Fact finding mission on

“Support for the development of the cashew sector in Dak Lak”

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In cooperation with:

RURAL DEVELOPMENT DAK LAK (DPI/GTZ)

and

MPI-GTZ SMALL AND MEDIUM ENTERPRISE DEVELOPMENT PROGRAMME

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Abbreviations

AEC	Agricultural Extension Centre
AES	Agricultural Extension Station
CNSL	Cashew Nut Shell Liquid
DARD	Department of Agriculture and Rural Development
DOST	Department of Science and Technology
EMA	Environmental Management Accounting
FAO	Food and Agriculture Organisation
FFS	Farmer Field School
FOB	Free on board
ha	Hectare
kg	Kilogram
MARD	Ministry of Agriculture and Rural Development
mm	Millimetre
NIS	Nuts in Shell
t	Metric ton
ToT	Training of Trainers
US	United States
VINACAS	Vietnam Cashew Association

1 Introduction

Cashew farming in Vietnam has been a lucrative business in the past years. Cashew demand has been steadily growing on the world market; Vietnamese entrepreneurs have been increasingly investing into cashew processing, and farm-gate prices have been extremely good in recent years.

The cashew processing industry has undergone a fast development. Up to 1994, Vietnam did not have enough capacity to process all internally produced cashew nuts to kernel. Around 20 % of the raw cashew nuts production was exported to India and other countries for processing. This situation has changed dramatically and as of today, Vietnamese processing facilities exceed the present production and Vietnam imports by around 50,000 to 100,000 tons of raw cashews for final processing to meet domestic capacities. This change from a nuts-in-shell (NIS) exporter to an importer of NIS was important for Vietnam to increase value adding of cashew in Vietnam and to become a direct trading partner to the international cashew buyers rather than only providing semi-processed products.

Cashew production in Vietnam is almost entirely carried out by small farmers with holdings between several trees to 5 ha per household. Looking at the total area under cultivation, total processing capacity and total production output in tons, Dak Lak ranks in the mid-range of provinces active in the cashew nuts business.

GTZ is active in Dak Lak through two projects which are implemented under the responsibility of the Department for Planning & Investment Dak Lak Province: one focusing on rural development and another one on the competitiveness of small and medium enterprises. Both projects consider the cashew nut sector in Dak Lak as one with potential to further increasing income to farmers and creating jobs in the processing industry. Albeit the recent success in the sector, there are also issues like sustainable management practices at the farm level and environmental dimensions in the processing companies that need short to medium term interventions in order to maintain the sustainability of the cashew nuts sector in Dak Lak. Additionally, there seems to be potential for further adding value to the cashew nuts by improving product quality, adding further processing steps and working on modern packaging combined with trade mark and brand development in order to market final products on the local and export markets.

Both projects want to further analyze the mentioned issues and potentials in order to come up with joint project implementation strategies for the cashew sector in Dak Lak. Therefore, this study was conducted by a team of national and international experts headed by EDE Consulting Asia Pacific in cooperation with both projects. Locally available technical and institutional know-how was made available through the active participation of provincial experts in the study team from the provincial Departments for Agriculture & Rural Development (DARD) and of Industries (DoI), from the Agriculture Extension Centre (AEC), the Western Highlands Agro-forestry Science & Research Institute (WASI), and from Café Control.

The objectives were:

1. To collect detailed information on the cashew nut sector in Dak Lak comprising the different actors in the value chain as well as describing supportive institutions and policies;
2. To evaluate the feasibility of the intervention ideas as proposed in the EDE study (2005);
3. To discuss these issues with relevant stakeholders and come up with a consensus based intervention strategy (action plan);and
4. To propose mechanisms, policies or adequate solutions to the province as a basis for the development of the provincial cashew development strategy.

The study was carried out in 5 districts in Dak Lak province, i.e. Ea H’Leo, Lak, Krong Ana, Ea Sup and Ea Kar. Particular emphasis was put on coverage of the province’s overall variability in the current cashew supply chain. Therefore the study included visits to: (i) small-holder private farmers of both Kinh and ethnic minority origin; (ii) small-holder farmers working for state enterprises; (iii) local collectors; and (iv) private and state owned processors/exporters.

