

MINISTRY OF SCIENCE AND TECHNOLOGY
VIETNAM-NETHERLANDS RESEARCH PROGRAM (VNRP)

FINAL REPORT

**Researching the status and potential for development of the
cashewnut (*Anacardium occidentale*) in accordance with
sustainable development and commodity-oriented
production on hilly and mountainous soils of the Hoai Nhon
district, Binh Dinh province**

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PART I: INTRODUCTION

1. The project proposal:

- The Hoai Nhon district belongs to the Binh Dinh province and is located in the agro - ecosystem area of a coastal province in the central part of Vietnam. It has a total land area of 41,295 ha, in which the area under crop production is 12,157.3ha. Within the province, 23,710 ha is sloping land, covering a proportion of 57.41% in the province. The population of the Hoai Nhon district is 217,609 people. Most of the people living in the mountainous area are in need of extra capital for production, they lack technology to enable improvements in productivity and the infrastructure is slowly upgraded. These factors cause difficulties in the lives of the local people.

- In fact, the sloping mountainous area has not been effectively used. Besides, the forestry area is in increasing and other mountainous land and not-yet-cultivated areas are being expanded beyond the authority control. These indirectly cause a regular occurrence of annual flooding, unbalancing the ecosystem.

- At present, the total area of cashewnut fields in Hoai Nhon is 1,116ha, covering 15% of the total area of trees in the province with 641ha cropped, but the capacity is still low, with an average yield of only 0.28 ton/ha. Moreover, the quality of the products is less than the required standard, as it does not reach the export standard, and the local people's income is still low. 100% of Hoai Nhon cashewnut fields was expanded using local seed from nuts from local farms.

- In 1999, with the approval of the Government for a project to cultivate cashewnuts in central coastal areas, the Binh Dinh people's committee is oriented towards developing an economically valuable cashewnut industry and the committee has offered a master plan for developing cashewnut fields.

- Based on the facts stated above, we decided to conduct the project proposal: **“Researching the status and potential for development of the cashewnut (*Anacardium occidentale*) industry in accordance with sustainable development and commodity-oriented production on hilly and mountainous soils of Hoai Nhon district, Binh Dinh province”**

2. The purposes of the project proposal:

The project's purpose aims to solve 3 current problems in the Hoai Nhon district:

(1) To analyse and find out the advantages as well as the disadvantages of the cashewnut plantations on the type of land in the district.

(2) To research and make suggestions for cashewnut plantation models that are sustainable both in economics and in the natural ecosystem of cashewnut plantations on this type of land which is aiming towards export production.

(3) To point out some solutions in order to improve the cashewnut fields on this type of land which is oriented towards the export market and sustainability.

3. Research Methodology:

(1) Rural Rapid Assessment (RRA).

(2) Participation Rapid Assessment (PRA).

These methods were used during the data collection (interviews, researches, surveys and forums).

(3) Besides the above approaches, other methods were used such as KIP, participation technology development (PTD), the heritage method, the expert method and the analysing method.

(4) Applied statistics.

(5) Model trial method.

4. Objectives-Research scale

4.1. Target audience of the research:

All households and offices that have cashewnut plantations, trade agents, processing centers and export units in the Hoai Nhon district in the Binh Dinh province.

4.2. Research scale:

In this limited research, the project proposal is focused on researching the current cashewnut production, evaluating other sustainable cashewnut plantation models and finding out some effective solutions for better developing cashewnut fields oriented towards commodity production and sustainability on the sloping lands in Hoai Nhon district in the Binh Dinh province.

PART II: CONTENTS AND FINDINGS

Chapter I

Overview base and realness of the project proposal

1.1. System theory:

- A system is a chain of different ordered factors, which have reacted to an outside input and are related to one another. In reality, there are two kinds of basic systems: (i) *closed system*, (ii) *open system*.

- Agricultural production is a system including manufacturing, processing and consumption.

- Within farming systems on sloping land: in Vietnam there are 3 kinds of farming systems of the tropical zone including: (i) *traditional farming systems*, (ii) *transferred farming systems*, (iii) *modern farming systems*.

- Cultivation system: this includes most of the species grown in the area and the duration of the different species in all agricultural ecosystems, in order to make good use of the socio - economic resources and other natural resources.

* ***Ideas of systemized research:***

- Approaching idea.
- Micro and macro ideas.

* ***Methodology for systemized research:***

- Modernized method.

1.2. Ideas on how to cultivate cashewnut fields in Vietnam:

* According to the Decision number 120/1999/QĐ-TTg, issued on 07/5/1999 by the Minister on the approval of cashewnut enlargement projects up to the year 2010, the following objectives were stated:

- To increase more cashewnut fields in order to make good use of the cashewnut advantages such as food values and wood exploitation. Also, it is easy to plant, requires a low investment in capital, has an ability to handle drought, can be grown in less - productive areas and it is especially suitable to local low-income people, to serve domestic demands and for export with the total quantity up to 100,000 tons of nut per year.

- To develop the cashewnut fields in advantage areas, priorities should be given to central coastal provinces and lower areas in high mountain provinces, coordinating to improve current cashewnut fields and newly planted fields.

- To increase the income and create more jobs (including agricultural and industrial processing labour), giving priorities to poor households and areas.

* According to the Institute for planning of agriculture (2000), the development of Vietnamese cashewnut fields are based on the following ideas:

- The idea of export goods production: This is for export activities to get foreign currencies.

- The idea of economical effectiveness: benefits and income are higher paid priorities.

- The idea of sustainable development: To save the environment and to ensure that the local people's regular profits are maintained.

* Also according to Mr. Hoang Si Khai and Mr. Nguyen The Nha (1996) some of the following ideas should be considered during the development of the Vietnamese cashewnut industry:

- Systemized ideas: developing activities of cashewnut commerce and production is a strict system including three different parts: production, processing and marketing for consumption.

- The idea of goods production: Cashewnut production is a faculty aiming to export products to get foreign currencies.

- The idea of economical effectiveness: Including some rates such as income rate and domestic profit. Besides, the idea of economical effectiveness is also based on the rates of the land use, labour rate or other effectiveness uncountable via money, such as the benefit obtained through protecting living environment, providing protection from erosion and upgrading the value of the land.

- The idea of protecting the living environment: Cashewnut fields are both an agro-ecosystem cultivation crop as well as providing benefits for sustainable development, since its provides positive benefits including providing an alternative to deforestation, requires less chemical uses and reforms the soil, water and weather resources.

1.3. Basics for sustainable development:

Sustainable development aims to meet the demands of the modern generation and it does not cause any harm on the development capacity of the following generations.

