SOUTHEAST ASIAN NETWORK FOR AGROFORESTRY EDUCATION

Vietnam Network for Agroforestry Education - VNAFE

Agroforestry Practical Models in Vietnam

Forest Garden – Binh Thuan

Mixed Garden - Daklak

Cashew – Annual crop - Daklak

Agroforestry Landscape - Daklak

Agroforestry landscape - Thai Nguyen

VAC- Binh Duong

2008

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Summary of Documentation of Agroforestry Practices in Vietnam

The objectives of this mission

- Analyze and document lessons learned from the field of agroforestry practices, including good points and challenges as well as its effectiveness.
- To produce appropriate materials/documents to share in the network for teaching and learning in Agroforestry

The project contributes towards the objectives and outputs of 'The Southeast Asian Network for Agroforestry Education – SEANAFE Phase II: "Sharing knowledge on markets, landscapes, and environmental policies"

Institutions who take charge of this task

Three Institution partners of VNAFE have carried out this project:

- Faculty of Forestry of Thai Nguyen Agriculture and Forestry University.
- Faculty of Agriculture and Forestry of Tay Nguyen University
- Faculty of Forestry of Nong Lam University in Hochiminh City

The region of study

The study to survey and document agroforestry practices which have been implemented in the three ecological regions of Vietnam:

- In the Northern Mountainous: Thai Nguyen Province
- In the Central Highlands: Dak Lak and Dak Nong Provinces
- In the South – Eastern: Binh Thuan and Binh Duong Provinces

Study time and location

The project was carried out during the period of December 2006 and May 2007 in 3 ecological zones in the Northern, Central and Southern including provinces of Thai Nguyen, Daklak, Binh Thuan and Binh Duong

Methodology

In fact long time practice in cultivation, farmer has had a lot of indigenous knowledge in land use for each ecological zone and also combining with technical knowledge transferred; they have adapted appropriate agroforestry models to their natural condition. Therefore in order to documenting these practices; interview, questionnaire, economic analysis (CBA) tools applied to find out, analyze aspects of model such as environment, socio-economic, techniques and also effectiveness, challenges of its model.

Models of agroforestry documented

Total, there are 07 models of agroforestry practices surveyed and documented in three main ecological – human regions in Vietnam including in the Northern, Central Highlands and Southern. Bellows are the titles of models were described, analyzed:

1. Agroforestry Model: Coffee – Pepper – Annual crop in Hoa Thuan Commune, Buonmathuot City, Dak Lak Province
2. Agroforestry Model: Cashew – Bean – Maize in Easo Commune, Eakar District, Daklak Province

3. Agroforestry Landscape Model: Natural and plantation forests – Industry trees, annual crop and husbandry in Cu Pui Commune, Krong bong District, Dak Lak Province
4. Agroforestry Landscape Model: Natural and plantation forests – tea, paddy in Khuon Village, Phuc Xuan Commune, Thai Nguyen City
5. Agroforestry Model: Plantation – Fruit trees – Annual crop – Husbandry in Bac Thanh Village, Quyet Thang Commune, Thai nguyen City
6. Agroforestry Landscape Model – Forest Garden. Lac Hoa Village, Lac Tanh Commune, Tanh Linh District, Binh Thuan Province
7. Agroforestry Model – VAC: Garden – Fishpond – Pigsty in Binh Duc Village, Binh Nham Commune, Thuan An District, Binh Duong Province

All these documented agroforestry models published in the Web site of VNAFE in both languages Vietnamese and English: ***http://www.socialforesty.org.vn***

AGROFORESTRY MODEL: COFFEE – PEPPER – DURIAN – ARECA – ANNUAL CROPS – Hoa thuan commune, Buonmathuot city, Daklak province

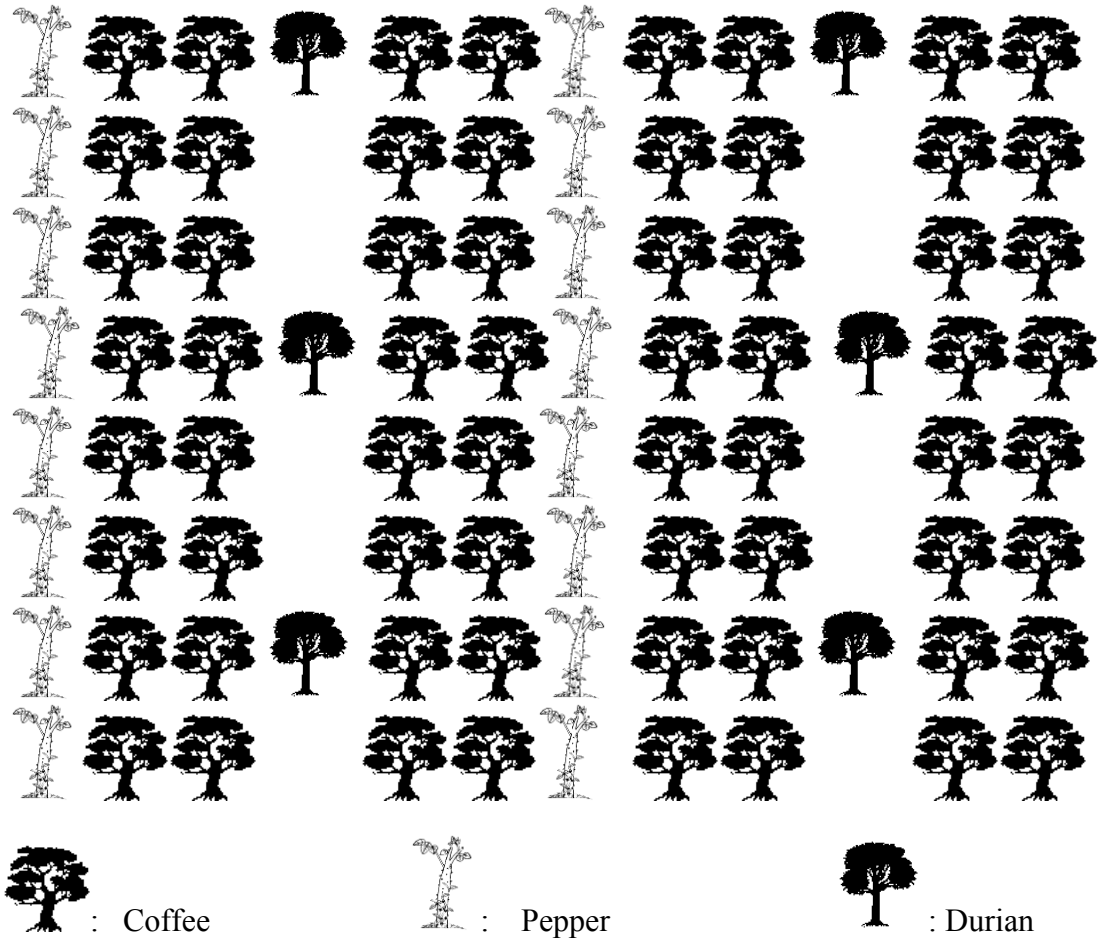
General information	
Model name	**Coffee - Pepper - Durian - Areca – Fruit tree – annual crops**
UTM position (GPS)	X: 0187982; Y: 1412389
Scale of area (ha)	3 ha
Farmer name: **Dương Văn Hùng** 45 year olds	 *Exchange of views between a farmer and students on technique of Agroforestry cultivation.*
Location (Village, commune, district, province)	Village 3, Hoà Thuận commune, Buôn Ma Thuột city, Đăklăk province.
Date of data collection	3nd February to 20th March 2007
Data collector	Forestry students,Tây Nguyên University: Hoàng Nhất Trí, Ngô Thế Sơn, Giang Thị Thanh Lecturer: Dr. Võ Hùng

Origins of model establishment	
Whom did the idea originate from?	Farmers
When did it start?	From 1995
The reason for model establishment (Economy, society, technique, market, natural conditions like soil, water and so on)	Due to coffee monoculture which was cropped first, it was unstable and low income. The weather was more and more severe, water for irrigation was limited and the pestilent insect increased.

Natural condition, socio-economic	
Natural conditions	
Thickness of soil level (cm)	>100cm
pH (fast-inventory by equipment if it is available).	pH = 5.5
% Gravels	<10%
% Exposition-rock	<5%
Altitude (m) (GPS)	579m
Topographical position (base, side, or peak)	Hill base
Slope (degree)	10^0
Average annual rainfall (mm/year)	1.897mm
Average annual temperature (^oC)	23.7^0C
Average annual humidity (%)	81%
Socio-economic	
Ethnic composition	Kinh
Household economic group	Moderately good
Household characteristic (head, labor, education background of wife/husband, etc.).	There are 6 people and two of them are main labours. Educational level: Wife: 9/12 Husband: 9/12
Ethnic composition in village	All villagers are Kinh people
Number of households	332
Population in village	1594
Cultivation structure (Type, area): - Households - Village	Household: Total of cultivated area is 3ha with 3000 coffee trees, 350 durians, 620 pepper plants, 350 arecas and 1000 soapberries. The soapberries were planted as a green fence. Village: Of 332 households living in the village, 310 mainly live on monoculture coffee tree. Few households have intercropped coffee tree with others such as acacia, banana. The planted coffee area per household is 0.81 ha. There are about 10 ha wet rice field in the whole village. 22 households have business of services. Garden economy is not very significant as the area of garden is small. Animal husbandry is not well-developed.
Economic household element in the village (the number of moderately good, moderate, poor household)	Moderately good: 271; Moderate: 50 and Poor: 11

Infrastructure (Electricity, road, school, station and irrigation).	The system of electric networks has been equipped sufficiently to serve usage and production. Some main roads are paved with concrete. There are enough primary and secondary schools. A health station has been established with adequate doctors and nurses. The area of wet rice field is very small. There is no any irrigation system in the village.
Occupation situation (Household and village).	Household: agricultural cultivation and seeding service. Village: agricultural cultivation - 95% of the households plant coffee trees.
The state of agricultural and forest product market.	In the early stage of implementing the model, the market was erratic and low price. At present, the market is relatively stable and the price of the products is increasing.
The state of forest management (forest allocation and forest flat rate).	There is not much forestry area in the village.
Credit	No credit

Description of Argroforestry model



Arrangement cultivated plants in Agroforestry model

Agroforestry model with coffee tree intercrops pepper, durian, areca and other fruits

Description of perennial tree: - Species (Common name, scientific name) - Arrangement (Density, space and combined time and so forth).	1. Common name: Coffee robusta Scientific name: *Coffea Canephora Piere* Density: 1000 trees/ ha Space: The trees were planted at 3, 2 meter intervals while the distance of rows is 3, 4 meter. Coffee trees were planted earliest in the model Common name: Durian (DONA) Scientific name: *Durio Zibethinus Murr* Space: Durians were planted at ten-meter intervals and 12 meters in row Durians were planted when coffee trees had been 2 years old. Common name: Pepper Scientific name: *Piper nigrum* Space: The intervals between them are 3, 5 meter while the distance of row is 12 meter. Pepper plant was planted on Acacia trees which play a role of the

	supporting trees. Pepper plants were planted when coffee trees had been 2 years while acacia trees were planted the same time as coffee. Common name: Areca Scientific name: *Areca Catechu* Space: Areaca was planted surrounding the fence and the demarcation lines with the intervals are 3 meter. Areca was planted in 2004.
Description of annual crop: - Species (Common name, scientific name) - Arrangement (How and when to intercrop with permanent crop, and so forth).	1st year: Maize, green bean Scientific name: *Zea mays L, Vigna sinensis* 2nd : Green bean Scientific name: *Vigna sinensis* Two above annual crops were planted alternately with the rows of coffee in the first two years when the coffee crowns had not closed. These species were planted in early rainy season.
Description of domestic animal: - Species (Common name, scientific name) - Arrangement (Where are animal grazed? How large is fishponds? breeding facilities? The time when the model should be associated and so on)	Common name: Domestic chickens Scientific name: belongs to Gallus branch Chickens were raised freely in garden as soon as coffee trees were planted.
Other description	1. Common name: Soapberry Scientific name: *Gledit schiaaustralis* – Hems They were planted with very close distance (0,3 – 0,4m) around the cultivated area for protection purpose. Soapberry trees were planted as soon as the model was set up. 2. Common name: Cuba acacia Scientific name: *Leucaena glauca* Space: Cuba acacia trees were planted at at distances of about 3.5 meters apart and 12 meters in row. Cuba acacia trees were planted not only surrounding the fence but intercropped in the coffee garden as supporting trees for pepper plants.
General and detail description of coordinated space and period among elements in the model.	The model was set up in 1994. At first, Coffee and Cuba acacia were planted in the way that one row of Cuba acacia was intercropped in every 4 rows of coffee. In the early time when the crowns of coffee had not closed, the bean was cropped at the same time with soapberry and Cuba acacia trees that was planted as a wind guard fence. To use every nutritional space, when the coffee was 4 years old, a row of durian was intercropped in every 4 coffee rows and the pepper plants were also planted between of Cuba acacia trees which were 4 years. In order to salvage the remaing free land inside the model as well as to increase income, the areca trees were planted in 2004.

Description of reciprocal impact, energy current and material rotation in the model: - The impact of the perennial crop to annual crops and livestock - The impact of annual crops to perennial crop and livestock. - The impact of livestock to cultivated crop - The rotation of materials and energy in the model	Because the annual crop (bean) was intercropped with the perennial crop (coffee) in the early stage, there were not many fallen-objects from the perennial crops in this stage. As a result, the perennial crops did not have a significant influence on the annual crop. Taking a good care of the perennial crop, such as putting down the fertilizer and spraying chemicals and so on, was a main way to create good conditions for the annual crop. The perennial crops with many fallen-objects created the good conditions for development of soil insects that supplied food for chickens. The bean plants, which were intercropped with the coffee, shaded and wind-guarded for the coffee plants in the early stage. After being harvested, the remaing parts of bean were used to cover foot of the coffee trees in the dry season. Besides, the bean plants improved soil conditions and limited the nutritional and water competition of weeds with the coffee trees. Besides, after being harvested, theirs stems were used for organic matters. The annual crops supplied directly food for the chickens through creation of living environment for insects which were food for chickens. The chickens, which were fed in the garden, helped with wiping out harmful insects for cultivated crops. As a result, the fallen-objects which supplied a little organic fertilizer for plants disintegrated quicker. Physical rotation: The plants which planted in the model had a close relationship each other and had a good impact to soils, for instance the fallen-objects of coffee trees and husk will return back to the soil; the acacia helped not only to improve soil conditions but played the supporting tree role for pepper plants as well. Besides, the creation of the living frames had limited the use of the support by wood. Soils were not overexploited and creation of the stabilization for the model.

Cultivation technique of different components in the model	
Cultivation technique of Coffee tree	
- Seed (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth)	Seeds were collected from the old coffee plants in garden. Selection of the big and ripe fruits from the trees with nice crowns and branches. The harvest time was from October to November. The fruits were dried in shadowed places and presevered naturally some 2-3 months.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to sow, how long to keep in nursery garden, criteria of sapling, and so on)	Seed processing: After being persevered, the fruits were soaked in limpid lime, then peeled and seeded under slightly sandy soil. When the seeds had grown up with 2 pairs of false leaf, they were grown in boxes. The component of a box: 40 -50 kg of muck were mixed with 1 cubic meter of soil. The boxes were watered once a day. Percentage of shading was around 50% - 60%. The nursery time lasted about 6 months (January to June). The time in the nursery garden was 5 months (February to June). The standard of sapling was to gain 4 – 5 pairs of leaf.

- Planting technique (to dig a pit, to fertilize, to shade, time to plant and so on)	Size of pit: 50x50x60cm Soil was basally fertilized with muck when starting to plant (1kg/foot of a tree). Lime was added to get rid of sour while Basudin was used to resist worms in simultaneity. It is unnecessary to shade coffee when planting. The annual crop was intercropped to protect coffee from wind and to limit weeds invading. The roots of coffee trees were covered with stems of beans in the dry season. The planting time: From June to July
- Tending technique (Fertilizing, watering, plant protecting, pruning, thinning an so on)	Fertilizing: early rainy season, coffee trees were fertilized with phosphate 1kg/1 tree). NPK: Divided into two times in rainy season, 500kg/time Muck was put down once every two year. Watering: 3-4 times during the dry season. They were irrigated by spray machine to limit pseudococcus Risso growing. Pesticide: Using Basudin to resist worm when planting, and mixing ant poison with fat when harvesting. Cutting branches immediately whenever harvesting, pruning of unsuitable small branches, breaking of shoot periodically (every 1-2 months). Leaves were buried under ground on August for being convenient to harvest.
- Harvesting technique (time, parts to be harvested (flower, fruit, branch, stem and so forth)	Coffee was exploited from October to December. It was not harvested in several times to avoid hardening soil. The quality of the kernels will be better if they are harvested in ripeness.
- Product preservation (how to preserve and time?)	Coffees were dried after being harvested; then they were preservated in store around December to January of the next year.
- Risks: disease, flood, market, technique and so forth.	Because bio-prevention methods were used, risk of getting disease was low. The main risk which reduced yield was due to drought. Besides, rain obstacle in preservation; as a result, the quality of products was not very high. Moreover, the market was erratic, hence the price was uncertain. However, the recommendations of technique were insufficient.
Technique of Durian cultivation	
- Variety (Origin, How and when to harvest, How to preserve, and how long to preserve and so forth).	200 plants of Monthon variety (Thailand) were bought and propagated into 150 plants afterward through agamid reproductive process. The shoots of the multiplied breeds were taken at the garden while stocks, which were 2 years old with 2cm in diameter, were bought in Bến Tre. The shoots were grown as soon as being taken. It takes shoots in the morning preferably.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on).	Shoots were transplanted as soon as being taken from mother plant in the morning at sunrise to limit the pus leaking out. The stocks were created in advance. Transplanted shoots were not watered in the first 20 days after being transplanted. They were covered with nylon to keep warm to help increase of survival rates. They were watered after 20 days and kept in completely light condition. Transplant time was from July to April of the next year. The criteria of sapling finished nursery garden: Transplanted shoots were 60 – 70cm in height and 8 – 10 mm in diameter.
- Planting technique (to dig a pit, to fertilize, to shade, time to plant and so on)	Size of pit: 50x50x60cm The pits were filled with 30cm by topsoil before planting. The saplings were planted in early rainy season (May – June). These were not required to cover.

	Using of Basudin with purpose of worm resisting.
- Tending technique (Fertilizing, watering, plant protection, pruning, thinning an so on)	Fertilizing: Muck was put regularly down for 2 rows of coffee which were planted along 2 durian-sides, adding 0, 5 – 1kg of NPK/each time. For sapling, it will be more effective if fertilizer was dissolved. The saplings were watered every 7 – 10 days with 30 – 40 liter/unit root. The root of saplings has often a chink in bird foot shape which caused to leak pus out. To overcome this, the root was coated with lime or using of Mangcozet, Rhidomin to treat. Fertilizer was sprayed over the leaves to make plants growing better. Branches were cut every year. For the big branches, it should leave the length of branch is 1.5 m long from stem. Flower will be more if the branches develop in breadth wise. For the branches which develop in vertical direction, it should pull down or cut the top of the branch to help the shoot will develop in widthwise. For the trees which had fruit-bearing, it should not leave fruit closes stem as when fruit is big, it thorn will harm to stem. Besides, fruits should be pruned so that fruits develop evenly and the branches will be not broken.
- Harvest technique (time, parts to be harvested (flower, fruit, branch, stem and so forth))	The harvest was from July to August, dealers harvested and bought at the garden instead of waiting for fruit falling.
- Product preservation (how to preserve and time?)	The fruit was harvested by dealers when it was done a turn, so it did not need to preserve.
- Risks: disease, flood, market, technique and so forth.	Some diseases like leaking pus out, pestilent insects which harmed the fruit. Loss of crop because of being drought. The local market was unstable. The cultivars in the model were well-developed due to being applied good techniques that were learned from the Southwest gardeners who have much experience.
Technique of pepper planting	
- Variety (Origin, How and when to harvest, How to preserve, and how long to preserve and so forth).	Varieties were bought from Vĩnh linh (Quảng Trị Province). They were multiplicities by cuttings; the cuttings were extracted before irrigating season.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	The cuttings were soaked in cold water during the night in order to eliminate sap completely. Note: the cuttings should be cross-cut and not to break as if so, the cuttings would become rotten. Size of pit was 7x12cm so that roots would not break when transportation. The pit was bored many hole to drainage. The component of the special box: there were 40 -50 kg of muck plus 3 - 5 kg of phosphate plus $1m^3$ of soil. Every one level of soil, there was a level of muck which was sprinkled; then soil and muck were mixed and covered up once a day so that the soil would not be sticky and scattered. The cuttings were put in the boxes then being watered so that the boxes were enough reasonably hard and tight. Watering the cuttings twice per day (morning and afternoon) at the time of rising. When they had started to have young shoot, they were watered every other day and the boxes were removed for the cuttings developing well.