2 Cashew development in Vietnam, Dak Lak in particular

2.1 General

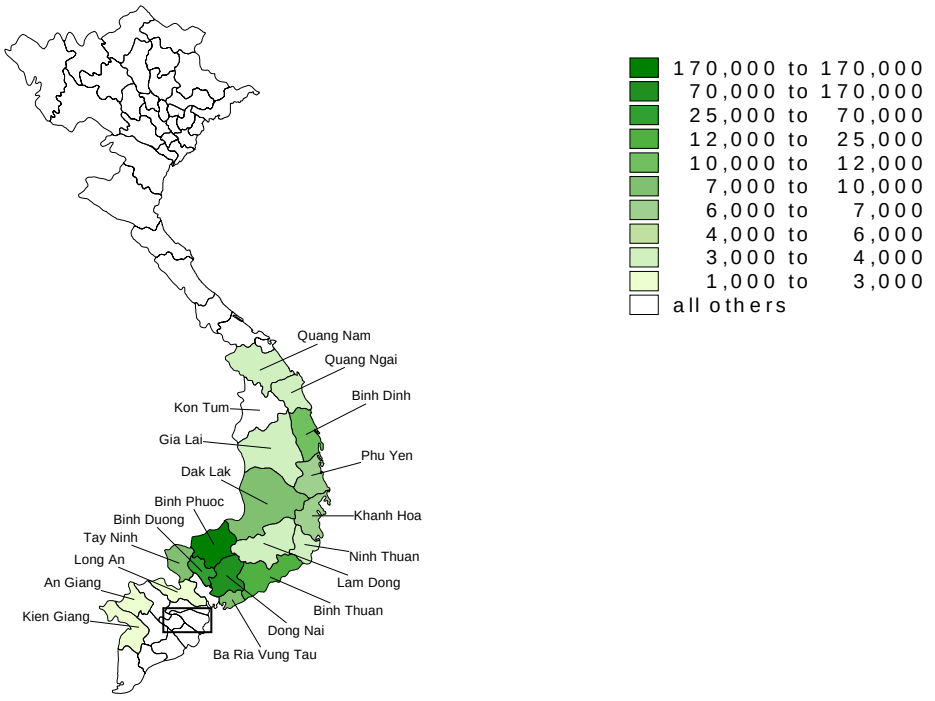
Cashew *(Anacardium occidentale)* originates from Brazil and has been discovered by the Portuguese in the 16th century as a commercial product. Outside Brazil, cashew was firstly planted in Mozambique and then extended to India and further to Asia. Today, Cashew is cultivated in large holdings and plantations as well as in the smallholder environment. Both the fruit and the nut can be utilised for trade and local consumption.

Cashew consists of a false fruit (apple) and an attached nut. Although the apple contains 90 % of the fruit, only the nut is being used as a commercial product in Vietnam.

The world cashew production has doubled since 1994, with most countries experiencing substantial increases, particularly Viet Nam. India pioneered the modern processing of nuts, and had been consistently the world's leading producer for decades prior to 2002. Since 1999 Vietnam’s cashew sector has steadily grown with an initial export volume of 18,500 t (revenue of 110 million USD) to 63,000 t (revenue of 214 million USD) in 2002. Currently, Vietnam’s production surpasses India by 55 % (FAOSTAT, 2006)

The main cashew production areas in Vietnam are Dong Nai, Binh Duong, Long An and Binh Phuoc provinces. Binh Phuoc is with 170,000 tons and 170,000 ha in 2004 the largest cashew producing province in Vietnam (Figure 1).

Figure 1 Cashew production in Vietnam (Mt)



2.2 Cashew development plan Dak Lak

Since 2004, cashew development in Dak Lak is included in the provincial strategy for agricultural planning (DARD, 2004). Cashew is considered a valuable agricultural crop for several reasons:

1. This low demand perennial tree can generate considerable income in poor and remote areas on poorer soil types.
2. The tree is considered a suitable alternative to replace inefficient, water consuming coffee plantations on marginal locations.
3. The tree can generate a diversity of by-products such as food, beverages, wood and oils for the chemical industry.
4. The plant is drought resistant, requires low inputs (labor and agro-chemicals), survives on low fertility soils and can be planted on steep slopes under agro-forestry conditions.