* Approach based on sustainable development:

- Moralized approach
- Economical approach
- Ecosystematical approach

* Background for sustainable development: To control decreasing harm to the natural resources and the environment; Conserving multiple natural living things, other aquatic animal and botanical systems and maintaining the necessary ecosystem for the community.

* Sustainable development (in the fields of agriculture-forestry-fisheries) means to preserve natural land, resources of natural water, resources of animal and botanical genetics, creating an un-declined environment, suitable applied technology, developing economy and bringing together an acceptable society (FAO, 1991).

1.4. Agroforestry idea :

“Agro-forestry means to make good use of the provided land, which is suitable for an agricultural cultivation system of all kinds including long term plants, short term plants for food and together with other forestry plants (sawlog exploitation for timber) and plants for feeding livestock and poultry (developing animal husbandry) on the same land provided”.

1.5. Basics of commodity agro - development:

1.5.1. Market economy:

- Commodity market is a production market, in which the producers are not producing what people need, but they are producing what they can sell to the community to the present market.

- A market is where the sellers and buyers meet together to barter commodities and money with three functions: (i) acceptance, (ii) harmonize and (iii) information exchange.

- A market economy is how the socio-economy is organized in which the economic relation of each personal is completed through selling and buying commodities in the market. This is a systemized economy that can be adjusted in order to ensure capacity, quality and higher effectiveness.

** The running structure of market economy:*

Usually, the market economy has suffered from economical impacts (value circle; supply-demand, competition circle, monetary circle...). Settling down all the economic relations is the key to running a market economy.

1.5.2. Market economy with the state management oriented for socialism:

The market economy controlled by the state is the one in which the society is both adjusted itself with the market and with the state control through regulations and ownership rights of the state.

In Vietnam, market economy oriented for socialism means *to set up a commodity market with multiple sections run by the market mechanism, at the same time to strengthen the state control role oriented for socialism. The economy increase is*

related to the progress and social equality, reserving and developing national cultural tradition and saving the ecosystem environment.

1.6. Ideas of transferring plants structure:

- (1) Idea of commodity production.*
- (2) Idea of developing a multi- sector economy, diversifying ownership rights and enhancing technical progress.*
- (3) Idea of multi-cultivations, multi-products and eco-system protection.*
- (4) Idea of competition advantages and priorities for agro products for export.*
- (5) Idea of effectiveness.*

Chapter II
**SOME SPECIFICS OF THE GEOGRAPHICAL-SOCIO-ECONOMIC
 CONDITION OF HOAI NHON DISTRICT-BINH DINH PROVINCE
 AND THE IMPACTS ON THE DEVELOPMENT OF CASHEWNUF FIELDS
 ON SLOPING AND HILLY AREAS**

2.1. Geographical condition of Hoai Nhon district:

(1) Hoai Nhon district is a semi-mountainous and semi-delta district located in the northern area of Binh Dinh province with 15 communes and 2 towns. The total natural area is about 41,295 ha, in which the agricultural cultivation area covers 12,157.3 ha. The sloping areas occupy 23,710 ha and cover 57.41% in the district.

(2) The average annual temperature is rather high, with an average temperature of 26.1⁰C. The annual average rainfall is 2,022 mm. In general, the weather is suitable for cultivation and to develop plantings of various crops all year round. However, there are many disadvantages: typhoons, floods and strong west-southern winds causing damage to cashewnut fields.

(3) There are 8 groups of lands in all, including 18 land units and 43 sub-land units that cover 35,632ha in the Hoai Nhon district. The type of lands are quite diversified within the district. The total area of sloping land covers 23,710 ha with 4 levels of sloping lands and 3 other specific lands (Acrisols, Ferrasols and Leptosols). The Acrisols covers a large area in the district.

(4) Forestry resources: Total forestry area covers 19,450 ha (out of which the actual forest land takes up 9,600 ha and non - forest land takes up 9,850 ha). The potential forestry land and land suitable for eucalyptus camaldulensis plantations are still high, at about 9.356 ha and are enough for cashewnut development.

The natural forest consists of a multi-botanical system, it is reforested and reforestation is set up everywhere in the district, especially there are 1,166 ha of cashewnut fields, in which 50% of the field is for crops.

(5) Waters from Lai Giang River and other lakes, as well as underground waters are protected well and are suitable for exploitation, serving agricultural production purposes and enhancing the quality of local people's lives.

(6) However, there are some constraints associated with exploiting the mountainous, sloping lands in the Hoai Nhon district:

- Complicated area, steep slopes, thin soil profiles, chemical and geographical properties of some land has partly had an affect on cashewnut plantations. Therefore, more attention on fertilizers and better cultivation practices are required to limit land erosion.

- In the dry season, the air and water is quickly evaporated and the humidity and rainfall are rather low. There is also out of season rain which reduces the yield, which affects the production and the quality of the cashewnut.

- The cashewnut area is 1,166 ha, only 34% of which is in good cultivation. In general, the capacity is low and the quality is low so there should be some more intensive cultivation as well as land reform.

2.2. Socio-economic highlights:

(1) The population of Hoai Nhon district is 217,069 inhabitants, in which 70,372 are forestry labourers. They all are labourers who have an ability to work hard and are practical.

(2) In general, Hoai Nhon is an agricultural district that specializes in paddy cultivation. Other industrial plantation areas are still low and for these reasons most commodity products are not developed enough. Therefore, local people's lives are still difficult and the capacity and quality of the products have not met the real demands, although they are encouraged to increase the production and quality of the products.

(3) The local industry has developed slowly, the services are often poor and less attractive to customers. In fact that there are not any processing enterprises in the district so the cashewnut value has not been highly appreciated.

(4) In remote areas, there has been less investment in infrastructure facilities and this has limited the economic development and potential of this land.

(5) Agricultural promotion work and agronomy services are still facing some difficulties although they have been organized from higher to lower levels in district. In particular, cashewnut promotion has not been conducted.

(6) The transfer of cultivation practices as well as development of livestock infrastructure has been slow in socio-economic development during the past few years.

(7) The cashewnut farmers' living condition is better than that of the other agricultural farmers, however the quality, prices and outputs are not stable.

(8) The socio-economic condition has been increasing and this is the basic factor required for well – informed and practical development

Chapter III

STATUS IN CASHEWNUIT PRODUCTION, PROCESSING AND CONSUMPTION IN DOMESTIC AND FOREIGN MARKETS

3.1. Analysis and evaluation of cashewnut operations in the Hoai Nhon district:

3.1.1 History of cashewnut plantation in the Hoai Nhon district

Cashewnut cultivation has existed in the Hoai Nhon district since 1975 on a smaller scale and has not been concentrated or further developed. From 1991-2000 cashewnut fields have been subject to further investment and development.