	The boxes were shaded about 75% in the early stage, when the shoots were 10 – 15cm in height; they were released from the shading-frame gradually to completely. When the cuttings started to have leaves and roots, they were manure with NPK. The cultivation sapling stage was 3 moths; the sapling was 30cm in high, they were brought to plant.
- Planting technique (to dig a pit, to fertilize, to shade, time to plant and so on)	Size of pit: 50x50x60cm The top soil was filled in bottom of the pits when planting; then the pits were filled nearly as equal as the ground. Basal fertilizer was not used. It did not need to shade as planting. The saplings were not deeply planted so that they could not be waterlogged. Usually, pepper trees are planted in early rainy season (May – June).
- Tending technique (Fertilizing, watering, plant protection, pruning, thinning an so on)	The muck was put down 2 - 3 kg per /one sapling/time/ for every year. It could add 0,3 kg of chemical fertilizer/time. Moreover, KNO_3 was added to stimulate flowering. When the peppers produced fruits, they were added 0,2 kg of NPK for one plant. After being harvested, the pepper was put fertilizer down periodically. Fertilizer was put down sequentially the second irrigation. The newly-planted pepper trees were irrigated with amount of water as equal as of this when they were cultivated. Thereafter, they were irrigated at the same time with coffee. They should be hindered to grow in height by pulling down and burying their trailing stems under the ground; the purpose is to make their branches developing in breadth so that they can bear fruiting spikes from the ground upward. Pruning of branches around the root if there were many. The vines which were long should be also removed. Before harvesting coffee, the vines should also be tied to a bunch so that they will be not broken. The pepper strings which are born for the first time should be removed. The flowers of pepper which are not fit are also removed for harvesting at the same time.
- Harvest technique (time, parts to be harvested (flower, fruit, branch, stem and so forth))	Pepper spikes were harvested once completely on March. Peppercorns were stripped off the spikes by machine.
- Product preservation (how to preserve and time?)	Peppercorns were collected and spread out to dry in the sun. If it is bright sun, it is necessary to dry 2 times, then to be stored.
- Risks: disease, flood, market, technique and so forth.	There were not many pestilent insects, so it did not influence productivity. The market was relatively good. However, drought or abundant rain caused unstable productivity. The peppers were well-developed due to being applied good techniques that were learned from many resources.
Technique of areca cultivation	
- Seed (Origin, how and when to harvest. How to preserve, and how long to preserve and so forth).	The seeds were collected at the location. The standards of seed selection to cultivate seedling were that: the fruit flesh was white without down, sweet, and old enough with yellow color in the top of the fruit. The fruits were harvested in January to February and preserved in normal conditions.

- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	The fruits were peeled as soon as being harvested. Areca shells were kept in humid sand so that they did not become rotten and spouted shoot quicker. After germinating, they were put in soil-boxes for their shoots to grow up. In another case, areca-nut should be cut and put the cutting-head in mixed-box in a cline angle, they spouted after 3 -4 weeks. Size of box is 12x20cm Component of the mixed-box included 20 -30 kg of muck + 3 – 5 kg of phosphate and $1m^3$ soil. The sapling-boxes were watered once a day, Basa was sprayed lightly every afternoon to prevent from ants, worms, and insects and so on. The boxes were shaded by 50% at the time of germinating. When the saplings were 10cm in height, they were gradually lighted. It was not necessary to put fertilizer down during the seedling cultivation time. The seedling cultivation time lasted 4 months and planted when the saplings were 20cm high.
- Planting technique (to dig a pit, to fertilize, to shade, time to plant and so on)	Size of pit is 50x50x50cm. Cow pat was mixed with phosphate at the time of planting. Arecas were planted in early rainy season (May – June) and they did not need to be shaded.
- Tending technique (Fertilizing, watering, plant protection, pruning, thinning an so on)	It did not need to care for much with the areca, except they were put down fertilizer at the time of planting. The areca trees were watered at the same time with coffee.
- Harvesting technique (Time, collected parts (flower, fruit, branch, stem, and so on).	They were harvested twice in one year (January to February and May to June). The buyers gathered acacia branches that were enough old and bought at the garden.
- Product preservation: How and how long to preserve and so forth.	It did not need to preserve because they were sold in fresh state.
- Risks: disease, flood, market, technique and so forth.	Drought could cause failure of crop. The demand of market was relatively high. However, buyers drove down the price. Furthermore, the price depended on festival seasons.
Technique of yearly crops: Green bean, maize	
- Seed (Origin, how and when to harvest. How to preserve, and how long to preserve and so forth).	Seeds were bought at seed selling centers and sowed as soon as being bought without preservation.
- Planting technique (Planting, seasonal cultivation)	Green bean and maize were cropped along the coffee rows They are usually cropped when the rains come stably (June). They should not be cropped when it is lasting rain since the corn will become rotten easily. In addition, ants and worms can destroy the seeds. Green bean: Cropped at 30cm intervals and 30cm in row. Maize: Cropped at 30cm intervals. Two lines of maize were cropped between every two coffee rows and the green bean trees were intercropped among the maize rows.

- Tending technique (Fertilizing, watering, plant protection, and so on).	Green bean and maize were intercropped beneath the coffee rows in early period when soil was usually rich. Therefore it did not need to put down a lot of fertilizer. NPK was put when the bean trees produced fruits. It was unnecessary to irrigate since they were cultivated in the rainy season.
- Technique of harvesting (Time, collected parts (flower, fruit, leaf, root, and so on).	The harvesting was from August to September. Fruits were harvested for products while stems were used to cover foot of the coffee trees to keep humid in the dry season.
- Product preserve: How and how long to preserve and so forth.	After being dried, green beans were extracted by handicraft method while corns were extracted by a special machine. The products could be sold as soon as being dried or preserved in normal conditions.
- Risks: disease, flood, market, technique and so forth.	Pestilent insects were relatively little. The seeds will be rotten if it is rain in the planting stage. The market was relatively stable. A continuous rain in the harvest stage would reduce quality and productivity as maize and green been could sprout on the tree, leading reduction of their productivity and quality.
Technique for domestic animal: Chicken	
- Breed (Origin, how to breed, and so on).	Breed chickens were bought at the location, multiplicated by a sitting hen. Avoid the phenomenon of co-blood by changing the cock continuously.
- Technique of raising, veterinary medicine (the food in internal and external model, rising time, disease prevention and so on).	The main food was insects that were available in the garden. Besides, grinded corn, bran and so on were also used as food sources for chickens. The chickens were raised all year round. It was essential to prevent chickens from getting inactive diseases. Chickens were also inoculated against chicken flu.
- Risks: diseases, market, technique and so on.	Recently, the spread of Bird flu has influenced chickens, so they did not raise chicken any more. Moreover, the market was unstable because of Bird flu; furthermore, the technique of chicken rising was poor, especially the method for preventing of chicken flu.
Technique for other components: Green fence: Soapberry, Cuba acacia	
Soapberry and Cuba acacia fence: Cuba:	Branches were frequently cut in order to create the clearing for the plants which were planted along the edge of the fence. Limiting of residing of pestilent insect should be considered. Pepper can be planted on Cuba acacia-fence.

Productivity, yield and income from the model				
Type of Products	**Unit (kg, ton, tree, …)**	**Productivity/ha/year**	**Price (VND/unit)**	**Income/ha/year (VND)**
Coffee	ton	5 ton/ha	25.000/kg	125.000.000
Pepper	ton	1 ton/ ha	45.000/kg	45.000.000
Durian	ton	6 ton/ ha	15.000/kg	90.000.000
Total income /ha/year (VND)				**260.000.000**

Analysis of economic effect of the model
(Calculation for the whole of model). Model area: 3ha

Unit: 1000 VND

Item	**Year**												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**n** (Business cycle or at least 3 years).
Input expenditures (VND)													
Seed	Coffee and short-day crop: 1.000		Durian: 21.000 Pepper: 6.000										
Fertilizer	4.000	6.000	10.000	21.400	30.500	44.500	42.600	47.000	45.500	50.000	48.500	50.400	
Irrigation	700	1.000	2.000	3.000	6.000	6.000	6.500	7.000	7.300	8.000	8.400	10.000	
Pesticide for plants, Medicine for animal	500	500	1.500	3.000	3.000	4.000	4.500	5.000	4.500	5.000	5.000	5.200	
Diesel engine	4.700			5.400			6.500			6.500			
Watering pipe	2.000												
Wage	3.000	4.000	6.000	10.000	15.000	23.600	24.000	25.000	26.500	31.400	37.600	44.000	
Total (VND)	**15.900**	**11.500**	**46.500**	**42.800**	**54.500**	**78.100**	**84.100**	**84.000**	**83.800**	**100.900**	**99.500**	**109.600**	

Income from output (VND)													
Product 1	Green been: 2.500	Green been: 2.000	Coffee: 21.600	Coffee: 110.000	Coffee: 95.000	Coffee: 164.000	Coffee: 90.000	Coffee: 60.000	Coffee: 95.000	Coffee: 156.000	Coffee: 265.000	Coffee: 375.000	
Product 2	Maize: 1.000	maize: 500			Durian: 15.000	Durian: 75.000	Durian: 127.000	Durian: 161.000	Durian: 234.000	Durian: 250.000	Durian: 256.000	Durian: 270.000	
Product 3					Pepper: 90.000	Pepper: 80.000	Pepper: 58.000	Pepper: 57.000	Pepper: 65.000	Pepper: 56.000	Pepper: 84.500	Pepper: 135.000	
Total (VND)	**3.500**	**2.500**	**21.600**	**110.000**	**200.000**	**319.000**	**275.000**	**278.000**	**394.000**	**462.000**	**605.500**	**780.000**	
Credit (If any) (VND)													
The interest rate: 8.4%/year													

Calculation of economic effect of the model according to Cost Benefit Analysis method (CBA):

Economic criterion (in 12 years)	Calculation for the whole model with 3 ha	For 1 ha
i (capital interest for developmental investment % year)	8.4	8.4
NPV (VND)	1.240.339.144	413.446.381
BPV (VND)	1.676.921.836	558.973.945
CPV (VND)	436.582.691	145.527.564
BCR (time)	3,84	3,84
Interest rate/capital (%)	284,1	284,1
IRR (%)	117,82	117,82
The time to revoke the capital T (year)	7	7
Gross revenue VND/ha/year		**34.453.865**

Product market of the model				
Type of product	**Market demand**	**Places to consume the products**	**Market forecast**	**Risk issues**
Coffee	High	Locations, commercial agent	There is no significant fluctuation of market in the next few years	Building a trading mark is difficult; Unfair competition with other countries is also issue.
Durian	Moderate	Locations	Local market may increase when living standard is increasing, so that the price should be high	At present, durian is planted on a large scale, if it is not planned in details, it will lead to decrease the price
Pepper	High	Commercial agents	The price will be still stable	If it increases in area, the price will be down and diseases may reoccur.
Areca	High	Locations	The market will be still high	If it increases in area, the price will be down. .
Bean	Rather high	Village commercial agents	The market will be insignificant fluctuation, it is mainly food consumption.	Bad impact from weather in harvest season, processing and preservation.
Maize	Moderate	Village commercial agents	The price is liable to go down	It cannot competition with cheaper imported corn.
Chicken	Rather high	Commune market	The demand of market is high and stable.	Bird flu can cause decrease of consumption

SWOT Analysis of the model

Strength

+ To create a stable income all year round
+ The products are good at quality and diversity. The market demand is creasing.
+ The use of chemical fertilizer has been limited therefore it does not affect the environment such as soil, water, and atmosphere and so on. The organic fertilizer has been used periodically.
+ To create the job for local people
+ The soil is rich and appropriate for many species of cultivars.
+ There is an abundant labour resource with good skills.
+ There are sufficient watering-engine and other equipments.
+ To salvage harvested waste products as a green manure.

Weakness

+ The technique of cultivation which has been built based mainly on personal experiences is relatively complicated.
+ The initial investment is high.
+ The income of the model has limited because of epidemic diseases (after bird-flu, they do not feed chickens in their garden any more).
+ In some first years, the price was low, hence household life met with difficulties.

Opportunity

+ Advantageous transportation
+ Programs, projects and national policies have encouraged agricultural and rural development.
+ The demand of agricultural products which are exported such as coffee, pepper, areca and so on is increasing.
+ Science and technology develop strongly, that creates opportunity for farmers to apply new progress.

Threat

+ The price of farm products is usually fluctuation since it depends on relationship between demand and supply in worldwide.
+ The quantity requirement of farm products from domestic and oversee market is strict more and more.
+ Extension has insufficiently supported for the farmers.
+ The price of fertilizer and fuel has increased quickly.

Analysis of social and environmental significance of the model

Social significance	
The satisfactory level of farmer and the contribution of the model in household income (%)	The farmer has been satisfied with this model because of its stability. The model had a stable productivity which created a high income all year round. The income from the model is nearly the essential one of family, account of 90% in total income.
The number of households in the village have applied this model	There have been only some tens of households who have applied this model. The durian has just planted in recent years, therefore it has not contributed income yet. At present, there have been many other farmers who have visited this model, so we hope that the disseminated possibility of the model will be high in the next few years.
The number of villages have applied this model	There are some households who have applied this model in every village in the commune, however they just have got the initial income and the economic effect has not been as high as the researched model.
Possibility of spreading out in scale, and reasons	Because the model is easy to perform, the possibility of spreading out will be high. Furthermore, it is not very difficult for plants to adapt in living environment. It is necessary to plan for the model with a large area. Besides, the reasonableness in investment, ensurement of water for irrigation, consumption market and prevention of disease do also need to consider.

Conditions to spread out (economy, technique, organization, policy, market and so on)	Although the technique in early stage is quite complicated, it is more simple in the harvest. The cultivation technique should learn from other locations. Contrary to the relatively high investment of seed in initial stage, especially with the large area, it uses every family's labour with a low-capital in small area. Extension agencies are willing to assist in technique, method of prevention of diseases. Moreover, the policies do not hinder on the dissemination of the model. The product market is always at high level, this is one of strengths to spread out the model.
Other problems	
Environmental significance	
How are ability of soil protection, effect of land use and sustainability of the model? Qualitative depict or quantitative number if it is.	Ability of soil protection is so good such as decrease in erosion through combination of multi-plants and multi-floors. In addition, the coffee peels are returned back to soil as well as annually fallen-objects have been very good effect in soil improvement.
Ability of water resource protection? To descript and prove relationship between the model and stabilization of water resource and protection of fresh water if it is possible.	The combination of several plant species has created structure of multi-floors, so the irrigation was decreased somewhat. It has to irrigate 4 – 5 times if it is monoculture. On the contrary, it needs to irrigate 2 -3 times with the intercropped model. The multi-floors and green fences have reduced water evaporation and maintained humidity for long time.
Ability of being against with environmental pollution (air, soil, water, and so on)	Combination of several cultivars has reduced even not to use pesticide, so it has not caused air pollution. In addition, suitable using of organic and inorganic fertilizer has not only enhanced soil nutrition but reduced the harmful minerals in water.
Ability of reducing of pressure on forest Relationship between forest and cultivation system	The use of Cuba acacia as a supporting tree for pepper has limited deforestation for supporting stake. Cuba acacia trees, which planted as the green fence, are the effective wind-guard ones. The green fence is not only the source provides the fallen-objects to improve soil but also protects for the whole system.

AGROFORESTRY LANDSCAPE - Dien Tan village, Cu Pui commune, Krong Bong district, Đak Lak province

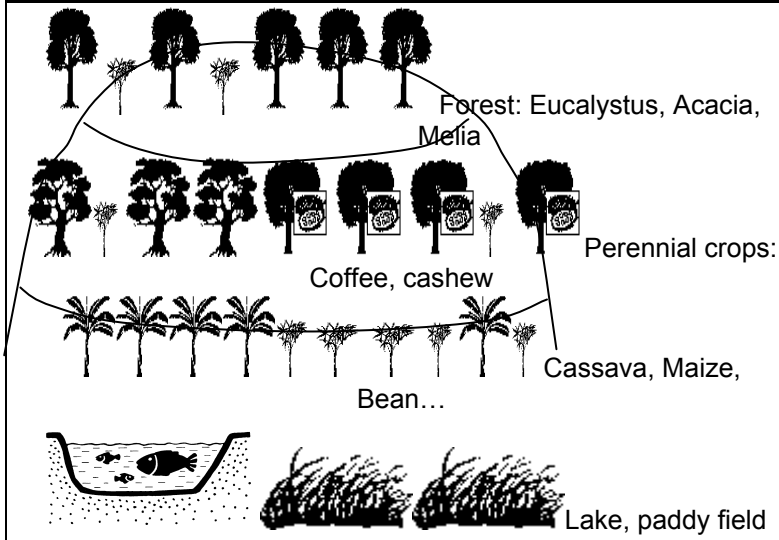
General information	
Model name	The model of forest, perennial crop, annual crops and livestock.
UTM position (GPS)	49P; X: 0230576; Y: 1382625
Total area (ha) (Including of all components in the landscape: Forest, wetland rice pasture, fields, perennial crop, irrigation, etc.)	- Plantation forest: 15 ha. - Household garden and fields: 100 ha including: Coffee, cashew, annual crops have intercropped with fruit plant such as maize, cassava, bean, etc. - Rice: 9 ha with 2 crops. - Lake: 10 ha in rainy season, 2ha in dry season. - Big pasture area.
The model of Landscape Agroforestry belongs to community of Điện Tân village, Cư Pui, Krông Bông district, Đăk Lăk province.	 Farmers and students was discussing in the field. The natural forest in the mountain with the important protective function in the landscape.
Location (Village, commune, district, province)	Điện Tân village, Cư Pui, Krông Bông district, Đăk Lăk province.
Date of data collection	From 10/3 to 15/3/2007
Data collector	Forestry students,Tây Nguyên University: Hoàng Nhất Trí; Giang Thị Thanh và Ngô Thế Sơn Lecturer: Dr. Võ Hùng

Origination of idea of model establishment	
Did the idea originate from whom?	To be formed during land use processing of community
When did it start?	Agricultural crops was cultivated long time ago, the forest was planted since 2002.
The reason for model establishment (Economy, society, technique, market, natural conditions like soil, water and so on)	- Monoculture has brought no effect. - Exhausted soil more and more. - Lack of water in dry season - Use every lands to diversified cultivation - Increasing population while limited land area - Creation of suitable job during the year. - Create income in the future. - Contribute to carry out the state policy, stabilize cultivation to develop the life.

Natural condition, socio-economic	
Natural condition	
Soil type, soil color	Feralit reddish-yellow soil on acid magma rock.
Thickness of soil level (cm)	>50cm
pH (fast-inventory by equipment if it is available).	
% Gravels	30%
% Exposition-rock	10%
Altitude (m) (GPS)	482m
Topographical position (base, side, or peak).	There are several kinds of topography from hill-base, hillside to peak.
Slope (degree)	Flat paddy fields to mountain fields with average slope is 10^{o}, plantation forest with the slope varies 10 – 15^{o} and the terrain with slope from 15^{o} upwards is covered by natural forest.
Average annual rainfall (mm/year).	1800 - 2000mm
Average annual temperature (^{o}C)	22^{o}C
Average annual air humidity (%)	84%
Socio-economic	
Ethnic composition	Kinh, Ê Đê, M'Nông, Tày, Nùng
The number of households	125
Population in village	625
Cultivation structure (Type, area): - Household - Village	- Plantation forest: 217 ha plantation forest which were planted in association way with state forestry company including following species: Eucalyptus, Acacia pycnantha (Golden Wattle**)**, Acacia mangium Wild. The varieties were provided by the company. There are 25 ha private plantation forest, which had been invested by themselves. - Perennial crops: Coffee, cashew, fruit plant (100 ha) - Annual crops: Maize, different kinds of bean and cassava - Paddy fields 2 crops: 9 ha
Economic background in the village (Moderately good, moderate, poor and poverty-stricken)	25 Moderately good, 80 moderate and 20 poor households. No poverty-stricken.
Infrastructure (Electricity, road, school, station and irrigation).	- Electricity: State network electricity. - Road: the inter-commune roads are concreted or asphalted. The inter-village roads are the pathways covered with gravels. The roads have created condition for transportation. However, the bridges are extremely damaged, so it is very difficult to move during rainy season.