Over the period 1996 to 2004 the area under cashew in Dak Lak province increased from 9,305 ha to 23,858 ha. Nevertheless the yield quantity and quality are not yet high, due to several reasons.

1. Little attention has been paid to careful selection of varieties, adapted to local regional conditions.
2. Insufficient attention has been paid to careful land evaluation and planning taking into account soil, topographic and climatic variability at adequate scale.
3. The introduction of cashew did not go hand in hand with a well-organized training programme for farmers, resulting in a lack of knowledge on agro-techniques and processing, unstable yields, fluctuating quality and unsustainable production.
4. Selection of varieties so far mainly focused on high production levels of NIS, partially neglecting pest resistance and final kernel quality.
5. Since the cashew processing sector is rather new in Dak Lak, it faces a lack of technical expertise and has to cope with unclear regulations on quality, hygiene and environmental standards.

At the moment the productive cashew area covers 6,087 ha, which is circa 25 % of the totally planted area (i.e. 23,858 ha). The province’s target is to reach a fully productive area of 25,000 – 27,000 ha by the end of 2010, with a total production volume of 35 to 40 thousand tons per year. Thus far the spatial coverage has reached 90 % of the development plan, while in terms of volumes only 12 % of the plan has been completed.

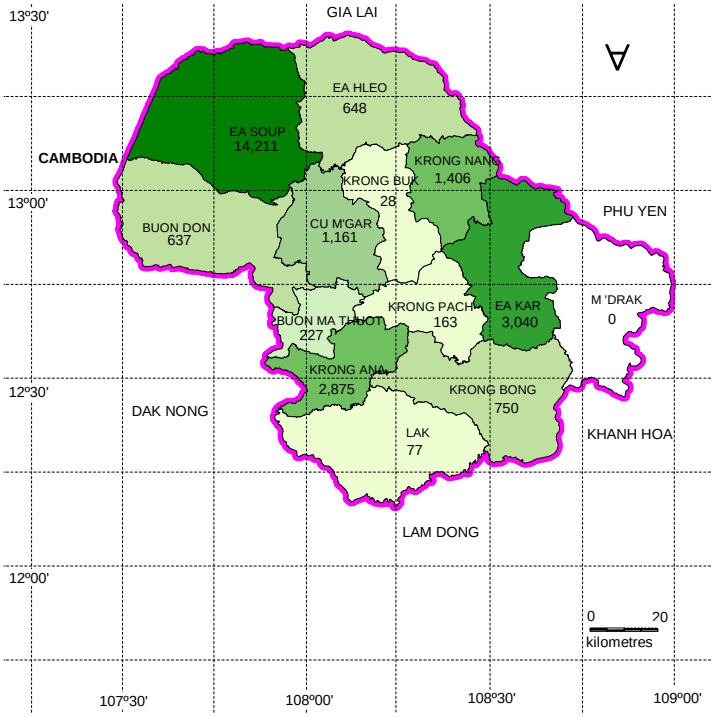
Currently cashew is mainly produced in the districts of Ea Sup, Ea Kar, Krong Ana, Krong Nang and Cu M’gar (Table 1, Figure 2). Minor cashew production is found in the districts Krong Bong, Ea H’Leo, Buon Don, Buon Ma Thuot, Krong Pach, Lak and Krong Buk.

