural Extension (extension agency at national level in Vietnam)
DARD	Department of Agricultural and Rural Development (Vietnam)
DFD	Department of Forestry Development of Vietnam
FAO	Food and Agricultural Organization
FRG	Federal Republic of Germany
FURP	Fertilizer Use and Recommendations Project (Kenya)
GDP	Gross Domestic Product
GFA-Agra	German Company for Agricultural Projects
GTZ	German Agency for Technical Co-operations
HTTP	Hypertext Transfer Protocol
IMF	International Monetary Fund
MARD	Ministry of Agricultural and Rural Development of Vietnam
MW	Megawatt
NSC	National (Vietnamese) Steering Committee
ODA	Official Development Assistance
OLS	Ordinary Least Squared
PPR	Project Progress Review
SDW	Song Da (Black River) Watershed
SFDP Song Da	Social Forestry Development Project Song Da
sq.m	Squared meter

SRV	Socialist Republic of Vietnam
UN	United Nations
UNDP	United Nations Development Program
USD	US Dollar
VND	Vietnamese Dong

ABSTRACT

This thesis aims to study the adoption of maize-related technologies in the Northwest of Vietnam. The study covers both sustainable and yield-enhancing technologies. A major hypothesis is to test the effects of training on adoption rate and farm yield. Previous literature shows that farmers' education and training are important in the adoption of new technologies, particularly with sustainable technologies.

Three models are used: the training model, the adoption model, and the yield model. Findings show that farmers with and without training as well as adopters and non-adopters of new technologies are insignificantly different. Training has positive correlation with the adoption of new technologies but shows insignificant effects on yield. Farmers in the studied area do not adopt new technologies as a package. Adoption of improved maize unambiguously increases the yield. However, the adoption of other technologies shows insignificant effects. Future studies need to take into account factors like the time when a household started with each technology, the education level of the household head, and the area of land under each technology.

CHAPTER 1: INTRODUCTION

Agricultural development has been proven to be critically important in the process of development. As many other developing countries, Vietnam is aware of this important role of the agricultural sector. Vietnam has been trying to improve its agricultural productivity and regards it as an important step toward the national economic stabilization and development. The 1990s have experienced considerable changes in Vietnamese agricultural sector. One of the most notable changes is the success of the Vietnamese agricultural sector to sufficiently meet the domestic rice demand and to become one of the world leading rice exporting countries in the 90s (World Bank 1999; Vietnam Embassy 2000).

The changes in agricultural sector in Vietnam are attributed to the national economic reform policy, known as the *Doi moi* policy, and the agricultural sector reform. The *Doi moi* policy, initiated in mid 80s, has supported the growth of productivity in both agricultural and non-agricultural sectors. The reform of the agricultural sector started in 1981 with the Directive No 100 CT/TW. It was consolidated in 1988 by the Resolution No.10 NQ/TW in which farm households are recognized as the main units of agricultural production, are independent in making their own decisions about purchase of farm inputs and sale of outputs (World Bank 2000b; Pingali and Vo 1992). The Land Law 1993 and its revised versions in 1998 and 2000 provide security in land use rights for farmers for 20 years for rice and annual crops production and 50 years for perennial crops (Vietnam 1993b).

However, not all the regions in Vietnam have experienced the same growth in food production. While the Red River delta in the North and the Mekong River delta in the South are the main rice producing regions of the country, other areas have not been able to keep pace with these two regions in terms of rice production. In fact, in the mountain area in Northwest of Vietnam, where the lower watershed of the Black River (Song Da) is situated, people are still facing many problems in improving their food production. For many years, there have been less national and international projects and programs implemented in this region than in the other parts of Vietnam. The main reasons are its geographical isolation and poor transportation and communication systems.

Since late 80s, the Northwest region has been given more concentration by the Government of Vietnam. This can be seen by the presence of more national and international development projects/ programs in the area. One of which is the Social Forestry Development Project (SFDP) Song Da, a bilateral technical co-operation project between Vietnam and Germany. The SFDP Song Da has been working since 1993 in the two provinces: Son La and Lai Chau of the Northwest region. The ultimate goal of the SFDP Song Da is to contribute to the integration of local economy into the national stream of economic development by introducing more sustainable (and economically profitable) land use practices (SFDP Song Da 1998).

In its baseline studies conducted in 1993-1994, the SFDP Song Da found out that the current land uses in the Song Da (Black River) watershed were not sustainable. Based

on these findings, a development strategy has been developed and carried out, aiming to achieve sustainable uses of land in the area and to help poor farmers increase their well-being. As part of its strategy, over the last couple of years, the SFDP Song Da has been working with the local (i.e. district level) extension service in Yen Chau district of Son La province and Tua Chua district of Lai Chau province in promoting the modern farming technologies to local farmers.

In this thesis, I am going to analyze the data collected by the SFDP Song Da from participating farmers as part of their project impact monitoring and evaluation work. The purpose of my analysis is to test the following hypotheses:

1. **What effects does training have on the adoption of new technologies and farm yield?** The idea of technical assistance from the SFDP Song Da and local extension services is to enable farmers to increase their production through technical assistance. It is believed that modern technologies (including new and improved seeds) have advantages over the traditional techniques, provided that the formers are rightly applied, i.e. according to the standard technical procedures. The SFDP Song Da has, therefore, been providing some basic training to selected groups of participating farmers in the related techniques. It is hypothesized that training has a positive relationship with the adoption of new technologies and the increase of yield in farm production. In other words, the group of farmers that receive training in the promoted technologies may be more likely to adopt the promoted technologies and have higher yield than the group of farmers that do not have any training.

2. **What effects does adoption of new technologies have on farm yield?** The thesis looks at the adoption of both yield-enhancing technologies as well as sustainable technologies. Since it is widely known that adoption of yield-enhancing technologies increases the farm yield while the adoption of sustainable technologies may reduce the yield in the short-run, it is hypothesized that the relationship between adoption of new technologies and the increase of farm yield is positive for yield-enhancing technologies and negative for sustainable technologies. However, it is expected that complementarity among the studied technologies exist. Thus, in general farmer who adopts both yield-enhancing and sustainable technologies has significant increase in yield.

3. **What are the effects of technical assistance?** It is hypothesized that a relationship between the prevalence of extension service (and the SFDP project involvement) and the yield of the farm production in general exists. Through direct contact to local farmers, extension services are expected to help increase farm production. It is assumed that farmers who generally have contact to the technical assistance are more likely to have higher farm yield than farmers who do not.

The collected data is preliminary as there are only 70 households covered in the study. Nevertheless, it is believed that the available data be able to show the hypothesized relationships. It is also noted that under the light of the land allocation policy, it is assumed that all farmers have equal access to land use security on the farmed land they have.

It is also necessary to mention that beside the original purpose to serve as a partial fulfillment for my Master of Science degree in Agriculture and Resource Economics in the University of Arizona this thesis is also expected to be a contribution to improve the Impact Monitoring system by the SFDP Song Da. As a team member from the beginning of the project until May 1999, of which two years as the project planning, monitoring and evaluation official, I would like to make this thesis as a practical consultancy report to the SFDP Song Da to improve its activity monitoring and evaluation system.

The thesis proceeds as follows: in the next chapter, I will introduce a brief background to Vietnam's economic reform, the *Doi moi* policy, the agricultural reform and their effects on the domestic products. Chapter Three discusses in details the institution analysis of the SFDP Song Da and the local extension services. The thesis then continues with the review of related literature in chapter Four, followed by a description of the data set, which is used for the hypothesis testing, in chapter Five. In chapter Six, I will present my theoretical models, the analytical work on the available set of data to test my hypotheses and the discussion on the estimation results. The thesis is concluded in chapter Seven with brief summary of the study and my conclusions and recommendations.

CHAPTER 2: BACKGROUND TO THE ECONOMIC AND AGRICULTURAL GROWTH IN VIETNAM

2.1 Introduction

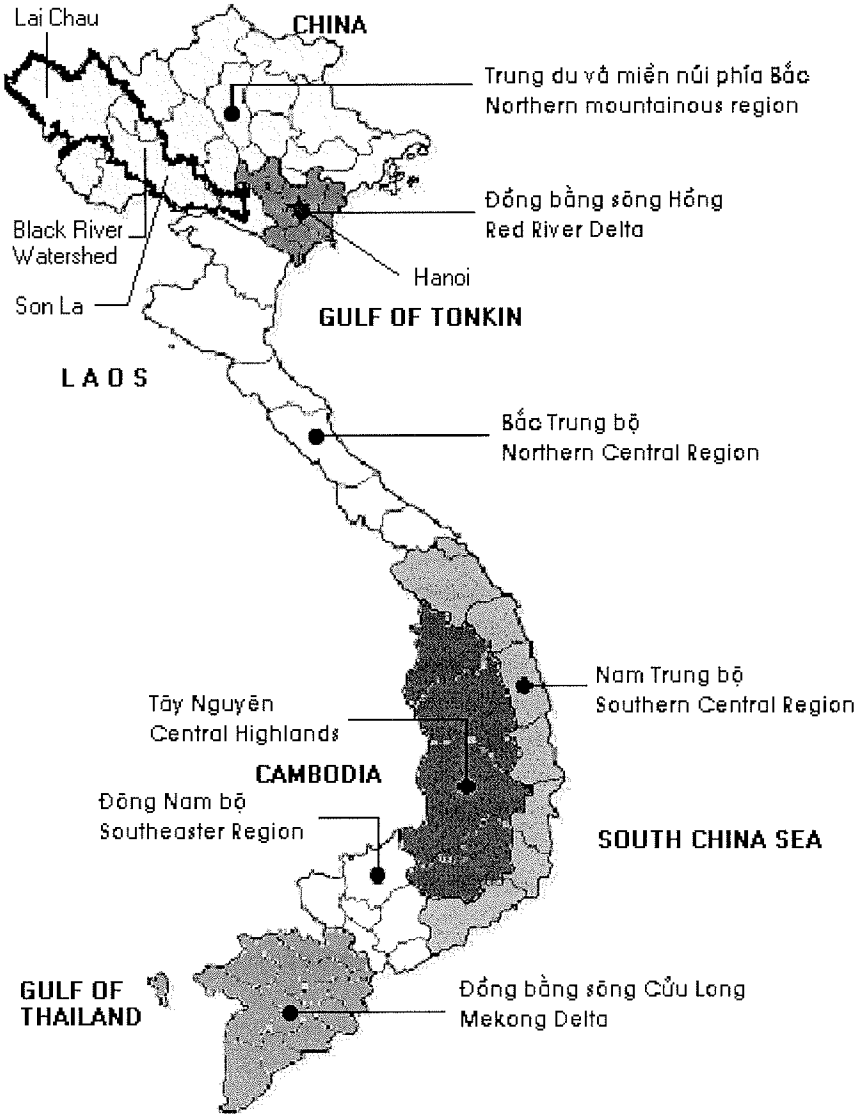
Vietnam is located in the Indochina peninsula, Southeast of Asia. Its territory stretches in an S shape along the coast of Gulf of Tonkin and South China Sea, from 8°30N to 23°22N latitude and from 102°10E to 109°21E longitude. Vietnam shares borders with China in the North and Laos and Cambodia in the West. It faces the Gulf of Thailand in the Southwest and Gulf of Tonkin and South China Sea in the East and Southeast (See Figure 2.1 on page 17).

