

**Center for Agricultural Research and Ecological Studies**  
Hanoi Agricultural University

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**REPORTS BY YOUNG RESEARCHERS**

**FACTORS INFLUENCING FARMERS'  
ADOPTION OF AGROFORESTRY MODELS**

**Case study: Seo hamlet, Cao Son commune,  
Da Bac district, Hoa Binh province**

Researchers:

Mai Van Thanh  
Vu Thi Thao  
Pham Mai Huong  
Pham Thanh Lan  
Le Thanh Phuong  
Tran Nam Anh

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## **LIST OF ABBRIVIATION**

AF	Agroforestry
HH	Household
NGO	Non-Governmental Organization
PAM	World Food Program
TV	Television
VND	Vietnamese Dong (Local currency)
WAI	Weight Average Index

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## I. INTRODUCTION

Agroforestry (AF) has long been recognized sustainable development models throughout the world due to benefits they brings not only to the economy, society but also to the ecosystem. AF models have been introduced to upland areas in Vietnam in recent years.

Da Bac is among 9 upland districts belonging to Hoa Binh province where appreciable number of AF models are being carried out by rural development programs and projects such as 327, 747 and PAM, etc.

Da Bac has totally five ethnic groups including Muong, Tay, Dao, Thai, and Kinh. Of these 5 groups, the Muong ethnic group occupies the highest proportion of 38.3% in terms of population. These groups depend mainly on agricultural production for their livelihood. Although services and industrial activities increasingly develop in the district, agriculture still plays an important role in the local economic development.

Insufficient attention has been paid on developing industrial crops and fruit trees even though they are major crops of the locality. Forestry has been the most important sector of the district. However, forestry resources have become exhausted due to improper exploitation. Upland farming systems and traditional grazing and population blooming are the main causes affecting the sustainability of natural resources. Application of advanced farming practices, therefore, should be encouraged in an effort to obtain sound management of this resource for sustainable development and living improvement purposes.

Local AF models, however, has met a relatively little demand of the reality and has yet been inapplicable to farmers' practices. Currently, there are only a few households carried out AF models. The question raised is why such a beneficial model has yet been not adopted by farmers in Seo hamlet, Cao Son commune. Therefore, a project titled "*Factors influencing farmers' adoption of AF models in Seo hamlet, Cao Son commune, Da Bac district, Hoa Binh province*" has been conducted by young researchers from Hanoi Agricultural University in order to investigate constraints facing farmers in application and popularization of the models in the study site.

## II. OBJECTIVES

### 1. General objective

This study focuses on examining the main factors impacting farmers on applying AF systems, and then recommends some solutions with aim of developing AF models.

### 2. Specific objectives

1. To identify socioeconomic situation of local people, specially of households applying AF models,
2. To examine factors impacting farmers on applying AF models,
3. To identify potentials and constraints for the local people to develop AF,
4. To recommend solutions to widen AF systems in the study area.

### III. RESEARCH METHODS

#### 1. Study Site Selection

Based on information from other research and preliminarily interview local people, we selected Seo hamlet, Cao Son commune, Da Bac district, Hoa Binh province to be the study site. Reasons of this selection are:

- Some programs and projects, both governmental and non-governmental including PAM, programs 135, 327, 661, and 747 were implemented in this area encouraging AF models.
- However, few households are applying AF models in Seo hamlet.

#### 2. Sample Size and Sampling Methods

With general and specific objectives above, we studied two groups of households:

- Households applying AF models, and
- Households not applying AF models.

According to local officials, Seo hamlet now has 18 households practicing AF, these households have the larger production scale as well as longer duration than others (normally growing persimmon fruit, corn and some other cash crops). The rest households also intercrop both annual crops and perennial crops; however, their cultivated area of these crops is too small. Additionally, income is low from these crops, so these households are not considered applying AF.

We surveyed all of 18 households applying AF. With households not applying AF, sample size was determined basically on Yamane formula, (1976).

$$n = \frac{N}{1 + N.e^2}$$

- Where:
- N- Total households not applying AF in the study site
  - n- Sample size
  - e- Level of statistic significance

As a result, we surveyed 27 households not applying AF.

#### 3. Method for data collection

We use both secondary data and household interview in this study.

##### 3.1. Secondary data

Documents used in this study consist of annual publications, summary reports, and government documents relating to this study. All these documents were provided by the Agricultural Department, the Extension Centre, the Statistical Department of Da Bac district, and the People's Committee of Cao Son commune.

### *3.2 Primary data*

- Semi-structured interview

The key informants in the study site (including: the leader, vice leader of Seo hamlet, and the head of Women's Union, Soldiers' Union, Youth Union as well as persons who know deeply about agricultural production of this hamlet) were interviewed in order to get general information about the commune and hamlet, especially the information related to AF.

- Directly observation

In order to be familiar with local people, we directly observed study site in initial days when we had just come. By direct observation, each member in the study group could understand generally about agricultural production of farmers here, natural and socioeconomic conditions of the study site. Moreover, we also knew some programs as well as policies of government in this area. In addition, this method helped us to make a close relationship with local people.

- Household survey

Total 45 households (consisted of 18 households applying AF and 27 households not applying AF) were surveyed to get more detail information. The information focuses on household resources (land, labor, capital, etc.) and factors deciding whether farmers apply AF or not.

## **4. Methods for data analysis**

### *4.1. Descriptive statistics*

This method is used in studying socioeconomic phenomenon by describing information and data. In this study, the method was applied to describe AF systems in Seo hamlet and main components of AF systems.

### *4.2. Statistical analysis*

- Weight average index (WAI): was used to calculate some qualitative indicators at three different levels, for example: thinking of farmers about influential factors in practicing AF.
- T - test: was used to compare some quantitative socioeconomic indicators between group of household applying AF and group of household not applying AF. The comparison based on some criterions, such as: age and education level of household heads, area of land, household income.
- Correlative matrix and logic function: was used to examine detailed factors affecting farmers' application of AF. There are a lot of factors including physiological, socioeconomic, institutional and environmental factors.

## IV. OVERVIEW OF AGROFORESTRY

### 1. What is Agroforestry?

The term AF was forwarded by King (1977) to replace the term *Taungya*, a local term of Myanmar meaning “cultivation on hillsides”. An important fact is that the term AF is new only in terminology and not in practice because the technique of AF cultivation has existed for a long time, in people’s traditional production experience in almost all the developing countries in the tropics (Linh, 1995). From 1978 the term AF has been used by ICRAF (International Council for Research on AF) and becomes now popular in many countries in the world.

There are many definitions about AF, however, the most popular definition which is commonly used in the world is:

*"AF is a collective name for land use systems in which woody perennials (trees, shrubs, etc.) are grown in association with herbaceous plants (crops, shrubs, etc.) and/or livestock in spatial arrangement, a rotation or both, and in which there are both ecological and economic interactions between the trees and other components of the system."* (Young, 1997).

The components of AF consist of industrial trees, crops, pastures, livestock and soils. It is depended on detail AF, other components of AF also are insects and some species living under the water (Young, 1997).