Table 1 Distribution of cashew production in Dak Lak

District	Area	Productive area	Total production	Productivity
	ha	ha	t	kg/ha
Ea Sup	14,211	1,761	1,426	810
Ea Kar	3,040	1,406	1,688	1,201
Krong Ana	2,875	64	51	797
Krong Nang	1,406	41		
Cu M’gar	1,161	382	342	895
Krong Bong	750	350	315	900
Ea H’Leo	648	65	75	1,154
Buon Don	637	358	359	1,003
Buon Ma Thuot	227	93	128	1,376
Krong Pach	163	163	218	1,337
Lak	77	39	50	1,282
Krong Buk	28			
M’Drak				
Total	**23.858**	**6.087**	**4.652**	
Average				**746**

Source: Statistical Yearbook 2005; In descending order of area (ha)

Figure 2 Total production area per district in Dak Lak province (ha)



2.3 Support policies

To support and facilitate the cashew development plan, the province will put in place a number of regulations for potential and actual cashew producers, processors and service providers. These regulations aim at (i) creating a favorable investment environment, (ii) promotion of the market, (iii) implementation of a price insurance system and (iv) provision of technical assistance (seedlings, extension services,…) and support to improved infrastructure. The regulations are described in the Prime Minister's Decision No. 80 and particularly describe the following topics.

2.3.1 Land policy

The provincial People's Committee is appointed to support and facilitate the evaluation of unused land and land unsuitable for the current land use system of households that want to invest in cashew production.

If the land is found suitable for cashew, the province will grant preferential land use rights to individual households and economic organizations that can be used as mortgage in order to get a loan from banks or credit providers.

2.3.2 Tax policy

For newly reclaimed land, meant for cashew development and land that previously fell under a different production category, but currently falls within the preferential cashew development regions, the same tax regulations as for long-term industrial crops hold (i.e. tax exemption during unproductive period).

It is proposed in decision No. 80 that the province would subsidize fertilizer and cashew seedlings for 2 to 3 years until the end of 2005. This regulation is indeed effective in districts that are issued to become cashew regions (50 % subsidized seedlings), but this is not so for districts (such as Lak) that are excluded from the provincial cashew development plan.

2.3.3 Capital policy

Decision No. 80 further outlines that the province should give priority to investments in cashew production through capital resources from the Dak Lak Fund for Assistance and Development and the Social Policy Bank.

The province should facilitate preferentially investment projects for cashew by enterprises, farms and cooperatives through allocation of public funds for subsidizing seedlings, fertilizer inputs, provision of technical training on agro techniques and processing and the development of nurseries.

Banks and credit organizations, especially the Social Policy Bank, are proposed to implement policies to guarantee mid-term credit for households and farms, for a minimum of 3 to 4 million VND per hectare for new plantations without mortgage and 1.5 to 2 million VND per hectare for running costs of cashew plantations.

Last but not least the decree No. 80, requests the province to allocate a budget to promote the processing and use of cashew by-products (e.g. beverage, jam, oil,…) as well as market development for these derived products.

The aforementioned regulations are very much in line with the measures taken in the mid-nineties to develop the coffee industry in Dak Lak. Basically the state will subsidize (i) interest payments relating to agricultural exportables when their international prices decline, (ii) to assist some exportables which face losses due to their weak competitiveness or other reasons, and (iii) to reward exporters who promote new exportables or access new foreign markets or enlarge their exports to foreign markets.

2.4 Suitability for cashew production in Dak Lak

The cashew tree is a fast growing, evergreen tropical tree. Cashew trees grow to a height of up to 12 m, are genuinely tropical and very frost sensitive (minimum temperature > 5 ^{0} Celsius). Therefore the tree generally prefers lower altitudes (< 600 m asl). Although cashew can withstand high temperatures, a monthly mean of 27 °C is regarded as optimal. An average yearly rainfall between 1,000 and 2,000 mm with a distinct dry season provides ideal conditions, but drier conditions are well tolerated (Table 2). More humid conditions should be avoided as it reduces flowering, pollination and fruit set as well as it increases the risk of pest infestation. Cashew is tolerant to sandy, poor soils with an acid to neutral pH range of 4.5 to 6.5. As such, cashew does not require intensive care and agricultural practices, like fertilizing, irrigating, spraying against pests/diseases and pruning, although advised for intensive production, can be limited to a minimum in small-holder environments.