3.1.2. The current cashewnut area and distribution:

3.1.2.1 The current cashewnut area:

- Only 265.9ha is concentrated on the better areas (S1), and 900.1 ha is concentrated on moderate land (S2). Yet, the capacity is still low and this partly shows that there has not been enough attention focused on seed production and investment in intensive cultivation practices.

3.1.3. The quality of current cashewnut fields:

- Total area:
- Good cultivation covers 33.92% with about 395.5 ha
 - Moderate cultivation covers 26.42% with about 308.0 ha
 - Bad cultivation covers 39.67% with about 462.5 ha.

3.1.4. The current situation of outputs and production:

- The average capacity is very low, only 0.28 ton/ha compared with the average capacity of the province which is 0.32 ton/ha. This equates to approximately 40% of the capacity of the whole country and 60% of the capacity of the South central provinces.

- Cashewnut production was about 225 ton in 2002.

- The reason for the low production is that most of the cashewnut fields are planted from unchosen seeds, less attention has been paid to intensive management of the trees, investment has been low, the cultivation density is very thick and the existing cashewnut fields are not suitable to the current areas where they have been planted.

- However, there are some higher performing cashewnut fields which produce 70 – 100kg/year/plant.

- The production of the cashewnut households over the last three years has obtained 88.30 – 120.05 kg, especially only 88.30 kg in 1999. This shows that the profits of the cashewnut households are still very low and unstable.

- Because of the low private outputs, the whole outputs have been accordingly low. Only 6.4% of the cashewnut fiels have stable production. Most production gained in Hoai Nhon district is not stable because of the unusal weather, insects, seedlings and the low investment in intensive cultivation.

3.1.5. Cashewnut seedlings and cultivation technology:

4.1.5.1. Seedlings:

- Most of the cashewnuts planted in the Hoai Nhon district is from unchosen seeds (covering up to 95.16%).

- Since 1998, the Center for agricultural research for coastal south central Vietnam (RACCOS) has created a grafted cashewnut that has provided good yields.

- In the Hoai Nhon district, 17 good cashewnut trees have been chosen, and a nusery area has been established for grafting cashewnuts covering 1.7 ha with 17 different kinds of cashewnut trees. During the years 2000 – 2001, the forestry farming has produced about 21,000 grafted cashewnuts and distributed them according to the project requirements as well as to the local people.

Within 4 years (1999 – 2002), the whole district has planted 97 ha of concentrated grafted cashewnuts and another 15 ha has been planned. Most of the grafted cashewnuts are from forestry farms in the province, in Hoai Nhon district or at ASISOV experimental sites. According to a survey, there are 4.84% households that have planted grafted cashewnuts.

3.1.5.2. Technology situation:

- Previously, cashews have been planted at a high density and inadequate care has been provided (such as cutting off branches), giving low production. The density has been up to 200 cashewnut/ ha, covering 57%

- Most cashewnut fields have not had specialized cultivation, have had low fertilizer application, have had no branches removed, and have not had any insect control.

- A few cashewnut fields have partly had intensive cultivation.

3.1.6. Lands for cashewnut cultivation:

- The land for cashewnut plantation in Hoai Nhon is low. The suitable land for cashewnut is only 265.9 ha (about 22.80%). This is the main factor causing low production and quality.

3.2. The cashewnut roles in protecting eco-system in Hoai Nhon district:

3.2.1. Cashewnut is the best tree for reducing bare land and the formation of deserts:

Cashewnut is the best plant for the local agricultural structure.

3.2.2. Cashew has a positive effect on erosion:

- Qualitativeness:

Cashewnut plantations cover 75.88% and will provide ground cover and will limit land erosion (covering 72.40%).

- Quantitativeness:

For a limited time, so the survey was based on some required information:

- + Duration and the coverage rate of cultivation models.
- + Land erosion.

Results in 2003 shows that the model of cashewnut + citronella, cashewnut + pineapple and cashewnut + peanut have the highest coverage rate (74.78 – 84.30%). Only cashewnut models after 27 months offers coverage of 13.30%. After 5-7 years, the coverage is bigger (the initial density is 200 tree/ha) providing good protection.

3.2.3. Situation of controlling cashewnut activities in Hoai Nhon:

(1) Policy on land ownership right:

The total area was 2-3 ha and the period of using the trees was 20-30 years.

(2) Protection activities:

- Conducted at the lower levels in Hoai Nhon to the households, communities, communes and the forestry bureau.
- Theft is still high
- The district and communes authorities have not paid much attention to protection activities, so the yearly capacity is very low.

3.3. Domestic and international markets for consumption and import-export of cashewnut

3.3.1. For international markets:

- In 1998, the amount of international cashewnut export was 150,000 ton

The main export countries included: India (72,000 ton), Brazil (30,000 – 35,000 ton), Vietnam (33,000 ton, profit 133 million USD) and Africa (10,000 – 15,000 ton).

- In 1999, 50% of the international cashewnut yields was reduced in Brazil, India and Vietnam. Because of the reducing supply of resources, the cashewnut prices were higher (6,400 USD/ton, higher than it had been previously which was 2,000 USD/ton).

- The main import countries from which cashews were obtained included: America, China, Australia, Netherlands and Canada

- The cashewnut markets have been opened in other countries and countries such as India, Mozambique, Tanzania and Indonesia have been enlarging their cashewnut field cultivation and placing a higher tax on the raw cashewnut (30%) to strengthen the export processing capacity.

- In 2002, the cashewnut markets were not stable. The total cashewnut inputs in India and Tanzania were much lower than that of previous years. The raw cashewnut outputs from India and African west-countries were reduced compared to previous years. If this market trend is continued, it is likely that the cashewnut supplying capacity in markets will be reduced accordingly.

- During the last 2 years, the surplus rate has been over the allowed rate of about 7%.

- It is expected that cashewnut yields will be stable during the year 2003 which means that the cashewnut market will be prosperous.

3.3.2. For the Vietnam market:

(1) Export activities:

- Before 1995, the raw cashewnut export to India was only at low prices.
- Since 1995, the cashewnut markets have been more open and it allows the consumption of all cashewnut products.
- In 1988, Vietnam exported 33 tons of cashewnut.
- In 1997, Vietnam exported 33,000 tons, obtaining 133 million USD.
- In 1998, Vietnam exported 25,440 tons, obtaining 115.12 million USD.
- In 1999, because of the crop failures and the limited imports, the export outputs were very low.
- In 2002, there was a good market for cashewnut in China.