	- Education: There are a high school and a primary school. Although the kindergarten helps to overcome the situation of three shifts study a day, facilities for study is considerably deficient. - Health care: There is a dispensary in commune. Community health care is performed in each village. Villagers are examined and treated for free of charge. The prevention of epidemic diseases and the state program on heath care such as extended vaccination, malaria prevention, vaccination for children are sufficiently implemented. - Irrigation: There is a lake, which supplies for cultivation (Ea H'mun Lake). Surface water area of the lake is 10 ha in rainy season, but it only remains 1 ha in dry season. The lake was put out to tender in dry season and Lê Hồng Cư householder was accepted to breed fish in the lake. There is a drainage-trench, which conducts water from the lake to paddy fields. - Running water: It is chiefly well water. Besides, the water from streams is used to bath for some families.
occupation situation (Household and village)	The farmers in this location have no secondary job.
The state of agricultural products market	There is not any purchase agent, only the dealers buy separately and they usually drive farmers down the price.
The state of forest management (forest allocation and forest flat rate)	They have the forest plantation contract with Krông Bông state forestry enterprise. This company provided the variety, capital and fertilizer while the lands are owned by themselves. They have invested their labor and earned wages from the enterprise (20.000VND per a working day, and 5.000.000 VND in total for one hectare). When the forests are exploited, they will sell for the company and get 40% from the earned value after deducting initial expenses above while the company will be shared 40% in total. Some households bought saplings to plant by themselves, but their forests have not been exploited so far. The state of natural and plantation forests is good. There is not any fire.
Credit	The farmers borrow with the incentive interest from Agricultural and rural Development Bank. Credit depends on demand of household individuals.

Description of Argroforestry model based on landscape



Some cultivated components in the landscape.

Plantation forest with Eucalyptus and Acacia in the landscape

- Position: X: 0230652; Y: 1382454. Altitude: 508m: Covered by natural forest.
- Red eucalyptus was planted evenly. Position X: 0230515; Y: 1382417. Altitude : 490m. Space: 2,5x1,5m.
- Cashew, fruit trees (mango, star apple and bananas). Position X: 0230555; Y: 1382580. Altitude 494m. Space: Cashew: 6x7m. Fruit trees were planted in rows. One row of fruit tree was intercropped with every 4 cashew rows with 4m in interval. The pineapple was planted to prevent from erosion.
- Cashew was intercropped with coffee. Position X: 0230499; Y: 1382511. Altitude 489m. Space of coffee: 4x3,5m. Once cashew row was intercropped with every 3 coffee rows.
- Some fruit trees was intercropped with cashew. Planted in 2002. Position X: 0230313, Y: 1382502 Altitude 493m
- Cassava was intercropped with eucalyptus in 2005. Position X: 0230576; Y: 1382625. Altitude: 494m
- Lake: Position X: 0230488; Y:1382623 Altitude: 475m
- Paddy field: Position X: 0230822, Y: 1382895. Altitude: 467m
- Coffee intercropped cashew. Position X: 0230778, Y: 1382810. Altitude 474m
- Coffee intercropped cashew and fruit trees. Position X: 0230271; Y: 1382716. Altitude: 486m. Space of coffee : 3x2,5m; Space of cashew: 9x9m, planted in 2000.
- Acacia mangium Wild. Position X: 0329525; Y: 1383959. Altitude: 472m. Space : 1,5x1,5m; planted in 2003. There has not been thinned yet.

Description of forest component *(Nature, plantation):* - Area, position in the landscape : Natural forest, plantation forest - Natural forest: Forest type, status, name of 2 -3 dominated species - Plantation forest: Uneven or even, species (commone name and scientific name). - Arrangement in plantation forest (Density, space, time, etc.).	- Natural forest: Natural forest of Chư Yang Sin national park distributes nearly by cultivated land of farmers. Forest type is upper montane forest with the status from poor to moderate. The species component is mainly quercus (Lithocarpus spp), Syzygium (Syzygium sp), wild Cinnamon (Cinamomum iner), Amoora (Amoora gigantea, wild melia (Melia azedarach) and so on. - Eucalystus: Eucalystus U6: It was evenly-planted, starting to plant since 2005 with 1,5x2,5m in space. The everage height is 8m and 7cm in average diameter. Some of these area were intercropped by cassava with productivity of 15 tons per hectare. - Acacia mangium Wild: it was evenly-planted in 2003 with 1,5x1,5m in interval, and density of 4400 trees per a hectare. The average height is 10m and 8m in diameter, it has not been thinned.
Description of perennial crops : - Area, position in the landscape - Species (commone name and scientific name) - Arrangement (Density, space, time, etc.).	**Some typical agrroforestry models are existing within the landscape :** **Coffee intercropped with cashew and fruit trees: Household: Mai Duy Văn** - Coffee arabica (Coffee Canephora Piere): Coffee arabica trees were planted on hillsides where lie around the lakes and streams. Some households planted them in their garden. Planting space is 3x3m; density is 1000 plants per hectare. They were planted in 2000. - Cashew (Anacardium occidentale L.): They were Intercropped with coffee plants with 9x9m in planting space 9x9m; density is 100 plants per hectare. They were planted in 2000. - Fruit trees: Durian (Durio Zibethinus Murr) and mango (Mangifera indica L) were planted for experiment, the initial result was to give a yield plenty of fruit with a very good taste. - In early years, he added some species of annual crops such as maize, black bean and green bean. **Cashew was intercropped with fruit trees: Household: Mai Duy Văn** - Cashew was planted in 1998; planting space is 6x7m. One row of fruit tree (composing of star apple, mango, orange) was intercropped with every 3 cashew rows. The pinapple plants were planted along the hillside to prevent from erosion. - Even cashew: Cashews trees were planted in 2002, 2003 and has been harvested. Planting space 6x7m, Pinapple trees were planted into the strips for erosion prevention. At the time when crown's cashew had closed, beans were added to increase income, prevent from soil erosion and improve the soils. - Coffee plants were intercrops with cashew: They were planted in 2002; planting space: 3x3m while cahsew trees were planted in 2006, with15x15m in space. **Coffee, cashew, fruit tree, forest tree and rice. Household: Phan Tiến Luật.** Area is 5,6ha and it was devided into 3 plots. - The crop plants in the model are with different age such as: Coffee is 4 years old, fruit tree is 2 years, cashew is 4 years, eucalyptus is 3 years, melia and acacia are 1,5 years. - The planting space is detailed as following: coffee: 3m x 3m; cashew: 20m x 20m (planted in square intercrop with 7 rows of coffee). The fruit trees were planted in garden and free land (where the coffee trees died but not to plant supplementally). Melia trees were planted in a separate plot and intercropped with acacia. The area of melia is 9000m^2, with 1.5 meter intervals and 3m x 3m in row.

	- Eucalyptus trees were planted surrounding the cultivated land while coffee mixed cashew are in the middle. Coffee plot is circled by sapan-wood for purposes of preventing of thief and livestock (buffalo, cow) and improving soil. - Evenly-planted cashew trees: the area is 6ha, they were planted in 2003 and 2004 on white-grey soils; graves are 30%, slope is 20^{o}, exposition-rock is little with thin soil level. They were planted along contour lines; planting space: 6x7m. Some kinds of bean species were added in the first years to increase income. Pineapple trees were planted along hillside to prevent from erosion, simultaneously for getting the fruits. Cashew plants have well-grown and given fruits. - Evenly-planted coffee trees: They were planted in 1998 on flat land with black-grey color, little graves, unexposition rock and rich soil. There is water enough for the coffee field during dry season. He did not plant wind guard tree because of its flat, moreover, the forests that are managed by other households shade for his field. The coffee plants grow healthy. Bean and maize were added in the model in the first years to improve income, and to cover land to prevent from soil erosion in the rainy season as well as restrict water evaporation in the dry season, decrease irrigation and enhance nutrition for soil.
Description of annual crops: - Area, position in the landscape - Species (commone name and scientific name) - Arrangement (How to intercrop with perennial crops, crops, time, etc.).	- Rice: 9 ha. This area is the wet and low land surrounding the village. Rice field is cultivated two crops a year. The winter – spring is from January to March while summer - autumn one is from May to August. After harvesting rice, he breeded duck in this area. There is a ditch system made of concrete to supply water for irrigating. - Evenly-planted cassava: The productivity of cassava was very high in the first year. The cassava trees were planted in old cultivated field which was bought from the ethnic minority households and is so far from water source that it could not be cultivated with other plants. Planting season is April while harvesting is December. - Cassava trees were intercropped in cashew field and one-two years old eucalyptus: The productivity of cassava was not very high in the first year. They did not affect to main crop plants. - Bean plants that were planted in the field, garden and intercropped gave a very high productivity. The planting season is May to June. - Maize plants which were planted in the field and intercropped with other cultivars brought high productivity. The planting season is April while harvesting season is August.
Description of livestock: - Area of pasture, lake, pond, stream, position in the landscape - Species (commone name and scientific name) - Arrangement (Where to pasture, area of fishpond, breeding facilities, time, etc.).	- The area of pasture is big (15ha). It surrounds the industrial crops, grassland and under forest canopy and grassland. The number of livestock includes: 50 buffalos, 231 cows and 60 goats. - The area of water surface is large with 10ha in the rainy season, however it is only 1ha in the dry season. The lake was tendered to breed fish. Total of water surface of stream, pond and lake that owned by households is about 3ha. - 600 pigs and domestic fowls have been bred at home, 2000 ducks have been bred in the paddy field after harvesting rice.
Description of other components	Fruit trees were planted scatteredly in the garden and the fields including mango, jack-fruit, avocado, curstard-apple, guava, durian, etc. However, because of small scale, they have just been used for family but not for market.
General description of spatial and time combining among the components in the model: Forest (Nature, plantation), perennial crops, annual crops, animal husbandry, irrigation etc.).	- Natural forest is managed by Chư Yang Sin National park. - Plantation forest: Acacia, eucalyptus, domestic melia. Some households planted cassava within eucalyptus forest in the first two years in area that is hillside. The area where is flat and near water source, they planted coffee trees. - In the hill area, they planted cashew since it is short of water in the dry season.

	- In the depression areas that have water, they have cultivated rice and bred ducks after harvesting rice. The lake, which was tendered to breed fish, is not only the water supply source for rice fields during dry season but reduction of flow in the rainy season and limitation of flood. - The old cultivated fields were planted maize and cassava trees. Coffee, fruit trees, pig and domestic fowls were planted and bred around the houses. - The pasture area is rather big for breeding livestock.
Description of reciprocal impact, energy current and material rotation in the model: - The impact of natural forest and plantation forest on agricultural system and animal husbandry - The impact of the perennial crop on annual crops, forest and livestock - The impact of annual crops on perennial crop, livestock and forest. - The impat of livestock on cultivars and forest. - The rotation of materials and energy in the landscape model	- Natural forest and plantation forest have effect of protection for the whole area. Natural forest which is managed by national park distributes in high mountain, so it absorbs and regulates rain-water, limiting surface flow, decreasing erosion and flood, increasing the ability of water keeping in soils and supplying ground water during the dry season. Plantation forest which was planted in hilltops with poor soil intensifies the retaining possibility of water in soil, salvaging land and stopping wind for the land in lower area. Moreover, its leaves and branches supply nutrition for soil. - The forest area is also the place that is used for breeding the big livestock. Branches, leaves, shoots, grass underground are all the food for livestock especially in the dry season. The forest with its high diversity creates the balance on biology for the whole area. - The perennial crops were planted to shade and stop wind for the annual crops. Because they occupy in upper floors, they have effect of stopping wind, reducing of drop rain intensity, restricting of water evaporation, creating conditions for other plants within the area to develop. Their leftovers have effect of covering land, increasing of soil humidity and soil nutrition and improving soil. In addition, their branches which were thinned are used for firewood, reducing of pressure on the forests. The leaves of several species are also used for livestock food. Some other species was planted as a green fence. - Livestock that is bred under forest canopy, especially big livestock, eats grass, shoot, etc., reducing fire materials. Furthermore, their shit makes soil is more rich. However, they harden soil as well as damage shoot of purposefully regenerating plants and young trees, so these problems should be paid attention. Their shit is also used for fertilizer for crop plants. - Circulation of materials and energy in the model. Forest: Leaf: ➔Livestock➔fish➔Food for human. ➔Soil ➔Annual crops➔Food for human ➔Soil ➔ Perennial Stem, branches ➔create income for human. Root ➔Becom rotten providing nutrition for soil, keeping water in soil. Perennial crops: Leaf: ➔Soil nutrition Stem, branches: firewood Fruit, nut: create income, food. Annual crops: Leaf, branch, stem: ➔nutrition for soil ➔Livestock food ➔Human Fruit, nut ➔Livestock ➔Human

Cultivation technique of different components in the model

Forest management technique and business

Plantation forest

- Variety (Origin, how and when to harvest, how to preserve, and	- Eucalyptus U6: Seeds were bought from Đồng Nai Province

how long to preserve and so forth)	- Acacacia: Bought seed collected from nature.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	- Eucalyptus: Seeds were dried under shadow until completely dry; then they were cleaned and kept in a thin cloth bag. When the seeds sprouted, they were sowed under soil. When sapling grew up to 4-5cm high, the shoots were pulled up and grew into soil box. Size of the box is 7x12cm. In the first days, the saplings were watered twice a day; then the water was decreased gradually; it did not need to shade. They sometimes were put down fertilize for impulsion purpose. The standards of saplings which finished nursery garden were the 3-4 months old ones with 20-25cm high, green leaf, straight, regular, without disease and diameter at foot was 0.5cm. - Acacia: Seeds were dried, cleaned, then soaked in hot water in rate of 3 parts of boiled water against 2 parts of cold water in 30 minutes; then they were kept with wet. When the seeds sprouted, they were sowed under soil. Size of the box is 7x12cm. In the first days, the saplings were watered twice a day, then water was decreased gradually, they were shaded with 50%. They were sprayed with NPK for impulsion purpose. They were also sprayed with pesticide to prevent from ulcer disease of root neck. The standards of saplings which finished nursery garden were the 3-5 months old ones with 20-25cm high, green leaf, straight, regular, without disease and diameter at foot was 0,5-0,7cm. - Melia: Seeds were dried, cleaned, then soaked them in hot water for 2 hours or in permanganate solution. Then they were cleaned again and kept wet; then they were sowed down soft soil. When sapling grew up to 3-4cm high, the shoots were pulled up and grew into soil box. Size of the box is 7x12cm with soft soil. The saplings were watered twice a day during a week, then water was decreased gradually; they were shaded nothing for healthy. They were sprayed with NPK for impulsion purpose and also sprayed with pesticide to prevent from disease. The standards of saplings which finished nursery garden were the 3-4 months old ones with 30-35cm high, green leaf, straight, regular, without disease and diameter at foot was 0,5-0,6cm.
- Planting technique (How to plant, planting season and so on)	Acacia and eucalyptus: Size of pit was 20x20x20cm. They were planted in middle dry season (July to August). Basal fertilizing with NPK with 500kg/ha.
- Tending technique (Fertilizing, watering, plant protection and so forth)	- Acacia: To weed to prevent from fire in the dry season. In the rainy season, they were weeded and put down with 1.000kg/ha fertilizers for 2 times, it did not need to prune branches. - Acacia: The farmers weeded and put down fertilizer twice a year in the first year. When forests were at age of 2 and 3, they did weed once at early rainy season. In dry season, they weeded to prevent from fire and pruned branches.
- Harvesting technique (Time, collected parts).	- So far, these forests have not been enough old for logging
- Product preservation: How and how long?)	
- Risks: Pestilent insect, flood, market, technique and so on	- Eucalyptus: wood eater - Acacia: Leaf white powder, etc..
Natural forest	

- Tending of technique, enrichment, thinning (species for branch pruning, thinning, measure of tending, weeding, etc.)	- The area of natural forest in the watershed is protected strictly by Chư Yang Sin National park. Therefore, the method to manage is not to impact. They protect the forest and prevent from fire only.
- Forest enhancement technique. Species (Common name, scientific name) - Create ditch, planting space, time, business cycle	
- Logging technology (Type of products (wood, firewood, none timber forest product (flower, fruit, branche, stem, firewood, etc.).	
- Product preservation (Time and measure)	
- Risks: disease, flood, market, technique and so forth.	
Cultivation technique of perennial crop	
- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve)	- Coffee: They bought variety from Research Institution of Tây Nguyên Agriculture and Forestry with price of 30.000đ/kg. They seeded by themselves. - Cashew: Variety was bought in the seed garden, having high productivity and good growth.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	- Coffee: They soaked the seeds in warm water, kept and cleaned with sour water, then sowed under sand or soft soil. When the saplings grew up to 3-4cm and the gammas flourished, they were grown into the boxes. The size of the box was 9x14cm including soil + 30% of muck. The sapling boxes were shaded with 80%; then they were uncovered gradually. The saplings were watered twice a day in early stage; then water was reduced little by little. They sometimes were sprayed with urea for impulsion purpose and pesticide to prevent from disease, especially rotten disease of root neck. The covering trellis was uncovered in late month so that the saplings were lighted completely. The standards of saplings, which finished nursery garden, were the 4-5 months old ones with 30-35cm high, green leaf, straight, regular, without disease and diameter at foot was 0,5cm. - Cashew: The seeds were sowed into boxes. Size of the box was 9x12cm. The box included 30% muck and 70% soil. It was necessary to cover the seed boxes. The standards of saplings which finished nursery garden were the 2-3 months old ones with 15-20cm high, green leaf, straight, regular, without disease and diameter at foot was 0,6-0,8cm.
- Planting technique (How to plant, planting season and so on)	- Coffee: Size of pit: 30x30x30cm, Interval: 3x3m. Basal fertilizing with cowpat, phosphate and lime, then filling the pits with topsoil and planting trees. Coffee saplings were planted in May to Jun when it was rain. It did not need to shade. - Cashew: Size of pit: 30x30x30cm, Interval: 6x7m. Basal fertilizing with cowpat, phosphate and lime, then filling the pits with topsoil and planting trees. It was planted in May to Jun. It did not need to shade. The cashew was intercropped with coffee in space of 10x10m.
- Tending technique (Fertilizing, watering, plant protection and so	They weeded 2-3 times a year in rainy season. If they planted annual crop, they had not weeded so much. Fertilizer was put