### 2. Classification of AF

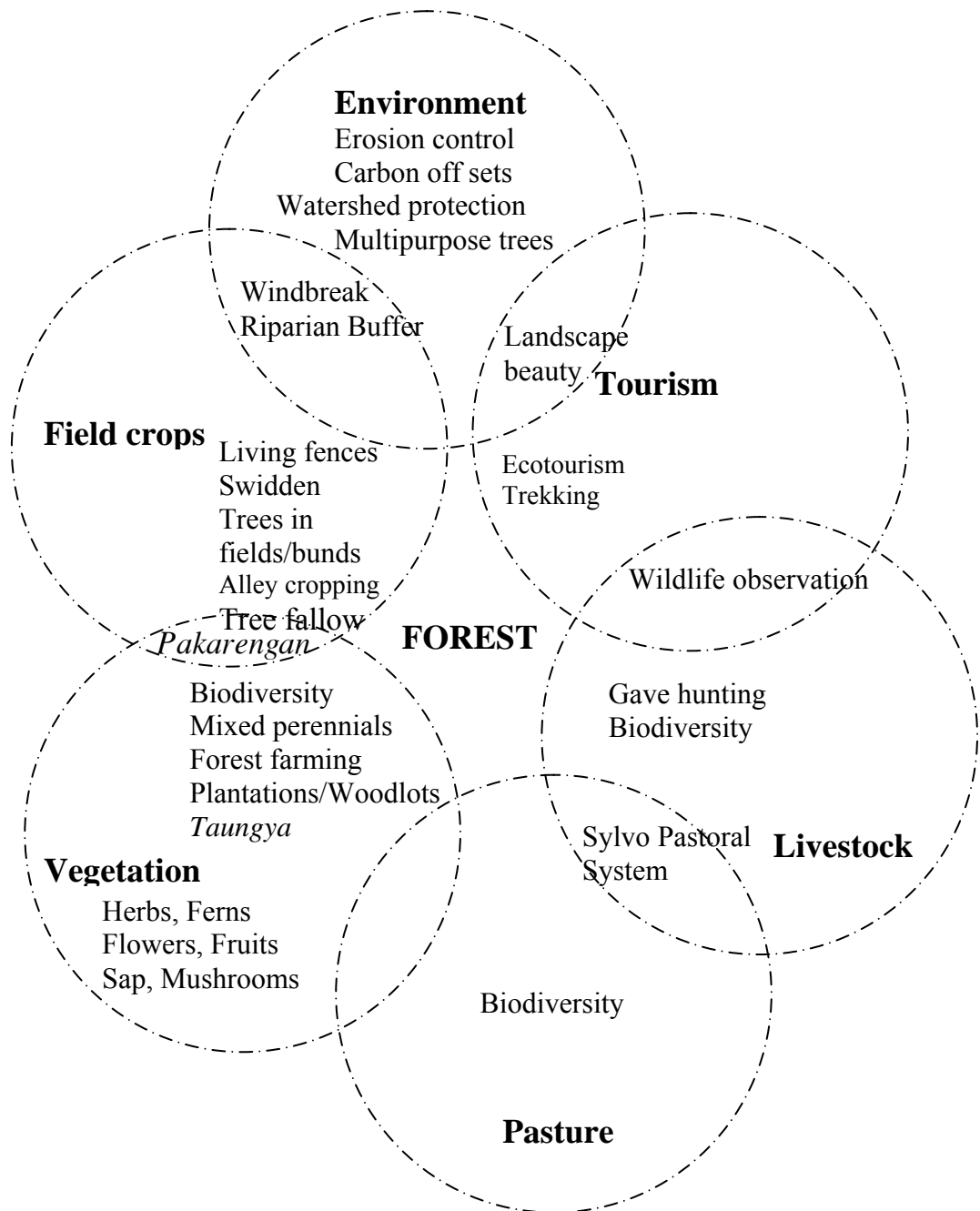
AF systems can be classified basically on some criterions about structure, function, socioeconomic, and ecologic condition, etc. However, these classifications are relatively divided and they also have the close relationship.

According to Young (1997), AF is practically classified into 4 major types:

1. Agro-sylvicultural: trees with crops
2. Sylvopastoral: trees with pastures and livestock
3. Tree predominant: forestry with other components subordinate
4. Components present: Trees with insects or fisheries.

According to Peter (2005), combination among different components creates many kinds of AF. Forest as a center combining each of these components – environment, crops, vegetation, pasture, livestock and tourism creates the six simplest forms of AF. For example, forests combined with environment can control erosion; forests combined with field crops create living fences; forests combined with vegetation become forest farming, forests combined with pasture give greater biodiversity; forests combined with livestock give hunting; and forests combined with tourism give ecotourism.

We can also combine forests with field crops and vegetation to have home gardens. Like this, there are now 28 AF systems in the world (Figure 1).



**Figure 1. 28 Agroforestry models**

According to Vien (2005), in the upland of Vietnam, the AF system is divided into two main categories: traditional AF and improved AF systems. The traditional AF systems were developed and accumulated over many generations by ethnic minority groups living near or in the forests. Improved AF systems are often introduced and developed in some areas by outside technicians. In improved AF systems, the types of trees and biological diversification level are simpler than those of traditional systems. These systems have been introduced into Vietnam by programs and development projects of the government or NGOs. Currently, many improved AF systems have been introduced and adopted in different upland regions in Vietnam.

### ***Category 1. Traditional AF systems***

1. *Fallow/Improved swidden system.* This is a traditional cultivation in many mountainous regions. After cultivating continuously for a long time in a swidden field, farmers shift to another one to cultivate and leave the previous swidden field restore soil nutrients. Additionally, farmers can collect forest products in their fallow land. When population density is sparse, fallow length is long. On the contrary, when population density is dense, fallow length is shorter.

2. *Forest and terraced fields.* This system consists of forest in hilltop and terraced field in hill base. This system has an important role in preserving irrigation water and regulates the water supply to terraces, preventing landslides.

3. *Composite swidden system.* This system includes three main components: shifting cultivation on hillside; paddy rice cultivation and livestock raising in valleys, and collecting non – timber forest products in forests.

4. *Traditional homegarden.* This system is well – known for home garden model called Pakarengan of Malayan. In Vietnam, the home garden is very popular in the lowland areas. In the homegarden system, three components including annual crops, animal husbandry, and aquaculture are combined to take advantages of soil productivity as well as spatial arrangement. This system however has not been developed yet in the upland regions.

5. *Forest garden.* Forest gardens mainly include perennial and fruit trees that supply highly value products. Normally, people grow light preferred trees in high storey, and dark preferred trees in lower storey. Depending on ecological conditions, farming habits and demand of markets, farmers can select suitable types of trees for their forest gardens.

6. *Perennial tree garden.* This system is often known as farms or plantations growing coffee, cacao, pepper, etc. Main components of this system are perennial trees that are grown in the upper storey with aim of trading, while multiple purpose crops are grown in low storey. This system is common throughout the southern provinces where they have a large and fertile land.

7. *Fruit garden.* Farmers usually grow special fruit trees with high trading value. This system comprises from 3 to 4 main storeys. The top storey includes large and light preferred

fruits; the middle one includes average and shading fruits; and the last one consists of small, short and shading fruits.

8. *Garden – Fish pond - Livestock*. This system is very popular in northern mountainous provinces in period of the cooperatives. In this system, trees, fish pond and animal husbandry are organized side by side. Similar to traditional home garden system, components in this system are in advance of spatial arrangement.

9. *Forest – Garden – Fish pond - Livestock*. In fact, this system is derived from the Garden – Fish pond – Livestock system and has long been developed in some upland areas.

10. *Forest – Cash crop – Paddy rice*. This system is established in upland areas where irrigation is available. Natural or planted forests are located at the top of the hill; cash crop is cultivated in terrace field and paddy fields in valleys.

### ***Category 2. Improved AF Systems***

1. *Alley cropping*. In this system, trees or crops are planted in contours in the slope lands. This system includes hedgerows and cash crops that are grown between hedgerows. Normally, the distance between hedgerows is around one meter depending on slope of the hill. Hedgerows are grown by improved the soil for the trees, simultaneously provided timber and other products for households.

This AF is often applied in slope land areas. There are some different models based on the proportion among the agricultural crops, perennial trees and livestock. This system offers various advantages, for instance, reducing the surface flow, supplying feed sources for livestock or humus to restore soil fertilizer. This system however needs higher technology, more capital and labor.

2. *Windbreaks and Shelterbelts*. This system consists of timber and bush trees that are grown in alleys to protect soil from damaging winds and reduce wind erosion. The structure of shelterbelts and the distance among shelterbelts depends on what type of trees are planted, agricultural crops, perennial trees or fruit trees, and blowing of the wind.

3. *Taungya system*. This system is applied in many forest projects in Viet Nam. Taungya helps farmers reduce management costs, increase benefits and protect environment. However, it also has disadvantage that is farmers have to find other cash crop cultivated area when the forest closes their canopies. Viet Nam implemented programs “afforesting in bare lands and bold hill, and program 661, farmers in many places have adopted this model. For instance, farmers in Hoa Binh province sow *Melia azedarach* seeds in parallel with cash crops in the beginning years when its canopy is still small.

### **3. Benefit of AF**

Benefit of AF could not be denied. AF creates not only socioeconomic but also ecological and environmental benefit. These benefits make model sustainable.

#### ***3.1. Socioeconomic benefit***

### ***Diversifying outputs***

According to Young (1997), one of the most important functions of AF is the diversity of outputs. There are many AF systems that are established and widened with the aim of taking most of space, typically home garden called *Pakarengan* of Malayan, or Garden – Fish pond – Livestock of Vietnamese people. Therefore, outputs are various including food, fruit, wood, timber, food for livestock, etc.

### ***Reducing risk and Ensuring food security***

Due to diverse structure and mutual influence between components in AF systems, AF systems stably exist when natural conditions change unfavorably such as disease, flood, drought, etc. Additionally, the diversity of outputs of AF systems helps farmers to avoid risks arising in market (Franzel, 2002). For above reasons, it can be said that AF systems give more economic benefit and food security is more reliably ensured than traditional cultivated systems. Food security is ensured, so the pressure on soil resource reduces.