Table 2 Crop requirements for cashew and land characteristics in Dak Lak

Physical characteristic	Unit	Crop requirement	Land characteristics
Average annual temperature	^{0} Celcius	27.0	23.5
Absolute minimum temperature	^{0} Celcius	≥ 5.0	11.0 -15.0
Absolute maximum temperature	^{0} Celsius	45.0	36.0 - 40.0
Average annual air humidity	%	85	83 - 85
Average annual rainfall	mm	1,000 - 2,000	1,400 - 2,400
Average annual wind speed	m/s	2-3	2-3
Altitude	m asl	< 600	500 (average)

Source: DARD, 2004; FAO, 2001

Matching the land characteristics of Dak Lak province i.e. soil, climate and topography, with the crop requirements for cashew, allows evaluating the land suitability for this crop. The land suitability map shown in Figure 3 was developed at a scale 1:250,000. As a consequence it may blur the details per individual district. Moreover the map was developed based on general crop information (FAO, ECOCROP), not taking into account the specific characteristics of the cashew varieties in Vietnam. As a consequence several map units are rated as moderately suitable (S2 class); in most cases this suitability class refers to slight erosion risk, presence of stones in top and subsoil and a sandy texture, which may impede initial tree establishment. The cashew survey though clearly indicates that these land units do have a large potential for cashew production, and hence moderately suitable soils on the map may be considered suitable soils (Table 3, Picture 1).

In general the suitability map coincides well with the proposed provincial cashew development plan, prioritizing 7 districts i.e. Ea Sup, Buon Don, Cu M'gar, Ea Kar, Krong Pak, Krong Ana and Krong Bong (DARD, 2004). It indicates that besides poverty alleviation and income generation in remote areas, the province draws a major attention to reduced water use for coffee on the marginal fringes of the basalt plateau.

A closer look to some more remote, poor districts, such as Lak and Ea H'Leo[1] indicates a due potential as well. It is true that the major soils in Lak district are poorly drained, lowland soils with a heavy clay texture, which are indeed unsuitable for cashew production. But on the other hand, both Lak and Ea H'Leo district have a moderately dissected geomorphology, consisting of sandy soil types derived from granite on moderate slopes (up to 8 %). These locations may as well be considered for cashew development, the more since Lak district falls in welfare category 3 (i.e. poorest districts) and cashew is considered a forest plant (programme 327 on the re-greening of denuded hills and barren land), which makes it an

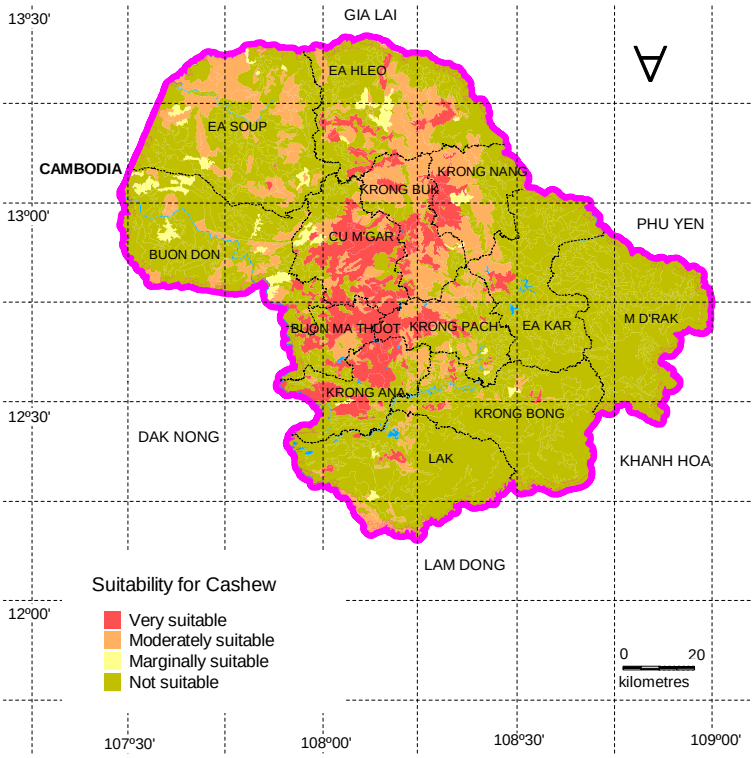
[1] Ea H'Leo district is not included in the cashew development programme, but currently receives support through the provincial Committee for Ethnic Minorities and Mountainous Areas (CEMMA) for agro-forestry development; therefore in particular cocoa and cashew are promoted, which are considered forest trees.