forth)	down at the same time weeding. The leftovers of the annual crops that were added in this area were used to cover foot of perennial crops. The perennial crops were pruned with their branches and shoots shape their crown. Coffee trees were irrigated in the dry season. The number of times depended on the drought state. I could be 3-5 times. - Coffee trees: They were put down fertilizer for three times in the rainy season and once in the dry season: the rainy season with NPK: 500kg/ha/time, the dry season: 300kg/ha at the same time irrigating. - Cashew: None irrigation. Put down NPK 2 times in the rainy season with 200g/foot.
- Harvesting technique (Time, collected parts).	- Coffee: Harvesting was from November to January. They sold fresh coffee as the harvesting time felled in the rainy season, so they could dry them. After harvesting season, they conducted to prune waterless, died and disease branches. - Cashew: cashews were harvested in February to April. They took true fruits while false ones were left at the garden for fertilizing. After harvesting the fruits, the waterless, died and disease branches were pruned. The true fruits were dried, and then sold for dealers.
- Product preservation: How and how long?)	- Cashew: To be dried or sold fresh after harvesting - Coffee: To be sold immediately after harvesting without drying.
- Risks: Pestilent insect, flood, market, technique and so on	- Plant louse, wood eater. - Leaking pus out, dried-branched disease - With no market information - Difficult preservation as lasting rain (coffee), not yet any processing factory - Lack of cultivation technique - Unstableness of many types of product
Cultivation technique of annual crops	
- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve)	- Maize: Variety was provided by a local agent - Cassava: variety was provided by government (high-yield cassava) or bought or exchanged among households. - Bean: Variety was stored from previous year by the famers. - Rice: Variety was bought from seed agents, district extension office of exchanged among the farmers.
- Planting technique (How to plant, planting season and so on)	- Maize: Maize was planted two crops a year – April and August. After harvesting the first one, the second one was planted afterwards. It was planted at 20-25cm intervals and 70-75cm in row, depending on quality of soil. Basal fertilizing with NPK 100kg/ha while planting. - Cassava: Variety was cut into separate frame with 20-25cm (there was 4-5 knots), then planted into beds in order to be easy to harvest. Basal fertilizing with NPK 50kg/acre. It was planted in early rainy season. - Bean: Bean was intercropped in the area of perennial crops or old cultivated field. The space: 15-20cm intervals and 50-60cm in row. Basal fertilizing with NPK. It was planted in early rainy season. After harvesting the first crop, the second one was planted afterwards. - Rice: Rice was planted twice a year: winter-spring from January to March and Summer-autumn from May to August. Basal fertilizing with muck, phosphate and lime.
- Tending technique (Fertilizing, watering, plant protection and so forth)	- Maize: After having six leaves, top dressing for the first time, the second one when maize was in the ear. Top dressing with 200-300kg/ha. Spraying pesticide for preventing of wood eater, bug, etc. - Cassava: Weeding, basal fertilizing. Cassava had not

	disease. - Bean: Weeding, hilling up, cutting of the top of tree for bean, spraying pesticide - Rice: Top dressing when rice produced branch, weeding and putting down fertilizer with 500kg NPK/ha, and 200kg (Urea + Kali)/ha when it was in the ear
- Harvesting technique (Time, collected parts)	- Maize: Harvesting in August for the first crop, the second one in November to December, extracting of the seed, then drying and selling to dealers. - Cassava: Harvesting was in January to February. Cassavas were peeled, cut into pieces and dried. - Bean: Harvesting seed and drying. - Rice: Harvesting in May and August, extracting seed and drying.
- Product preservation (How and how long?)	- Corn: Harvesting of seed, drying, keeping in dry place, then selling to dealers. - Cassava: Cutting into pieces, keeping in dry place, selling to dealer or husking for livestock food. - Bean: Drying seed, keeping them in dry place such as bag, tight container, etc., then selling to dealers or bringing and selling in the local market. - Rice: Drying, packing and keeping in dry places.
- Risks (Pestilent insect, flood, market, technique and so on	- Maize: blast disease, wood eater. - Rice: Rice blast disease, yellow-waterless, - Bean: Raining in harvesting season, carterpillar, rotten seed
Technique for livestock	
- Breed (Origin, how to breed, and so on)	- Buffalo: Breed was bought or exchanged at the location or others. - Cow: Breed was bought or exchanged at location or others. They bought the cross-bred-cow for artificial insemination. - Goat: Bach thao goat was bought from other locations. - Pig: Domestic; móng cái, local breed, artificial insemination. They bought boars to improve breed. - Domestic fowls: Local breed
- Technique of raising, veterinary medicine (the food in internal and external model, raising time, disease prevention and so on)	- Buffalo, cow, goat: They were bred in the forests, grassland. They were fed with bran, banana stem, straw, etc. They sometimes were inoculated against an epidemic. - Pig: Pig was bred in pigpen, fed with banana stem, corn, cassava, gain-weight bran, etc. Some households bred with a big number (30-40 pig) - Domestic fowls: free-breeding, duck was bred in the paddy field.
- Risks: diseases, market, technique and so on.	- Buffalo, cow, goat: Buffalo, cow: foot-and-mouth disease. Goat: diarrhoea, Green or blue tongue disease. - Pig: Foot-and-mouth disease, cholera, typhoid, etc. - Domestic fowls: Flu, inactive, white shit, variola disease, etc.

Productivity, average yield and income from the component: Industry trees				
Products	**Unit (kg, ton, plant, etc.)**	**Productivity/ha/year**	**Price (VND)**	**Income/ha/year (VND)**
Coffee	ton (undried)	12	3.500.000	42.000.000
Cashew	ton	2	8.000.000	16.000.000
Intercropped cashew	ton	1	8.000.000	8.000.000

Productivity, average yield and income from the component: Annual crops				
Products	Unit (kg, ton, plant, etc.)	Productivity/ha/year	Price (VND)	Income/ha/year (VND)
Cassava	ton	25	600.000	15.000.000
Rice	ton	5,5	2.800.000	15.400.000
Green bean	ton	1	8.000.000	8.000.000
Intercropped cassava	ton	20	600.000	12.000.000
Black bean	ton	1,5	7.000.000	10.500.000

Productivity, average yield and income from the component: Livestock				
Products	Unit (kg, ton, plant, etc.)	Productivity/landscape/ year	Price (VND)	Income/landscape/ year (VND)
Cow	beast	80	4.000.000	320.000.000
Goat	beast	50	2.000.000	100.000.000
Pig	Ton	30	17.000	510.000.000
Domestic fowls	beast	2000	20.000	40.000.000
Total income/landscape/year				**970.000.000**

Market of products in the model				
Type of products	**Market demand**	**Places to consume the products**	**Market forecast**	**Risk issues**
Coffee	High	Buying at garden	An increasing tendency to price in recent years.	Dropped price, an unsatisfied demand to export due to bad quality.
Cashew	High	Sell to dealers at the village.	Fluctuation of market every year	Dropped price, unstable productivity.
Maize	High	Sell to dealers	Relatively suitable price	Dropped price
Cassava	High	Sell to dealers	An increasing tendency to price	Poor soil in coming years as monoculture
Bean	Average	Sell to dealers at the local market	Relatively suitable price	Unfavorable impact as bad weather
Wetland rice	High	Sell to dealers	Relatively suitable price	Pest and irrigation water.

SWOT analysis of the model	
Strength - The model creates stabilization (for what???). Crop plants and livestock are mutual relationship, which helps sustainable cultivation. The model promotes protective function of the natural forest. - Income is increasingly, so it is attracted by villagers. - Reducing of pressure on natural forest - Reducing of input expenses. - Increase income. - Reducing of pressure on cultivated lands as associated cultivation, leading harvesting many kinds of products.	**Weakness** - It is difficult to cultivate for some households as diversified crops. - Lack of technical knowledge. - Deprived of supports from extension agents of commune and district. - Lack of capital to invest for production. - Inconsideration from local leaders as well as stakeholders
Opportunity - To be supported a part of technical guide, and loaned capital from the bank - Having market information - Locally purchase agents consume a great part of products of the farmers. - The state forestry enterprise buy forest products.	**Threat** - Difficult transportation, especially in rainy season. - The weather varies complicatedly, the climate changes. - Pestilent insects are increasingly and it is difficult to exterminate. - There is unclear plan for agriculture and forest production. - Forest plantation takes long time to get products so that some poor households are discouraged - Land conflict happens among households within the community.

Analysis of social and environmental significance of the model	
Significance on socio-economy	
The satisfactory level of farmer and the contribution of the model in household income (%)	The farmers satisfied with profit which comes from the model. The income from the model was the chiefly revenue source (90%). However, because there is not processing factory at the location, so the income was still low. The abnormal weather affected to productivity as well as quality of products.
The number of households in the village has applied this model (If subject is household) The number of households has participated to perform this model. (If subject is group of community).	Most of households have applied this model. The model such as intercrop between coffee and cashew or fruit trees has been applied commonly. The species of fruit plants, which are intercropped, is diversified more and more.
Subject who has managed the forests (nature and plantation). (Forest allocation? Investment and Priority?).	The natural forest is managed strictly by national park. This contributes a great importance to protect soil, water which serve for cultivation of many households within the watershed. Plantation forest, which was planted by the contraction between farmers and the company, creates stable and long-term job and important income for farmers.
The number of villages has applied this model.	The model has not broadly spread out at commune level. Some other villages have applied but not so many. At present, there are some farmers come for learning technique. The model can be disseminated in the next few years.
Possibility of dissemination and reason?	The propagation ability of the model will be high since the cultivars are easily suitable with living conditions. On the other hand, cashew trees can live in dry condition. It not need to tend much but they give the stable income. The planted cassava in plantation forest in first two years gave a

	good result but the cassavas made soil was poor..
Conditions to disseminate (economy, technique, organization, policy, market and so on)	Economy: The building of the model does not require a big capital. For small area, it can salvage labor from within family. In term technique: The technique in early stage is not very complicated. The cultivation technique can be learned from other locations. The extension is quite willing to support technology, policy as well as the measure of pestilent insect prevention. The market of these products is always high price. This is the strength to propagate the model.
Significance on environment	
Ability of soil protection, effect of land use and sustainability of the model? Qualitative depict or quantitative number if it is possible.	Soil protective possibility of the model is rather good and the model reduces soil erosion. The natural forest and plantation forest on high mountain and hilltop have action on system such as prevention of landslide, soil erosion by water and wind. In addition, association of multi-plants with multi-storeys lessees rainfall going down under ground. Furthermore, soil will be improved through repayment of leftovers.
Ability of water resource protection? To descript and prove relationship between the model and stabilization of water resource and protection of fresh water if it is possible.	The natural forest and plantation forest on high mountain and hilltop have effect of reducing surface flow, erosion, restricting of flood, intensifying of water absorbability, keeping water in dry season, protecting of underground water, which supplies for crop plants in dry season. The combination of multi-plants reduces partly water for irrigating. The Irrigation is only performed 2 -3 times instead of 4 – 5 times. The multi-storey's reduce considerably evaporation, the state of drought in long time does not happen.
Ability of being against with environmental pollution (air, soil, water, and so on)?	The model helps enhancement of biodiversity and decrease of pesticide. Forest tree make more fresh air. The association of many crop plants within an area as well as the whole model helps to reduce pesticide. Pestilent insects did not boom into epidemic and the damaging level was low. Tendency of using organic fertilizer will delay the degradation process of soil. Besides, the soil will be rich more and more. Use of leftover for fertilizer will decrease invested expenses and make environment is clean.
Ability of reducing of pressure on forest? Relationship between forest and cultivation system?	For perennial crops, their fallen branches are used for fuel after each harvesting crop. This reduces pressure on the forest. Besides, wood is used for fuel including wind guard, shading and green fence trees while wood for furniture is taken from acacia, melia trees and so on. In addition, the branches, which are left after logging are a big fuel source while foliage is used as the covering materials to improve soil.

AGROFORESTRY MODEL: CASHEW – SQUASH, GREEN BEAN, MAIZE – Ea So commune, Ea kar district, Dak Lak province

General information	
Model name	**Cashew+ Squash (Green bean+ Maize)**
UTM position	49P; X: 023478; Y: 1428141
Area	6 ha (4ha cultivated land +2 ha forest)
Farmer name: **Phạm Văn Tuyến, (47 years old)**	 *A Farmer and student group researches agroforestry*
Location (Village, commune, district, province)	Village 7, Easô commune – Eakar district – Đăk Lăk province
Date of data collection	From 27th February to 3nd 2007
Information collector	Forestry students,Tây Nguyên University: Lê Thị Kha; Dương Thanh Tân và Hoàng Trọng Khánh Lecturer: Dr. Võ Hùng

Origins of model establishment	
Whom did the idea originate from?	By himself
When did it start?	2002
The reason for model establishment (Economy, society, technique, market, natural conditions like soil, water and so on)	The established model based on: - Suitably natural conditions: Black-grey soils, thick soil level, available water for irrigating. The climate and weather are appropriate for many crop plants. - The householder has much experience in cultivation of the crop plants in the model. Moreover, the transfer of new technique to attend these crops is really simple. - The market: The market of these products in this model is relative stable and higher price comparing other agricultural products.

Natural condition, socio-economic	
Natural conditions	
Soil type, soil color	Grey soil on granite rock; Color soil: black-grey.
Thickness of soil level (cm)	Relatively thick and soft soils (>30cm)
pH (fast-inventory by equipment if it is available).	
% Gravels	5%
% Exposition-rock	5 - 10%
Altitude (m) (GPS)	377m
Topographical position (base, side, or peak).	Hill-base
Slope (degree)	7^o
Average annual rainfall (mm/year).	1800 - 1900
Average annual temperature (^oC)	23 - 24^oC
Socio-economic	
Nationality/ethnic group	Kinh
Household economic group	Moderately good
Household characteristics	- There are 10 people and five of them are the main labors. - Educational level: Husband 9/12.
Ethnic group in village	There are 4 ethnic groups living in the whole village: Kinh (70%); Mường (10%); Cao Lang (8%) và Ê Đê (12%).
Number of households	90
Population in village	363
Cultivation structure (Type, area): - Household - Village	- Household: Of 6 hectares in total, 2 hectares natural forest in moderate status (hilltop), are used for protection purpose; 4 hectares are used for cultivation and 5000 m^2 of water surface are sued for irrigation. - Village: existence of the following models: Cashew +Maize (150ha); Acacia + Eucalyptus (50ha)
Economic background in the village (Moderately good, moderate, poor and poverty-stricken)	Moderately good: 20; Moderate: 35 Poor: 35 and Poverty-stricken: 0
Infrastructure (Electricity, road, school, station and irrigation).	- Electricity: The system of electric networks in the village has not been improved yet. Electricity has not been every household as expectation, in 1-2 coming year, the whole village will be supplied with electricity. - Roads: The traffic system is chiefly the pathways, but they could ensure for transportation. - School: There are a primary school and 2 high schools. - Irrigation: It has not been irrigation system in the village; the households have self-supplied water for irrigation as well as running water.
Occupation situation (Household and village)	The householders as well as the village have cultivated essentially agroforestry; they have no any other traditional profession.
The state of agricultural product's market	The market has been erratic, and farmer had been forced in price by dealers. At present, the squash's market is relative more stable.

The state of forest management (forest allocation and forest flat rate)	Most forested areas are managed by Ea Sô Natural Conservation Area. The farmer in the village have expectation to be allocated with forest land and had forested land in flat-rate way to manage and protect, so according to the plan, they will be allocated about 2000ha forested to manage.
Credit	Although many farmer need to be loaned, the bank has not met until now. Some farmers are loaned by policy bank, since they get many priorities.

Description of Argroforestry model	
Student researches Agroforestry model in the field	*Discussion to collect information from farmer*

Description of perennial crop - Species (Common name, scientific name) - Arrangement (Density, space and associated time and so on)	- Species: Transplanted cashew - Latin name: Anacardium ocidentales - Density: 180 trees/ ha, space: 7x8m. - Associated time: Cashew was planted in 2002, associating annual crops in first 5 years when the crown of cashew had not closed.
Description of annual crop: - Species (Common name, scientific name) - Arrangement (How and when to intercrop with perennial crop, and so forth).	Annual crops including: Squash (Cucurbita pepo Cucurbita moschata); Maize (*Zea mays*) and Green bean (*Vigna sinensis*) - Cashew+Squash: Planted in the first five years when the cashew crown had not closed; planting season was from October to January or from March to June. - Cashew+Maize+Bean: Intercropped in first five years, the planting season of annual crops was from July to October.
Description of domestic animal: - Species (Common name, scientific name) - Arrangement (Where are animal grazed? How large is fishponds? Breeding facilities? The time when the model should be associated and so on)	Domestic animal has not invested in this model. Fish has been fed in fishpond but it has not been a great sticker.
Other description	
General and detail description of coordinated space and period among	- Space: The model includes 2ha moderate forest; 5000m^2 ponds; 5.5ha cultivated land.

elements in the model.	- Time combination: Annual crops was intercropped in cashew garden in the first five years when the cashew crown had not closed (from 2002 – 2007).
Description of reciprocal impact, energy current and material rotation in the model: - The impact of the perennial crop to annual crops and domestic animal - The impact of annual crops to perennial crop and domestic animal. - The impact of domestic animal to cultivated crop - The rotation of materials and energy in the model	The cycle of energy of material rotation in the model has not closed - The impact of the perennial crop to annual crops: The cashew had not noticeably influenced on annual crops and domestic animal (fish) in the model. - The impact of annual crops: + On domestic animal: Their products had been used as food resource for fish. + On Cashew: Annual crops, that covered the surface ground and surrounding the cashew root, reduced water evaporation as well as hold soil humidity. Besides, the crops which belong to bean family fix protein inner soils; moreover, they are used to do organic fertilizer to improve the soil. + The competition between the perennial and annual crop roots did hardly happen as the cashew root system develops strongly and deeply while those of the annual crops is shallow and broad on the ground. + The irrigation for annual crops brought the positive effect for cashew growing up - The rotation cycle of materials and energy in the model has not closed, the energy that cultivars have used from the soil more than those has repaid for it. In addition, pesticide, chemical fertilizer and so on were used a lot in the model.

Cultivation technique of different elements in the model	
Cultivation technique of perennial crop: Cashew	
- Seed (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth)	- Origination: Bought from Research Institution of Tây Nguyên Agriculture and Forestry - Collection: True fruit was collected when the pseudofruit ripened. - Time collection: Around March to April. - Preservation: True fruit was sold after harvesting without preserving at home.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	- *Seed processing*: True fruits were dropped in water to remove the one that floated, and then sunk them for 3 days: the first two days, they were sunk under water; the last day was of water mixed pesticide (Basudin 0.5%+Benlate C 0.05%) to limit ant and fungi. The water was changed once a day. Then the true fruit was fished out and kept in a gunnysack with fresh sand. When they had just geminated, their root-cap was removed and then was sowed in soil box. They would be covered with dry straw and watered everyday if they had been sowed in dry season. - *Soil box*: Made by P.E plastic with black color and thickness, 0.15mm in deep, and 15x25cm to 15x33 cm in size. The soil box was bored 9 holes from bed box up to 20cm. The mixed soil box included 70-90% topsoil + 10-30% decomposed muck + 5% Super phosphate. - *Tending*: Watered once a day. When the seed was 15 days to one month, it was sprayed with leaf fertilizer. Weeded when plant was little. Sherpa 25 EC was sprayed to prevent from pest, pug and mosquito. Doconit or Benlat was sprayed with recommended concentration by producer to prevent cooper fungi for foot of the tree. Anticipation of neck of root ulcer disease which happens usually the first month when sapling stem had not created wood.

	- *Criteria of nursery garden finished saplings*: the time from cultivating sapling to finished period was 4 months, at that time, the sapling reached 40-50cm in high and 1-1.5cm in diameter.
- Planting technique (to dig a pit, to fertilize, to shade, time to plant and so on)	- Pit size: 60 x 60 x 40cm. - Basal fertilizing with phosphate: about 300g/1 tree. - Planting time: Early rainy season, from April to May
- Tending technique (Fertilizing, watering, plant protection, pruning, thinning and so on)	- Watering: Cashew was simultaneously watered with the annual crop (squash) in dry season with 5-7days/time in rotation. - Pesticide: used stimulus substance once a month; pesticide: 3 times a year (no more in flowering time).
- Harvesting technique (time, parts to be harvested (flower, fruit, branch, stem and so forth)	After pseudo-fruit ripening and falling (or to collect in the tree), the true fruit was collected. The harvesting time was from February to April.
- Product preservation (how to preserve and time?)	Normally, cashew is dried 1-2 sunny days, or to be sold as soon as harvesting.
- Risks: disease, flood, market, technique and so forth.	Pestilent insect: Cashew was often stung and harmed at the top trunk by insects, Colletotrichum gloesporioides fungus and other disease
Cultivation technique of annual crops: Squash, Bean, Maize	
- Seed (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth)	**Squash**: High-yield squash variety which was mongrelized by F1 suprema, the seed was bought at retail agents. The chosen varieties were butter-nut squash. + Collection: as it would give highest productivity. + It was sold immediately after harvesting for not to be rotten, withered and other reasons. + Harvesting time: February (first crop), June (second crop) **Bean, Maize**: Fat green bean of Hai Mũi Tên đỏ enterprise, the seed was bought in retail selling agents + How to collect: collected fruit and took the seeds + Preservation: The seed was dried completely. + Harvesting time: October.
Planting technique (How to plant, planting season and so on)	- Squash: The seeds was germinated in the box (box size: 15x7cm, box mixture: 80-90% topsoil + 10-20% decomposed muck) around 12 days and then planted in beds - Planting time: planted 2 crops a year: The first one was from October to January; the second one was planted from March to June. - Bean and Maize: They were sowed on mounds or holes. The first crop was from July to October; the second one was from April to June.
Tending technique (Fertilizing, watering, plant protection and so forth)	**Squash**: It was invested and cared more than others. - Watering: One time/5-7 days. - Basal fertilizing with phosphate: 200g/1 mound (3 bushes) - Top dressing with nitrogenous 300g/1 bush. - Pesticide: - Stimulus chemistry: - Pest: It was mainly attacked by young worm at the young period. **Bean, maize**: They were cared less than squash. - They was mainly basal fertilizing and top dressing when they were just sowed and busted into tassel (100g/tree) - Water supply was from rainfall
Harvesting technique (Time, collected parts)	**Squash:** - Harvested parts: Fruit. - Fruit harvesting in January and June. **Squash and Bean:** - Harvested parts: Pods were harvested and then husked for seeds.