According to the most recent census in April 1999, the total population of Vietnam is 76,328 thousand people. Of which, 58,409 thousand people, about 76.5% of the total population, are living in rural areas (World Bank 1999). The average population density is around 235 people per squared kilometer. However, the distribution is highly variable with the most densely populated areas being the municipal cities and the provincial centers. There are 54 different ethnic groups living in Vietnam. The largest group, the Kinh (Viet), makes up 87 % of the total population and is living mainly in the lowland and coastal area. The other 53 ethnic groups are over 8 million people and are living in mountain and hilly areas of about two third of the country's territory (Vietnam Embassy 2000).

Vietnam is divided into seven economic zones. The two most economically important regions are the Red River and Mekong River deltas. The least developed

regions are the Northern mountainous area, North Central region and the Central high land. Figure 2.1 shows the map of Vietnam, the locations of the seven economic zones and the Black River watershed.

Figure 2.1: Vietnam: Seven Economic Zones and the Black River Watershed



Source: Vietnam Economic Information Network, available HTTP: <http://www.vneconomy.com.vn/en/basic_data/map>, with author's addition.

Vietnam is a poor country with the average GDP per capita of USD145 in 1992 and USD376 in 1999 (United Nations 2000). According to the standard set by Ministry of Labor, Invalids and Social Affairs (MOLISA) of Vietnam, by 1999 about 12.5 million people, 15.7% of the total population, are living in poverty (United Nations 1999). The poverty distribution is not equal all over the country. According to United Nations common country assessment, the Northern Mountainous region is the poorest part of the country with about 58.6% of the regional population living in poverty during 1997/1998 (United Nations 1999). However, Vietnam has high level of literacy compared to other developing countries. By 1998, the literacy rate among the population of 15 years of age and older is 92% nationwide, with literacy rate of 91% for female and 95% for male (United Nations 1999).

2.2 The Economic Reform Policy and Its Effects

2.2.1 Summary of Vietnamese Economy before the Economic Reform

Vietnam declared its independence in September 1945. In the three decades that followed, the Vietnamese economy was characterized by the war-time economic policy. The first nine years after the independence, the country was still at the war. By 1954, Vietnam was divided into the North and the South. In the North, starting from 1958, the government adopted a socialist centralized-economy and nationalized all means of production. A system of product distribution by norm payment and budget subsidies through coupons was carried out. In the South, starting from 1954, the economy was oriented towards market model (Vietnam Embassy 2000).

Vietnam's economy changed to a new stage in 1975 after the war ended. In 1976, Vietnam formally became a unified country. It was expected that Vietnam's economy start to grow after the end of the war. However, the economic performance of Vietnam in the years after re-unification was not satisfactory. Most of the planned targets for the five-year plan of 1976 -1980 were not achieved. During this period, production was standstill and annual growth rate was only 0.4% versus the planned 13-14% (Vietnam Embassy 2000). On the other hand, the population growth rate was more than 2.3% per year. As a consequence, Vietnam remained a major food importing country. In 1980, for instance, it had to import 1,576 thousand tons of food to meet the domestic food demand. Budget deficit was large. Inflation rate was around 20% a year. The trade deficit was substantial with imports of 4 to 5 times more than exports (Vietnam Embassy 2000).

In the following five years (i.e. 1981-1986), the economic situation was still problematic with continuous imbalances. Production was stagnant in all sectors. Inflation went up from super-inflation of 30-50% per year in early 80s to hyper-inflation of 587.2% in 1985. The worst point of the hyper-inflation level in Vietnam was reached in 1986 at 774.7% (Vietnam Embassy 2000; Ryan and Wandel 1996). Vietnam was facing a serious economic crisis.

2.2.2 The Economic Reform and Its Effects on the Face of the Economy

Vietnam started its economic reform, known as the *Doi moi* policy, in December 1986. The policy's major points were to shift the economy to a socialist-oriented market

economy, to develop an open, diversified and multi-sector economy, and to reform the state administrative system (Vietnam Embassy 2000).

The *Doi moi* has been quite effective in improving the economic situation and living standard. The reform, first of all, focuses on the improvement of the administration system and the legal framework. In the first several years after the *Doi moi* was launched, a large number of resolutions and decisions in various fields, such as economic management, monetary and agriculture, were issued with the aim to improve the situation. Gross domestic products (GDP) increased by 3.9% on average for the five-year period of 1986-1990. Inflation was brought under control from high three digit level in 1986 to low two digits and one digit in mid and end of 90s (Vietnam Embassy 2000). Table 2.1 shows the inflation rate in Vietnam in pre and post reform years:

Table 2.1: Annual Inflation Rate in Vietnam in Selected Years

Year	Inflation rate	Year	Inflation rate
1976-1980	20%*	1992	17.5%
1985	587.2%	1993	5.2%
1986	774.7%	1994	14.4%
1987	223.1%	1995	12.7%
1988	393.5%	1996	4.5%
1989	34.7%	1997	3.6%
1990	67.4%	1998	9.2%
1991	67.5%	1999	0.1%**

Sources: Vietnam General Statistics Department, IMF, UNDP and World Bank.

Note: *: figure is the average of the period. **: figure is the official estimation

The economic reform in Vietnam was strengthened in June 1991. During the five-year period of 1991-1995, Vietnam had a substantial growth in GDP. On average, GDP increased by 8.2% per annual during this period. One decade after the peak of the economic crisis in 1985-1986, GDP growth rates of Vietnam reached the record at 9.5% and 9.3 in 1995 and 1996, respectively. Table 2.2 shows the per-annual GDP growth of Vietnam in the 1990s:

Table 2.2: Total GDP and GDP Growth Rate in Vietnam in the 90s

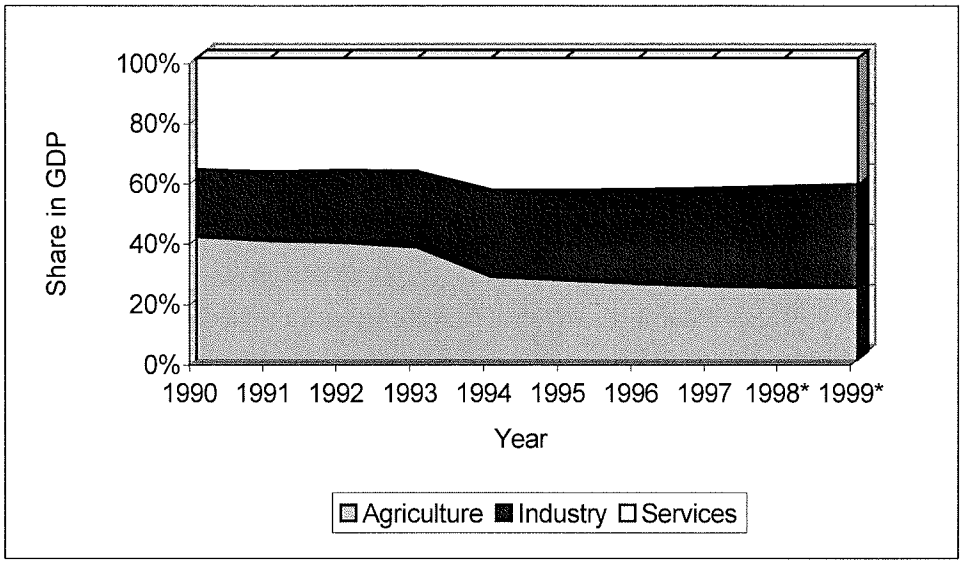
Year	**GDP at current price** (Bil. VND)	**GDP growth rate** (%)
1990	41,955	5.1
1991	76,707	6.0
1992	110,535	8.6
1993	140,258	8.1
1994	178,534	8.8
1995	228,892	9.5
1996	272,036	9.3
1997	313,623	8.1
1998	368,690	5.8
1999	399,942	4.7
Average growth rate from 1991 to 1995:		**8.2**
Average growth rate from 1990 to 1999:		**7.7**

Sources: UNDP, IMF and Vietnam General Statistical Department with author's computation
Note: See Appendix J for the exchange rates.