### ***Increasing household income***

Due to the stability of production and reduction of risks of distribution, AF models also raise household income. What is more, AF systems consist of various components that help farmers effectively use family labor and create extra jobs.

### ***3.2. Environmental benefit***

#### ***Improving soil***

According to Young (1997), AF systems have a lot of functions such as wind blow reducing, weed avoiding, and hedgerows creating. Moreover, AF systems are important in avoiding erosion, remaining humus, developing circulation of nutrient soil, and increasing efficiency of nutrients use. Thus, these systems improve fertile of soil and efficiency of land use as well as reduce the pressure population growth on soil resource.

In addition, because of fixed protein plants and green fertilizer in AF systems, farmers will use less chemical fertilizer, thus underground water pollution decreases (Young, 1997).

#### ***Conservation of forestry resources and biodiversity***

AF systems provide some forest products such as wood, timber, etc. that are very necessary for farmers, so they also help to reduce pressure of forest products exploitation. Due to high efficiency of land use, AF systems play a role in reducing deforestation for cultivation. Besides, AF systems preserve water sources and pastures.

Combination of different plants aim of taking full advantage of spatial arrangement in order to increase biodiversity in the scale of farms and landscape.

## **4. Factors influencing farmers' adoption of AF**

In farmers' point of view, whenever they have to decide to apply a new production model or not, they always consider on three aspects including: feasibility, profitability and acceptability (Franzel, 1999 quote from Swinkels and Franzel, 1997).

*Feasibility* means that whether farmers get enough knowledge to manage new technology and cultivation techniques or not; and do they have capital and necessary information to apply these technique. For *profitability*, farmers calculate whether applying new technique is more economically effective than other techniques that they can practice or not. *Acceptability* appears when farmers realize that advantages getting from these systems are higher than its disadvantages. Thus, acceptability consists of many other factors.

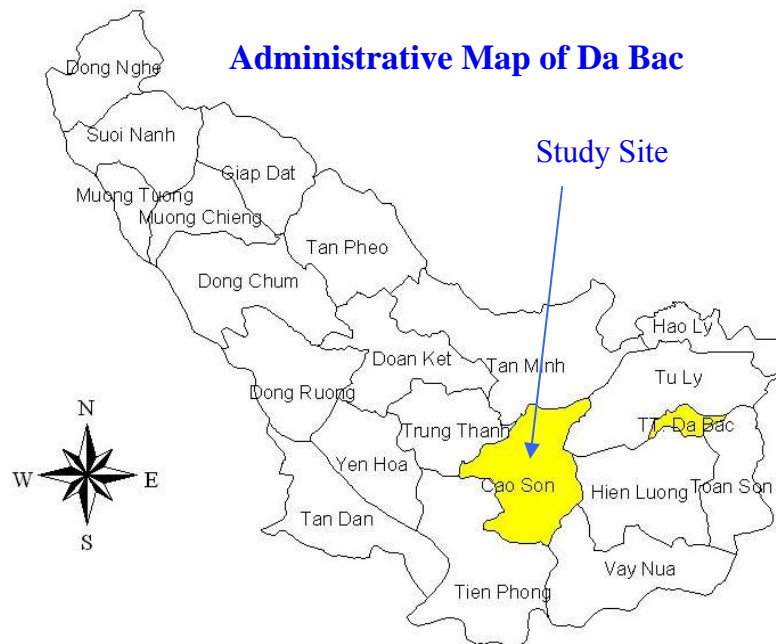
Feasibility includes support of government, experience of farmers, labor, land, and capital, etc. Profitability is explained by crop productivity, labor cost and so on. Acceptability concerns about environmental awareness, poverty, and gender issue, etc.

In summary, to make decision in applying a new technique like innovative AF systems, farmers have to consider all factors including internal family capital, external provisions as well as profit getting from new technique.

## V. CHARACTERISTICS OF STUDY SITE

### 1. Da Bac district

#### 1.1 Location and Natural Conditions



**Figure 2. Location of the Study Site**

Da Bac is a mountain district of Hoa Binh province, at elevation of 560m. The district locates along Da river, is of subtropical climate zone with the average temperature of  $23.50^{\circ}\text{C}$ , the humidity of 81%, the rainfall of 1,570 mm/year and affected by hydrographical mechanism of Da river.

Da river with 70 km of length within the district, the discharge of  $1,062 \text{ m}^3/\text{second}$ , consisting of 4 main flows and many small ones is an important source of water for Da Bac. Its area and reserves is about 8,000 ha and 9 billion  $\text{m}^3$  of water respectively. This is a potential for developing hydroelectric plant, tourism and fishing.

Total natural land of the district is as much as 81,894.4 ha.<sup>1</sup> Of which unused land occupies the largest area, followed by forest and specific land. Forest mostly is secondary one. Agricultural land is smallest.

The greatest resource of Da Bac is forest. Besides, limestone and granite also contribute remarkably to construction industry of Hoa Binh province.

#### 1.2 Social and Economic Characteristics

Da Bac is one of the poorest mountain districts of Hoa Binh province including 20 commune and 1 town, of which 16 is considered as particularly disadvantaged communes based on the categories of Program 135.

<sup>1</sup> Source: People's Committee of Da Bac district, 1999

About agriculture, grain crop production is of importance, accounting for 78% of agricultural land area and 80% of agricultural production output value annually. Industrial and fruit crops have a high potential however have not been exploited properly. Livestock raising is developed in household scale with the small number of buffalo, cattle and poultry. The contribution of animal husbandry to income then is little. Forestry is an important industry of the district; however forest exploitation is not reasonable. In recent years due to program 327, program 661 supplying capital for planting and protecting forest, newly planted forest area is increasing. Industry and cottage industry have not got an opportunity to develop because of poor infrastructure. Irrigation facilities are few in terms of number and small in terms of scale. Electric system is not spread all over the district. The system of agriculture service does not meet the requirements of production.

According to the census in 1999, the population of the district is about 48,366. Muong people are of the highest percentage accounting for 38.3%, followed by Tay, then Kinh, Dao and Thai. Over 90% of population lives in rural areas and works in agriculture.

The education level is low in general. Approximate 14% of children at schooling age does not go to school. 10% of population of working age is illiterate. Percentage of people at higher education level is very small, about 0.27% of working age. In recent years, thank to economic improvement together with government support, education is more considered and makes progress.

## **2. Cao Son Commune**

Cao Son is a particularly disadvantaged commune of Da Bac, being the beneficiary of Program 135. The commune has 9 hamlets, of which 3 hamlets Dao people live in and 6 hamlets for Muong, Tay and Kinh people.

### *2.1. Natural Conditions*

*Location:* Commune center is about 15 km far from district center to the East. It is bounded by Tan Minh commune in the North; by Hien Luong and Vay Nua communes in the South; by Tu Ly commune in the East; Trung Thanh and Tien Phong in the West.

*Terrain:* as a remote commune of Hoa Binh district, Cao Son has more than 80% of mountain and hill area, separated by many mountains and streams with a high slopping level of 35<sup>0</sup>-50<sup>0</sup>.

*Soil:* Total natural area of the commune is about 4,200 ha. Many places lack water for 4-5 months a year. Soil layer is 50-80 cm deep and of light to medium components, suitable for industry crops such as Cinnamon, *Styrax Tonkinesis*, or fruit crop like persimmon, apricot particularly for forest trees like bamboo and timber tree. Agricultural land area is very small, accounting for 3.4% of total natural land. Forest land but without woody trees is large, therefore, potential for forestry development is high.

*Vegetation:* There are plenty of precious timbers including *Fokienia hodginsii*, *Chukrasia tabularis*, etc. and bamboo. Besides, people grow some valuable trees such as cinnamon, *Styrax Tonkinesis*, *Aleurites montana* and medicinal plants

**Table 1. Land Use Status of Cao Son Commune**

No.	Type of Land	Area (ha)	Percentage (%)
<b>1.</b>	<b><i>Agricultural land</i></b>	<b>411</b>	<b>8.49</b>
1.1	<i>Annual crops</i>	296.8	72.21
1.2	<i>Mixed Garden</i>	35.2	8.56
1.3	<i>Perennial crop</i>	40.8	9.93
1.4	<i>Aquaculture</i>	38.2	9.29
<b>2</b>	<b><i>Forest land</i></b>	<b>2,332.7</b>	<b>48.18</b>
2.1	<i>Natural forest</i>	1,254.9	53.80
2.2	<i>Planted forest</i>	1,077.8	46.20
<b>3</b>	<b><i>Specific land</i></b>	<b>108.1</b>	<b>4.63</b>
<b>4</b>	<b><i>Residential land</i></b>	<b>83.13</b>	<b>0.02</b>
<b>5</b>	<b><i>Unused land and river</i></b>	<b>1,907.07</b>	<b>0.39</b>
	Total	<b>4,842</b>	<b>100</b>

*Source: Department of Agriculture and Rural Development, Da Bac district, 2003*

*Animal:* In the past, Cao Son has various animal species including bull, tiger, wild boar, wild buffalo, eagle, hill myna, pheasant, jungle fowl, and so on. However, after long time of hunting wild animals are becoming exhausted.