	- Harvested in July and November.
Product preservation (How and how long?)	**Squash:** It was sold immediately after harvesting for not to become rotten and other reasons. **Maize, Bean**: They were dried completely under 3 – 4 sunny days.
Risks (Pestilent insect, flood, market, technique and so on	When squash was young, their leaves were harmed by young worm while their fruit was carved by a kind of another one.
Technique for domestic animal (Domestic animal has not attached special importance to develop).	
- Breed (Origin, how to breed, and so on)	
- Technique of raising, veterinary medicine (the food in internal and external model, raising time, disease prevention and so on)	
- Risks: diseases, market, technique and so on.	
Technique of other components	

Productivity, yield and income from the mode				
Type of products	Unit (kg, ton, plant,…)	Productivity/ha/year	Price (VND/unit)	Income/ha/year (VND)
Cashew	kg	200	9.000	1.800.000
Squash	kg	28.100	1.800	50.730.000
Maize	kg	8.500	2.000	16.670.000
Green bean	kg	2.330	7.500	17.500.000
General income/ha/year (VNĐ) (including expenditure) 86.700.000				

Analysis of economic effect of the model Calculation for the whole of model. Model area: 4ha					
Items	Year				
	1 2002	2 2003	3 2004	4 2005	5 2006
Input expenditures (VND)					
Variety	7.074.000	6.462.000	5.697.000	4.932.000	4.932.000
Fertilizer	8.400.000	8.400.000	8.400.000	8.400.000	8.400.000
Irrigation	15.600.000	15.600.000	15.600.000	15.600.000	15.600.000
Pesticide and medicine for animal	920.000	920.000	920.000	920.000	920.000
Labor	320.000	320.000	320.000	320.000	320.000
Watering pump and pipe	11.700.000	0	0	0	0
Total (VNĐ)	**44.014.000**	**31.702.000**	**30.937.000**	**30.172.000**	**30.172.000**
Income from output (VND)					
Cashew	0	0	0	0	1.800.000
Squash	67.680.000	67.680.000	67.680.000	107.600.000	112.000.000
Maize	61.200.000	61.200.000	61.200.000	72.400.000	110.000.000
Green bean	42.240.000	52.800.000	59.400.000	66.000.000	123.000.000
Gross income (VND)	**171.120.000**	**181.680.000**	**188.280.000**	**246.000.000**	**346.800.000**
Credit (if any) (VND)					
The interest rate/year: 8,4					

Calculation of economic effect of the model according to Cost Benefit Analysis method (CBA):

Economic criterion (within 5 years)	Calculation for the whole model with 4 ha	For 1 ha
i (capital interest for developmental investment % year)	8.40%	8.40%
NPV (VND)	736,274,038	184,068,510
BPV (VND)	870,154,684	217,538,671
CPV (VND)	133,880,645	33,470,161

Economic criterion (within 5 years)	Calculation for the whole model with 4 ha	For 1 ha
BCR (Time)	6.50	6.50
Interest rate/capital (%)	549.9	549.9
IRR (%)		
The time to revoke the capital T (year)	1	1

Gross revenue/ha/year (VND)	**36.813.702**

Product's market of the model				
Type of products	**Market demand**	**Places to consume the products**	**Market forecast**	**Risk issues**
Cashew	High	At location	Varying price	It has not a big purchase since the enterprise of cashew processing was bankrupt. Pestilent insects reduced productivity.
Squash	High	At location	Stable	Depending on export market to China.
Maize	Moderate	At location	Stable	Competition with imported corn which is cheaper.
Green bean	Moderate	At location	Stable	It is easy to be impacted by weather in harvesting season and preliminary treatment.

SWOT analysis of the model	
Strength - Broad land, soft soil with thick soil level. - Having lake, so initiative in irrigation - Interface of two region of climate - The Central Highland and Middle, so having a lot of rainfall. Temperature and humidity are suitable for developing of several crop plants in agroforestry way. - Sufficient equipments for production. - The farmers have experience.	**Weakness** - It has not approached with credit to expand production. - There has not been red book which certifies for long using land, making. Some famers do not feel secure to invest cultivating perennial crop. - Organic fertilizer has not used adequately.
Opportunity - Agricultural processing factory is going to be built in this area. - Traffic and electric system are going to be improved. - There is a need to develop a forestation program with the species of acacia and eucalyptus.	**Threat** - The market has not been stable. - There is deficient in market information. - The corn and squash's market have depended on exporting to China.

Analysis of social and environmental significance of the model	
Social significance	
The satisfactory level of farmer and the contribution of the model in household income (%)	- The householder has satisfied with this model. This has given a large income for his family, contributing 100% household income. There has salvaged the time and labor in this model. - At present, the application of agroforestry model in intercropping Cashew, Maize and different kinds of bean or intercropping between bean and squash has brought high economic effect, contributing from 60 to 90% in total income of household.
The number of households in the village have applied this model	About 70% households have applied this model.
The number of villages within the commune have applied this model	Because the neighboring villages have different conditions on land, economy, technique and experience, so they have applied the model very few. They have mainly cultivated sugar cane for the sugar factory.
Possibility of spreading out in scale, and reasons?	The disseminated possibility of the model will be high as it has brought high economic effect, increased the income and improved their life. Besides, it is easy to apply the model with intercropping technique. And although there was less investment, it brought high effect. For instance Maize and green bean that were applied in the model.
Conditions to disseminate (economy, technique, organization, policy, market and so on)	To disseminate this model quickly and effectively, there is a need of conditions as following: **Technique**: - For annual crops: Maize and bean are the ones that are familiar with farmer, so the cultivation is actually simple. It requires a seed selection that gives high productivity that can replace the kinds of local variety with low quality. Simultaneously, there is a need of a suitable caring regime like: timely weeding, rationally fertilizer using and stimulus substance for flowering and bearing fruits with high productivity. - Squash and cashew are the ones that require intensively caring. Since they have been applied commonly in recent years, so the cultivating information and technique would be supplied more. **Market**: Though the price of the products which were created from the model has been higher than other agricultural ones, their price has still been impacted by dealers. Hence, there is a great need for the stable market and the big purchase agent at the location.
Significance on environment	
Ability of soil protection, effect of land use and sustainability of the model? Qualitative depict or quantitative number if it is.	Possibility of soil protection: Some species of annual crops such as bean which has ability of fixing protein in the soils has very good function of soil protection. On the other hand, sub-products (branches, leaves) keep humidity for soil as well as repay a part of lost nutrition for soil if they are spread on ground surface.
Ability of water resource protection? To descript and prove relationship between the model and stabilization of water resource and protection of fresh water if it is possible.	In the model, the householder has used 2 ha forested land to promote effect of protection and maintenance of water for year-round, ensuring irrigating requirement during dry season.
Ability of being against with environmental pollution (air, soil, water, and so on)?	The use of chemical fertilizer and pesticide did not impact considerably to water resource and the air. For above mentioned products were used with a insignificant amount and correct principle and guide, so they did not cause negative impact on environment and other natural resources.
Ability of reducing of pressure on forest? Relationship between	* *Reducing of pressure on forest*: The households within the village have enough cultivation area to apply agroforestry model, resolving the labor in their family, improving their living conditions. As a result, it reduces

forest and cultivation system?	pressure on the forest. For this reason, creation of conditions to expand the agroforestry is necessary and significant in several aspects. * *The relationship between forest and other ecological system:* The great function of forests is to protect soil, prevent from landslide, soil erosion by water and wind, etc. for other ecological systems such as the agriculture, society (human) and so on. Forests create conditions for agricultural systems exist and develop. Apart from the defined functions above, forests help to maintain constant supplies of good quality water, to make fresh air and to improve climate condition in region.

AGROFORESTRY LANDSCAPE - Khuon 5 Hamlet, Phuc Xuan commune, Thai Nguyen city

General information	
Model name	**Agrofrorestry Landscape model**
Position	Latitude: $21^{0}35$ - Longitude: $105^{0}14$
Total area (ha) (Including of all components in the landscape: Forest, wetland rice pasture, fields, perennial crop, irrigation, etc.).	Total area:13.3 ha including: - Forest: Plantation forest: 7 ha, natural forest: 1ha - Tea tree: 2.3 ha - Rice and farm products : 1,7 ha - Fruit tree: 0,7ha - Breeding facilities: 0.1ha - Planted grass: 0.6ha
Farmer group Vũ Văn Bắc Vũ Trọng Hiển Vũ Đình Quang Vũ Đ ình Vinh Dương Văn Lực	
Location (Village, commune, district, province)	Khuôn 5 Hamlet – Phúc Xuân commune – Thái Nguyên city
Time of information collection	15/01/2006
Information collector:	Phạm Thu Hà - Trần Đức Thiện – Faculty of forestry, Thái Nguyên Agricultural and Forestry University.

Origins of model establishment	
Whom did the idea originate from?	The farmers learned and developed by themselves during their cultivation process and land use.
When did it start?	1986
The reason for model establishment (Economy, society, technique, market, natural conditions like soil, water and so on).	The model has given a stable income and household economic development, satisfying market's demand within area.

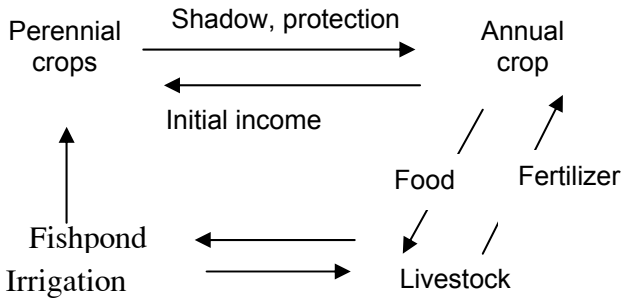
Natural condition, socio-economic	
Natural condition	
Soil type, soil color	Flesh soil mixes sand for agricultural area; clay soil in forest area.
Thickness of soil level (cm)	40 cm
pH (fast-inventory by equipment if it is available).	
% Gravels	<1%
% Exposition-rock	<1%
Altitude (m) (GPS)	200m
Topographical position (base, side, or peak).	Base, hillside and hilltop.
Slope (degree)	45^{o}
Average annual rainfall (mm/year).	1.745 mm
Average annual temperature (^{o}C)	$23,6^{0}$C
Average annual air humidity (%)	83%

Socio-economic	
Ethnic group	Kinh
Economic household group	Moderately good
Household characteristics (Head, labor, education of wife –husband, etc.).	Head: 24heads including: Male: 11, Female: 13. (5 households) Labor : 17 labors including: Male: 8, female: 9 Education background: From high school upwards
Ethnic group in village	Nùng (15%), Sán Dìu (20%), Tày (15%), Kinh (50%)
Number of households in village	72
Population in village	200
Cultivation structure (Type, area): - Household - Village -	In village: Rotational crop of rice and maize and bean: Area: 16ha Fruit tree: 7ha, Tea tree: 23ha, Forested land: 140ha (Plantation forest: 123ha, natural regeneration forest :17ha)
Economic background in the village (Moderately good, moderate, poor and poverty-stricken)	Moderately good: 45 Moderate: 15 Poor : 12
Infrastructure (Electricity, road, school, station and irrigation).	100% using of electricity. All main roads within the hamlet are concreted. The irrigation system satisfies the farmer's demand.
Occupation situation (Household and village).	Agricultural production is mainly: Rice and tea; The income comes from the forest account for a little rate.
The market state of agricultural and forest products	Agricultural products market have developed in which: The main product is tea with stable market, however the price depends on according to years and seasons. The others are chiefly met for family's demand only.
The state of forest management (forest allocation and forest flat rate)	The forest was allocated for each household with a flat rate.
Credit	The households who are loaned with a special interest rate (0-2%) account for 26%; the loaned capital has only met about 48% of household's demand.

Description of Argroforestry model based on landscape

Landscape of agroforestry

Description of forest component *(Nature, plantation):* - Area, position in the landscape : Natural forest, plantation forest - Natural forest: Forest type, status, name of 2 -3 dominated species - Plantation forest: Uneven or even, species (commone name and scientific name). - Arrangement in plantation forest (Density, space and time combination, etc.).	The forest lays the highest position in the model. Total natural area makes up 1ha. Total plantation forest account for 7ha. - The natural forest is mainly regeneration forest with essential species of garcinia (***Garcinia oblonggifolia***), different species belongs to ***Fagaceae*** family and Machilus Odoratissima Nees; forest status is IIa. - The species of plantation forest is acacia (***Acacia auriculifomis***) and eucalyptus (***Eucalyptus camaldulensis***). Even plantation forest: Eucalyptus. Uneven plantation forest: Eucalyptus and acacia. - Density: 1000-1200 trees/ha, planted according PAM program.
Description of perennial crops : - Area, position in the landscape - Species (commone name and scientific name) - Arrangement (Density, space, time, etc.).	Area: 2,8ha The perennial crops were situated in the low hillside of the model Tea plant (Camelia sinensis), litchi (Litchi chinensis), longan (Euphobia longana), Diospyros (Diospyros kaky) and pomelo(Citrus grandis) plant. - Tea plants were planted in density of 120x30cm (10 years). - Litchi plants were planted in density of 4 x4m (from 1995 - 1997) - Longans were planted in density of 4 x4m (from 1995 - 1997) When the litchis and the longans had not closed in their crown, the annual crops was added in this area (peanut, bean and sweet potato).
Description of annual crops: - Area, position in the landscape - Species (commone name and scientific name) - Arrangement (How to intercrop with perennial crops, crops, time, etc.).	The annual crop area is 1,7ha, they were planted at the base of the hill. They included rice (Oryza sativa), maize, (Zea mays), cassava (Manihot utilssima), sweet potato (Pomea batatas), potato (Solanum tuberosum), soybean (Glycine max) and peanut (Arachis hypogea). At the hillside, the annual crops such as peanut and soybeen were intercropped with the fruit trees like longan, diospyros, litchi and tea plant. Two rows of peanuts was seeded paralel within two rows of tea plant. They were cultivated both crops, spring from February to March and autumn in July. They were put down with 60 – 100kg P2O5 when seeded. The soybeans were planted within 2 tea rows. Maize, sweet potato, cassava and peanut were planted at the base of the hill in winter crop. Rice was rotationally cultivated in 2 crops: Spring rice and crop rice.
Description of livestock: - Area of pasture, lake, pond, stream, position in the landscape - Species (commone name and scientific name) - Arrangement (Where to pasture, area of fishpond, breeding facilities, time, etc.).	The right hillside of the landscape is used for livestock. Area (fishpond): 0,4 ha The piggery was built in the garden and quite near the fishpond. Apart from being used to breed fish, the fishpond plays an important role in supplying water for cultivars.
***General description of spatial and time combining among the components in the model*:** *Forest (Nature, plantation), perennial crops, annual crops, animal husbandry, irrigation etc.).*	The natural and plantation forest distribute in the highest position of the model (mountain). This is the part that plays the protective role for the model. Sequence of the forest is hillside where is cultivated with tea tree, and the fruit tree was planted in the lower area where is near the house. The fruit trees and fishpond are arranged in front of the house. The lowest area is cultivated by 2 crop- rice and other agricultural products. The paddy field supplied water itself.

***Description of reciprocal impact, energy current and material rotation in the model*:** - The impact of natural forest and plantation forest on agricultural system and animal husbandry. - The impact of the perennial crop on annual crops and livestock - The impact of annual crops on perennial crop, livestock and forest. - The impact of livestock on cultivars and forest. - The rotation of materials and energy in the landscape model	The natural forest and plantation forest play an important role in regulation of water, protection of the landscape, prevention of soil erosion and so on. Moreover they are places to graze livestock. The perennial crops area plays the shadow and windguard role. They limit water evaporation and create conditions for the growth of annual crops. Apart from mentioned functions above, it is the place that is habitat for livestock. The perennial cultivars limit surface flows as a result to restrict soil erosion. The annual crops keep humid soil for development of perennial crops, and repay organic matter for soil. They use every nutrition space in the big area. In addition, they were used as food source for livestock. The livestock gave considerably fertilizer for cultivars. Apart from being used to breed fish, the fishpond plays an important role in supplying water for cultivars. 

Cultivation technique of different components in the model

Forest management technique and business

Plantation forest

- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth)	Breeding saplings acacia and eucalyptus were produced in accordance the process of PAM 3352 program.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on).	Before being grown, the seeds were soaked in boiled water for 1 minute and let getting cold gradually. After 8 hours they were fished out and kept in the cloth bag which was put in the jute bag. Washing the seeds one a day until they germinated. Then they were sowed in the soil boxes. The size of the soil box was 7 x 12 cm. The components of the box included: topsoil: 80%, decomposed muck: 20%. The geminated seeds were sowed in the middle of the box, they were filled 0,5 – 1cm deep with soil. The breeding crop was February to March and September to October while the nursery garden time was 3-4 months. Tending: They were watered once every day with 3 - 4 liter/m^2 and kept warm for the first three months. After 15 days they were weeded and sapped scum, then watered with decomposed muck or NPK which was diluted up to 1%. Prevention of the saplings from rotten root neck disease by Bordeaux pesticide with 0,5 – 1% in concentration, spraying 1liter/5m^2 on the saplings. If the saplings had leaf powder disease, they could be sprayed with 1liter benlat per 4m^2 (concentration was 1/1000).