The economic reform has also altered the economic structure of the country. Agricultural production grew at high rate of average 4% per annual during the 90s but the share of agriculture in national income decreased. Statistical data shows that the share of

agricultural output in the national GDP went down from 40.6% in 1990 to 24.2% in 1997 while the shares of both service and industrial sectors have increased over this time period (International Monetary Fund 1999; United Nations 2000). These are the indicators that Vietnamese economy is becoming more diversified. Figure 2.2 shows the shares of main economic sectors in the Vietnamese economy:

Figure 2.2: Share of GDP by Economic Sectors in Vietnam: 1990-1999



Source: Adapted from United Nations –United Nations Development Program– "Vietnam: Socio-Economic Statistical Bulletin" (2000) Chart 1.2

*: data is official estimation

In international economic relations, Vietnam has normalized relations with all countries and important economic-political centers in the world. By the end of 1996, Vietnam had official economic-commercial relations with more than 120 countries (Vietnam Embassy 2000). In addition, starting from July 1995, Vietnam became an official member of the Association of South East Asia Nations (ASEAN). As a result of the open-door policy, a total number of USD 8.53 billion of official development

assistance (ODA) was received by Vietnam between 1994 and 1997. In addition, foreign investment to Vietnam during 1988-1996 accounted for USD 26,976 million (Vietnam Embassy 2000). Vietnam has opened its economy to foreign investors.

However, Vietnam is still a poor country. According to World Bank (2000a), Vietnam's GDP per capita in 1999 is USD 370, compared to USD 410 of the low income group. The GDP growth rate of Vietnam was high in the early and mid 90s but slowed down in 1998 and 1999 (see Table 2.2 on page 21). On the other hand, the economic growth has started from a low base. Thus, though vigorous growth rates were recorded in the beginning and mid 1990s, the per capita GDP of Vietnam is still as low as USD 370 in 1999 (World Bank 2000a). The banking sector is not able to keep pace with the growth in the economy. In addition, the reforms in legal and administrative systems, which have been the focus of the *Doi moi* policy since the beginning, are still incomplete. For a take-off of the economy, Vietnam needs a comprehensive reform in all the production, service and administration systems.

To summarize, the economic situation in Vietnam in the early and mid 80s was dramatic. The economic reform launched by the end of 1986 has efficiently eradicated the economic crisis and has revitalized the national economy. However, what was achieved from the reform is just the beginning. Vietnam needs to maintain the rigorous growth rate and to strengthen the reforms in all sectors in the economy in order to catch up with the well-performing neighbors.

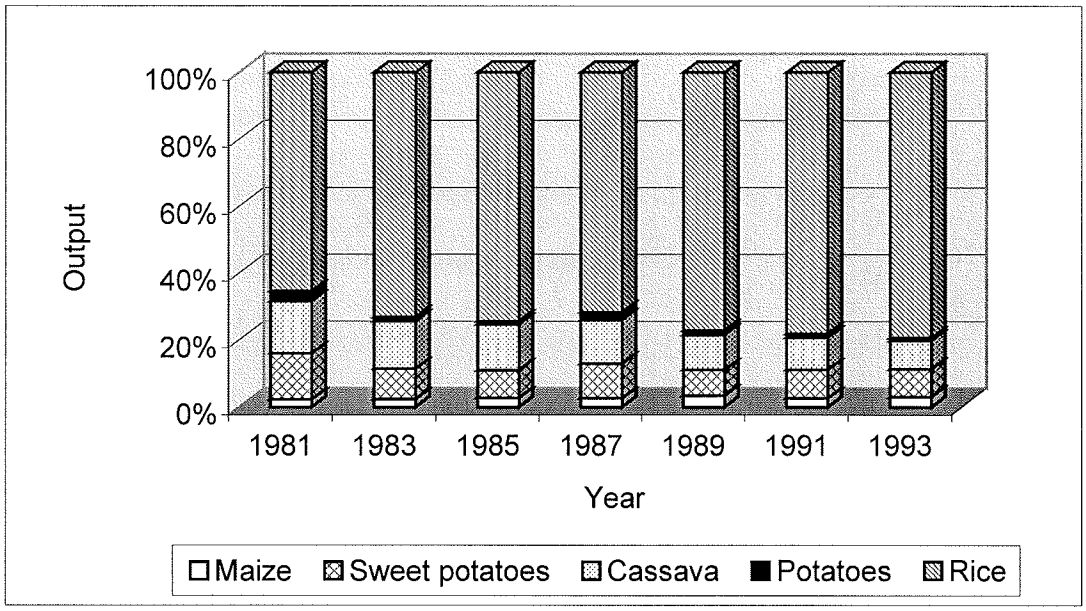
2.3 The Reform in Agricultural Sector of Vietnam

2.3.1 Background to Agricultural Situation in Vietnam

After the French war ended in 1954, Vietnam set up an agricultural production system based on collective ownership and management. According to Pingali and Vo (1992), the system started during 1956-1958 in the North with the establishment of work-exchange team, a simple form of agricultural collectivization where farmers still kept their land and equipment but were organized in seasonal or permanent working team. Then, the working team system developed to low rank cooperatives (1958-1960), a system in which farmers also kept their own land, traction animals and equipment but farmed according to the general plan of the cooperative, and to high rank cooperatives (1960-1972), where all land and farm instruments were put under cooperative properties and farmers worked under a unified management (Pingali and Vo 1992). In the South, the collectivization could only start as early as 1976, one year after the war ended.

Vietnam has a total of about 8.2 million ha of cultivated land, around 25% of the country's total land size. The average agricultural land size per farm household is quite low at 0.5ha (Ryan and Wandel 1996). This is among the lowest farm size in the developing world. The main crop is rice, which accounts for a major share of the total food production. Other food crops, including maize, potato, sweet potato and cassava, contribute a minor share in the total food production. Figure 2.3 illustrates the share of food production by major food crops in Vietnam in selected years.

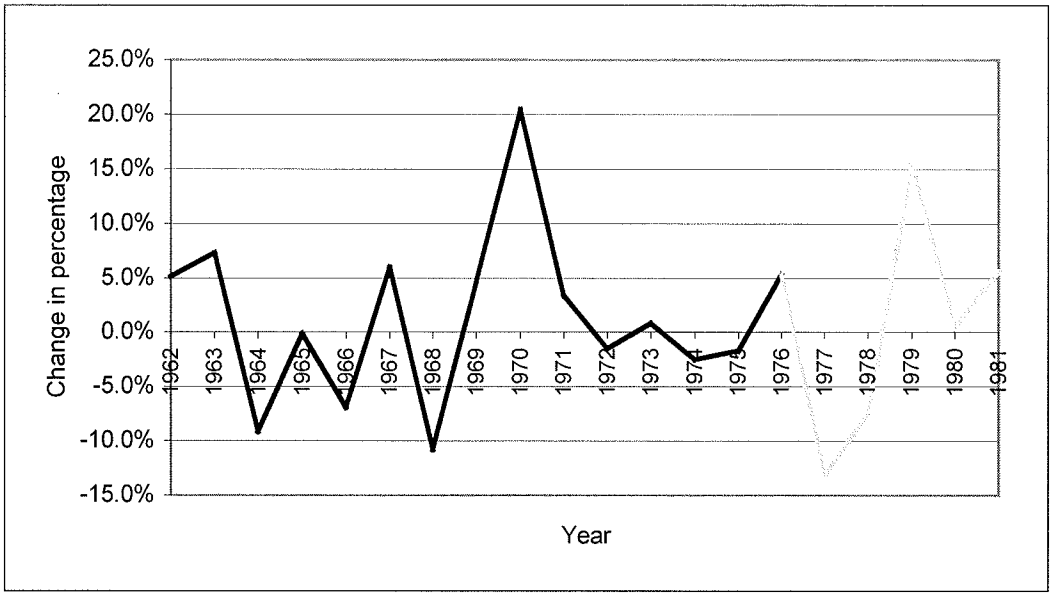
Figure 2.3: Share in Outputs of Major Food Crops



Source: Vietnam Statistical Yearbook 1994.

However, rice production is not very stable. From mid 60s, agricultural production started to experience decreases in rice yield in some years. According to on-line statistical data from Food and Agriculture Organization (FAO), the average growth in yield of rice, the most important crop of the country, between 1962-1975 was only 1.1% per year with negative growth in seven out of fourteen years (FAO 2000). During the post war period of 1976-1981, the situation turned out to be more dramatic. Agricultural production was stagnant in the whole country. Though negative growth in rice yield was observed in only in two out of six years, the rice yield at nationwide grew as low as 1% per year. Vietnam was a major food importer during this period.

Figure 2.4: Growth of Rice Yield in Vietnam during 1962-1981



Source: FAO on-line statistics with author's computation

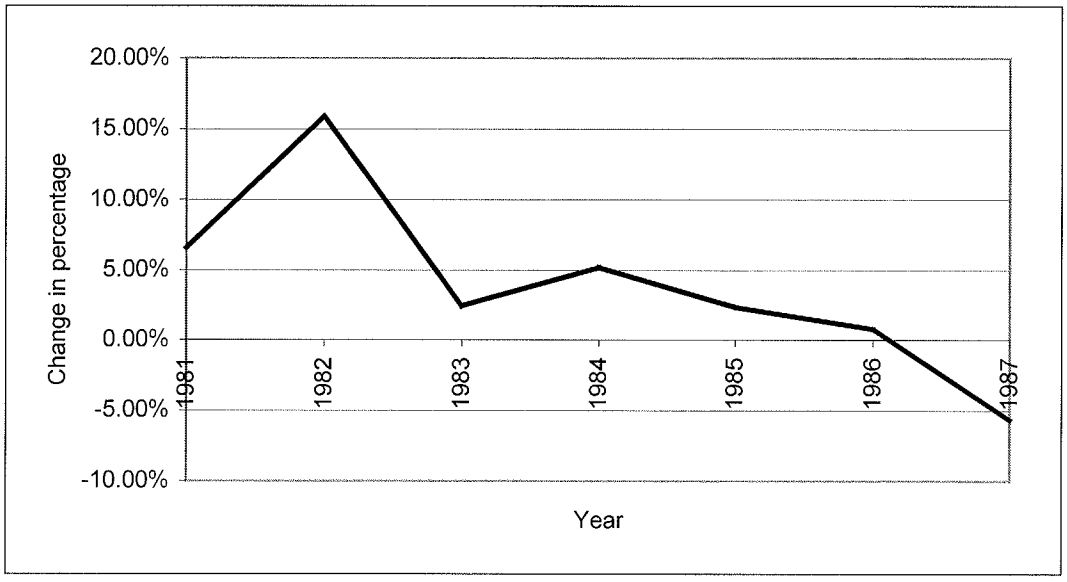
Figure 2.4 illustrates the growth in rice yield during 1962-1981. As shown in the chart, almost half of the time the growth in rice yield is negative. The worst year was 1977 when the yield was 13% less than that of the previous year. Vietnam definitely needed a change in the agricultural sector if it wanted to change the economic situation.