(2) Cashewnut markets in Vietnam:

- The market was reducing in the Chinese market, but increasing in America, Australia, Holland and Canada.
- There is good quality and good prestige in the markets, bringing opportunities for cashewnut development at a larger scale.
- It is also expected that the total cashewnut export outputs in Vietnam to foreign countries will reach at least 2 million ton.

(3) The import market in Vietnam:

- Vietnam began to import raw cashewnut since 1998 and imported a large quantity in 1999.

- The imported raw cashewnut was mainly from Africa, usually indirectly imported, so the prices were not stable and higher.

(4) The local market:

- The local market favours only cashewnuts with a smaller quantity (about 10%) of mainly lower quality cashewnuts.

- The products being processed from nuts were not diversified because of the out of date production lines.

- In general, the local cashewnut market is not for the target market.

3.3.3. Processing and consumption in Binh Dinh:

3.3.3.1. Consumption:

In Binh Dinh, the raw cashewnut prices range from 6,500 – 11,000 VND/kg. The consumption capacity is good (never had stock in storages for a long time), about 50% is exported to China and the rest to European markets. The export price is from 4.4 – 4.6 USD/kg. Because of the low consumption needs, the local market is not enlarged.

The 2 cashewnut processing factories in Binh Dinh need an output of 5,000 tons, however the input is over 1,000 tons, especially if they have to buy the cashewnut from southern provinces or import the cashewnut.

The obstacles in the cashewnut consumption market in Hoai Nhon include less market information, lack of price information as well as consumption of products.

There are 18 collection agencies and 80 collection households at home or in the field.

Moreover, there have now been two provincial processing factories and some processing factories in the southern provinces, which have collection agencies in Hoai Nhon district. This shows that the consumption of products for local cashewnut farmers is very convenient.

3.3.3.2. Cashewnut processing industry in Binh Dinh:

There exists 2 processing enterprises for export with a total capacity of 7,000 ton/year. Most of the equipment and production lines have been made in Vietnam. The labour force consists of about 1,200 workers. Because of the handicraft production, local equipments and low investment costs the payback cost is quicker.

3.3.4. Survey on the collection system, processing, consumption of cashewnut products in Hoai Nhon district:

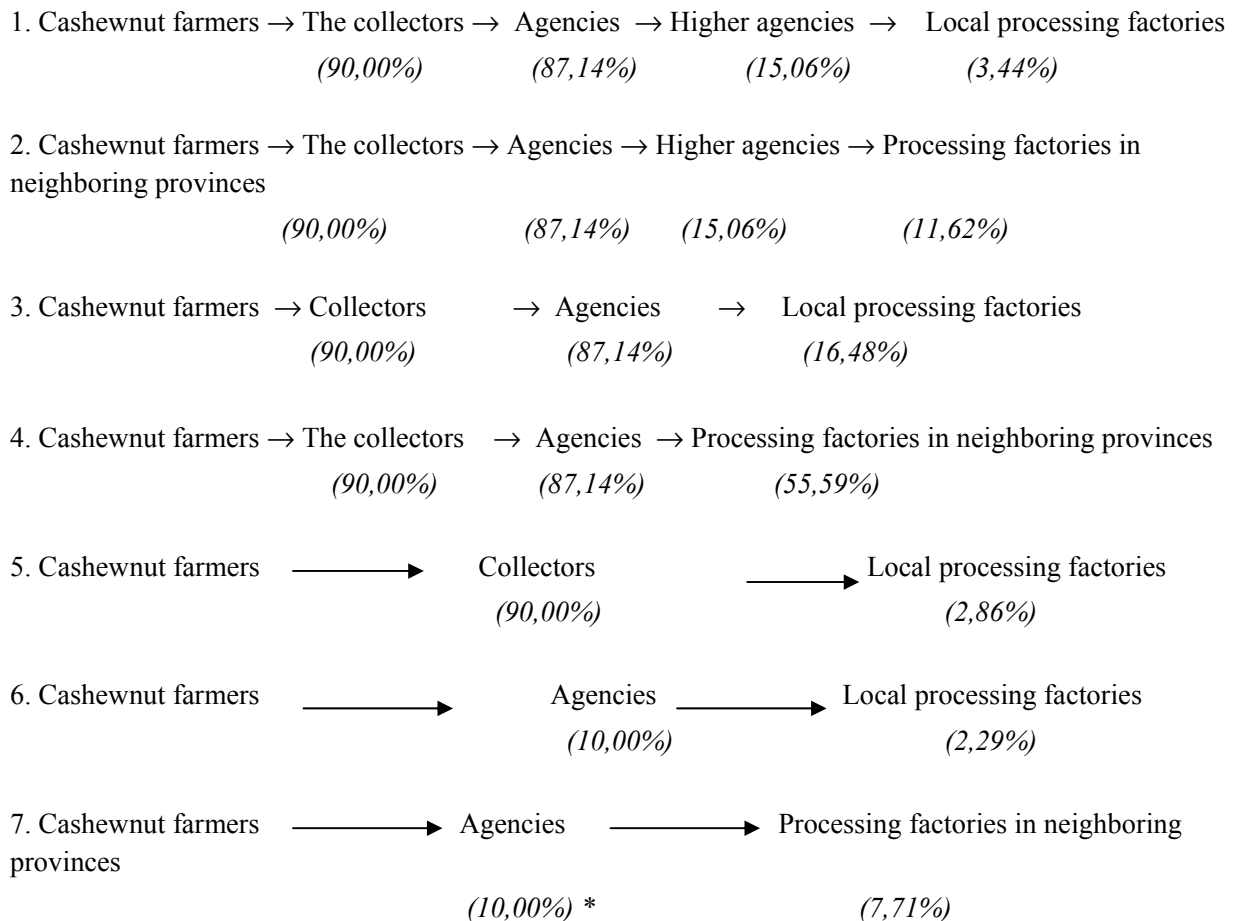
3.3.4.1. Cashewnut collection system:

Participants engaging in the business:

- Farmers
- Collectors
- Agencies
- Processing factories

The relationship between members in the business is as followed:

Chart I: channels for cashewnut collection:



Notes: * % Outputs

The authority, the managers in Hoai Nhon district as well as Binh Dinh authority should work together to reduce distribution channels down to 1 or 2 mediate channels, to produce a higher rate in the consumption channel.