### *2.2. Economic Situation*

Agriculture and forestry production is of the transformation from self-sufficiency to commodity production.

*Agriculture:* The combination of corn cultivation, husbandry, forest and fruit trees plantation is quite popular in Cao Son. Main crops are corn, canna, cassava, red persimmon, and sugar cane. Main animals are buffalo, cattle, poultry and fish.

*Forestry:* Forest land was allocated to households for protecting and afforesting since 1994. Forest has been planted thank to Government programs 327, 661, 747. Deforestation for shifting cultivation almost does not happen anymore. However, forest protection is implemented in some places. Illegal forest exploitation still exists. The principal product exploited from forest is bamboo.

*Population:* Population of Cao Son is 3.627, of which working force accounts for 30%

### *2.3. Social Conditions*

*Education:* There is a high school located in commune center. Each hamlet has its primary school convenient for children. Because of many reasons, the quality of education however is poor. 80% of children of schooling age goes to school but drop-out and class repeating rate are still high. Therefore, percentage of students graduating secondary school is 40% only.

*Information and cultural activities:* Access to information and cultural activities is limited. Although near Hoa Binh hydroelectric plant, national electricity is provided here since. Until now, many hamlets have not had loudspeaker system yet.

*Health care:* There is only one clinic in the commune. Each hamlet has a nurse responsible for healthcare activity. In fact, medicine and treatment tools are very deficient so that disease protection and cure face many difficulties.

#### *2.4. Programs and Projects in Cao Son commune*

In the past, people lived largely on shifting cultivation and forest exploitation. Currently, due to many reasons like building Hoa Binh hydroelectric plant, land and forest allocation, the development of infrastructure and market economy, etc. agricultural production have changed. Area for swidden rice cultivation reduces. People are not allowed to cut forest for shifting cultivation and exploit the forest freely whereas infrastructure is improved, people have opportunities to access advanced technology, circulation of inputs and outputs is easier. Hoa Binh hydroelectric plant was built in 1979 then many Da Bac people had to move to other places for a reserves of 7,000 ha (Emigration happened in 14 out of 21 communes in Da Bac district). In 1995 because lives of emigrant people were too hard, Government enacted Decision 747 (popularly known as Project 747) to help them overcome difficulties.

Besides infrastructure improvement (road, electricity, clinic, irrigation, and land reclaiming), Government provided 5 millions dong to each household in order to develop fruit trees, cattle and fish raising. In 2002, Project continued to support each poor household with 7.5 millions dong and medium one with 5 millions (guided by Decision 472, completing in 2005). This project supported litchi, plum, bamboo; fertilizer, fish and cattle species, etc. Program 135 supported to particularly disadvantaged communes since 1999 in infrastructure and agricultural production (completing in 2005).

With the supports of Government and NGOs, Da Bac has developed many models of agricultural production such as model of fruit trees, model of AF, model of animal husbandry-crop cultivation. Authority organizations have opened technical training courses and provided a part of varieties and tools. Farmers by themselves have had many initiatives and tried to operate models successfully.

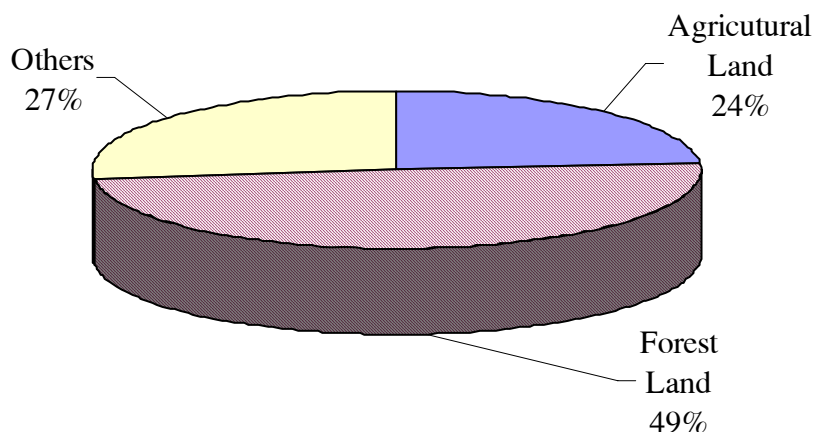
Clubs for agricultural extension activities were established in each hamlet since 2000. There are 30-50 members in each club. Monthly, agricultural extension officials help the clubs based on the requirements of club members. Club's fund is contributed by members and used for poor families as loans. Like this, clubs for agricultural extension activities play an important role in developing models suitable for real situation of the commune.

Among models mentioned above, AF model is still in initial period of application. There are few households applying this model. The question is that whether there is any obstacle for using AF model or not.

### **3. Seo Hamlet**

Seo hamlet belongs to Cao Son commune, Da Bac district, Hoa Binh province. Previously, it was managed by Tu Ly commune, then by Cao Son since 8 September 1998. Households are located scatteredly along road 433, and 2 km far from commune center and 6 km from district center to the Southwest.

The hamlet has 375.8 ha of natural land, of which 90 ha is agricultural land, 185 ha of forest land and 100.8 ha of others.



**Figure 3. Land Use proportion of Seo Hamlet**

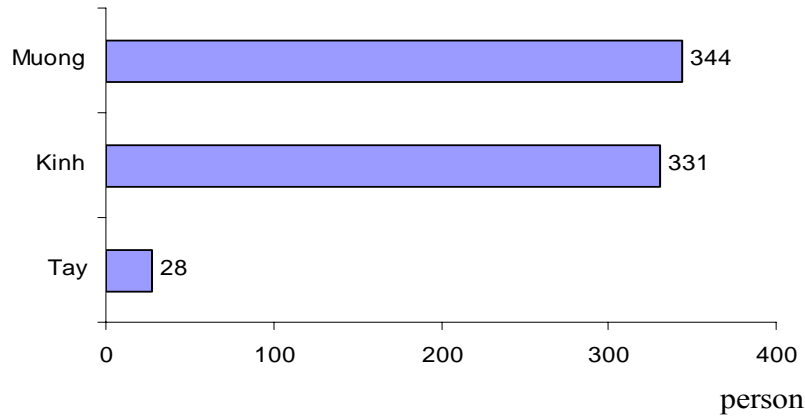
### 3.1 Agricultural and Forest Production

Main crop of Seo hamlet is corn with the largest cultivation area, stretching 3 km along road 433. Corn variety and fertilizers are partly supported by Government. There are two crops of corn per year. The summer crop begins in May or June and spring crop December or January (lunar calendar). Productivity of corn is 0.26 tones/ha. Standing in the second rank of cultivation area is fruit trees, particularly red persimmon. Previously, variety named Yen Thon was popular. However, this variety is being damaged by truck-eating worm. Some households change to variety named *Diospyros kaki* “Nhan Hau” whose colour is more attractive and taste is sweeter. There is 2 ha of paddy rice and no shifting cultivation. Besides, some projects of Government and NGOs help people to develop forest trees such as *Dendrocalamus brandisii*, Acacia. In the hamlet, there are total 40 ha of *Dendrocalamus brandisii*.

In terms of husbandry, principal animals are pig (about 400 heads) and poultry (2,300 heads). Also, each household feeds a buffalo or cow on average. Currently, land surrounding home is of agricultural use therefore people have to herd their animals to prevent them from damaging crops.

### 3.2. Population and Labor

There are 174 households with 703 people in Seo hamlet with the ratio of male and female is 0.52 : 0.48 respectively. 352 of 703 people is of working age, accounting 50%. The hamlet consists of 4 teams where 3 ethnic groups live in. Team 1 (38 households) is the home of Tay, Muong and Kinh. Team 2 (44 households) and team 3 (32 households) mainly include Muong people. Team 4 (58 households) is of Kinh group. Ethnic minority groups have live here for long time while Kinh have come since 1964 due to policy of “new economic region establishment” or 1962 after moving from Da river. Number of Muong people is the largest, then Kinh and lastly Tay.