2.3.2 The Agricultural Reform

The agricultural reform in Vietnam actually started before the *Doi moi* policy. In January 1981, Vietnam made a breakthrough in agricultural sector by introducing an individual-oriented contract-based system, the Directive No 100 CT/TW, into the agricultural production. The new system enabled individual farm households to cultivate more independently and to be responsible for providing the contracted amount of output to the state (Pingali and Vo 1992; Vietnam 1981).

The initial reform had some effects on the agricultural production. According to FAO on-line statistical data, rice yield growth in the period from 1982 - 1987 was at an average of 3.66% per year, the highest growth rate since 1960. However, the growth was unstable and occurred mainly in the first year after the Directive No 100 CT/TW was stated. After 1982, the country again experienced a continual decrease in rice yield growth rate from year to year and back to negative rate in 1987. Vietnam was still a food importing country, though the import volume was less than during the war period. In 1988, Vietnam had to import 450 thousand tones of food to meet the insufficient domestic food supply (Vietnam Embassy 2000). Figure 2.5 shows the growth in rice yield between 1981-1987:

Figure 2.5: Growth of Rice Yield in Vietnam during 1981-1987



Sources: FAO on-line statistics and VN Statistical Yearbook 1994 with author's computation

The reasons that the contract system did not function as expected are manifold. These include top down planning approach in production, frequent failure of the state to

buy all the contracted products from farmers during the harvest time due to financial deficit, and lack of security in land tenure resulting in insufficient investments at farm level (Pingali and Vo 1992).

In 1986 and 1987, Vietnam tried to consolidate the agricultural reform but the real push to the reform was made by the promulgation of Resolution No 10 NQ/TW in 1988. The new regulation places farm household in the center of the economic activities. Households are regarded as independent production units (Vietnam 1988). This resolution is followed by a number of legal documents. Particularly important is the 1993 Law on Land, which provides farmers the rights to transfer, inherit, mortgage, exchange and rent the land use title. It also gives farmers security for long-term land tenure of 20 years for annual crops and 50 years for perennial trees/crops. In addition, farmer can apply for reallocation of the land at the end of the tenure period provided that the land has been properly used (Vietnam 1993b). The Law on Land was revised in 1998 and 2000 with the aim to provide better conditions for people to invest in the long run.

The new legal framework has had significant impacts on the agricultural production of the country. Between 1991 and 1997, the country experienced an average annual growth rate of 5% in the agricultural sector (13% and 10% of growth rates in industrial and service sectors in the same period, respectively) (World Bank 2000b). The most notable achievement in agricultural sector during this period is the growth in rice and coffee production. In 1989, for the first time Vietnam was able to not only produce enough to meet the domestic demand for rice but also to have a surplus of around one

million tons of rice for export. In 1990, Vietnam increased its rice export volume and became the third world leading rice exporting country after the US and Thailand. By 1997, Vietnam surpassed Thailand in rice export and became the second largest rice exporter. Table 2.3 shows the volumes of rice export from Vietnam since 1989.

Table 2.3: Export Volume of Rice of Vietnam

Year	Export volume (ton)	Year	Export volume (ton)
1989	1,048,100	1995	2,308,200
1990	1,624,000	1996	3,123,000
1991	1,033,000	1997	3,550,000
1992	1,946,190	1998	3,748,766
1993	1,722,000	1999	4,508,000
1994	2,222,300		

Source: FAO on-line statistics, UNDP, Vietnam General Statistic Department.

In addition, Vietnam also became a major exporter of coffee during the 90s. In 1997, coffee output was over 400 thousand tons, 32 times of the 1985 output. Also in 1997, Vietnam became the top coffee exporter in the region and the fourth in the world. Vietnam has the coffee yield of 1.5 ton per ha compared to the world average yield of 0.5 ton (Economist Intelligence Unit 1998).

Although Vietnam experienced the high growth in agricultural output during the early and mid 1990s thanks to the agricultural reform policy, the growth started to slow down in 1998 with the annual growth in agricultural production of 2.8% (World Bank 1999). In addition, the food situation is not the same in different parts of the country.

While the Red River and Mekong River deltas with 45% of the national agricultural land produce more than 60% of the country's total rice production and are the main sources for Vietnam's export of rice, other regions, such as the mountainous Northwest, are still facing problem of food insecurity. Beside the goal to increase the export quantity of rice, Vietnam needs also to achieve an important goal in eradicating the hunger and poverty in the whole country. For this task, the Northern mountainous area of the country, the least developed part of the country, is given high consideration.

To conclude, Vietnam's agricultural sector went through major changes in its "green revolution" during the 80s and 90s. From a low starting point as a food importing country, reforms in agricultural production began in 1981 and the consolidation of reforms in 1988 have tremendously improved agricultural production. The reforms in Vietnamese agricultural sector have helped to boost the growth in other sectors of the economy as well. Nevertheless, the country's agricultural reform still has a long way to go in improving the agricultural productivity in different regions of the country.

2.4 Conclusion

Vietnam is a small, S-shaped country in the South East Asia with a high population density and small size of arable land per farm household. It is a poor country with low per capita GDP and high number of people living under the poverty line. However, the literacy rate of Vietnamese ranks pretty high among the developing countries.

The economic situation in Vietnam from mid 70s mid 80s was ominous. Super and hyper-inflation and slow economic growth had pushed the economy into a crisis by mid 80s. By 1986, Vietnam was in the situation of "to reform or not to reform" the economy when the economic crisis was at the peak and the inflation rate was at 774.7% per year.

The *Doi moi*, economic reform, policy launched in December 1986 is known as a bold action of Vietnam in dealing with the economic crisis. In the circumstance where economic reforms in most of the socialist countries face failure, the *Doi moi* policy in Vietnam has proved to be one of the successful steps that Vietnam took to cope with the economic problems and to revitalize the economy.

The reform in agricultural sector of Vietnam was initiated in 1981, which, to a certain extent, helped improve the agricultural productivity in the following year. However, it was only after the agricultural reform was strengthened in 1988 that the agriculture really started to grow. From a food importing country in 1988 and before, Vietnam has become a major rice exporting country in the world in the 90s.

However, the *Doi moi* policy and the agricultural reform in Vietnam still need to be further advanced. Though the economic and agricultural growth rates are at the records during the 90s, the country is still a poor country. On the other hand, as Vietnam began from a low starting point, the high economic growth rate during the 90s is not sufficient to help the country keep pace with its higher-income neighbors. In the agricultural sector, the land productivity is not the same in all regions of the country.

While the low land areas make major contribution to the country's export volume of food, the high land and mountainous regions of the country still face the food self-sufficiency problem. Vietnam needs to maintain its strong development in agricultural sector in order to increase the export quantities and the food securities within the country.

CHAPTER 3: THE SFDP SONG DA AND THE LOCAL EXTENSION SYSTEM

3.1 Introduction

Although Vietnam has experienced substantial growth in agriculture, production patterns and potentials are diverse in different regions of the country. The main sources of supplies for domestic food needs and export come from the two major river deltas, Red River and Mekong River deltas, which contribute over 60% of the national rice production, and the other flat land areas. Other regions, particularly the hilly and mountainous area in the Northwest of the country, are far behind the national levels in food crop production.

The Northwest region of Vietnam is characterized by hills and mountains and strongly dissected topography. The most important part of the Northwest region is the lower Song Da (Black River) watershed[1]. The Song Da Watershed (SDW) covers the territory of twenty-four districts in five provinces[2] but the most important part of the watershed is located in the provinces of Son La and Lai Chau. The SDW covers an area of approximately 2.6 million hectares and is home for around 1 million people (Van der Poel and Nguyen 1993). The total agricultural area in the SDW is 150,373 ha, about 5.77% of the total area. The irrigated paddy land is 48,032 ha, approximately 1.84% of the total land size (Van der Poel and Nguyen 1993). The population in the SDW is from

[1] The upper watershed of the Black river is located cross-border in China. The term Song Da (or Black river) watershed hereafter refers to the part of the watershed located in Vietnam territory.

[2] The five provinces are: Son La, Lai Chau, Lao Cai, Yen Bai and Hoa Binh.

23 different ethnic groups. The largest group, the Thai, makes up 42.1% of the region population, then followed by the Kinh (17.9%), H'mong (17.5%), Muong (9.5%) and Dao (4.8%). These five ethnic groups together comprise 91.8% of the whole population (Van der Poel and Nguyen 1993).

The road system in the SDW is poorly developed. The only road through the whole region is the National Road No 6, which is prone to destruction in the rainy season. Another transportation system is via the Hoa binh reservoir, which starts from Hoa Binh dam and goes as far as 240km into the region. However, this water-way is only convenient for the areas in the close vicinity. The road system from provincial and district centers to the reservoir is still under improvement. Since mid 90's Son La and Lai Chau provinces are accessible by air with two airports in Dien Bien Phu of Lai Chau[3] province and Na San of Son La province. However, the air routes mainly serve as passenger transport.