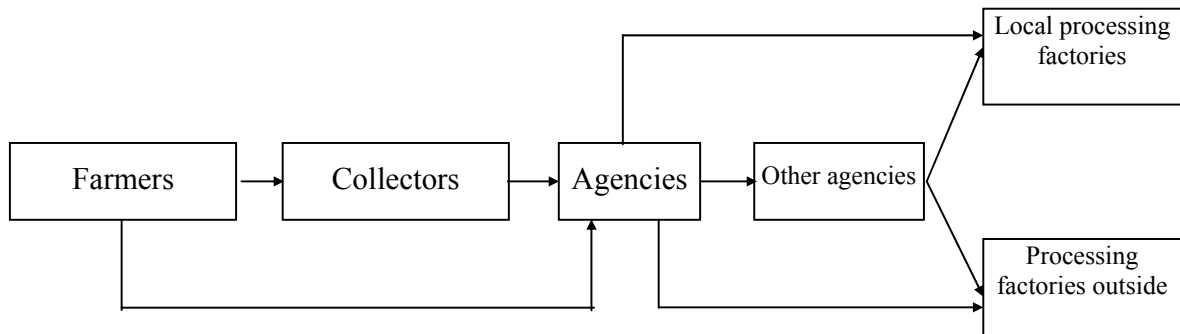
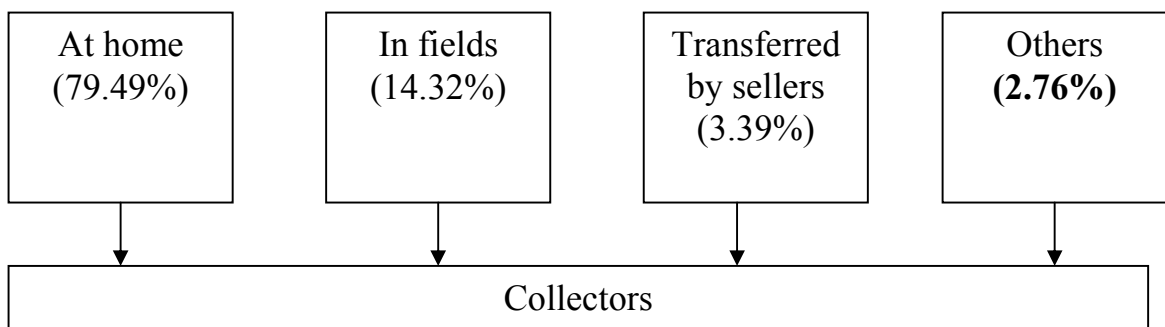


Chart II: Main channels for collecting cashewnut

3.4.2. Collectors

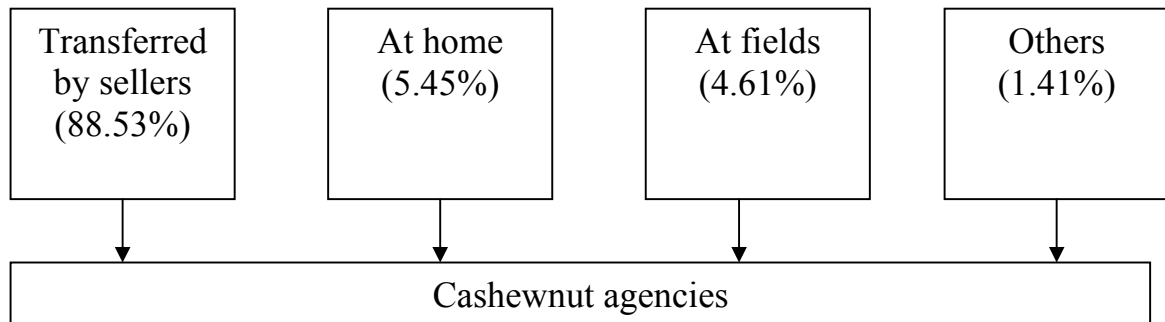
- In 1999, when the production was high, the collectors as well as agencies did good business, more than the previous years at about 8,350 kg. The average profit/kg of cashewnuts over the past few years was stable, the problem of course is that with the higher cashewnut prices, there is more profit (4,746,140 VND). Each crop and collection activities last about 60 days. So the average benefit/working day is at 62,717 VND/day. The cashewnut farmer's working day is at 52,990 VND and other industrial careers 20,000 VND/working day.

Chart III: Collection network



3.4.3. Collection agencies:

The collection of agencies is summarized as the chart 4:



Within two years between 1999 and 2000, cashewnut trade at agencies decreased, covering about 63% compared to the year 1998 and the benefit covered only 129-178 vnd/kg.

Reasons:

- Local Cashewnut agencies have been issued increasingly;
- Some lower agencies directly sell the cashewnut collected to cashewnut processing factories or sell the cashewnut collected to other provinces.
- Low yielded crops.
- The selling and buying prices of cashewnut at the same crops was not stable, having effects on the business as well as profit.
- The average profit per crop at local agencies was too low, so the laborers' incomes was not high, only 43,453 VND/day, 52,990 VND/day/cashewnut planter, compared with 62,717VND/day/cashewnut collector.

3.4.4. Processing methods:

- Cropping: when cashewnut fruits ripen: 85.16%
- Getting the fallen fruits: 14.84% (at households with more cashewnut fields, less thieves and less time spent for getting nuts)
- Taking off nuts, then drying: 68.68%
- After getting the nuts from cashewnut fruits, local people used to wash, then dry under direct sunlight: 31.32% (to lighter the nuts and increase values).
- After collecting the cashewnuts from farmers, agencies used to classify and then dry under sunlight. After this, the farmers stored the cashewnuts in packets of 50 kg and transferred them to processing factories or sold them to local or outside agencies. Most of the agencies would sell off all of the cashewnuts after each crop every year.

- Most of the households have not made good use of the cashewnut fruits, wasting fruits and polluting the environment (covering up to 92.26%). Or they have not made good use of cashewnut for livestock medicines, fresh fruits or for trades.

- In the years 2001 - 2002, The Institute for agro-products looking after crops (belongs to the Ministry of Agriculture and rural development) has showed their findings on using the cashewnut fruit with good results in Binh Dinh province including some products such as processing cashewnut to brewery products: cashewnut alcohol, foodstuff alcohol, cashewnut janes and cashewnut fruits that are good with edible mushrooms. Distiling with smaller scales at households and moderate scales at cashewnut processing enterprises are set up accordingly in Qui Nhon.