**Figure 4. Ethnicity Components of Seo Hamlet**

### 3.3. Infrastructure

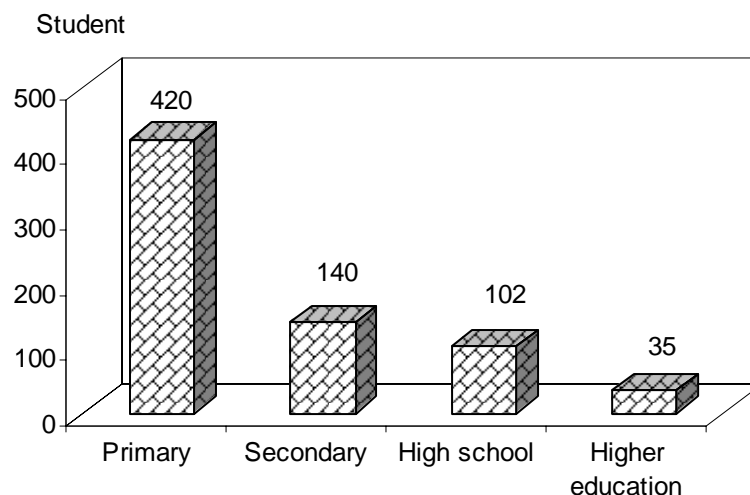
Seo hamlet has 3 km of road 433 covered tar. That is an important road connecting communes together and with Da Bac district center. The road facilitates local people's trading and accessing to developed regions.

Every household in the hamlet has used national electricity since 2003. The national electric system has brought people the light of development and opportunity of using electricity for production.

There is no market within the hamlet. The nearest market is situated in the center of Cao Son, 2 km from Seo hamlet. Market meets twice a week on Wednesday and Saturday. Cao Son market only serves the demand for consumer goods and vegetable retail selling, not for main agricultural products exchanging.

There is a nurse supplied with popular medicines in the hamlet. His ability is limited, only curing simple diseases.

The hamlet has a primary school. Students of secondary and high education levels have to study in the centers of Cao Son commune or Da Bac district.



**Figure 5. Pupil/Student Distribution at different levels of education in Seo Hamlet 2004**

### 3.4. Living Conditions

With the supports of some policies, programs and projects of Government, living conditions of Seo people has been improved. Only 9% of total households are poor. Most

families have TV set so that they can receive information. There are only 3 houses on stilts, the rest are tiling houses. Almost all households live around road 433 thus they have no difficulty in traveling or agricultural product transportation. However, their lives are not stable. In recent years, the price of *Diospyros kaki* reduces and crops have diseases, therefore local people's income is affected. Per capita income is 2.5 millions VND a year.

### 3.5. Two Typical Model of AF in Seo Hamlet

- Mr. Xa Van Qua (54 year-old, Muong people):
  - Fruit trees: 200 trees of *Diospyros kaki* named Yen Thon available for harvest (up to 20 millions VND/year)
  - Cash crops: about 2 ha of corn, canna, cassava, generating 15-20 millions VND/year
  - Forest trees: about 2 ha of *Dendrocalamus brandisii*, generating 10 millions VND/year
  - Fish raising and animal husbandry
- Mr. Nguyen Hong Quang (50 year-old, Kinh people):
  - Fruit trees: 150 trees of red *Diospyros kaki*, bringing 15-20 millions VND/year
  - Cash crops: corn, soybean, peanut, generating 15 millions VND/year
  - Medicine plants: 1000 trees of 5 year-old cinnamon, not yet harvested
  - Forest trees: 1.5 ha of bamboo, generating 8-10 millions VND/year

These models of AF are implemented mainly with their own capital and partly with the support of project 472 (support to emigrant people). Besides, they also were provided with fruit tree varieties by program 135 (*Household interview, 2004*).

## VI. CHARACTERISTICS OF HOUSEHOLDS SURVEYED

### 1. Age of household heads

In Seo hamlet, the age of household heads is very different (24-72 year-old), mostly in 31-60 year-old (accounting for 77,8%). The average one is 44 year-old. This is the age of good health, experience and maturity in production decision.

**Table 2. Age of Household Heads**

Age	HH applying AF		HH not applying AF		Total	
	n	%	n	%	N	%
< 30	2	7.4	3	16.7	5	11.1
31 - 60	22	81.5	13	72.2	35	77.8
> 60	3	11.1	2	11.1	5	11.1
Total	27	100.0	18	100.0	45	100.0
Mean	43.6		44.4		43.9	
T Test	Df = 42; Significance = 0.813					

Source: *Household Interview, 2004*

HH: Household

AF: AF

T test shows that there is no difference between the age of household heads applying and not applying AF.

## 2. Education Levels of Household Head

Education level of household heads strongly fluctuates from grade 1 to grade 12. Average level is grade 7 (secondary school). Their education level and diligence is barely enough for them to acquire and apply new production techniques.

**Table 3. Education Levels of Household Heads**

Education levels	HH applying AF		HH not applying AF		Total	
	n	%	n	%	N	%
Primary school	10	37.0	3	16.7	13	28.9
Secondary school	14	51.9	10	56.6	24	53.3
High school	4	11.1	5	27.8	8	17.8
Total	27	100.00	18	100.00	45	100.00
Mean	6.22		7.89		6.89	
T Test	Df = 43; Significance = 0.031					

*Source: Household Interview, 2004*

By T test, it can be seen that education level of household heads with AF is higher than that of household heads without AF at the significance of 95%.

## 3. Household Size

Number of members is quite different among households in Seo hamlet (3-8 members/household). The average size is 4.8 people/household, higher than other regions. This is a signal of abundant labor force.

**Table 4. Household Size**

Number of household member	HH applying AF		HH not applying AF		Total	
	n	%	n	%	N	%
< 4	13	48.1	6	33.3	19	42.2
5 – 6	13	48.1	9	50.0	22	48.9
> 7	1	3.7	3	16.7	4	8.9
Total	27	100.0	18	100.0	45	100.0
Mean	4.70		4.94		4.80	
T Test	Df = 43; Significance = 0.528					

*Source: Household Interview, 2004*

T test shows that there is no difference in populations size between AF application household and non-application ones at the statistic significance 95%.

## 4. Household Labor

Main laborers are the people who directly works regardless they are of or out of working age as stipulated by Government. Like this, in Seo hamlet number of laborers in each household ranges from 0 to 5 with the average of 2.32 laborer/household.

**Table 5. Household Labor**

Number of main laborer	HH applying AF		HH not applying AF		Total	
	n	%	n	%	N	%
1	1	3.7	7	38.9	8	17.8
2 - 3	17	63.0	9	50.0	26	57.8
> 4	9	33.3	2	11.1	11	24.4
Total	27	100.0	18	100.0	45	100.0
Mean	2.65		1.83		2.32	
T Test	Df = 43; Significance = 0.015					

Source: Household Interview, 2004

T test affirms the difference in number of main laborers between two groups. AF application households has more laborers (2.56 laborer/household) than non-application ones (1.83 laborer/household) at the significance of 95%. The scale of AF model is small, do not attract a large quantity of laborers. This situation happens not only in Seo hamlet but also in many other places in the country.

## 5. Land Use

Most households have three types of land allocated by Decree 64/CP<sup>2</sup> and Decree 163/CP<sup>3</sup>: (i) home garden; (ii) forest garden; và (iii) and swidden land. Each household has 1-4 swidden plots for cultivating cash crops. These plots are scattered and the farthest one is 1.5 km far from home (about a haft hour by walking). Some households plant fruit trees such as longan or persimmon together with cassava, corn and canna. However, the plots are small and people are not familiar with planting perennials in the land where they merely have grown annual crops to meet their short-run demand for food therefore AF is not popularly applied.

T test shows that no difference in areas of the above three land types between two household groups. However, some households with forest land near home applying AF model gain high economic efficiency as well as can protect forest. At present, there are two types of AF model in Seo hamlet (can be known as transformed AF models)

- *Households with forest land near home:*
  - On the hilltop (Natural forest, *Dendrocalamus brandisii*, *Chukrasia tabularis*, Cinnamon),
  - On the hillside (*Diospyros kaki*, longan, litchi, grape fruits, papaya, combined with corn, cassava),
  - Poultry raising (Chicken, Duck).