Despite the poor access, the SDW plays an important role in the national economy. The region is the upstream of the biggest power plant in South East Asia, the Hoa Binh Hydro Power Plant, which has a designed capacity of 1920MW and is the major source of energy for the whole country. Since the completion of the Hoa Binh Hydro Power Plant, the region has been given considerable attention for its critical role in watershed protection of this important installation (Van der Poel and Nguyen 1993).

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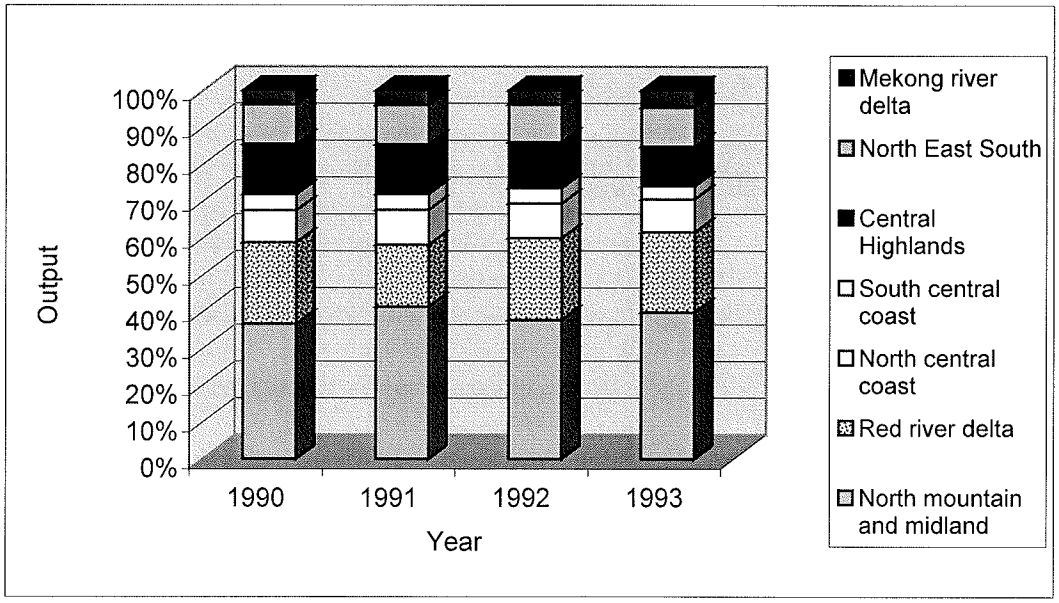
[3] Dien Bien Phu is the capital city of Lai Chai province. However, it is not located in the SDW.

However, the economic situation of the SDW is behind the national average. For many years, the SDW has been among the poorest parts of the country. While the national GDP per capita was around 200 USD in 1992, the region had a per capita GDP of only 40 USD[4] (Van der Poel and Nguyen 1993).

Food crop production plays an important role in the region's economy. Major food crops include maize, rice and cassava. Maize is cultivated on a large area of land in the region. Figure 3.1 below illustrates the maize production of Vietnam by different economic regions in selected years.

Figure 3.1: Maize Production by Economic Regions



Source: Vietnam Statistical Yearbook 1994

[4] There is difference in GDP per capita reported by different sources; these figures are only for relative comparison.

One of the important issues in the SDW is to improve the agricultural productivity while the sustainable use of natural resources within the watershed is maintained. Absence or lack of necessary soil conservation measures in the traditional upland farming practices of the local dwellers has led to soil degradation and reduction in agricultural productivity. It is clear that if the situation continues in the same way, it will not be very long before the resources become exhausted.

3.2 The Social Forestry Development Project (SFDP) Song Da

The SFDP Song Da initiated in May 1993 and is intended to continue for a total of 10-12 years. It is the first bilateral technical co-operation project in the field of forestry between the Socialist Republic of Vietnam (SRV) and the Federal Republic of Germany (FRG). From the Vietnamese side, the Ministry of Agriculture and Rural Development (MARD) is responsible to its government for the implementation. The Vietnamese executing agency is the Department of Forestry Development (DFD) with the DFD's Director being the SFDP national project director. From the German side, the German Agency for Technical Co-operation (GTZ) is responsible to its government for the implementation. The German executing agency of the project is the German Company for Agricultural Projects (GFA-Agra) (SFDP Song Da 1999; Vietnam [1998]). The highest body of SFDP Song Da from the Vietnamese side is the National Steering Committee (NSC), which is chaired by the Vice-Minister of the MARD and is participated by representatives from concerned ministries, provinces and institutions. The

NSC meets biannually to discuss the project activities and its plan of operations (SFDP Song Da 1999).

According to the SFDP Song Da's annual plan of operations (APO) for 2000, the current organization of SFDP Song Da is as followed. The National Project Director or NPD, who is the director of the Department of Forestry Development of Vietnam, and the German Chief Technical Advisor (CTA) are partners in the management of the project. The project is divided in three levels with the head office located in Hanoi, whose function is to coordinate with the national/ international level offices and institutions. The regional office is based in Son La town of Son La province, 320km Northwest of Hanoi. The role of the regional office is to maintain and make the provincial level contacts and to co-ordinate the activities of the two project districts. At the district level, there is one field office in each district led by the district coordinator. The field offices are where the coordination of field activities takes place. At each level, the SFDP Song Da offices have close contact to the concerned institutions and authorities, i.e. the local administration and the agricultural and forestry related institutions. The project has six national long-term experts in the fields of agriculture, forestry, planning, land allocation and training, whose duty station is in the Son La regional office. There are three expatriate experts working in the fields of forestry, training and agricultural economics. The agricultural economist is the project CTA. District level staffs are seconded from the local forestry, agriculture and extension offices (SFDP Song Da 1999).

The SFDP Song Da started with a two-year orientation phase from May 1993 to March 1995. This period served as the project design phase, since the SFDP Song Da is the first bilateral project between the two countries in this field. The intended 10-12 years of the project life is phased in 4 different periods. The first two years of the project orientation were followed by a four-year Implementation Phase I, which was from April 1995 to December 1998. The Implementation Phase II is scheduled from January 1999 to December 2001. The last two years are for handing-over and following-up. The continuation of the project from one phase to another is conditional upon the performance of the project and the recommendations from the Project Progress Review (PPR) team, which consists of independent consultants appointed by the two sides.

The goal of the project is stated as: "The living conditions of the local population in the Song Da region are improved in accord with a stabilization of the ecology" (SFDP Song Da 1998, p.1). The project purpose for the Implementation Phase I is: "Methodology for sustainable natural resources management by local communities is developed and implemented." (Kaiser 1997, p.1) and for the Implementation Phase II: "(Rural) communities in Son La and Lai Chau provinces manage their natural resources in an ecologically, economically and socially sustainable way." (SFDP Song Da 1998, p.1). As shown by the project goal and purposes, the SFDP Song Da aims to improve the living standard of the local population in the SDW by testing and introducing more sustainable land use practices.

The SFDP Song Da works in the following fields of activities: 1) Land use planning and land allocation, 2) development of forestry and agricultural technical options, 3) agro-forestry extension, 4) village development planning, and 5) training (SFDP Song Da 1998). In the first implementation phase (1995-1998) the task of the SFDP Song Da is to set up the methodological frameworks in the above mentioned fields of activities. The Implementation Phase II that follows from 1999-2001 expands the activities based on the developed methodologies.

Although the name implies the activity coverage of the whole SDW, the SFDP Song Da project area initially covers two districts (out of twenty-four) in two major provinces of the SDW. Yen Chau district of Son La province was selected as the representative of the Thai's upland farming system while Tua Chua district in Lai Chau province represents the farming practices of the H'mong people. Yen Chau is rather accessible even during the rainy season as it is located along the Road No 6. However, Tua Chua is quite remote. The only road to the district center, not to mention to its communes, is often prone to destruction during rains. It is, however, important to note that the project's effects are seen in not only the two pilot districts but also other areas (SFDP Song Da 1999).

The SFDP Song Da was initially designed to be a forestry project as suggested by its name. However, the project soon recognized the importance of the agricultural development in the protection of the natural resources and included the agricultural component as part of its intervention activities. It was seen that the growing needs for

food lead to the deterioration of the natural resources, which include both forestry and agricultural resources (Kaiser 1997). People will continue to do this until their demand for food is met. In order to maintain a sustainable use of and to protect the scarce natural resources, it is required that the agricultural productivity be improved (Kaiser 1997).

The engagement of SFDP Song Da in extension activities began as early as 1995 when the Implementation Phase I started. The aim of the SFDP Song Da's extension activities is to enable local farmers to increase their (upland) agricultural production in a more sustainable and diverse way (Kaiser 1997; Foerster and Nguyen 1999). Though SFDP Song Da maintains close contact with the extension authorities at the central and provincial levels, most of the activities take place in the pilot project areas in the districts of Yen Chau and Tua Chua. In fact, the SFDP Song Da has been working with the extension units in these two districts since their very beginning days. In the Implementation Phase I, the project had very close co-operation with the district extension units in implementing their agricultural trial programs.

In the field of extension, the involvement of the SFDP Song Da in the two districts includes upland soil conservation measures, intensification of crops on the upland, intensification of crops on the paddy land, development of fruit trees and perennial crops, and animal production (Foerster and Nguyen 1999; SFDP Song Da 1999). The tree/ crop components may vary from one district to another depending on the nature of the district.

To conclude, the SFDP Song Da is the first bilateral technical cooperation between Vietnam and Germany in the field of natural resource development. Though originally named as a forestry project, the SFDP Song Da has set agricultural goal as one of its priorities in the development strategy. It is understood that in order to achieve the natural resource protection and life-quality improvement for the local people, we have to employ both forestry and agricultural means. The SFDP Song Da has closely cooperated with the extension system in realizing its tasks, which are to develop and to expand the agro-forestry technological options.