	The criteria of finished nursery garden sapling: Healthy, no disease, 50cm minimum high and 5 – 7mm in root neck diameter.
- Planting technique (Pit digging, fertilizing, shadowing, and so on).	Size of pit: 40 x 40 x 40cm. Filling the pit before planting 10 days, basal fertilizing with superphosphate with 75g/unit pit before planting a week. The saplings were planted in the days that it was cool and planted in spring crop.
- Tending technique (Fertilizing, watering, pesticide and so forth)	Tending 2-3 times in the first and second year while 1-2 times in the third. Pruning off creeper, weeding, turning over the soil and hilling up.
- Harvesting technique (Time, collected parts).	Plantation forest: To start to exploit from the eighth year and later. The exploiting measure is selective logging. The harvested parts are firewood and wood.
- Risks: Pestilent insect, flood, market, technique and so on	Risks: Pestilent insect, flood, market, technique and so on.
Natural forest	
- Tending of technique, bringing up, thinning (species for branch pruning, thinning, measure of tending, weeding, etc.)	The farmer has hardly intervened on the natural forest but just let its composition adjusts itself such as elimination of unadapted plants, selection and keeping the species that is high adaptability and healthy.
- Forest enhancement technique. Species (Common name, scientific name) Create ditch, planting space, time, business cycle	In order to improve productivity and quality of the forest in the human's orientation, a number of given plants which are the fast growth and high economic value was added. Besides, they have used every naturally regenerated trees from the big and high economic mother trees.
- Logging technology (Type of products (wood, firewood, none timber forest product (flower, fruit, branches, stem, firewood, etc.).	Almost the natural forests have been protecting strictly, hence the farmers have not been allowed to log but they have to take part in forest protection.
Cultivation technique of perennial crop: Tea tree	
- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth) -	- Bought from Núi Cốc lake nursery garden. - Bought from market Tea: Harvesting of young leaves, twigs and buds. The harvesting time was from March to August. Tea was dried and kept carefully to avoid becoming musty.
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	Soil preparing: Land was ploughed 40 – 45cm deep by tractor, then it was sowed with green mature plants. Tea trees were planted in October in the following year. After preparing soil, the land was split on by rows with 15 – 20 cm deep and 20 – 25 cm width. Basal fertilizing with 20 -30 tone of organic mature + 100 P_2O_5 per hectare, filling the pit with a thick soil layer 2- 5cm deep. Putting down fertilizer before burying the seeds 4 – 5 months. Seed processing in following sequence: Soaking the seeds in water from 12-24 hours, removing the floating ones, piling the seeds into layers 7-10cm width and covering on these layers with a thick sandy layer 5cm width and watering them with warm water. Sowing the seed when 50% of those were gemination. The sowing time was October and November. They were sowed by clusters, each of those

	had 5-6 seeds. They were buried 2-5 cm deep, then filled them with the thin layer of small soil and stepped on them to help them touching the soil, then covered on them with straw to hold warm. When the seeds start to sprout, the straw was removed so that it was easy for the seed to spout.
- Planting technique (Pit digging, fertilizing, shadowing, and so on).	* Litchis: Size of pit: 60x60 x 60cm Basal fertilizing: Muck: 20kg; phosphate: 2,5kg Planted in spring season. Topdressing aroud the foot of the litchi trees according to the projection of their crown for every year. (muck: 10kg, NPK: 3kg; put down in February and March). *Tea plants: Planted on ditches with ditch size was 40 x40x40cm Distance between two ditchs was 120cm. Basal fertilizing with 20 tone of muck per hectare. Filling the ditches with topsoil before planting one month; the planting crop is in September every year. Covering them with straw to keep warm.
- Tending technique (Fertilizing, watering, plant protection and so forth)	In the first three years (supplemented-planting, felling to create shape and top dressing) Periodic felling in November to December every year. Put down muture every year: periodic fertilizing according to harvesting course. Use pesticide (trebon 20EC; 1,2liter/course) every harvesting course to prevent from pestilent insect (stink bug, mosquito) .
- Harvesting technique (Time, collected parts).	Tea: Harvesting bud, young leave and twigs. Harvesting time: from March to October every year.
- Product preservation: How and how long?)	Tea: Tea was dried and kept in tightly covered nilon bag to avoid becoming musty. Preservation for every year.
- Risks: Pestilent insect, flood, market, technique and so on	The market was sometime unsuitable
Cultivation technique of annual crops	
- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth).	Bought from co-operative and market. It did depend on the different parts of the plants and business purposes to harvest such as seed for rice, grain for maize, bulb for potato, and so on.
- Planting technique (Pit digging, fertilizing, shadowing, and so on).	Planted in two crops: Spring and season crop.
- Tending technique (Fertilizing, watering, plant protection and so forth)	According to guide process of extensionists.
- Harvesting technique (Time, collected parts).	
- Product preservation: How and how long?)	Dried and kept in dry places.
- Risks: Pestilent insect, flood, market, technique and so on	Disease, flood, drought, erratic market.

Technique for animal husbandry	
- Breed (Origin, how to breed, and so on)	Bought from neighbor locations. Pig: Use of common species of economic hybrid at the location Bought from provincial breeding farm. Use of breeding buffalo at the location, breeding itself, or bought from other locations.
- Technique of raising, veterinary medicine (the food in internal and external model, raising time, disease prevention and so on)	Grazing, inoculation against an epidemic. Year-round rotational raising; food from other products of the model such as corn, cassava, etc., and bought other foods like corn, foodstuff. Periodic inoculation against an epidemic.
- Risks: diseases, market, technique and so on.	Disease and approach with market.

Productivity, yield and income from the component: Natural forest				
Type of products	**Unit (kg, ton, plant, m3, etc.)**	**Productivity/ha/year**	**Price (VND)**	**Income/ha/year (VND)**
Wood	m3	4	450.000	1.800.000
Firewood	m3	8	120.000	960.000
			Total income/ha/year	**2.760.000**

Productivity, yield and income from the component: Plantation forest				
Type of products	**Unit (kg, ton, plant, m3, etc.)**	**Productivity/ha**	**Price (VND)**	**Income/ha (VND)**
Acacia wood	m^3	60	500.000	30.000.000
Firewood	m^3	26	120.000	3.120.000
			Total income/ha/rotation	**33.120.000**

Productivity, yield and income from the component: Perennial crops				
Type of products	**Unit (kg, ton, plant, etc.)**	**Productivity/ha/year**	**Price (VND)**	**Income/ha/year (VND)**
Tea (Dry bud)	kg	2.932	35.000	99.120.000
Litchi Longan	kg	400	2.000	800.000
Other fruits	kg			300.000

Productivity, yield and income from the component: Annual crops				
Type of products	**Unit (kg, ton, plant, etc.)**	**Productivity/ha/year**	**Price (VND)**	**Income/ha/year (VND)**
Rice	kg	4.155	3.100	12.880.500
Maize	kg	3.986	3.000	11.958.000

Productivity, yield and income from the component: Livestock				
Type of products	**Unit (kg, ton, plant, etc.)**	**Productivity/year**	**Price (VND)**	**Income/year (VND)**
Buffalo (4 years)	Buffalo	1	4.500.000	4.500.000
Pig	kg	1950	15.000	29.250.000
Chicken	kg	680	40.000	27.200.000
Fish	kg	600	11.000	6.600.000
			Total income/landscape/year	**67.550.000**

Market of products in the model				
Type of products	**Market demand**	**Places to consume the products**	**Market forecast**	**Risk issues**
Tea	High	at location/market	High demand	Varying price
Rice	Average	Local market	Moderate	Epidemic disease, loss crop
Chicken	High	at location/market	High demand	Epidemic disease
Fish	Average	at location/market	High demand	Drought
Maize	Average	Market	Moderate	Drought
Livestock	Average	At location	High demand	
Wood + Firewood	Average	At location	High demand	

SWOT analysis of the model	
Strength - Local labor was rather sufficient - There was a closed combination - The productivity of tea was stable has a high economic value - There was much experience in tea production - Land use right is long time.	**Weakness** - Lack of water in dry season - Forested land is high slope and the soil is poor.
Opportunity - The model located in the famous tea region Tân Cương. - The tea product has the trade name and to be high favorite.	**Threat** - Animal illnesses - Epidemic disease - The price of the product was low and erratic - Disaster.

Analysis of social and environmental significance of the model	
Significance on society	
The satisfactory level of farmer and the contribution of the model in household income (%)	- Rather satisfactory with the model - The model contributed more than 90% in total income
The number of households in the village has applied this model (If subject is household) The number of households has participated to perform this model (If subject is group o community).	58
Subject who has managed the forests (nature and plantation). (Forest allocated? Investment and Priority?).	The forest is allocated for household with a flat rate. Local farmers are invested seed and fertilizer
The number of villages has applied this model.	100%
Possibility of dissemination and reason?	Rather good, ensuring the aim of economy and sustainable development.
Conditions to disseminate (economy, technique, organization, policy, market and so on)	- Land use right for long time. - There was a high solidarity among the households in the model. - The main product's market (tea) was quite stable. - There was a support from extensionists as well as the research organization in systematic plan.
Significance on environment	
Ability of soil protection, effect of land use and sustainability of the model? Qualitative depict or quantitative number if it is possible.	Ability of soil protection and using of the model was high effect and sustainable. The highest position of the model is forest, so it protects the remaining components.
Ability of water resource protection? To descript and prove	Three sides of the model are surrounded by mountain where is covered by forested land, so it help to protect the water resource as well catch the rain water for the model.

relationship between the model and stabilization of water resource and protection of fresh water if it is possible.	
Ability of being against with environmental pollution (air, soil, water, and so on)?	Since the forested land in the model accounts for two-third in total area, so the ability of being against with environmental pollution is so good. The area of tea is intercropped and being contiguous with the forested land, so the influence of pesticide reduces to minimum extent. However in the future, it should use the pesticide that is unstable substances so that it will not leave on tea product. Applied IPM on the cultivars.
Ability of reducing of pressure on forest? Relationship between forest and cultivation system?	The several role of forest are to hold and regulate water source, regulate climate and prevent soil erosion for lower components in the model.

AGRROFORESTRY MODEL: FOREST – FRUIT TREE – ANNUAL CROP – ANIMAL HUSBANDRY – Bac Thanh hamlet, Quyet Thang commune, Thai Nguyen city

General information	
Model name	**Quyết Thắng Agroforestry Model: Plantation forest + Fruit tree + Annual crop + Animal husbandry**
Geographical position	Latitude: $21^0$35.031'(N); Longitude: $105^0$46.328'(E)...
Area (ha)	1 ha
Location (Village, commune, district, province)	Bắc Thành hamlet – Quyết Thắng commune - Thái Nguyên city
Date of data collection	11/1/2007
Information collector	Phạm Thu Hà - Trần Đức Thiện, Faculty of forestry, Thái Nguyên Agricultural and Forestry University.

Natural condition, socio-economic	
Natural condition	
Soil type, soil color	Yellowish brown soil and grey-brown soil; mixed flesh soil
Thickness of soil level (cm)	Thinness
pH (fast-inventory by equipment if it is available).	
% Gravels	20 -25%
% Exposition-rock	
Altitude (m) (GPS)	
Topographical position (base, side, or peak).	Hillside
Slope (degree)	10^0
Average annual rainfall (mm/year).	1.745
Average annual temperature (^{c}o)	$23,6^0$
Average annual air humidity (%)	83%
Socio-economic	
Ethnic group (household)	Kinh
Economic household group	Moderately good
Household characteristics (Head, labor, education background of wife – husband, etc.).	9 heads: 4 chief labor Secondary school.
Ethnic groups within the village	Kinh, Nùng, Sán dìu
Number of households in the village	156
Population in the village	660
Cultivation structure (Type, area):	
Economic background in the village (Moderately good, moderate, poor and poverty-stricken)	Moderately good: 24 Moderate: 86 Poor: 46
Infrastructure (Electricity, road, school, station and irrigation).	100% households have electricity, 50% country lane is concreted or asphalted; Irrigation meets difficulties.
Occupation situation (Household and village)	Agriculture, mainly planting tea tree
The state of agricultural and forest products market	Tea's market is rather suitable and strong development.
The state of forest management (forest allocation and forest flat rate)	Forest is managed by household in flat rate way. The forest was allocated for households in a flat rate.
Credit	The farmers are loaned to develop economy from the organizations such as: Hunger eradication and poverty alleviation capital; Agricultural and rural development bank, woman association, etc.

Description of Argroforestry model

Description of perennial crops : - Species (common name and scientific name) - Arrangement (Density, space, time, etc.).	Acacia, eucalyptus, Schima wallichii Choisy; Canarium album, bamboo, palm, jack-fruit, longan, litchi, and pomelo tree
Description of annual crops : - Species (common name and scientific name) - Arrangement (Density, space, crop, time combination, etc.).	- Tea, banana, ginger, cassava, sweet potato, pineapple, coconuts and premium. - Rice, sweet potato and bean plant. The gingers were intercropped under crowns of fruit trees and tea beds. The sweet potato and pineapple were intercropped under the fruit trees. The tea plants were planted under crowns of litchi trees.
Description of animal husbandry: - Species (common name and scientific name) - Arrangement (Where to breed, scale of fishpond, breeding facilities, time combination, etc.)	Chicken, pig and buffalos. Chickens were fed freely. The area of fishpond is 200m^2
General description of spatial and time combining among the components in the model	
Description of reciprocal impact, energy current and material rotation in the model.	The perennial crops shaded and created conditions for annual ones such as ginger, tea plant growing and developing. Moreover, the perennial crops were home for livestock. The perennial crops prevented from weed invasion, supplementing the organic matters and being the food for the livestock. The livestock makes the soil getting soft and theirs waste is also the primary nutrition for the plants.

Cultivation technique of different components in the model	
Cultivation technique of perennial crops	
- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth)	Litchi: Lục Ngạn variety - Bắc Giang town Longan: Hưng Yên variety
- Creation of sapling (how: seed process, component of intestine box, taking care in nursery (watering, fertilizing, shading and so on), when to seed, how long to keep in nursery garden, criteria of sapling, and so on)	
- Planting technique (Pit digging, fertilizing, shadowing, and so on).	The pit size was 40 x 30cm. The saplings were fertilized and shadowed in the first stage. They were planted in the spring season and fertilized following the projection of their crown for every year. Tea plants were grown by ditches, rows, and covered in order to prevent the invasion of weeds. They were frequently fertilizered.
- Tending technique (Fertilizing, watering, plant protection and so forth)	Regular irrigating for them, especially in dry season. Slight pruning and heavy pruning every year.
- Harvesting technique (Time, collected parts).	Harvesting of fruit for litchi plant Harvesting of buds for tea plant (year-round)
Product preservation: How and how long?)	The products were dried and kept in nylon bags to prevent from unsuitable moisture.
- Risks: Pestilent insect, flood, market, technique and so on	Market Disease
Cultivation technique of annual crops	
- Variety (Origin, how and when to harvest, how to preserve, and how long to preserve and so forth).	Varieties were bought at location. Some ones were kept by households for seed for later crop. While rice was dried to keep, bean was held in the closed covered jar.
- Planting technique (Pit digging, fertilizing, shadowing, and so on).	Rice: rice was sowed, and transplanted (2 crops: spring and fifth-month crop). Maizes were planted by pricking hole then burying the seed.
Tending technique (Fertilizing, watering, plant protection and so forth)	Rice: It did need to weed when rice plants were robust. It did not to weed when they were in the ear or too young. Muck and chemical fertilizing according to the growth and development demands of the rice plants. Using of pesticide when they attacked by disease.
- Harvesting technique (Time, collected parts).	Rice: Harvesting the clump or flower. Maize: harvesting the grain, other parts were used for livestock food.
- Product preservation: How and how long?)	Harvested rice and corn were cleaned, dried and preserved in dry place.
- Risks: diseases, market, technique and so on.	Pestilent insect and flood.
Technique for livestock	
- Breed (Origin, how to breed, and so on)	Breeds were bought at local market, the breeder mates were controlled to copulate with female periodically.
- Technique of raising, veterinary medicine (the food in internal and external model, raising time, disease prevention	Animal husbandry: They were inoculated against an epidemic and the enclosures were cleaned regularly.

and so on)	
- Risks: diseases, market, technique and so on.	Epidemic disease, unstable market.

Productivity, yield and income from the component

Type of products	Unit (kg, ton, plant, m^3, etc.)	Productivity/ha/year	Price (VND)	Income/ha/year (VND)
Tea	kg	6400	45.000	28.800.000
Rice	kg	1400	4.000	5600.000
Maize	kg	1500	3.000	4500.000
Litchi	kg	640	3.000	1920.000
Longan	kg	360	5.000	1.800.000
Pig	kg	600	15.000	9.000.000
Breeder pig	kg	120	20.000	2.400.000
Chicken	kg	140	45.000	6300.000
Fish	kg	400	12.000	4800.000
Buffalo	body	2	3000.000	6.000.000
Wood	m^3	7	700.000	4900.000
Firewood	m^3	3	150.000	450.000
Palm leave	leaf	700	600	420.000
Ginger	kg	310	5.000	1.550.000
			Total income/ha/year (VND)	**78.440.000**

Market of products in the model

Type of products	Market demand	Places to consume the products	Market forecast	Risk issues
Tea	Average	Bought at home, market, buying for export	High	Drought
Rice	Average	Bought at home	Average	Epidemic disease
Maize	High	Bought at home, market	High	Epidemic disease
Litchi	Average	Bought at home, market	Average	
Longan	High	At location	High	Pestilent insect, drought
Pig	Average	At location	Average	Pestilent insect
Breeder pig	Average	Bought at home, market	High	Pestilent insect, loss of crop
Chicken	Average	Bought at home	Average	
Fish	Average	Bought at home	Average	
Buffalo				
Wood				
Firewood				

Palm leave				
Ginger				

SWOT analysis of the model	
Strength - The model was situated in the famous tea region Tân Cương. - Redundant labor. - The soils is suitable for tea planting and some species of fruit trees such as longan, litchi.	**Weakness** - Disadvantage for agricultural production as poor soil. - Lack of water for tea plant and agricultural production in dry season.
Opportunity - There are capital resources support for production - Tea products has trade name in the market and many places buying.	**Threat** - Epidemic disease. - The climate conditions are unfavorable.

Analysis of social and environmental significance of the model	
Significance on society	
The satisfactory level of farmer and the contribution of the model in household income (%).	- The farmer has rather satisfied with the model - The model contributed more than 90% in total income
The number of households in the village has applied this model in the village.	30
The number of villages in the commune has applied this model.	8
Possibility of dissemination and reason.	Ability of spreading out the model at location is quite good as it has not only ensured economic profit but also environment. In addition, this area has the mountainous topography is suitable with the model.
Conditions to disseminate (economy, technique, organization, policy, market and so on)	- Economy - Market
Significance on environment	
Ability of soil protection, effect of land use and sustainability of the model Qualitative depict or quantitative number if it is possible.	Possibility of soil protection of the model is good, ensuring the effective and sustainable use. Because the model was linked among the components so they have interacted on production and erosion prevention.
Ability of water resource protection. To descript and prove relationship between the model and stabilization of water resource and protection of fresh water if it is possible.	The forest component lies in the center and upper part, so it has helped water regulating in rainy season as well as making the climate equable in dry season.
Ability of being against with environmental pollution (air, soil, water, and so on).	The model is green and clean, so the protective ability of environment from pollution is good. Good water source.
Ability of reducing of pressure on forest. Relationship between forest and agricultural cultivation system.	The forest has regulated water and prevented from erosion and protected other components in the model.

AGRROFORESTRY MODEL: GARDEN – FISHPOND – BREEDING FACILITIES (VAC) – Binh Duc hamlet, Binh Nham commune, Thuan An district, Binh Duong province.

General information	
Model name:	**VAC**
UTM position (GPS)	
Area	14.800 m^2
Farmer: **Lê Ngọc Sơn**	
Location:	A 46, Bình Đức hamlet, Bình Nhâm commune, Thuận An district, Bình Dương province**.**
Time of data collection	29/12/2006
Information collector	Đặng Hải Phương and co-worker - HCM.City Agricultural and Forestry University.

Origins of model establishment
VAC model was established since 1997, and originated from householder himself. The model aimed to create income for his family. Based on his family suitably available conditions, the model was set up. One the other hand, the other households, who have similar conditions living around his family, cultivated with VAC model already. In fact, the perennial fruit plants such as mangos teen and durian were planted nearly 100 years ago in Lái Thiêu, Bình Dương province. They formed a famous fruit tree garden. At the time, the combining between livestock and annual crops in order to create the maximum use of recourses as well as income has not been noticeably considered.

Natural condition, socio-economic	
Natural conditions	
Soil	There are two main types are grey soil and sandy soil.
Slope	$0\text{-}3^0$
Average annual rainfall (mm/year)	1800 - 2000
Average annual temperature (^oC)	26.5
Average annual humidity (%)	
Socio-economic	
Ethnic composition	Kinh
Household economic group	Moderate
Household characteristics	
Ethnic composition in village/hamlet/commune	The whole commune is Kinh people.
Population at village/hamlet	2864 households with10.246 heads
Cultivation structure	Fruit tree garden – breeding fish – breeding pig
Household economic background (poor household rate)	
Infrastructure	The traffic is advantageous even in the rainy season. The

	services of electricity, production and society are well-done. The interest area is in drastic urbanization.
State of occupation	Tamed agriculture
The market state of agricultural and forest products	With no information
The state of forest management	The interest area has not forest
Credit	With no credit

Description of the model	
Description of perennial crops	
 Species: Mangosteen Scientific name: Garcinia mangosteen belongs to family Clusiaceae.	This is a fruit-tree, average-good stem. Mangrosteen is the commercially valuable fruit and a favourite one in market. Some documents showed that the mangrosteen can be used as a medicine. Depending on tending conditions, the Mangrosteen products fruit at the age of 20 to 25. Harvesting rotation of mangosteen can last 100 years. It have cultivated relatively wide in Southeast and Southwest Vietnam. In this model, the mangosteens were planted at 6 x 6m intervals. theirs age was believed is about 100 years. At present, there are about 25 trees at the age of 4-5 years were planted by himself. Most of the old trees have not given fruit or very few.
Species: Langsat Scientific name: Lansium domesticum belongs to Meliaceae family.	Langsat is a fruit-tree with average-good stem. In this model, it was intercropped beneath the mangoteen's crown since 1997. The planting interval and density were not homogeneous. The present Langsats are different in age; they were planted or regenerated since 1997.
Species: Mango Scientific name: Mangifera indica	Mango is a fruit-tree with big-good stem. Mangos are planted generally in Southeast and Southwest Vietnam.
Apart from mentioned species above, the model have some other perennial species with a few quantities. They have mainly used within the family such as durian, jack-fruit (Artocarpus heterophyllus, belong to Moraceae family), otaheite gooseberry (Phyllanthus acidus, Euphorbiaceae family), carambol (Averrhoa carrambola), Malpighia (Malpighia glabra). These species have hardly been tended, so they did not give fruit as the marketable products. Some species were planted for food such as fiber melon, Cymbopogon. Some species was planted for ornament with a few quantities such as Traveller's Tree (Ravenala madagascariensis), areca and ochnas.	