<sup>2</sup> Decree 64/CP: Allocate agricultural land to household for agricultural production

<sup>3</sup> Decree 163/CP: Allocate forest land to household for forestry

**Table 6. Land Use Structure of Households**

Type of land	HH applying AF		HH not applying AF		T Test
	Average area (m <sup>2</sup> )/HH	$\delta$	Average area (m <sup>2</sup> )/HH	$\delta$	
Home Garden	4905.56	3520.74	4905.56	3583.208	df=43;Sig=0.181
Forest Garden	2194.12	3159.26	2194.12	1724.265	df=42;Sig=0.385
For Cash Crop	3700.00	4514.81	3700.00	3267.847	df=43;Sig=0.102
Total per HH	10.952.94	11.194.81	10.952.94	6240.805	df=42;Sig=0.888

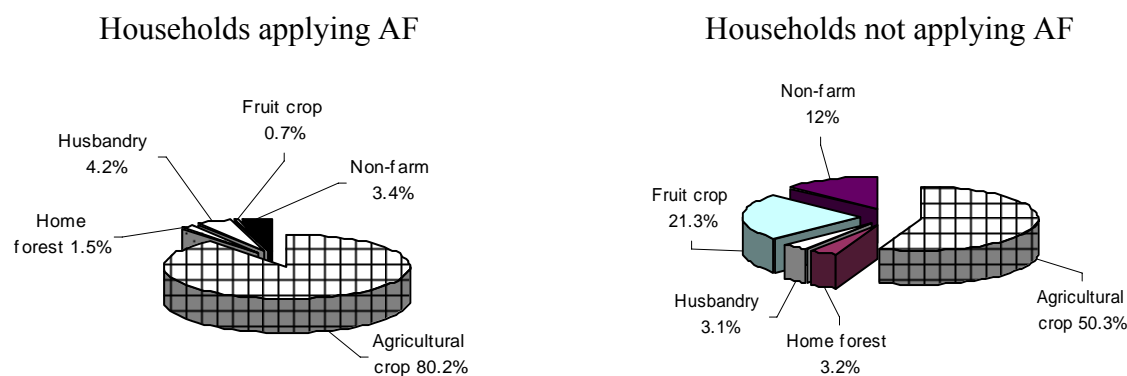
Source: Household Interview, 2004

- Households without forest land near home:
  - On the hillside (*Diospyros kaki*, longan, litchi, grape fruits, papaya, combined with corn, cassava),
  - Poultry raising (Chicken, Duck).

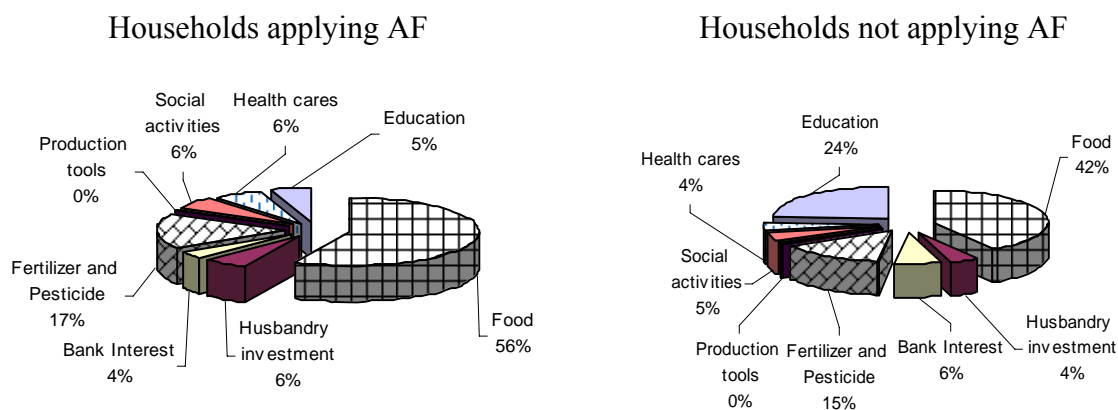
### 6. Income and Expenditure

Two groups have a similar structure of income and expenditure. Income is from “agricultural crops”, “fruits”, “animal husbandry”, “home forest” and “non-farm activities”. Income of AF application households from most sources is higher than that of non-application ones at the significance of 95%, excepting income from agricultural crops.

List of expenditure items includes food; education; health cares; social activities; productive equipments; fertilizer and pesticides; bank interest and investment in husbandry. AF model application households spend on food less and on education and bank interest more than another one.



**Figure 6. Income of Households**



**Figure 7. Expenditure of Households**

## VII. THE IMPACT OF AGRICULTURAL EXTENSION ON AF APPLICATION

AF models currently applied in Seo hamlet are transformed ones. They come to the hamlet through agricultural extension programs and projects. Possibly say that these programs affect the application of AF models very much.

### 1. Programs and Organizations of Agricultural Extension in Study Site

Agricultural extension programs and organizations carry a great role in transferring techniques for and training about agricultural production in uplands. As mentioned above, there have been many projects and programs in Seo hamlet. Most of them aimed to develop agriculture and forestry. Agricultural extension organizations are one of the actors who directly conducted and implemented.

Since 1991, agricultural extension programs have supported local people in terms of cash, crop varieties, technical training. PAM project provided capital, crop varieties of *Dendrocalamus brandisii*, Eucalyptus, Acacia in 1991. In September 1998, project 747 supported varieties such as litchi, plumb, mango, longan, and 7000 dong a tree for feeding. During 1998 and 1999, project 747 organized 6 two-day training courses for disseminating information and cultivation techniques for local people. Besides that, project 327 of “afforesting bare land and bold hill” also supplied varieties of *Dendrocalamus brandisii* in 2001.

Under the development of technology and science, the need for applying advanced techniques of agricultural and forestry production is increasing. Correspondently, club of agricultural extension was established in the hamlet in June 1999 with the main function of transferring technique and science information to farmers. This is one of two agricultural extensions clubs in Cao Son commune. Members voluntarily adhere in the club. At the beginning, the club had 25 members and this number goes up to 45 at present. Regularly, members meet twice a month with the support of district or commune agricultural extension officials in contents, experience exchange, and information relating to agriculture and forestry. Members make a fund in order to loan poor families without interest. Currently, the balance of fund is 7 millions.

Besides agricultural extension programs and clubs, other local organizations including Farmers' association, Women's association, Youth's union and Aged's union also open technical training courses for their members. However, these activities are not remarkable.

## 2. Supports from Agricultural Extension Activities

Both AF application households and non-AF application ones were supported by agricultural extension activities. AF application households received greater benefit than another; however the difference is not significant (significance 0.65).

The below table illustrates that agricultural extension organization should pay more attention to supporting inputs and researching market for outputs.

**Table 7. Supports from Agricultural Extension Activities**

No.	Support Activities	HH not applying AF		HH applying AF	
		WAI	No. of HH	WAI	No. of HH
1	Market information supply	0.52**	5	0.67***	4
2	Visit of AE officials	0.63**	4	-	-
3	Technical information supply	0.87***	2	0.94***	1
4	Inputs support	0.74***	3	0.84***	3
5	Technical training	0.90***	1	0.86***	2
	Mean	0.732***		0.668**	
	Statistical significance	df = 4 ; Significance = 0.65			

Source: Household Interview, 2004

WAI: Weigt Average Index

AE: Agricultural Extension

\*: Weak impact (0.1-0.3)

\*\* : Neutral impact (0.31-0.67)

\*\*\*: Strong impact (0.68-1)

## 3. Farmers' Evaluation on Agricultural Extension Activities

One reason for the success of AF model is agricultural extension activities. Taking these activities regularly will encourage the development of AF model and vice visa.

Table 8 shows that among 45 household interviewed, only few households received support from agricultural extension activities and the efficiency is evaluated as poor and average. Projects or programs have just provided technical training by theory neither by practice nor successful model visit. As a result, many household did not apply the right production procedure leading to low productivity. The main cause of this situation is that projects and programs did not understand conditions of local people and their needs. Also, the aspect of market was not considered properly. For example, the variety of *Diospyros kaki*,

supported by project 747 was not suitable for local soil and the output was not able to sell. This affair abated the belief of local people in Government programs and projects.

It is recommended that agricultural extension activities be close to reality, provide enough technical and market information. Besides that, agricultural extension activities should consider the sustainability of model rather than the extension of model.