3.4.5. Advantages and disadvantages in production and consumption:

3.4.5.1. Advantages:

(2) The Hoai Nhon climate is favourable for cashew production as the weather is suitable for planting and developing cashewnut fields. Moreover, cashewnut fields planted in this area have been developed and enlarged in most communes of the district.

(1) Unused land in Hoai Nhon district is still high, many kinds of land can be used for cashewnut cultivation. Moreover, many eucalyptus camaldulensis areas are not economic and not sustainable in this environment and could be transferred to cashewnut cultivation.

(3) The geographic location is favourable as the transportation and communications system has been connected to communes and other provinces. These partly play an important role in agricultural development in general, cashewnut development in particular.

(4) The investment cost for planting cashewnut field is low (only about 25 – 50% compare to other industrial plants such as rubber, coffee, tea, pepper...) and suitable for poor households.

(5) The grafted cashewnut would offer quicker crop development, it is a multi-purpose plant and it is one of the long-term agricultural plants that has good uses of protection as a forestry area, suitable for the Ministerial 5 million ha.

(6) The People's Committee of Binh Dinh province and the People's Committee of Hoai Nhon district have considered cashewnut development as a commodity economy in the specialized industrial plants and have approved some projects for cashewnut development.

(7) The cashewnut markets for export are diversified, most of the cashewnut products are very popular in domestic and foreign markets and are slowly putting its stance in different markets. Moreover cashewnut is a favourite product in most restaurants in Vietnam.

(8) The requirements of raw cashewnuts in processing factories is very high. Particularly, there are two processing factories in Binh Dinh with 3 processing enterprises that are able to collect raw cashewnuts from farmers covering only 20 – 30%, the rest has been collected from other provinces or imported from neighboring countries.

3.4.5.2. Disadvantages:

(1) As for the master plan: For years cashewnut management has not been controlled, has not had a master plan yet, as well as not having a concrete plan for cashewnut farmers in Hoai Nhon. In the past, cashewnuts have been planted and enlarged by the local people without the authority's management, so that when local people face disadvantages, they destroy or cut down or even neglect their cashewnut field. Without care and intensive investment, there has been a decrease in the cashew fields. On the other hand they have not made use of competition advantages when comparing to other industrial plants.

(2) The annual rainfall is not stable, whereas the raining seasons may be in March and April. The low rainfall is not good for planting and insects cause low capacity, low quality and unstable production.

(3) Local farmers have used seeds for planting new cashewnut fields and have not chosen the best seedlings. Once, cashewnut was considered as a forestry plant to cover bare lands. Most cashewnut farmers are poor, lack the required investment capital, have less knowledge of intensive cultivation and in particular their knowledge of intensive grafted cultivation is poor.

(4) In there past, there has been a lack of a tech-supporting system in choosing the best seedlings and cloning via grafting methods. Up until now, farmers have not had the price-supporting policy or a product collection policy. The fact that cashewnut farmers have regular passiveness in selling prices, results in instability in the market. The processing system and post-yield crop storage is not affilitated and there is not a good use of fruit cashewnut to process for higher value commercial products.

(5) The raw cashewnut price is not stable and usually farmers will invest more when the price is high, and when the price is low, they don't provide proper care, even cutting down all the cashewnut trees, causing an unstable situation at the cashewnut processing factories.

(6) The infrastructure in cashewnut planting communes is not very good, especially the transportation facilities. Also there is not enough knowledge and not enough capital to invest in more cashewnut fields.

CHAPTER IV

DESIGN AND SUGGESTIONS FOR SOME MODELS FOR SUSTAINABLE CASHEWNUIT PLANTINGS ON THE SLOPE SOIL AREAS IN HOAI NHON, BINH DINH PROVINCE

4.1. Some of the current models of agro-forestry in Hoai hon district:

Model 1: Cashewnut

Model 2: Cashewnut + cassava

Model 3: Cashewnut + pineapple

Model 4: Cashewnut + citronella

Cashewnut grown by seeds and models of cashewnut + pineapple and cashewnut + citronella have higher economic effectiveness

4.2. Some models of agro-forestry cashewnut cultivation on the sloping lands in Hoai Nhon district, Binh Dinh province:

-The land surveyed has poor fertility.

-Due to the poor fertility of the soil, we would like to provide 6 models of agro-forestry cultivation and grafted cashewnuts for higher production:

(1) Model 1: Transfer the eucalyptus camaldulensis instead of cashewnut.

(2) Model 2: Cashewnut + pineapple.

(3) Model 3: Cashewnut + cassava

(4) Model 4: Cashewnut + citronella.

(5) Model 5: Cashewnut + peanut.

(6) Model 6: Cashewnut + banana.

4.3. Evaluation of the findings:

4.3.1. Evaluation on the cashewnut growing in the pilot models:

In general, the cashewnut plants are not well grown, the most balance is from models of cashewnut + peanut, cashewnut + citronella and cashewnut + pineapple. After 27 months, the average capacity in models are cashewnut + citronella (547,2kg/ha), cashewnut + ground peanut (498,0kg/ha), cashewnut + pineapple (464,4kg/ha) and the lowest capacity is for the model of planting in normal conditions, which attained only 245,6kg/ha. However, comparing with the cashewnuts grown

from seedlings at the same site, the cashewnut grown from seedlings had not reached maturity yet.

Table 1: Summary of the cashewnut growth situation via trial models

Trial model	H (cm)	D ₀₀ (cm)	D (cm)	Capacity (kg/ha)	Ranging up to capacity
1. Cashewnut	249a	8.0a	291a	245.6a	1
2. Cashewnut + pineapple	289b	11.0b	413b	464.4b	4
3. Cashewnut + cassava	289b	10.6b	400b	418.4b	2
4. Cashewnut + citronella	281b	11.0b	417b	547.2b	6
5. Cashewnut + peanut	288b	10.8b	431bc	498.0b	5
6. Cashewnut + banana	283b	10.5b	380b	446.4b	3
<i>Average</i>	<i>279.8</i>	<i>10.3</i>	<i>388.6</i>	<i>436.6</i>	<i>-</i>
	C _V % = 8.5 LSD _{0.05} = 30.9	C _V % = 8.2 LSD _{0.05} = 1.1	C _V % = 9.9 LSD _{0.05} = 50.0	C _V % = 23.8 LSD _{0.05} = 135.8	

4.3.2. Evaluation on economical values of the pilot models:

Table 2: Economical values of the pilot models after 27 months

N ⁰	Model	Total value		Total costs 1,000 VND	Net profit		
		1,000 VND	Evaluation		1,000 VND	Evaluation	Range
1	Cashewnut	1,9648	VL	912.0	1,052.8a	VL	1
2	Cashewnut + pineapple	7,315.2	VL	2,420.0	4,895.2c	VL	5
3	Cashewnut + cassava	5,039.2	VL	1,090.0	3,530.2b	VL	2
4	Cashewnut + citronella	13,679.6	L	6,133.0	7,546.6d	L	6
5	Cashewnut + peanut	9,609.0	VL	4,986.0	4,623.0c	VL	4
6	Cashewnut + banana	5,446.2	VL	1,890.0	3,556.2b	VL	3
	<i>Average</i>	<i>7,175.7</i>	<i>VL</i>	<i>2,975.0</i>	<i>4,200.7</i>	<i>VL</i>	<i>-</i>
		C _V % = 13.9		LSD _{0.05} = 1,038.2			

*Notes: VL: very low, L: low, M: moderate, H: high, VH: very high

Economically, it is suggested that the chosen models should be: cashewnut-pineapple, cashewnut-peanut and cashewnut-citronella.