3.3 The Local Extension System

The extension system in Vietnam is quite new compared to other countries. The history of the extension system in Vietnam can be traced back as early as March 1993, when the Government's Decree 13-CP stipulated the set-up of the extension system at national, provincial and district levels (Kaiser 1997; Vietnam 1993a).

At the national level, the Department of Agricultural and Forestry Extension (DAFE) was set up under the Ministry of Agriculture and Rural Development. It consists of eight separate divisions: Planning and International Co-operation, Administration and Finance, Ruminant, Small Livestock, Industrial Trees/ Crops, Food Crop, Training and Communication, and Forestry Extension. The DAFE is responsible for agricultural and forestry extension activities in the whole country (Kaiser 1997; Vietnam 1993a).

The establishment of the extension system at provincial and district levels in Son La and Lai Chau provinces occurred some time later. Though the system existed before, the official decree to set up the provincial level extension service, the Center for Agricultural and Forestry Extension (CAFE), in Lai Chau was dated August 1996 and June 1996 for Son La. The CAFE is technically under the administration of the province level Department of Agriculture and Rural Development (DARD) (Kaiser 1997). The main task of the provincial extension service is to implement the extension programs and projects within the province. The task includes transfer of technologies, training of extension workers, skills and economic management, cooperation with other organizations inside and outside the country, and evaluation of extension programs and projects within the province. CAFE also provides advice to other agricultural organizations and the provincial authorities on the planning and implementation of extension programs and projects in the province (Kaiser 1997).

At the district level, the official directive to establish the district level extension service, the district Agriculture and Forestry Extension Station (AFES), was some time after the issuance of the document to set up the province level extension service. In fact, Yen Chau and Tua Chua districts are among the pioneer districts in the two provinces in having the district level extension service.

The district extension service directly under the Center for Agricultural and Forestry Extension in terms of activities, budgeting and personnel management (Kaiser 1997). The main tasks of the AFES are transfer of technologies through extension project

and programs, establishment of on-farm demonstration for crop and animal, provision or organization of training to farmers, preparation of extension materials, setting up and guiding an extension network at commune and village levels and co-operating with concerned authorities and institutions in the related fields (Kaiser 1997).

In Yen Chau district of Son La province, the technical backgrounds of the AFES staff are: livestock, lowland rice, aqua-culture, irrigation/ water management. In Tua Chua district of Lai Chau province, the technical backgrounds of staff are: forestry, livestock and food crops. Additionally, there is in each district one station head, who is responsible for the administration of the station, and an accountant, who is in charge of budgeting and accounting work (Kaiser 1997; Vu and Littooy 1995; Littooy 1995). In both districts, and also in other districts in the two provinces, the extension service is still in the process of learning and organization.

Beside the Agriculture and Forestry Extension Station, there are four other formal organizations at the district level also involved in the extension activities: the Plant Protection Station, the Seed Supply Station, the Veterinary Station and the Forest Protection Station (Kaiser 1997; Littooy 1995).

To conclude, the extension system in Vietnam is new and lacks operational experience. In the SDW, the establishment of an extension system as a support system to help farmers increase the efficiency of their production is important. However, it is clear that the system will need much support in terms of capacity building to be able to provide assistance to farmers.

3.4 Conclusion

The SDW is an important, yet poor region in Vietnam. The region plays an important role in the national economy for its critical watershed protection function for the Hoa Binh Hydro Power Plant. However, the region is among the poorest parts of the country with the per capita GDP approximately 4 –5 times lower than the national figure in the early 90's.

The transport system in the region is also underdeveloped. There is only one road through the region. The alternative water-way is only possible for the area along the Black river. The regions have two airports, which mainly serve the purpose of passenger transportation.

One of the important tasks for the regional economic development is to improve the agricultural productivity. The potentials for a higher productivity in agricultural production exist, as the level of intensification in traditional farming practices in the region is very low. However, it may be a difficult task to change the traditional way of farming because local cultivators have been used to these practices for generations.

The presence of development projects and the establishment of an operational extension system are important factors for the development of agricultural production. However, the effectiveness of the technical assistance may be reduced by the poor infrastructure in the region. Besides, the newly established local extension system requires additional experience and training in order to be able to provide good technical advice to farmers.

CHAPTER 4: LITERATURE REVIEW

This chapter will be organized as followed: it starts with the review of previous studies that have analyzed farmer's decision to adopt new technologies, followed by a review of research on the adoption of sustainable technologies. Finally, major literature from the SFDP Song Da related to the studied technologies promoted by the project are reviewed and discussed.

4.1 Issues Related to the Adoption of New Agricultural Technologies

Though new technologies are usually promoted in a package, the response of farmers is often to adopt one or more components and gradually add more components rather than adopting the whole package immediately. "Sequential or stepwise adoption of parts of a technological package has been observed in a variety of settings..." (Leathers and Smale 1991, pp. 740-741). The whole package may only be adopted over the period of several years. Previous research has offered a number of theoretical models to explain this adoption process. According to Feder, Just and Zilberman (1982, p1), the conventional explanations for the sequential adoption process are "lack of credit, limited access to information, aversion to risk, inadequate farm size, inadequate incentive associated with farm tenure arrangements, insufficient human capital, absence of equipment to relieve labor shortage..., chaotic supply of complementary inputs (such as see, chemicals, and water), and inappropriate transportation infrastructure."

Based on the study of 60 farmers from 2 villages in India, Hodgdon (Hodgdon 1974) argues that factors which influence the adoption of new technologies in developing countries can be classified in three levels: the farmer, the village and the world outside the village. Those factors are named situational, local and external variables, respectively. The rationale for this classification, according to Hodgdon, is that there exist different conditions in developing countries (India) compared to more developed countries. Though the study is only in two villages, the author asserts that "many of the conditions affecting adoption of recommended practices in these two villages apply to broad areas of rural India" (Hodgdon 1974, p. 89).

Saha, Love and Schwart (1994), in their article "Adoption of Emerging Technologies under Output Uncertainty", divide the adoption process into three stages: information collection, decision on whether or not to adopt, and decision on how much to adopt. Though the study is based on the adoption of bovine somatotropin (bST) among dairy farmers, the authors claim that the model is applicable for any divisible technology about which the information is insufficiently available. Based on the study results, the authors conclude that the decision to adopt the technology is optimal if the expected net marginal benefit of adoption exceeds its marginal cost. A farmer's attitude to risk has no influence on the decision to adopt the new technology but rather on the degree of adoption, if the farmer ever decides to adopt (Saha, Love and Schwart 1994).

A study by Smale, Just and Leathers (1994) aims to find explanations for the partially adopted seed-fertilizer technologies. Their assumption is that the incomplete

adoption of new technologies is based on input fixity, which assumes that a farmer has a fixed amount if inputs available (in the short-run) for both traditional and new crops; portfolio selection, which implies that a farmer chooses to adopt a new seed at the same time with traditional varieties in order to reduce overall risks; safety-first behavior, which "postulate that the probability of failing to achieve producer goals constrains producer choice" (Smale, Just and Leathers 1994, p. 536); and farmer experimentation, which assumes farmers must expend time and resources to learn about new technologies. By studying the survey research in Malawi, they find out that the process of hybrid maize adoption in Malawi is explained by all four of these factors. With data from 420 Malawian farm households during 1989-1990 cropping season, Smale, Just and Leathers apply econometric estimation to test their hypothesis. The estimation involves the use of simultaneous equations with two step procedure. In the first step, probit model is employed for the estimation. Based on the fitted values, the inverse Mills ratio for each sample observation is also calculated in this step. In the second step, they estimate the linear equations with inverse Mills ratios as regressors from observations with positive dependent variable. Based on the results of their analysis, they conclude that no single argument can give full explanation for the decisions of the hybrid maize adopters. On the other hand, four of them together can explain the patterns better than any single approach or combination of two or three approaches (Smale, Just and Leathers 1994).

An earlier study by Leathers and Smale (1991) uses a Bayesian approach to explain the sequential adoption of components of a technological package. They set out to understand why farmers adopt components of a technological package sequentially

rather than as a whole package even when the latter is obviously more profitable. Based on the results of the study, the authors conclude that farmers are uncertain about the success of a new production technique and that experiment with new techniques does not always improve farmers' problem of uncertainty. In some situations, adopting part of the package may allow the farmer to learn more about the package as a whole. The study also supports the assumption that insufficient information may make the farmer rationally choose to adopt the technologies sequentially. According to the study, sequential adoption should not be seen as the results of institutional shortcomings or farmers' irrationality. The study ends with the question of whether sequential adoption should be viewed as the least cost way to diffuse the information to farmers if the sequential adoption is in fact the response of farmers to uncertainty (Leathers and Smale 1991).

An excellent overview of the studies on the adoption of new technologies was done by Feder, Just and Zilberman (1982). They look at the adoption model of farm household with respect to farm size, risk and uncertainty, human capital, labor availability, credit constraint, land tenure and supply constraints. In addition, econometric techniques for modeling the adoption of technological packages, including the use of ordinary least square regression, log-linear probability model, logit probability function, probit model and discriminant analysis by different researchers were also reviewed.

The results of the literature review by Feder, Just and Zilberman support the theoretical conclusions discussed hereafter. Larger farmers are often the early adopters. The intensity of adoption depends on specific conditions. In some cases, a smaller farmer

may allocate a higher proportion of his available land to the new crop variety compared to the larger farmer. In other cases, the opposite situation is observed. The results also support the assumption that labor supply is a problem for the adoption of new labor intensive technologies. On the other hand, empirical studies do not support the assumption about the credit constraint and land tenure as obstacles to the adoption of new technologies. The relationship between risk aversion and adoption is not clearly explained by the studies though the role of education and access to information is recognized (Feder, Just and Zilberman 1982).