**Table 8. Impact of Agricultural Extension Activities in Study Site**

Items	Level of Acquirement							Level of Utility						
	n	%	Much	Average	Little	WAI	Level	n	%	Much	Average	Little	WAI	Level
Market information supply	5	11.11	4	0	1	0.86***	Much	4	8.89	1	3	0	0.75***	Quite much
Visit of AE officials	–	–	–	–	–	–	–	6	13.33	2	4	0	0.78***	Quite much
Technical information supply	24	53.33	16	8	0	0.89***	Much	24	53.33	19	5	0	0.93***	Much
Inputs support	26	57.78	3	18	5	0.64**	Average	29	64.44	15	12	2	0.82***	Much
Technical training	21	46.67	8	12	1	0.78***	Quite much	21	46.67	14	7	0	0.89***	Much
<b>Total</b>	<b>45</b>							<b>45</b>						
Items	Level of Application							Level of Satisfaction						
	n	%	Much	Average	Little	WAI	Level	n	%	Much	Average	Little	WAI	Level
Market information supply	4	8.89	0	1	3	0.38**	Too little	5	11.11	0	1	4	0.37**	Little
Visit of AE officials	6	13.33	0	3	3	0.49**	Too little	6	13.33	2	2	2	0.66**	Average
Technical information supply	24	53.33	0	14	10	0.52**	Little	24	53.33	3	13	8	0.59**	Average
Inputs support	29	64.44	1	14	14	0.5**	Little	29	64.44	5	10	14	0.55**	Average
Technical training	21	46.67	0	12	9	0.51**	Little	21	46.67	3	11	7	0.59**	Average
<b>Total</b>	<b>45</b>							<b>45</b>						

Source: Household Interview, 2004

#### 4. Information Sources on AF Application for farmers

Most of 31 interviewed households answered that they know the “AF” term through radio and newspapers. However, they have not understood clearly the meaning of this term. Some of them said that “AF” is combination of agriculture (grow crops) and forestry (grow fruits and bamboos) production.

**Table 9. Main Information Sources on AF Application**

Sources	Ranking 1	Ranking 2	Ranking 3	Ranking 4	WAI	Average of ranking	Percentage (%)
Newspapers, books and other documents	8	6	1	0	0.85***	1	83.3
Medias	4	3	6	2	0.65**	3	77.8
Stated organizations	2	1	3	1	0.64**	4	38.9
Successful households	6	8	1	0	0.83***	2	77.8

Source: Household Interview 2004

Table 9 shows that the major source information of AF model is newspapers (WAI = 0.85). 15 households among 18 applying households get information from this source, accounting for about 83.3%. They are hard working and curious to new technology. In order to establish a successful model, they find and buy books by themselves to study cultivation technique.

One of the most important sources is successful households. Seo people also gets information from this source, clearly proved by WAI (0.83). As mentioned above, activities of extension are not much, so that the role of stated organizations such as agricultural and forestry extension and social associations is not highly appreciated in terms of supplying information.

#### VIII. FACTORS INFLUENCING FARMERS’ ADOPTION OF AF MODELS

##### 1. Factors Influencing Farmers’ Adoption of AF models

Research team has interviewed 45 households on factors influencing the application of AF model and evaluated their influence. There are three main factor groups: natural, economic and social condition.

Table 10 presents natural condition group. It does not influence on farmers’ decision. WAI are 0.46 and 0.45 respectively for not applying and applying households. For not applying group, the most important factor is new variety (85% agreed and WAI = 0.62). Many households wish to have new variety of *Diospyros kaki* (named *Nhan Hau*). They said that if they have they will intercrop persimmons with corn. Meanwhile, applying group said that the most important factor is pest and disease with WAI is 0.68.

**Table 10. Natural factors influencing on farmer's adoption of AF**

Criteria	Being affected		Percentage		WAI	
	Not Apply	Apply	Not Apply	Apply	Not Apply	Apply
Soil quality	18	8	66.67%	50.00%	0.42**	0.35**
Water source	15	8	55.56%	50.00%	0.42**	0.37**
New variety	23	9	85.19%	56.25%	0.62**	0.40**
Pest and Disease	21	14	77.78%	87.50%	0.39**	0.68***
<b>Total</b>	<b>77</b>	<b>39</b>	<b>71.30%</b>	<b>60.94%</b>	<b>0.46**</b>	<b>0.45**</b>

Source: Household Interview 2004

In 2003, edible cannas were totally died; as a result this season was of failure. Some agricultural officials have taken samples for researching. But until now results have not informed yet and local people still do not know the reason of crops death. In addition, persimmons were destroyed by worm. Therefore, not applying households concerns much more on new variety than applying group; they hope that new variety will give high productivity. Applying households also concern on new variety but not so much (WAI = 0.40). Pest and disease are much concerned by applying group. Both groups said that water does not influence on applying model, WAI are 0.42 and 0.37 for not applying and applying households, respectively. It is easy to understand because Da river runs through Da Bac district with area of 8,000 ha and a reserves of 9 billion cubic meters.

**Table 11. Economic factors influencing on farmer's adoption of AF**

Criteria	Yes		Percentage		WAI	
	Not apply	Apply	Not apply	Apply	Not apply	Apply
Increasing income	27	16	100.00%	100.00%	0.92***	1***
Family Labor	10	7	37.04%	43.75%	0.24*	0.42**
Capital	24	6	88.89%	35.29%	0.75***	0.19*
Diversifying products	12	11	46.15%	68.75%	0.36**	0.50**
Decreasing risk	20	15	74.07%	93.75%	0.54**	0.62**
<b>Total</b>	<b>93</b>	<b>55</b>	<b>69.40%</b>	<b>67.90%</b>	<b>0.56**</b>	<b>0.54**</b>

Source: Household Interview 2004

Table 11 presents economic condition factor group influences decision on applying AF model. It is easy to see that for both groups, economic condition factors fairly influences with approximated WAI are 0.56 and 0.54 for not applying and applying groups, respectively.

All interviewees said that increasing income influences strongly on applying model (WAI are 0.92 and 1).

Households without AF said that their capital is the second most important factor influences applying AF model, WAI = 0.75. In fact, applying model requires a lot of money in the basic construction phase. However, for applying household group, this factor does not influence significantly, WAI = 0.19. In general, applying household group is better-off, they do not worry about capital vary much.

Most of households thought that applying AF model means that they will intercrop different types of plants, therefore, if risk happens, it hardly loses all. AF thus helps to reduce risk. Among economic condition factor group, decreasing risk has the highest influence compared to other factors, WAI are 0.54 and 0.62 for not applying and applying households, respectively. For both groups, labor factor does not influence strongly, because number of people in their families are not different.

**Table 12. Social factors influencing on farmer's adoption of AF**

Criteria	Yes		Percentage		WAI	
	Not apply	Apply	Not apply	Apply	Not apply	Apply
Food security	26	14	100.00%	87.50%	0.90***	0.69***
Market	24	14	88.89%	87.50%	0.77***	0.73***
Successful households	24	13	88.89%	81.25%	0.70***	0.73***
Training and Extension	20	9	74.07%	56.25%	0.50**	0.45**
Input support	25	9	92.59%	52.94%	0.64**	0.29*
Capital support	23	9	85.19%	52.94%	0.59**	0.33**
Information	22	16	81.48%	94.12%	0.56**	0.72***
Infrastructure	11	8	42.31%	47.06%	0.24*	0.37**
Local organizations	11	10	40.74%	58.82%	0.23*	0.39**
Land property right	12	8	44.44%	47.06%	0.35**	0.37**
Cattle Sabotage	2	2	7.41%	11.76%	0.06*	0.06*
<b>Total</b>	<b>200</b>	<b>112</b>	<b>67.80%</b>	<b>61.20%</b>	<b>0.50**</b>	<b>0.46**</b>

*Source: Household Interview 2004*

There is no difference for in social condition factor group between applying and not applying model households, WAI are 0.5 and 0.46, respectively. Food security strongly influences both groups, ratio of people selected and WAI are high (100% of households applying models selected and WAI = 0.9; 87.5% of not applying and WAI = 0.69). One of the most important motivations to applying AF model is to supply enough food for their family. On the other hand, market is the second most important factor, it is clearly shown in WAI of

0.77 for not applying group and 0.73 for applying group. In Seo hamlet, market of some agricultural products such as persimmon, corn, litchi, and apricot are not stable, excepting sugar-canes are consumed by a processing factory. Agricultural products were sold to collectors at low price.

In particular, it is not easy for farmers to make decision when they are not sure about the result. However, if their neighbors did something successfully, they probably follow. It is presented through percentage of agreed answerers and WAI; these are 88.89% and 0.7 for not applying group and 81.25% and 0.73 for applying group. Besides, information also influences their decision strongly. WAIs of input material and capital support of not applying group are higher than that of applying group. Applying group is richer than not applying group, so that these factors less influences than other factors. Similarly, cattle sabotage has very weak influence, WAI is 0.06 for both groups. In Seo hamlet, cattle sabotage does not happen usually, local people can control this action. In addition, Seo hamlet is located near the road, therefore it is easy to sell agricultural products. And 26-3 Sugar Company also collects sugar canes. Like this infrastructure does not influence farmers' decision (WAI are 0.24 and 0.37 for not applying and applying groups).

## 2. Main Factors Influencing Farmers' Adoption of AF models in the locality

There are 20 factors influencing on applying AF models in Seo hamlet. These are natural, economic and social factors such as income, expenditure, support from state organization, etc. The purpose of this part is to identify which factors influence farmers' decision strongly.