ideal agro-forestry crop on sloping, barren land, contributing to poverty alleviation. The authorities of both districts are motivated to promote cashew development, but since they are excluded from the provincial cashew development plan, they do not benefit from the support policies and subsidies for cashew promotion. Nevertheless both districts are convinced of the benefits cashew may bring. Hence Ea H’Leo wants to increase the current cashew area (i.e. 2,815 ha) to 4,000 ha and wants to install a local processing factory by 2010. The district has a budget for cashew of 300 million. VND (E.M. Department for 3 communes: Ea H’Leo, Ea Sol, Ea Hiao) for 2006. Lak has a current cashew production area of 172 ha and carries out a cashew demonstration program with WASI and DARD. Although the district is not included in the provincial cashew promotion programme, it is currently promoting cashew under the ethnic minority programme 132 and wants to increase the cashew production area up to 500 ha by 2006.

Table 3 Land suitability per district (ha)

District	Suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Cu M'Gar	38,674	11,493	2,243	30,238
Krong Ana	23,067	5,704	329	33,788
Krong Buk	17,589	31,578	263	14,739
Buon Ma Thuot	16,544	5,047	-	15,183
Ea H’Leo	13,330	32,590	4,870	83,933
Krong Pach	13,275	16,837	415	32,423
Krong Nang	10,325	22,895	1,688	26,990
Buon Don	4,340	16,322	9,230	107,701
EaKar	2,764	5,849	-	95,645
Krong Bong	2,397	5,325	508	118,889
Lak	2,150	9,397	813	113,220
Ea Sup	440	48,368	4,233	120,554
M'Drak	-	-	130,471	137,593
Total	144,895	211,405	155,063	930,896

Figure 3 Physical land suitability for cashew in Dak Lak province at scale 1:250 000



Picture 1 Sandy, well-structured, well-drained soil (Acrisol), high in organic matter

3 The supply chain in Dak Lak

3.1 Production

3.1.1 Farming systems

Three production systems are recognized:

i. Small-holder private farms

Small-holder producers often own a few cashew trees up to 4 hectares. The varieties planted depend on the region. There is a large variability between farmers developing a plantation from either grafted seedlings or from seedlings developed from selected seeds.

ii. State-owned processing companies with plantation

Some processing companies are derived from former state-owned coffee plantations (e.g. Chu Quynh company is the former Viet Duc 5). The difference with the former system is that the cashew plantations are planted on better soil types with a higher fertility. Farmers working on the enterprise's land receive training and inputs.

iii. State-owned agro-forestry enterprises

Farmers lease the land from the enterprise. The enterprise decides on the land for plantation development and clears the land. Subsequently the farmer is responsible for the management of the field and its input use. The farmer is requested to return a certain quota (i.e. 40-70 kg per ha per year in Ea Sup, depending on the yield and the investment provided by the enterprise) to the enterprise, while the remainder is for own sales.

3.1.2 Cashew varieties

Field observations indicate that there is a wide range of varieties available on the local market, provided by different suppliers. Varieties may be offered by:

- local state-owned enterprises (e.g. Ea H'Leo);
- local Agricultural Extension Departments (e.g. Lak) upon or without advise from WASI, subsidized by the province or not, depending on the fact whether the particular district is regarded a potential cashew development area according to the provincial cashew development plan (e.g. AES/Lak District gets no subsidies to distribute seedlings to farmers); advised varieties are ES05, ES08[2]
- private farmers from other provinces such as Binh Phuoc (e.g. in Ea H'Leo; SC13, EK15, SC40, BS20, BGW15);
- district farmers' union upon advise of WASI (e.g. in Ea H'Leo).