Miller and Tolley (1989) study the impacts of price support and input subsidies in the adoption of new agricultural technologies on the social welfare. They argue that the rate of adoption is dependent on how different the profitability of the new technology is compared to that of the old (traditional) technology. The amount of land in time *t* that a farmer cultivates the new seed is a combination of the following functions:

$$L_t^* = \left(e^{\beta_0 t} - 1\right)L \qquad \text{if } L_t^* < L/2$$
$$L_t^* = L - L/2e^{3\beta_0(t-\hat{t})} \qquad \text{if } L_t^* > L/2 \text{ or } t > \hat{t}$$

where L is the total amount of land that the new technology will finally be adopted, L_t^* is the amount of land under the new technology at time t, $\hat{t}$ is the time when half of L is under new technology. At $\hat{t}$, the adoption of new technology changes from increasing at an increasing rate to increasing at a decreasing rate, which forms the S-shape of the adoption curve. According to Miller and Tolley, a price support or input subsidy policy helps increase the amount of land under new technology, reduces the land

under old technology and consequently increases the marginal gain from the adoption. However, this gain is offset by the marginal cost arising from the distortions in input and product prices. Their analysis also shows that the level of distortion in input usage due to subsidy can be reduced when the elasticity of substitution is relatively small. In the sensitivity analysis of fertilizer subsidy, the result shows that with $\sigma = 0.5$ and a 55% fertilizer subsidy, the net social product can remain positive for 8 years before it becomes negative. Miller and Tolley concluded that the price supports or fertilizer subsidies can speed up the adoption of new technologies have little effect on the social welfare (Miller and Tolley 1989).

Since most if not all, farmers in developing countries are operating under incomplete information about new technologies, adoption under uncertainty and risk is also a concern of a number of economists. According to Scherr (1995), farmers adopt new practices when the economic incentives are clear and the associated risks including crop failure, damages caused by weather, and tenure insecurity, are managed, which can be in terms of building on familiar practices, species diversity, and technology adaptation. Because of such associated risks, poorer farmers find it more difficult to take advantage of the new opportunities, even when the expected incentives are attractive (Scherr 1995).

A more complete study about farmer's response to new technologies under risk and uncertainty is by Feder (1980), who takes farm size and risk into the consideration of adoption model. Feder sets out to study the effect of risk aversion, farm size and credit

constraint on factor use and output mix. The answers for these issues are derived from the model of production under uncertainty. According to Feder, the actual (random) output is constructed by the following model:

$$Q = Y(L, X) + \varepsilon \cdot H(L, X)$$

where Q is the actual output, Y is the mean output, H is the term related to output variability (assumed to be positive), ε is the random variable with mean zero, L is the amount of land allocated to the modern crop and X is the fertilizer input. Both H and Y are functions with the positive first derivatives and negative second derivatives.

The study by Feder arrives at a number of conclusions. With respect to amount of fertilizer use, Feder concludes that the optimal level of fertilizer per cultivated unit is independent of the degree of risk aversion, variability of ε and the farm size but dependent on the prices of modern crop. The optimal area of land under which the farmer would adopt the new technology is dependent on the degree of risk aversion, variability of ε and the response of risk aversion toward income increase/ decrease. The binding credit constraint will result in the increase of optimal level of fertilizer per cultivated unit, reduction of optimal amount of land under new crop and reduction of expected total output of the new crop if the degree of uncertainty or risk aversion increases. In addition, the farmer operating under a binding credit constraint will increase the fertilizer/land ratio and reduce the area under new crop if relative risk aversion increases with higher income (Feder 1980).

Hassan et al. (1998) use qualitative response model to analyze the adoption patterns of maize farmers in Kenya. The data is from a geo-referenced survey of the Kenyan maize growers at household and village level. The study examines factors that influence the decision to adopt improved varieties and hybrids by maize growers in Kenya. A logit model is employed to test the hypotheses about the determinants to adoption. Based on the results, they conclude that adoption of new maize varieties is higher in the high potential areas compared to other locations. They also conclude that the differences in maize yield are important for the farmers' choices of different varieties. Availability of seeds and seed quality are also important determinants that influence the farmer's decision to adopt. Other factors, such as access to extension services and farm size are also important to the adoption of the new seeds, particularly in the early stages. According to Hassan et al., small farmers usually take longer a time to adopt the new seed after it is released than do larger farmers. Hassan et al. also conclude that better access to information, education, credit and market and younger age have positive influence on the probability that the farmer adopt the technology, particularly the hybrid seeds. Male farmers are more likely to adopt new seeds than the female because the new seeds often require more post harvest processing than do the local seeds, which burdens women's job in rural Kenya (Hassan et al. 1998).

Another study that focuses on the farmers' knowledge in the adoption of new technology is from Lin (1991), who conducted a research in hybrid rice production in China. According to Lin, besides lack of credit, inadequate farm size and unstable supply of complementary inputs, the role of education in the farm household's decision to adopt

a new technology (hybrid rice in this case) are also important factors. Lin hypothesizes that "farmers with relatively high level of education may have a higher probability of adopting new technologies than those with relatively little education" (Lin 1991, p.713). With the application of probit and tobit models, Lin tests hypotheses using a data set from 500 households in Hunan province of China. Adoption was treated in the study as a portfolio selection problem. Based on the results of the estimation, Lin concludes that the level of education of the head of the household is positive and statistically significant to the probability that the household adopts the technology. He also concludes that the farm size is positively related to the adoption of the technology (Lin 1991).

Hassan, Murithi and Kamau (1998) conduct a study on the use of fertilizer on improved maize fields by Kenyan farmers. The data set is from two sources: a survey of 1,400 maize farmers and experimental records from Fertilizer Use and Recommendations Project (FURP). They estimate the fertilizer response parameters for maize using the data from FURP. In the empirical model of fertilizer adoption, logit and tobit models are used to test the hypotheses. The gap between actual and optimal yields is calculated based on the ratio of farmer's maize yield and the optimum yield. Results show that Kenyan farmers apply much less than the optimal level of fertilizer and the gap between actual and potential yield is large. Two important factors that are crucial for the farmer to apply more fertilizer are lower nutrient-grain price ratio and higher yield gain from fertilizer use. High transaction and transport cost due to poor infrastructure cause the demand for fertilizer to go down. The authors conclude that the increase in yields from fertilizer use will increase the probability of fertilizer use. It is also confirmed that soil type and level

of soil nutrients are important for the determination of optimal fertilizer rates (Hassan, Murithi and Kamau 1998).

4.2 Issues Related to Practice of Sustainable Agricultural Technologies

With sustainability issues becoming more and more of a concern worldwide, the adoption of sustainable agriculture technologies has become an important research issue. This section reviews the studies on the adoption and practice of sustainable agricultural technologies in different places in the world.

To begin with, the popular concept is that sustainable practices are normally less accepted by farmers than conventional fertilizer-seed technologies. Rosegrant and Livernash (1996) address four problems related to the adoption of sustainable technologies. First is the cost and technical requirement related to the adoption of available practices. Second, the damage caused by the current practices may not be observed by farmers, as it happens gradually. Third, lack of long term security to resource use may inhibit adoption of sustainable technologies. Fourth, government support policies, institutional weaknesses and poor infrastructure may have adverse effects on farmers' decisions to adopt new technologies. To address these problems, Rosegrant and Livernash (1996) suggest that both developed and developing countries need concentrated, large-scale efforts for improvement of agricultural research and extension, improvement of the policy environment, and commitment to further improvements in agricultural technologies.

With regard to adoption of sustainable agricultural technologies, which include inter-cropping, biological control, use of plant-derived pesticide as substitution for chemicals, minimum tillage and multiple cropping, Filho (1997) applies probit and logit models and duration analysis to explain the maize growers' behavior in the adoption of these new technologies. The data set is from 148 personal interviews in 1994 in the State of Espírito Santo in Brazil. Filho looks at a number of different explanatory variables, including farm characteristics, farmer's education, farmer's access to outside information and land tenure. He concludes that both economic and non-economic factors influence a farmer's decision to adopt the new technologies. Of these factors, many are out of the farmer's control. A farmer's decision to adopt the sustainable technologies for maize is positively related to his/her contact with government/ non-government organizations, the farmer's understanding of the negative effect of chemicals, the available labor force in the family and the soil fertility. Filho also concludes that the adoption is negatively related to farm size (Filho 1997).

Salamon and Farnsworth (1997) also study the family factors that influence the decision to adopt sustainable technologies. A data set from a survey of 60 farm households in Illinois, the United States, is used. Of the 60 households, 30 are adopters of sustainable practices. The other 30 households are non-adopters. Under the assumption that the problem with the adoption of sustainable technologies is related to social factors, the authors study the characteristics of families and farms of both the adopters and non-adopters. The findings show that adopter families are traditionally environmentally conscious and are careful about resources. Their adoption of sustainable technologies is

not only for environmental reasons but also strongly from financial motives. The findings also identify the non-adopter families that share a number of characteristics with adopter families as the best target for educational programs (Salamon and Farnsworth 1997).

Pehu ([1999a?]; [1999b?]) provides a description of the soil erosion situation and the conservation measures in the Southeast Asia and in Vietnam. Soil degradation, resulted mainly from soil erosion, reportedly leads to a loss of around 7-11% of the agricultural GDP (Pehu [1999a?]). Soil erosion is the consequence of forest destruction and shifting cultivation without proper conservation measures. Where cultivation of crops on erosion-prone upland is unavoidable, due to the shortage of cultivated land, the use of proper conservation practices can reduce the loss of surface soil. The most popular measures that are currently practiced in the region include multiple cropping, contour cultivation, no-till cropping, cultivation of cover crops, use of buffer strips, hedgerow and terraces. However, according to Pehu, adoption of sustainable practices in the poor communities is constrained by the limited investment potentials of the local people. Assistance to help them change their unsustainable practices requires both agricultural and non-agricultural efforts (Pehu [1999a?]).