**Table 13. Factors influencing AF Model Adoption in Seo hamlet**

<b>Sign</b>	<b>Factors</b>	<b>Sign</b>	<b>Factors</b>
<b>soil_na</b>	Soil quality	<b>suc_na</b>	Food security
<b>water_na</b>	Water source	<b>mark_na</b>	Market
<b>hyb_na</b>	New variety	<b>succ_na</b>	Successful households
<b>ins_na</b>	Pest and diseases	<b>ext_na</b>	Training and extension
<b>inc_na</b>	Increasing income	<b>kind_na</b>	Input material support
<b>lab_na</b>	Labor	<b>cash_na</b>	Capital support
<b>catt_na</b>	Cattle sabotage	<b>info_na</b>	Information
<b>farm_na</b>	Capital	<b>infr_na</b>	Infrastructure
<b>div_na</b>	Diversifying products	<b>loc_na</b>	Local organizations
<b>re_na</b>	Decreasing risk	<b>land_na</b>	Land property right

*Source: Household Interview 2004*

**Table 14. Matrix of Factors Influencing AF Application in Seo Hamlet**

HHs' ID		soil_na	wate_na	hyb_na	ins_na	inc_na	lab_na	catt_na	farm_na	div_na	re_na
	Pearson Correlation	-0.09	-0.05	-0.28	0.38	0.23	0.20	-0.01	-0.61	0.16	0.10
	Sig. (2-tailed)	0.58	0.76	0.07	0.01	0.14	0.20	0.94	0.00	0.30	0.52
	N	43	43	43	43	43	43	44	44	42	43
		suc_na	mark_na	succ_na	ext_na	kind_na	cash_na	info_na	infr_na	loc_na	land_na
	Pearson Correlation	-0.36	-0.07	0.04	-0.05	-0.44	-0.32	0.22	0.17	0.23	0.02
	Sig. (2-tailed)	0.02	0.68	0.82	0.76	0.00	0.03	0.16	0.28	0.14	0.90
	N	42	43	43	43	44	44	44	43	44	44

Source: Household Interview 2004

Table 14 shows that there are only 5 factors among 20 factors are related to farmers' decision in applying AF models. Those are pest, capital, food security, capital support and input material support. In order to identify the influence level of these factors, research group used logic function

\* Logic function

$$P(Y_i = 1|X_i) = \frac{\exp(\lambda_i \beta)}{1 + \exp(\lambda_i \beta)}$$

Factors	Coefficient	Standard division	Audit Wald	Free level	Sig.	Exp(B)
farm_na	-4.5443	1.5678	8.401	1	0.00375	0.0106
div_na	2.99191	1.54161	3.767	1	0.052286	19.924
kind_na	-3.8548	1.76265	4.783	1	0.028745	0.0212
limitation	1.87034	0.92658	4.075	1	0.043534	6.4905

Result shows that there are only three factors that real influence farmers' decision. They are capital, diversifying products, and input material support. Minus (-) means not applying households, and plus (+) is applying households. In Seo hamlet, major factors which preventing farmers form applying AF models are the shortage of capital and input material support. For apply households, group diverse products is main factor encourage to maintain AF model.

### 3. Potentials and Constraints in Developing AF Models in Locality

The researchers group also asked farmers about the possibility of extending and developing AF models in local site. According to most households (40/45 households), Seo hamlet is fully potential to develop this model. The following table shows some potentials and constraints in developing/extending AF models in locality.

**Table 15. Potentials and Constraints in Developing AF Models in the Locality**

Factor	Number of answerers	Rate (%)
<b>Potentials</b>		
Suitable soil, natural condition	37	48.7
Organizations' help	11	14.5
Geographic position, infrastructure	17	22.4
Human factor	10	13.2
New seed	1	1.3
<b>Total</b>	<b>76</b>	<b>100</b>
<b>Constraints</b>		
Output	16	18.4
Difficulties in capital	21	24.1
Pest, limited soil	21	24.1
Diverse difficulties (technology, fertilizer, seed)	19	21.8
Farmers' awareness	7	8.0
Infrastructure	3	3.4
<b>Total</b>	<b>87</b>	<b>100</b>

*Source: Household Interview 2004*

According to table 15, it can be found that favorable soil and natural condition are decisive factors to develop AF models in locality with 37 answerers (48.9%). Many farmers interviewed said that soil here is fertile and suitable for development of persimmon and corn. Besides, weather condition is also favorable for development of some kinds of plants. Remarkably, other factors such as support of organizations, new variety or human factor have the fairly low proportion (correlatively, accounting for 14.5%, 1.3%, and 13.2%). These factors depend on human. Therefore, for farmers, extension of models is not decided by man but mainly on objective factors such as soil and natural resources.

It is positive to see that farmers' awareness is not a constraint. Only 8% of answerers considers this factor as a constraint. Infrastructure such as road and processing plants is quite developed with only three people said that it is a constraint, accounting for 3.4%. Meanwhile

17 farmers, accounting for 22.4%, think that infrastructure is in favorable condition. Farmers said that their biggest difficulties are capital, pest and soil. For them, the initial expenditure for setting up an agroforestry model is relatively high. Therefore, when being interviewed, about 21 respondents, accounting for 24.1%, said that capital is a big obstacle for them, this number for pest and soil is 21, accounting for 24.1%. Although soil is suitable for many kinds of plants such as corn and persimmon if farmers wish to practice this model, they must have a large area of land. Many households expect to enlarge planting area but they do not have enough land so they can not carry out. Besides, a lot of land here is not fertile; it is thus so difficult for them to apply AF

## **IX. CONCLUSIONS AND RECOMMENDATIONS**

### **1. Conclusions**

- \* Number of households applying AF models in Seo hamlet is 174. AF models here can be divided into two categories (i) households with forestry land near their house, AF model is the combination of natural forest, forestry plant, fruit tree intercropped with cash crop and cattle raising; (ii) households with forestry land far from their house, the model is fruit tree intercropped with cash crop and cattle raising.
- \* There is no remarkable difference in the age, family size, land and income sources between two household groups (applying and not applying AF model). However, household group that applies this model has higher income and education level than that of non-application group.
- \* Many agricultural/forestry extension programs were carried out in the study site through AF practices. Agricultural extension programs mainly supplied technical information and training but did not pay attention to market study and input support. Moreover, the operation of programs was not regular and equal between different areas in the hamlet.
- \* The efficiency of agricultural/forestry extension programs is low. The reason is that farmers' detailed situations and expectations were not found out. Those programs only focused on model extension but not on its sustainability. Farmers do not trust very much in the efficiency of agricultural extension programs because agricultural products are difficult to be sold.
- \* Main information sources of agricultural models are materials, books, newspapers and also successful model of other households in the hamlet.
- \* The main factors promoting farmers' decision in applying AF models are increasing income, decreasing risk, ensuring food security and the successful households.
- \* The main factors preventing farmers from applying AF models are new variety, capital and input support shortages, pest, unstable price of products.
- \* The factors strongly influencing AF practice are diversifying products, input support and capital of households.

\* Soil proper for agricultural production, favorable geographic position and good infrastructure are advantages for applying AF models in the hamlet. However, it is necessary to solve some difficulties in capital, market, crop variety to develop the models.

## **2. Recommendations**

To develop and extend AF models in the local area, it is crucial to carry out following solutions:

- The credit agencies should facilitate farmers, especially poor farmers in accessing capital. Additionally, it is necessary to disseminate information of capital sources and loan procedures. Capital should be provided in both cash and kind.
- The activities of agricultural/forestry extension programs must be carried out more regularly. Opening many training courses on new production technologies and post-harvested preservation technologies. Organizing visits to successful AF models. Organizing community activities, in which farmers who well practiced agricultural models will exchange their experience with other farmers in the hamlet. Before carrying out any agricultural extension program, it is essential to understand concrete socioeconomic conditions as well as farming habits and indigenous knowledge of farmers to have a sustainable development.
- Setting up information channels about market for products; Setting up groups or consumption cooperatives to avoid being paid at low price.
- Setting up co-operatives providing inputs under the help of district agricultural extension office to support crop and animal variety as well as other inputs of production.

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APPENDIX. FARMERS' EXPECTATION ON EXTENSION ACTIVITIES

No.	Expectation	Number of households
1	Technique training	35
2	Input support (capital, seed, fertilizer)	45
3	Seeking output for local products	13
4	Extension workers paid attention to households, visiting the effective model	11
5	Establishing seed and fertilizer agents	5
6	Disseminating information of capital sources	4
7	Testing soil quality	3

*Source: Household Interview, 2004*