Description of annual crops	
Species: Banana Scientific name: Musa sp, belongs to Musaceae family.	Banana is the species that is easy to plant. It is planted widely in Eastern-south Vietnam. In this model, Bananas were planted in free land within the garden to salvage land and improve income for the household.
Species: Pinapple Scientific name: Ananas comosus, belongs to Bromeliaceae family.	Pineapples were planted for fruit. In this model, they were scattered or along small alleys in the garden. The fruits meet mainly for family's demand.
Description of livestock	
Species: Channa Scientific name: *Channidia sp*	Fishpond was formed near center of garden with the area of 400 m^2 (20 x 20 m)
Species: Pig Scientific name: Sus sp	Pigpen (pig for food and sow) was built at the end of the garden with 144 m^2 in area.
General description of spatial and time combination among the components in the model	
▪ Spatial combination: In term storey structure: There are 3 floors in which the highest is mangosteen with 12-14 meters in height. The second one is the species types of fruit plants such as mango, jack-fruit, durian, langsat and banana. The lowest one is unclear, mainly pineapple	

trees were scattered or along small alleys in the garden. The fishpond and pigpen were sequentially arranged. The remaining food and pig shit were used for fish food, the pig shit was also fertilizer for the plants in the garden

- Time combination: Because of characteristics of the perennial and annual crops as well as livestocks, the time combination of these components was continuously. Banana regenerated strongly, each pseudostem could produce a bunch of bananas before dying and being replaced by another pseudostem, thus after taking the bunch, the pseudostem was removed. The 20 years old mangosteens were planted to aim replacing the very old and stunted ones that did not give fruit any more. Durians and mangos that were planted since 1997 were scattered over the garden with a few quantities. langsats were planted under mangosteen's crown but theirs space was unclear, their ages were homogeneous. The young plants (3-5 years) regenerated naturally or supplemented with the saplings regenerating in the garden. These were pull out and planted in the free places where were made by the died and fallen mangosteens.

Description of reciprocal impact, energy current and material rotation in the model

The perennial crops which occupy with many quantities are mangosteen and langsat. They have suitably shaded for banana. The fallen objects such as small branches and dry leaves from these plants have used as an organic fertilizer for newly- planted trees. The shadow has contributed to limit weeds which competes nutrition with the annual crops. The waste matters from pig like shit and pig's wash water have been used as fertilizer for crops in the model, a part of those is food for fish. Previously, bred fishes were taken according to the river water source and they were fed in extensive breeding, theirs chief food was to use pig's remaining food and pig's shit. A small trench system which leads water into fishpond and watering was rationally disposed; therefore there has enough water for crops even during dry season. It is this system along with the surface water area of fishpond make high air humidity in the area. According to quantitative feeling, there is a difference between air temperature inside and outside the model.

Cultivation technique of different components in the model	
Cultivation technique of perennial crops	
Mangosteen	
Variety and sapling	He (Lê Ngọc Sơn) is inherited some 100 years mangosteens from his grandparents. The varieties of new ones (1997) were bought from fruit-variety agents. Remainings were pulled up from regenerated trees and planted then.
Criteria of sapling and cultivation technique.	For the mangosteen, the saplings for planting had to obtain 50 cm in height, starting to ramify and having three floors of leaf. The mangosteens were planted in early rainy season. The size pit was 50 x 50 x 30 cm, basal fertilizing with fallen objects (dry leaves, small branches), straw and decomposed cowpat.
Tending technique	He weeded twice a year in the first three years after planting. Mangosteen is the plant that adapts to high light, hence they could be planted to shade for others. In fact, the fertilization for mangosteen garden depends essentially on financial resources of the household, besides, component and quanlity fertilizer, and regular requirements have not a obvious rule. In that time, it did hardly put out fertilizer.
Harvesting technique	Mangsteen ripes aroud may and June every year. The fruits riped by course and were harvested dirrectly in the tree or by collecting-cage. I should be noted that not to harm green fruits while harvesting.
Langsat	
Variety and sapling	The majority of langsat ages in the model is 10 and below. They were planted in 1997. Theris varieties were taken from naturally regenerated trees in the garden. The saplings were pulled up and planted in early the wet season.
Critera of sapling and cutivation technique.	The saplings were one year old and strong. They were uprooted and planted into the availablly dug pits. Basal feritlizering with fallen objects (dry leaves, small branches), straw and decomposed cowpat. Langsat is the plant that adapts to low light and humid conditions, hence they were planted under the mangosteen's crowns.
Tending technique	As being planted under the crowns, They did not compete with weeds. The main tending was to put down fertilizer with unclear technique.The essential ferilizer was the pig muck. At present, the household does not put down fertilize for langsat as lack of investment, furthermore the effect has not been high for the disadvantageous weather.

Harvesting technique	Bòn bon usually ripes in calendar May to June, the ripe fruits have yellowish color. They harvested by breaking the branches which had the fruits.
Mango	
Variety and sapling	The saplings were bought from the fruit-variety agents at location, originated from Southeast Vietnam provinces.
Critera of sapling and cutivation technique.	The average height of the saplings were 50-60cm, normal growth and physical injuryless since they were easy to be infested by pestilent insects. As other plants, mango trees were planted in early wet season in the availably dug pits which were basally fertilized with muck and lime.
Tending technique	The newly-planted mangos were weeded since they are the low growth plant, very easy to be covered by weeds. It should be noted to ant and woodeater.
Harvesting technique	Both ripe and unripe fruits could be harvested, it depended on market's demand. Therefore they are usually havested by the time before Lunar New year's days (Tet). Particularly, mango fruit is one of favourite fruits to workship the ancestors in Tet festival in Southeast and southwest Vietnam in generally, so there is a big demand at the time. They ripe profusely in May to June calendar. The tool was used to collect them was a bamboo tree which was fasten with nylon or cloth bag to avoid injury the fruits.
Cultivation technique of annual crop	
Banana	
Variety and sapling	Bananas were planted from the saplings which were extracted from the big banana bushes in the garden. The saplings can be given by other households because they are very cheap. Furthermore, the technique of sapling extraction from banana bush is very simple.
Critera of sapling and cutivation technique.	Banana trees were planted with different sizes, varying from 400-500 cm. The saplings which were extracted should keep in cool place if they had not been planted immedietely. Bananas were planted in deep ditchs with 30-40 cm in depth, the surface of the ditchs was covered with dry grass and plant waste to keep humid.
Tending technique	Banabas did not need to tend, very easy to plant and quick to harvest comparing to other fruits.
Harvesting technique	Bananas can be harvested round-year. Usually, the harvesting time is when the fruits change to yellow color. However, Farmers based on their experience to collect the fruits to avoid damaging of mice and flittermouses. When being harvested, it did not only cut the bunch but also the mother plant for creating conditions for new one to grow up.
Pineapple	
Variety and sapling	Pineapple trees were planted by shoots which were the top of pineapple. The breeds were created by the household.
Critera of sapling and cutivation technique.	The pineapples in this model were not detail standards. The planting technique was quite simple. It was only necessary to turn over the soil, putting the saplings down, jamming around their foot then.
Tending technique	It did not require any special tending, expecially in this model that pineapples were planted for food for within family.
Harvesting technique	When the fruit-peel changed yellow, the fruits were collected by cutting the mother trees. It should be noted not to harm as well as do physical injury the fruits. The fruits were preserved normally within 5-7 days for being more sweeter.
Technique for livestock	
Species: Channa Sicientific name: *Channidia sp*	
Breed source	The channas were bought from An Giang province by the householder. In addtion, in the first experiment raising, he bred some catfishs (Pangasius bocourti) which were caught from the river.
Technique of raising	The fishs were bred in fishpond 2 meters in depth. Use of the trelliss turned around for not to suffer a loss. The fishpond water was taken from the river. The water level of fishpond surface depends on how the river water level is. It could be taken one or two times a day. The initial density was 10.000 fishs/400 m^2 (price: 150VND/1 fish). In young stage, they were fed with red egg yolk and with fish intestine and animal waste. Besides, the supplement food was provided by pig shit which creates

	microorganism in water for fish. It was hardly to prevent from fish disease. When they had disease phenomenon, the householder bought medicine from veterinery medicine agents to treat them, as a result, the effec from raising was not high.
Harvesting	After being bred 6 months, channas were harvested, their average weight obtained from 0.6 to 1.2 kg/a fish while basa fish gained 2-3kg/unit fish.
Market	The fishs were sold to dealers at the location with average price was 15 - 16.000VND/kg. Althought the price was cost-effective, the high price of fishfood and loss for died fish reduced considerably the income from this products. Before 2002, the productivity by class could reach 1000kg. At present, those decrease since fishs grow slowly and high price of fishfood, so the breeding scale decreases accordingly.
Other problems	The breeding of fish started since 2001. Because of the first time to breed fish, the householder did not know well in technique. Namely, breeding fish with unsuitable density as well as choosing with wrong food caused the fishs dying many. On the other hand, the water which was used to breed the fish was polutted, so it affected badly the growth and develoment of the fishs.
Species: Pig Scientific name: Sus sp	
Breed source	At first, the breed pigs were fed with the small scale, from 10 to 20 pigs/class, after that when the movement of breeding pig had boomed, the household chose the best ones to breed.
Technique of raising	The piglets that were separated from their mother gained the weight from 90 – 200kg/unit pig after three months. During bred time, they were inoculated against the common epidemic diseaseses like typhoid, cholera and germ congestion.
Harvesting	When they gained relevant weight, dealers came home to buy.
Market	In spite of being bought in home, the recent price has been low tendency. Moreover, it is belived that the dealers co-ordinated to drive down the price.
Other problems	Previously (since 2004), the pig breeding scale was a tendency to technology with about 20 sows and 100pigs for food (market). At present, the scale decreases for the different reasons, for examble the price of food increases, epidemic disease threatens frequently and the price of pig decreases. As being bred in technology tendency, the pigs were fed by processed food without using the food from the system. This made the interaction amongst components became less.

Productivity, yield and income from the model				
Products	**Unit**	**Productivity (ha/year)**	**Price (VND)**	**Income ha/year (VND)**
Langsat	Kg	60	6500	390.000
Fish	Kg	500	15500	7.750.000
Pig	Kg	1600	14000	22.400.000
Total income/ha/crop				**30.540.000**

Analysis of economic affect of the model (Calculation for the whole of model). Model area: 1.48 ha										
Input expenditures (VND)										
Item	Year									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sapling	0	0	0	0	500.000	0	0	0	0	0
Breed	8.000.000	11.500.000	11.500.000	11.500.000	11.500.000	11.500.000	11.500.000	11.500.000	11.500.000	11.500.000
Food for raising	16.000.000	35.040.000	35.040.000	35.040.000	35.040.000	29.040.000	152.400.000	29.040.000	29.040.000	29.040.000
Pesticile	0	0	0	0	0	0	0	0	0	0
Pigsty building cost	30.000.000	0	7.000.000	0	0	0	0	0	0	0
Fishpond digging cost	0	16.300.000	0	0	0	0	0	0	0	0
Tool	1.000.000	400.000	0	0	200.000	0	0	0	0	0
Veterinary medicine	240.000	240.000	240.000	240.000	240.000	240.000	240.000	240.000	240.000	240.000
Total	**55.240.000**	**63.480.000**	**53.780.000**	**46.780.000**	**47.480.000**	**40.780.000**	**164.140.000**	**40.780.000**	**40.780.000**	**40.780.000**
Income from output (VND)										
Langsat										390.000
Mangosteen		1.188.000	2.000.000						0	
Fish			7.750.000	9.300.000	12.400.000	12.400.000	15.500.000	10.850.000	12.400.000	10.850.000
Pig for market	30.400.000	38.000.000	47.500.000	47.500.000	47.500.000	47.500.000	200.000.000	57.000.000	45.000.000	22.400.000
Pig for breeding	0	0	0	0	5.000.000	6.000.000	10.000.000	5.000.000	0	0
Total	**30.400.000**	**39.188.000**	**57.250.000**	**56.800.000**	**64.900.000**	**65.900.000**	**225.500.000**	**72.850.000**	**57.400.000**	**33.640.000**
Credit (If any) (VND)										
The interest rate: 10.0%/year										

Calculation of economic effect of the model according to Cost Benefit Analysis method (CBA):

Economic criterion (in 10 years)	Calculation for the whole model with 1.48 ha	For 1 ha
i (capital interest for developmental investment % year)	10,0	10,0
NPV (VND)	42.533.038	28.738.539
BPV (VND)	406.342.801	274.555.947
CPV (VND)	363.809.763	245.817.408
BCR (time)	1,12	1,12
Interest rate/capital (%)	11,5	11,5
IRR (%)	26,6%	26,6%
The time to revoke the capital T (year)	6	6
Gross revenue VND/ha/year		**2.873.854**

Product's market of the model				
Type of product	**Market demand**	**Places to consume the products**	**Market forecast**	**Risk issues**
mangosteen	High	At location	Probability of extending both domestic and export market.	The weather has not been advantage for mangosteen since 10 years.
Langsat	High	At location	Speciality fruit. At present, supply more than demand.	Continous failure of crops. The fruits quanlity is uneven.
Banana	Low	At location	Small market, mainly local consume.	Variety with low productivity, low product quantity, low price.
Pig	Moderate	At location	Less probability of extending	High risks of price. Under competition with breading farms in technology scale.
Fish	Moderate	At location	Less probability of extending	Erratic price, unclear for breed-fish source. Water resource is polutted.

SWOT analysis of the model	
Strength The farmer has experience in production. The system of trenchs serves irrigatiion and the infrastructure is quite developed, satisfying of requirements in production. It is easy to approach the market. The trade name of 'trái cây Lái Thiêu' has been widely known	**Weakness** Perennial crops: mangosteen and Langsats are too old and the ability of fruit giving of them decreases considerably. The recent weather has not been advantageous for fruit tree as mangosteen to develop. The product quanlity is low and uneven. It is easy to be droven down the price by dealers. In general, agricultural producers lack of capital to invest. The system of extension agents works ineffectively.

Opportunity	Threat
The area is located contigously with area where is planed to develop into Cầu Ngang ecotourism. The model is considerated by authorities and suitable with the develoment plan of Bình Nhâm commune ; that is to strees on agricultural, service and technology development. The interest are is taxed free agriculture within 10 years from 2002 to 2012.	The adapting ability with the changes of economic development polycies, especially lack of labor as expanding of industrial zone in the location The problem of water poluttion impacts to productive force of the components in the model Epidemic disease causes unstableness for breeding. More risks than before There is very high competition about product quantity and the price with those in other areas. High requirement of investment and time for conversion and importation of new varieties with better quanlity

Analysis of social and environmental significance of the model	
Significance on society	
The satisfied level of famer with income which had contributed in household economy.	Since recent 10 years, the income from the model VAC at Bình Nhâm has been lower than that before by far. The reason is the productivity of fruits has decreased, simultaneously the raising has faced difficulty for epidemic disease and the erratic price. The farmers have been reducing their investment on agriculture and shifting to others. Thing showed partly that the urbanisation has been taking place rapidly at the location.
The number of household had applied this model in hamlet.	According to the investgated data, there are only 2 VAC models at present while almost households had applied this model before. This is why epidemic disease during the raising process, so the number of housheulds who have applied this model decreases rapidly.
The number of hamlets had applied this model in commune.	All hamlets in the commune have applied VAC model, however the numbers are different at each village and not to be sufficiently calculated.
Probability of spreading out at scale.	At present, the VAC decreases in investment aspect for production. Poor economic effect leads this situation. Moreover, the fruit plants are too old with low productivity along with abnormal weather, so they have invested less. However, the tendency of maintainance of these models is supported strongly by the local authority.
Condition to spread out	With regard to economy: It needs to have the various forms of credit support to be suitable with long production rotation of fruit species. With regard to technology: Conversion of new species of plants which give high productivity and quanlity in order to meet the market's demand more and more Research on process technology of post-harvesting product to suit scale and households' ability in order to improve the product's value With regard to policy: It needs to have an obvious plan of production land to set farmer feeling at rest.
Other items	At present, It is believed that the reducing produtivity of the fruit trees is common situation at the location. This has not related to tending or fertilizer but mainly abnormal weather. Especially, it was alot of rain by the time of flowering and producing fruit, so the flowers fell many. The fruit quantity would be low in such condition. Therefore, finding of varieties that flower sooner or later the rainy season is very impotant factor.
Significance on environment	
Protective ability of soil, effectively and suitainably using land of the model.	If the model is suitably maintained and developed, it will create the good effects for water and soil resources through useful interaction among the components as well as soil and water. Especially, the perennial crop component is believed that it prevents contamination from alum.
Ability of water resource protection	The interest area is located in lowland of system of Saigon and Bình Nhâm river. The farmers have used natural water from these rivers for producing. If waste water from the raising is not processed before reaching to rivers, it will contribute to pollute this water sources.
Possibility of being against with	Though we have not experiment data in hand, direct observation showed that eliminated water and air from industrial zones has been influencing seriously

environmental pollution (air, soil, water, and so on)	on the normal growht and development of crop plants.
Possibility of lossing of presure on forest, the relationship between forest and cultivation system	There is not distribution of natural forest in the interest area, so we do not depic this criterion.

AGROFORESTRY MODEL BASED ON GARDEN - FOREST LANDSCAPE – Lac Hoa 2 hamlet, Lac Tanh town, Tanh Linh district, Binh Thuan province

General information	
Model name:	**Garden - Forest**
UTM position (GPS)	X: 0792724; 0792730; 0792717; 0792712 Y: 1226243; 1226245; 1226272; 1226269
Scale of area	23.000 m^2 (2.3 ha)
Householder: Đào Ngọc Hào, 67 years old	
Address	Lạc Hóa 2 hamlet, Lạc Tánh town, Tánh Linh district, Bình Thuận province
Information collector	Đặng Hải Phương – HCM.City Agricultural and Forestry University
Date of data collection	May 2007

Origins of model establishment

This model was built by Mr. Đào Ngọc Hào in 2000. However, cashew trees were planted in this area before that with the area is 8.000 m^2 (total area is 23.000 m^2).
Householder (Mr. Đào Ngọc Hào) is a retirement army officer, he had ever managed a productive farm belonged to army. The idea of building the garden - forest model had started during the time when he served in the army. However, because of his task condition as well as insufficient labor in his household, the model had built gradually. Up to now, his model is relative well-done with typical components of a forest garden system.

Natural condition and socio-economy

Natural conditions

Soil	The soil which is interest area belongs to the mountainous yellowish red soil group. The physical elements are relative complicated with the varying of soils from sandy flesh to clay-heavy flesh. The soil level is relatively thick from 70 – 100cm deep, the content of humus is high; the soil is not too acid[1].
Slope	
Average annual rainfall	2.000 – 2.200

[1] Cited from the reoport of Tánh Linh District People's Committee on situation of Socio-economic task performance in 2006 and orientation of Socio-economic task in 2007.