4.3.3. Evaluation on the environmental impacts of agro-forestry models:

4.3.3.1. Duration, coverage rate and yearly land erosion of the cultivation models:

- These models of cashewnut-pineapple, cashewnut-cassava and cashewnut-citronella have the best coverage rate of all (74.78 – 84.30%). The model of only cashewnuts after 27 months covers an area of 13.30%. The coverage of cashewnuts after planting for 27 months ranged 13.30 – 29.17%. If we don't have cashewnuts planted together with other cultivation in the agro-forestry model, the land will be less stable and more prone to erosion.

Table 3: Duration, coverage rate and yearly land erosion of the agro-forestry cultivation models

N ⁰	Model	Coverage area (m ²)			Coverage rate (%)	Numbers of month covered	Land erosion Ton/ha/year
		Cashew nut	Others	Total			
2	Cashewnut	1,330	0	1,330	13.30 a	-	26.83
3	Cashewnut + pineapple	2,678	4.800	7,478	74.78 c	12	7.81
4	Cashewnut + cassava	2,512	3.905	6,417	64.17 b	10	11.09
5	Cashewnut + citronella	2,730	5.700	8,430	84.30 c	12	4.86
6	Cashewnut+ peanut	2,917	4.750	7,667	76.67 c	10	7.22
7	Cashewnut + banana	2,267	3.577	5,844	58.44 b	12	12.86
		$C_V\% = 9.5$			$LSD_{0.05} = 10,484$		

4.3.3.2. Land erosion evaluation:

- The evaluation on the land crumbling from erosion by water was conducted using the following methodology: $A = R.K.LS.C.P$

- From values in the formula, it is easy to define the yearly land erosion on the grey Feralit soil:

$$A = (9926 \times 0.225 \times 1.54 \times 0.9 \times 1) : 100 = 30.95 \text{ tons/ha/year.}$$

- The land erosion in pilot models at the highest values were **Cashewnut + banana**, **Cashewnut + cassava** and **Cashewnut** 824,844 – 1,995,542 VND/ha/year. The least land failures of the models are cashewnut + citronella, cashewnut + peanut and cashewnut + pineapple, with the total production of 361,473 – 580,886 VND/ha/year.

Environmentally, models of cashewnut + citronella, cashewnut + peanut and cashewnut + pineapple are the most sustainable.

Table 4: Quatativeness on the yearly fertilizer failures

N ⁰	Models	Failure quantity (kg/ha)				Failures (VND)	Best range
		Dust	Nitrogen	Phosphor	Kali		
1	Planted in sloping and bare hills	321.88	27.86	18.69	7.12	2,301,976	7
2	Cashewnut	279.03	24.15	16.20	6.17	1,995,542	6
3	Cashewnut + pineapple	81.22	7.03	4.72	1.80	580,886	3
4	Cashewnut + cassava	115.34	9.98	6.70	2.55	824,844	4
5	Cashewnut + citronella	50.54	4.38	2.94	1.12	361,473	1
6	Cashewnut + peanut	75.09	6.50	4.36	1.66	537,004	2
7	Cashewnut + banana	133.74	11.58	7.77	2.96	956,491	5

4.4. Orientation and suggestion some agro-forestry models:

-Based on the evaluation on the economic effectiveness, the reaction of the cultivation models to the stability of land and the environment, natural condition, socio-economic condition, production habits and market factors, some of the agro-forestry models sustainable in an socio-economic and environmental context are suggested as followed:

- **Cashewnut + citronella** (about 4 - 5 initial years);
- **Cashewnut + pineapple** (about 4 - 5 initial years);
- **Cashewnut + peanut** (about 1 - 3 initial years).

Chapter V

ORIENTATION AND SOLUTIONS TO DEVELOP CASHEWNUIT FIELDS ON SLOPING AND MOUNTAINOUS AREAS IN HOAI NHON DISTRICT, BINH DINH PROVINCE

5.1. Orientation:

The cashewnut development up to 2010 should be developed according to the following ideas:

- Have the right orientation of cashewnut plantations as well as a good transfer of the plants, considering cashewnut production is an important commodity.
- More attention should be paid to the chosen seedlings, intensive cultivation for higher outputs and more valuable products (mainly for export).
- Considering the development of households plays an important role for better implement of reforestation on bare land, the Ministerial 5 million Ha programs should be completed in order to partly improve local people's living standard in the district.

5.2. Scientific base for cultivation orientation:

- Based on the scientific reports and an evaluation of the land situation in Hoai Nhon district, the project proposed to develop cashewnut fields in Binh Dinh from 2001 – 2010.
- The natural condition factors are also important such as geography, slope, lands for use as well as climate, temperature, humidity, rainfall, sunshine, socio-economy and other cultivated habits.
 - Biological properties and needs for land uses of cashewnut cultivation.
 - Domestic and abroad cashewnut markets.
 - Economic values of some main plants on the slope land in Hoai Nhon district.

5.3. Master plan to develop cashewnut fields up to 2001 - 2010 in Hoai Nhon:

Based on the orientation and the scientific research up to the year 2010, the Hoai Nhon district will have a master plan of cashewnut fields consisting of 5,500 ha and will have an increasing area compared to the current fields of 4,334 ha. To solve this problem, there should be a master plan for new plantings of cashewnut fields on the sloping lands, transferring to a suitable structure for the competition advantages of each area.