Though most of the studies show that farmers are mostly aware of the environmental effects from non-sustainable practices, it is often difficult for farmers in the developing countries to adopt more sustainable practices. In both developed and developing countries, the more educated farmers are mostly the pioneers in the adoption of sustainable practices. Recommendations to improve the adoption rate are to take a

more holistic effort of both agricultural and non-agricultural sectors to improve the situation for the poor communities.

4.3 Previous Work by the SFDP Song Da

The SFDP Song Da initiated some agricultural related experiments in 1995. Since then, the agricultural component in the project has become increasingly important. There have been a number of working papers and reports from project staff and consultants on the issues related to agricultural development. Some major findings from researches undertaken by the SFDP Song Da regarding the selected technologies and methods are summarized below.

Promotion of both new seed and soil conservation technologies in the SFDP Song Da project has been undertaken in a gradual process. The purpose of this strategy is "to do things gradually, in order to do them well" (Bunch 1997, p. 21). Trial and demonstration plots of new technologies are always set up before any large scale dissemination as it is believed that farmers are best convinced by seeing the real things that are happening in or around their neighborhood.

Foerster and Nguyen (1999) give a detailed description of the promoted agricultural activities by the SFDP Song Da, including the use of new seed varieties, inter-cropping, hedgerows, micro-terraces and the use of fertilizer on the upland, in the two districts of Yen Chau and Tua Chua. Since maize is among the most important staple

crops in the SDW and is the major upland crop, the SFDP Song Da has put much effort to the promotion of maize related technologies.

Before massive dissemination of new varieties, trial plots of new and traditional seeds, with and without fertilizer, are set up in the area to show the difference between the old and new seeds and also to refine the selection of the most suitable seed(s) to promote. Since the result can be seen after a short time, farmers can quickly decide whether or not to adopt. However, there are a number of factors that influence the decision to adopt the new varieties; including production risk, investment cost (including purchase of seed and fertilizer), household labor and land resources, storability, taste and the market price (Foerster and Nguyen 1999).

Promotion of fertilizer use on the upland follows the introduction of new seeds on the upland as the use of new seed without fertilizer may lead to the decline in both expected maize yield and soil nutrient level (Foerster and Nguyen 1999). This component of the new seed package, however, faces more difficulties in the promotion process as farmers do not notice immediately the decline of soil fertility. According to Foerster and Nguyen, a farmer may invest in some fertilizer on his maize field if the output market price for maize increases. Since this option requires expenditure of capital, poor farmers often find other ways to invest their already limited cash rather than putting it into maize (Foerster and Nguyen 1999).

The soil conservation measures have been less widely adopted than the new seed varieties. With regard to hedgerows, different varieties, either individually or

combinations of two or three varieties, have been tried in the area to find the most suitable ones. This technology is well known for its capacity of soil retention and production of green manure. It also has other direct advantages for farmers, such as production of fodder, food, and cash crops (Bunch 1997). However, there are also a number of disadvantages to the adoption of this technology. Hedgerows give shading to the crop on the field, compete with crops for nutrients and water, occupy space which can be used for main crop, reduce residues available to crop, and require extra labor for pruning (Bunch 1997; Foerster and Nguyen 1999). In the SFDP Song Da project area, the adoption of hedgerows is low given its disadvantages and the not yet proven effects on yield and soil improvement in short time (Foerster and Nguyen 1999).

4.4 Conclusion

Studies on the adoption model of the agricultural technologies show the importance of both financial and non-financial (social) factors in the decision making process. While new technologies are often promoted in a package, previous studies show that the response from farmers is usually to adopt some components rather than a complete package even though the economic superiority of adopting the whole package is clear to them. The whole package is often adopted after a trial period.

Government policies of price support and input subsidies do not often give positive effects. Studies show that support policies may create price distortion, which offsets the gain in marginal benefit. The level of efficiency of support policies depends on the length of the support program and the elasticity of substitution of inputs.

Among the economic factors that influence the decision making of a farmer, the profitability/ yield of the new technologies plays the most important role. Choice is often made on the most profitable technology from the available packages. With regard to non-economic factors, studies show that information is a very important factor for a farmer to choose whether or not to adopt the new techniques. The probability that a farmer will choose to adopt the new technique is positively related to his exposure to information related to the promoted package.

Attention should also be given to the role of education. Studies show that more educated farmers are more open to adopting changes. In both developed and developing countries, educated farmers are often seen as the pioneers in adopting the new technologies. This fact is more clearly seen in the adoption of sustainable practices.

Risks related to crop production are also a subject for a number of studies. Generally, risk-averse farmers are not among the first adopters of new technologies. A farmer often adopts a new technology in a way that the overall risks are reduced. Better access to information may help farmers make more informed decision about their production and, thus, reduce the production risks.

Studies on the adoption of sustainable agriculture show that a farmer's decision to adopt the technologies is based on both environmental concern and economic benefit. While the conventional thinking is that the problem with the adoption of sustainable technologies is a technical one, studies show that problems also arise from the social side which includes information scarcity, and local traditions. Recommendations are that an

integrated effort of both agricultural and non-agricultural sectors and from both developed and developing countries is to be made to improve the rate of adoption of more sustainable farming practices.

CHAPTER 5: DESCRIPTION OF THE DATA SET

The data used in this thesis comes from the Impact Monitoring Database of the SFDP Song Da. As described in Chapter 3, the assistance of the SFDP Song Da in the agricultural extension activities are: upland soil conservation measures, intensification of crops on the upland, intensification of crops on the paddy land, development of fruit trees and perennial crops, and animal production (Foerster and Nguyen 1999; SFDP Song Da 1999). In 1999, the SFDP Song Da started setting up their Project Impact Monitoring System. The idea of this system is to keep tracks of the impact of the project on the target groups. In March 2000, the first attempt was made to collect data at household level regarding the promoted agro-forestry and extension activities. The collected data is to follow up the effects of project interventions.

5.1 Description of the Survey and Data

During the household survey in March 2000, household interviews to men and women, separately where possible, were conducted. A total of 15 villages in the districts of Yen Chau and Tua Chua, 9 villages in Yen Chau and 6 villages in Tua Chua, with an average of 5 households per village was covered in this survey. Altogether in 15 villages, 74 households were interviewed in this first data collection. In 60 households, the surveyors were able to conduct the interviews with both men and women. In the remaining 14 households, the data was only taken from men. The selection of the households for the survey was done in a random basis (Luibrand 1999).

The survey aims to get the information about responses of farm households to the promoted activities and the extension service. It also covers information about farm/ family characteristics, including farm size, wealth classification, major crops and product marketing situation (See Appendix A for the questionnaire for the household interview).

The 15 selected villages are half the number of villages that the SFDP Song Da has been working in for 2 years or more by the year 2000 (Luibrand 1999). Data related to production of a promoted activity is collected only from the households that presently practice the activity. In other words, the questionnaire was designed in a way that the numerator skips the information related to an activity if the household does not know about the activity or does not currently practice the activity (see Appendix A).

According to Luibrand (1999), the questionnaire was carefully designed and tested prior to the actual survey. A short-term training course was conducted in each district in which the surveyors were trained to conduct the farm interview and do the problem solving. As part of the training course, test interviews to farmers were conducted and observed issues were discussed among all the training participants (Luibrand 1999).

5.2 The Selection of Data for the Thesis

Permission to use the questionnaire and the data set from the household survey described in the previous section was granted by the chief technical advisor of the SFDP Song Da, who provided the questionnaire and the data set for the analyses reported in this thesis.

From the pool of data, which contains information about 15 different activities promoted by the SFDP Song Da in co-operation with the local extension service, a complete set of data is selected to test the hypotheses addressed in Chapter one. The selection of necessary data proceeds as follows:

1. Yields are assumed to depend on the factors within the households as well as factors outside the household. The major household factors included in the analysis are training, wealth and position of the household head in the village. Other factors such as geographical difference by district, which may also imply the differences in culture, ethnicity, soil condition and farming practices from the surveyed farmers in two districts, and the technical assistance from the SFDP Song Da and the local extension service are also included.

2. The SFDP Song Da's range of support activities includes animal husbandry, intensification of upland and irrigated crops and fruit trees. For the purpose of this thesis, the analysis is limited to maize cropping. The main reason to focus only on maize related activities in the analysis is that maize is the most important enterprise for farmers in the SDW. Besides, maize is an annual crop. The effects from technical assistance may become apparent after a couple of years. Other crops like fruit trees may require longer time to observe the effects. In addition, data about actual maize yield was also collected at household level during the survey, which can be used to evaluate the success of the maize related technologies. Three activities, which may affect maize

yields, were selected for the analysis: improved maize varieties, hedgerows, and use of fertilizer on the upland.

3. It is important to note that since the interviewers did not get full information concerning the specific activity if the household did not know about the activity, some fields are left blank. For the sake of estimation, I treat the blanks for training variables as zeroes, which imply no training was received for this specific activity.

4. It is necessary to combine the separate answers from men and women into a single household response. The two coded responses of men and women separately from the same question are combined them into one single attribute with 1if the corresponding value from either man or woman or both is 1 and 0 if responses from both man and woman are 0. By doing this, the differences in answers from man and woman, if exist, are ignored.

The final data set consists of household's wealth categories (rich, medium, poor), district, whether or not the household head has a position in the village, actual maize yield and selected items listed under each of the selected activities including training and practice of activity. Except for the actual maize yield and maize land area, whose value is continuous all data attributes are coded with binary discrete values (see Appendix B for the data set).

Concern should be noted about the data quality. Although the questionnaire was carefully designed and tested before use in both districts and the enumerators trained before the survey, mistakes are often unavoidable. According to Luibrand (1999), there may still be some problems with the accuracy and representativeness of the collected data as the enumerators are inexperienced in household interviewing (Luibrand 1999).