(mm/year)	
Average annual temperature (^{c}o)	22 - 26^{0}C
Average annual humidity (%)	70 - 85%
Altitude (m)	Average from 170 - 200 meter
Socio-economic	
Ethnic group	Kinh
Household economic group	Moderately good
Ethnic composition in village/hamlet/commune	Kinh people account of 100%
Population at village/hamlet	This is a town of 10 villages, in which there are 224 households with 1.483 heads who are Chăm people. The population in total is 16.727 people.
Cultivation structure	Forest tree – perennial plant – fruit tree - livestock
Infrastructure	Communication routes which connect within villages have fully-built and well-used. At the interest area, though the roads are narrow, motorbike can approach to transport products as well as provide materials and fertilizer.
The state of agricultural and forest product market	Farm products have been consumed on the location. There was hardly any processing basis of post-harvesting products.
The state of forest management	Lạc Tánh town has of 7,5 forest land; there is no any villager who is allocated forest land to manage.
Credit	No credit

Description of Landscape Agroforestry

Model of Landscape Agroforestry – Forest Garden

Description of perennial crops	
Species: Aquilaria tree (Aquilaria Crassna Pierre ex Lecomte), belongs to Thymelaceae family.	Aquilaria tree is a big-wood and evegreen one, the hight is about 20 – 40m and diameter at breast height reaches 50 – 80cm. Its bark is grey. The bark thickness is 2 – 4cm with the bark fibres. The wood is light yellow or white color, the core is undistinguishable. Aquilaria tree is a light wood species (density d =3,395) Aquilaria tree distribute in many places in Vietname, Kampuchia, Thailand and Lao territory. In Vietnam, they scattere from North to South such as Quảng Ninh, Bắc Giang, Thanh Hóa, Quảng Bình, Quảng Trị, Quảng Nam, Quảng Ngãi, Phú Yên, Khánh Hòa, Bình Thuận, Lâm Đồng, An Giang, Kiên Giang ,etc. Aquilaria tree can create agarwood which is extremely valuable favori and used for medicine. At present, Aquilaria tree in the model have intercropped under cashew and banana crown.
Species: **Mangosteen** Scientific name: Garcinia mangostana, classified in	This is a fruit-tree, average-good stem. Mangrosteen is the commercially valuable fruit and a favourite one in market. Some documents have showed that the mangrosteen can be used as a medicine. Depending on

family Clusiaceae.	care condition, the mangrosteen products fruit at the age of 20 to 25. Harvesting rotation can last 100 years. They are cultivated relatively common in South east and Notheast Vietnam. In this model, the ones which are 5-6 years old was planted at 6 x 6m intervals and has not been harvested yet.
Species: **Mango** Scientific name: Mangifera indica	Mango is the fruit tree with big-wood stem. However, the currently grafted mango species is lower so it is very easy to pick the fruit. They have been cultivated popularly in Southeast and Southwest Vietnam.
Species: **Durian** Scientific name: Durio zibethinus, classified family Bombaceae	Durians that is cultivated South and Central Hghlands is the fruit tree with average wood stem. The edible flesh emits a distinctive odour and durian is the economiacally valuable one. Durian is a lightly favourite species, it can be planted toghether wiht other fruit trees that whose crown is lower.
Species**: Cashew** Scientific name: Anarcardium occidentale, thuộc họ Anacardiaceae	Cashews have been cultivated commonly in the Middle and Southeast Vietnam. Their seeds have been used as food. The seeds contain resin. There are 8000 m^2 planted cashew since 1989.
Species: **Giant bamboo** Scientific name: Dendrocalamus asper	They were planted along the small stream not only for bamboo shut, but for preventing from landslide.
Apart from the decribed perennial plants as above, others ones such as carambola (Averrhoa carrambola) and Acerola (Malpighia glabra) were planted to use within the household. Citronella with few number of individuals, so it has only been used in family. It has been found in the model with a limited quantity of planted tree species for ornament like Ochna integerrima (lour.)Merr, several species of Adenium and cactus	

Description of annually crops	
Species**: Banana** Scientific name: Musa sp, belongs to Musaceae family	Banana is very easy to plant and it has been planted popularly in garden of households who live in Southeast Vietnam.

Description of livestock	
Livestock species: Red Tilapia Scientific name: Oreochromis sp	The area of fishpond is 125m^2 and 3m deep, built at the lowest position of the model. The pond was built with brick, having manhole for drainage. The water source which supplies water for the pond is a small stream flowing from the hilltop. The pond plays the role of water supplying for fruit trees during dry season.
Livestock species: **Chicken** Scientific name: Gallus gallus	The coop, which was built with brick and leaf roof, is situated at the high and dry position behind the house. The coop area is 20m^2.

General description of space and time combination within the components in the model.

- Arranging space: The planted fruit trees in the model were arranged at zones. Aquilaria trees were intercropped with cashew and banana in the early period. Through direct observation and experience of the farmer showed that the intercrop was in order to shape for Aquilaria tree, helping it grows and develops favorably. The observed result showed that the Aquilaria tree that planted under the canopy of cashew and banana have round and straight stem. Their growth norms such as height, diameter is higher than those of without shadowed at the same age. Although Aquilaria tree was not watered in the early stage, its living rate had increased thanks to shadow. At the areas near hilltop, because Aquilaria tree which was planted in 2001 had grown, so banana density was reduced to increase the light for Aquilaria tree

- Time combination: The species trees were planted in time sequence. In the model, cashew and banana were firstly planted, Aquilaria tree was intercropped afterwards under their canopy. Chickens were fed continuously, however their amount could increase or decrease by time period.

Description of reciprocal impact, energy current and material rotation in the model

Bamboos were planted along the small stream which rises from the hilltop; others in the model were

arranged at zones. The stream has water all year round, though water flow reduces considerably in the dry season. Fruit trees were planted near the fishpond in order to be able to be irrigated in the dry season. The fallen-objects from cashew, fruit trees and Aquilaria tree had been used as fertilizer source. Moreover, fallen-leaves and fallen-branches had been used to cover the bamboo to stimulate bamboo shoot coming out of the ground. The plants that were cultivated on hilltop play an important role in landslide decrease and surface flowing reduction, besides; they help to stabilize the stream flow which is unique water source in the model. Two rows of bamboo along the stream have reduced significantly landslide so that it limits filling the fishpond below.
The fishpond which supplies water for plants plays a specific role in maintain of air humidity more suitable, especially in the dry season in cultivated area. The muck has been used to manure for planted trees in the garden. (Muck was mixed chemical fertilizer)

Cultivation technique of different elements in the model	
Cultivation technique of perennial crops	
Mangosteen	
Variety and sapling	Seeds were bought in Phương Lâm (Đồng Nai province), originated from famous granary of fruit in Cái Mơn, Tiền Giang province.
Critera of sapling and cutivation technique.	The sapling was from 40 – 50cm high, having 3 layers of leaf. Size of pit is 60x60x60cm. Basal fertilizing with mixture of decomposed muck, lime and Furadan. The pits were filled with on equal neck of root. Time cultivation was early rainy season.
Attending technique	After one year, plants were matured with decomposed muck and weeding. Watering 2 times per one week in dry season.
Harvesting technique	At present, mangosteens give early fruit, fruits were harvested when they changed green to dark light-violet brown colour (similar grape colour).
Aquilaria tree	
Variaty and sapling	There are two kinds of Aquilaria tree veriaty in the model. In the first plantation (2002), there were 800 plants were taken from natural forest. However, dead rate was very high, up to the rainy season of the following year, it remained 30 trees. In the second and third one in 2001 and 2005, the saplings were bought from Quảng Nam province.
Critera of sapling and cutivation technique.	The saplings were planted in the early year and were 45 – 50cm high. Size of pit is 60x60x60cm. Basal fertilizing with chemical fertilizer DAP (about 3 handful of DAP) which mixed with top soil. The saplings were removed lightly from the mixed bag. Avoiding from breaking the bad. The saplings were filled as equal orifice of pit. The very young Aquilaria tree adapt to low light , so it is suitable to intercrop under canopy of cahsew or banana.
Attending technique	Due to being planted under canopy of banana or cashew, it did not need to water in the first dry season but it had to be weeded and sprayed chemical to exterminate leaf pest eaten. Although Aquilaria tree were not watered in the early stage, it subsistance rate increased thanks to shadow
Harvesting technique	With no information
Durian	
Critera of sapling and cutivation technique.	Variety of durian was bought at Phương Lâm (Đồng Nai province), originated from Cái Mơn, Tiền Giang province. Similarly other fruit trees, durian was planted in the early rainy season. Size of pit is 60x60x60cm. Basal fertilizing with mixture of lime, decomposed cowpat and Furadan.
Attending technique	Durian is suitable with humid content but it is unsuitable with waterlogged condition. It roots will be rotten if it is waterlogged. In the dry season, it is necessary to water and mature with decomposed muck to keep humidity for soil.

	When trees bear fruits, they should be matured with muck once a year after harvesting fruit. Normally, durians flower so many, so it should be necessary to remove some of them to ensure tree and fruit reaching bigger size.
Harvesting technique	Harvesting is in July. When being ripe, the fruit will fall by itself.
Mango	
Variaty and sapling	Varieties of mango were bought at Phương Lâm (Đồng Nai province) originated from Cái Mơn, Tiền Giang province.
Critera of sapling and cutivation technique.	Saplings were planted when their height reached 50 – 60cm, the stem was robust and balanced. Mangos were planted in early rainy season. Size of pit is 60x60x60cm.
Attending technique	Mango is suitable with high light and humid content but not waterlogged, so the land for mango should be good-drainage area. They were watered twice a week in the dry season, and their foots were covered to limit evaporation.
Harvesting technique	The ripe fruit is yellow in color. It can be harvested when it is enough old by using collecting cage. (The collecting cage is a stick 5 – 7m long. One of head is fasten by a net cage to contain fruit). Depending on price and demand of the market, the fruit can be harvested when it is unripe.
China bamboo	
Variaty and sapling	The varieties were given by a relative.
Critera of sapling and cutivation technique.	The cultivated bamboo trees were bamboo hedges or bamboo foots which were raised previously. They had root alrealdy. Every bamboo hedges were planted in the pit with the size of 40x40x40cm. Because the root system develops strongly, bamboo was planted along the stream to limit landslide.
Attending technique	Because bamboo is quite easy to live and grow and develop quickly, it does not need a special taking care. In the dry season, it will product bamboo shoot if it is covered by straw or leaf and watered. However, it should water during the dry season to avoid from losing health of bamboo, if not, it will not be shoot in the rainy season.
Harvesting technique	After 2-3 years, bamboo can bear shoots. They are often collected in the rainy season. Using the special tool to cut bamboo shoots at close ground position.
Cultivation technique of annual crop: Banana	
Variaty and sapling	Bananas were planted from saplings which were extracted from the big banana bushes in the garden. The saplings can be given by other households because they were very cheap. Furthermore, the technique of sapling extraction from banana bush is very simple.
Critera of sapling and cutivation technique.	Banana can be planted at various sizes, changing from 50 to 100cm high. The saplings should be placed in cool place if they are not been planted immediately. Size of pit is 30 – 40cm deep, the pits were filled by top soil leaving 4 - 5cm. The sureface was covered by dry grass and fallen objects to keep humid. Because the bananas were planted in high hill, so that to avoid the bananas fall the banana bunch must be directed toward the top hill. The householder has experience of extracting saplings from the mother. Cut-face should be towards slope base so that the scar will not be able to sprout. In addition, according to the expérience of farmers have shown that when banana trees produce the bunch, their bunch is alway towards the top hill. This is a good experience of planting the banana on the slop hill
Attending technique	Banaba did not need to attend, very easy to plant and quick to harvet comparing to other fruits.
Harvesting technique	Bananas can be harvested round-year. Usually, the harvesting time was the fruits change to yellow color. However, Farmers based on their experience to collect the fruits to avoid damaging of mice and flittermouses. simulteneously cuting of the bunch and the mother plant to creat conditions for new one to grow up.

Technique for domestic animal	
Chicken	
Breed	Breed chickens were created from chicken mother owned by the household. The hens that were chosen to creat breed could be a nice shape and their weight was higher others that were of the same rank. A hen could lay and hacth from 10 to 12 young chikens in one laying. At the time when he fed many chicken, there were five hens hacthed and gave 50 – 60 young chickens in total at the same time.
Technique of raising	The bred chickens were the domestic one, had a good resistance and had possibility of finding food by themseves. The herd of fed chicken has at least 2-3 different age, so every rank has harvested apart from 2-3 months. The young chicken after 2-3 days old was inoculated against an epidemic. The supplemented food was maiz and rice. In order to avoid the phenomenon of co-blood, it would change the cock continuosly after hatching. And they should not breed each other in the same rank. The weight when they were paid out reached 1,6 – 2kg after 5-6 months.
Other problems	Contrast to the chicken farm at industrial scale has been influenced by bird flu, the chickens were bred in garden with inoculation against an epidemic have been still maintained and created the considerable income for the household. The market demand of this product is alway high due to high quality of chicken and customer habit. However, extension ability was limit since the raised chicken places were solitary, so the chickens were bitten by snake, attacked by fox and stolen by some time.
Red Tilapia (Oreochromis sp)	
Breed	Breed fishes were bought from an agent at location. The average size of them reached 4 - 5cm in long, they were healthy.
Technique of raising	The bred fish density was from 10 to 20 fishes/m^2. The food could be one that was for fish only. Besides, it could be supplemented by others like spinach and sweet potatos buds. The water hyacinths were dropped in water surface (made of 20% of water surface area) to cool water. Because they were not really tended and fed in correct way, they grew slowly. They were harvested once a year instead of two times a year if they would be cared correctly.
Other problems	Since the fishpond was improved and circled with brick wall in order to take water for irrigating, it was dug 3 meters in deep. This depth was not suitable for feeding fish. As a result fish grew slowly. In general, the technique and consume of this product were not complecated, however, the density and the food were under requirement as the household had really expected this product as a commodity market.

Productivity, yield, income from the model 2006				
Products	**Unit**	**Productivity (ha/year)**	**Price (VNĐ)**	**Income ha/year (VNĐ)**
Chicken	Kg	100	50.000	5.000.000
Fish	Kg	100	10.000	1.000.000
Bamboo	Kg	300	7.000	2.100.000
Cashew nuts	Kg	1.000	10.000	10.000.000
Mango	Kg	100	8.000	800.000
Banana	Bunch	100	30.000	3.000.000
Durian	Kg	480	12.000	5.760.000
Total				**27.660.000**

(Source : Household interview)

Analysis of economic affect of the model (Calculation for the whole of model). Model area: 2.3 ha							
Item	Year						
	1 (2000)	2 (2001)	3 (2002)	4 (2003)	5 (2004)	6 (2005)	7 (2006)
Input expenditures (VND)							
Labor hire	10800000	10800000	10800000	10800000	10800000	10800000	10800000
Variety : ▪ Fruit plants ▪ Aquilaria tree	 600000 2000000	 400000 3200000	 0 0	 0 0	 0 0	 0 1200000	 0 0
Breed	0	210000	0	0	200000	0	0
Fertilizer	1000000	2000000	800000	800000	800000	1200000	800000
Irrigation (Power)	0	0	0	0	2000000	2000000	2000000
Water pump and pipe	960000	0	0	0	0	0	100000
Breeding facilities building	0	1200000	0	0	30000000	0	0
Pesticide, medicine for animal	0	200000	200000	200000	200000	200000	200000
Total	**15340000**	**18010000**	**11800000**	**11800000**	**44000000**	**15400000**	**13900000**
Income from output (VND)							
Chicken	5000000	5000000	5000000	5000000	5000000	5000000	5000000
Fish	0	0	0	0	1000000	1000000	1000000
Bamboo	0	0	0	700000	2100000	2100000	2100000
Cashew nuts	10000000	10000000	10000000	10000000	10000000	10000000	10000000
Mango	0	0	0	0	400000	800000	800000
Banana	3000000	3000000	3000000	3000000	3000000	3000000	3000000
Durian	0	0	0	0	0	3600000	5760000
Gross income	**18000000**	**18000000**	**18000000**	**18700000**	**21500000**	**27660000**	**27660000**
Gross income – Total costs	**2660000**	**-10000**	**6200000**	**6900000**	**-22500000**	**12260000**	**13760000**

NPV value (10% discouting rate) if the whole model is : NPV = 11.791.638 VND > 0

Product market of products of the model				
Type of product	**Market demand**	**Places to consume the products**	**Market forecast**	**Risk issues**
Chicken	High	Local commerce	Demand will increase in the future	Bird fly To face with the protection problem
Fish	Moderate	Local commerce	Market will be stable	Breed tecnique has been suitable
Mangosteen	Moderate	Market	Local market will be stable	Product specification has not been fixed, depending season so the price is not high.
Cashew nut	High	Local commerce	Market will be stable	The price of product has varied and depended on international market It is impossible to extend due to no more land.
Mango	Moderate	Local commerce	It will mainly consume at the location	It has competition with the same products from orther locations.
Banana	Moderate	Market	It will mainly consume at the location	There is not remarkable risks.
Durian	High	Market	It will mainly consume at the location	The price has decreased in recently year.
Aquilaria tree	Although this product has been exploited, several dealers have asked to buy with the price is 400.000VND/plant. This infers that the market potential of this product is very high. At present, one-third of Aquilaria tree in the model has been interfered in order to create agarwood.			

SWOT analysis of the model	
Strength ▪ Householder has much expérience in garden doing (in army-service time) and confidence in investment. ▪ The cultivated area is quite favourable, nearly roads so approach to services as well as selling products are initiatively. ▪ Water for iirigation is enough during the dry season.	**Weakness** ▪ Cultivated crops have not been invested properly ▪ It has to rent labor because of lack of labors ▪ It is difficult to develop livestock (chicken) bacause it cannot be protected. ▪ Steep slope, difficulty in cultivation
Opportunity ▪ Do bau market is high currently. ▪ There is always high demand on the products in the market.	**Threat** ▪ Unknow the product price in the future ▪ The harvested products had not garthered, product specification and quality have not homogenous. ▪ To start to be under competition with others location on the same products.

Analysis of social and environmental significance of the model	
Social significance	
The satisfied level of famer with income which had contributed in household economy.	Although it did not contributed so much in total household income, the potential income is high in the future when Aquilaria tree will be harvested. The householder released that he will continue to invest in the model in order to bring effect in the next few years.
The number of household had applied this model in hamlet.	There are 3 households who have applied this model. However, the componets in theirs model are different.
The number of hamlets had applied this model in commune.	Except village Chăm, remaining villages in Lạc Tánh town have applied this model.
Probability of spreading out at scale.	The initial given capital is necessary to build the model. Furthermore, the area need to be big enough and labors are available. Therefore, the posibility of dissemination of the model is not so much.
Condition to spread out	In term of economy: Capital is initial and the most essential factor. However, the farmers did not loan the capital to invest even the state issued the credit policy for farmer. They worried about the risks of price and others. In term of technique: To define the crop plants that are suitable with conditions. The processing of cultivating and taking care of perennial plants like do bau has not been disseminated broadly. The farmer learned mainly by themselves or learned experince from others. In term of policy: Along with economic policy, manager's point of view as well as policy related to environment will impact positively on cultivation according to suitainable manner in which stresses environmental factors, namely, the famers should be favoured to implement this model, for instance free or reduction tax for them in the early years. In fact, in the early years, the harvested products are very few.
Environmental significance	
Protective ability of soil, effectively and suitainably using land of the model.	The affect of the model on environment has been several positive factors. Especially limitation soil erosion by planting perennial crops on the top hill. Therefore the land-use is more reasonable and sustainable.
Ability of water resource protection	The specific evidence of water resource protection is the small stream which originates from the hilltop has still sufficiently supplied water even in the dry season. Like this, possibility of water protection in the larger scale is possible if the model will be disseminated.
Possibility of being against with environmental pollution (air, soil, water, and so on)	It is the arrangement of cultivated crops, especially perennial crops, and rational using of resources of soil and water has maintained general productivity of the model. Like this, other functions of perennial crops have brought into play effect.
Possibility of losing of pressure on forest, the relationship between forest and cultivation system	At present, there are only 7,5 hectares of forest land and there is not any household who lives on forest. Therefore, the information on possibility of losing of pressure on forest as well as the relationship between forest and cultivation system were not depicted. The inventory showed that some households who had lived on the forest previously had applied this model, however, they have changed in recently years due to impact of forest management policy which has been enforced more strictly, simultaneous impact of urbanization made land to be interested more, hence these households had planted perennial crops to the annual crops as a form in order to confirm their land ownership.