5.3.1. The capacity planned to develop cashewnuts in Hoai Nhon district, Binh Dinh province (2001 - 2010):

Table 6:

N ⁰	Commune, Town	Total area	Plant	Reformed	Reforestation				Set up pilot model
					Total	New cultivation on sloping areas	A transfer from Eucalyptus camaldulensis and others	A transfer from current, old fields	
1	Hoai Hao	323.0	-	-	323.0	30.0	293.0	-	-
2	Hoai Hai	42.0	7.9	2.1	32.0	10.0	22.0	-	-
3	Hoai Duc	762.0	24.5	102.5	635.0	240.0	395.0	-	-
4	Hoai My	275.0	34.0	12.0	225.0	60.0	165.0	-	4.0
5	Hoai Son	1,020.0	-	195.0	825.0	665.0	160.0	-	-
6	Hoai Thanh	239.0	108.0	-	131.0	20.0	111.0	-	-
7	Hoai Thanh Tay	146.0	-	22.0	124.0	15.0	109.0	-	-
8	Hoai Chau	330.0	5.7	1.3	323.0	198.0	125.0	-	-
9	Hoai Chau Bac	392.0	-	-	392.0	242.0	150.0	-	-
10	Bong Son	285.0	27.2	29.7	222.1	10.0	101.0	111.1	6.0
11	Hoai Xuan	30.0	3.2	0.8	26.0	-	26.0	-	-
12	Hoai Phu	370.0	16.3	22.5	329.2	250.0	75.0	4.2	2.0
13	Tam Quan Nam	15.0	-	-	15.0	15.0	-	-	-
14	Hoai Tan	565.0	52.0	97.4	409.6	211.0	122.0	76.6	6.0
15	Hoai Huong	139.0	10.0	-	129.0	59.0	70.0	-	-
16	Tam Quan Bac	35.0	-	-	35.0	25.0	10.0	-	-
17	Forestry farming Hoai Nhon	532.0	142.8	4.7	384.5	350.0	-	34.5	-
	Total	5,500.0	431.6	490.0	4,560.4	2,400.0	1,934.0	226.4	18.0

Source: Master plan to develop cashewnut fields up to 2001 - 2010 in Binh Dinh
The Department of Agriculture and Rural development (6/2001)

5.4. Solutions for cashewnut development on the sloping land in Hoai Nhon district:

5.4.1. Solutions for better land uses:

- Up to the year 2010, a master plan to develop the cashewnut fields of 5,500 ha (out of which 1,166 ha is included in the current fields) per suitable land unit. To make good use of the advantages of specific areas, there should be concentrated cultivation, creating raw cashewnut areas to processing factories. Moreover, planting cashewnut together with other kinds of forestry is also important.

- It is important to make good use of all the bare land, hilly and mountainous areas and eucalyptus camaldulensis land for cashewnut cultivation. Also, there should be suitable plants on the on suitable areas. The total sloping lands suitable to cashewnut plantation in Hoai Nhon is 7,735 ha with 19 land units (of which 2,729 ha is less suitable level S1, S2). The organization for production and trading must be in accordance with the capacity of the land and the need for land use of cashewnuts.

5.4.2. Technical solutions:

+ Applying more intensive technology solutions from seeds choice, planting, investment, care and protection from insects.

+ Most of the seedlings that cashewnuts are grafted from come from other kinds chosen in all corners of the country (rounded figure, multi-fruitable cashewnut, below 170 seed/kg obtaining the standard for export, capacity potentials 3 ton/ha, an average from 1.0 – 1.5 ton/ha, intensive plant > 2 ton/ha, if applied higher intensive tech obtaining > 3 ton/ha). Step by step processes are required to train good technicians for grafting and planting seedling cashewnuts at the site.

+ To transfer the technical progress and to set up a pilot model.

+ For intensive cultivation, replanting former cashewnut fields, which provide low capacity and have less quality with higher quality grafted cashewnuts with better quality to slowly replace the current ones.

+ Also, other agricultural trees should be planted for better reforming the lands, reducing the risk of erosion and increasing the local people's benefit.

5.4.3. Land policy :

To transfer the right to use lands for long-term planting cashewnut. It is focused on the use of bare soils for cashewnut instead of transferring Eucalyptus camaldulensis trees.

5.4.4. Investments-Capitals :

It is necessary to have a preferred-investment loans policy with low interest and at least 5 years of payback period. These loans should be drawn from farming economy

development projects, programs of the Ministerial forest 5 million ha, capital from foreign and local organizations and from local farmers.

5.4.5. Consumption and processing of cashewnut products:

To expand the local and foreign markets, simultaneously to enhance the cashewnut processing capacity and diversify the products.

PART III

CONCLUSION AND SUGGESTION

1. CONCLUSION:

Over the past two years of implementing this project proposal, some basic findings have been concluded as followed:

(1) The natural condition in sloping lands in Hoai Nhon district has been convenient such as weather, land condition and other natural resources serving for agro production as well as cashewnut production. However, these sloping and mountainous lands still have many obstacles, giving this area a strict ecosystem environment for economic development.

(2) The potential for producing cashewnuts in Hoai Nhon, Binh Dinh province and in Vietnam markets are very high. It is expected that the total outputs of the whole country will be 100,000 tons up to year 2010. Cashewnut will be the main highly economic commodity plant in Hoai Nhon district as well as for the coastal south central area of Vietnam. The outputs for cashewnut products are very prosperous and stable.

(3) Hoai Nhon farmers have a traditional experience with plantations with larger scale, and these have been the main target for the commodity economic plants. However, most of the cashewnut fields were planted from seedlings without good choice, were subject to uncontinuous planting, were too old for optimal production and the markets were not stable.

(4) Based on the geographical condition as well as other socio-economical factors, presenting cashewnut markets both domestically and abroad, we would like to make our suggestion for a new model of agro-forestry cashewnut cultivation: (i) **Cashewnut + peanut**, (ii) **Cashewnut + pineapple**, (iii) **Cashewnut + citronella** in order to enlarge cashewnut field oriented to and sustainable commodity production.

(5) Up to the year 2010, Hoai Nhon district will have a total area of intensive cashewnut fields of 5,500 ha that provides a stable base of cashew production.

2. SUGGESTION:

(1) To continue expansion, investment and more application of cashewnut cultivation models of agro-forestry: (i) **Cashewnut + peanut**, (ii) **Cashewnut + pineapple**, (iii) **Cashewnut + citronella** in Hoai Nhon and in other provinces in coastal south - central Vietnam which have the same natural condition.

(2) To have a master plan for implementation of cashewnut enlargement programs in Hoai Nhon district up to the year 2010 and the following years.

(3) To enhance management activities, provide more instruction on the cashewnut field enlargement, as well as reorganizing the consumption market of cashewnut products in Hoai Nhon and in Binh Dinh province.

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