Cashew research started in Dak Lak in 1992 and was carried out by WASI. It was long interrupted in the nineties, because priority was given to coffee cultivation. It was only restarted in 1999. From 2000 to 2001 the institute screened 171 best cashew varieties in Ea Sup, Ea Kar, Cu M'gar and Buon Don. After two years, in 2002, 106 varieties were selected, of which 5 were officially recognized and approved by the science committee under MARD (i.e. ES-04, EK-24, BD-01, KP-11 and KP-12). The varieties were selected for high productivity, large nut size and high kernel ratio (DARD, 2004).

Discussion with farmers and processors yields contrasting information about the advantages or disadvantages of grafted cashew trees. Although officially believed that the approved grafted varieties are higher yielding and produce a better quality (larger kernel size), some producers and processors believe that cashew developed from selected seeds performs better. One private processor in Ea Kar even solely buys from plantations developed from seeds (Picture 2).

[2] The abbreviations refer to the origin of the varieties; e.g. ES = Ea Sup, EK = Ea Kar, BD = Buon Don.

Picture 2 Young grafted cashew on steep slope in Lak; well-developed graft in Ea H’Leo

3.1.3 Agricultural practices

Land preparation: land clearance and preparation is mostly done manually by burning of existing vegetation. Depending on the wealth status, some private farmers or farmers belonging to a state-enterprise use mechanical traction (Picture 3) to plough the land (e.g. in Ea Sup).

Picture 3 Mechanical land preparation in Ea Sup district

Nursery management: during the study tour, only the nurseries implemented by ethnic farmers in Cham village and supervised by AES with support from RDDL project in Ea H’Leo were visited (Picture 4). Although the seeds had not yet germinated, an initial observation shows that the nursery bags seem slightly shorter (27 cm), as compared to an advised 30 cm (WASI). The optimal dimensions are 33 x 13 cm. The length of the bags is of crucial importance, since the roots of cashew trees develop preferentially into the depth. All too short bags may obstruct proper root development. To avoid roots to grow into the subsoil in the nursery, it is further advised to move the bags from time to time. The soil mixture used was unclear. Physically, the sandy texture appeared good (excellent drainage), though it is advised to use topsoil only, which contains a higher organic matter content and guarantees better water and nutrient retention capacity.

Picture 4 Nursery gardens introduced by AES with support from RDDL to minority farmers in Cham Village, Ea Sol Commune, Ea H’Leo District

Planting: There is a large variability between farmers in planting techniques (Picture 5). Basically three different methods are observed. (i) The simplest method is to plant seedlings directly in the field, making a planting hole that exactly fits the dimensions of the polybag, without additional inputs. (ii) Some farmers plant the seedlings in a planting hole with average dimensions of 0.5 x 0.5 x 0.5 m to 0.6 x 0.6 x 0.6 m without supply of additional inputs. (iii) The most advanced and preferred method is identical to the second method but with supplementary input of organic matter (compost). This method has the advantage to supply the seedlings with sufficient nutrients, as well as to improve the soil structure, i.e. the nutrient and water retention capacity increases in sandy soils. The latter technique is advised on demonstration fields by AEC in Ea Kar and by AES/ RDDL in Lak and Ea H’Leo. Farmers are advised to dig planting holes of 0.6 x 0.6 x 0.6 m and to apply 15 – 20 kg of organic matter mixed with 0.5 kg NPK per hole.

Picture 5 Newly planted cashew with (left) and without (right) soil improvement

Planting density: Depending on the service provider different plant spacings are advised. Currently AEC advises 5 x 5 m, WASI 7 x 7 m and DOST 8 x 8 m. The advised spacing depends on the soil quality and the slope; the steeper the slope the higher the initial density, the poorer the soil, the lower the plant density. The most common plant spacing is 7 x 8 m, but further technology transfer to farmers is advisable.

Weeding: Weeding is mainly done manually, while some better off farmers hire a company to assist in chemical control of weeds (i.e. Ea Sup). In the poorer and more remote areas (Lak, Ea H’Leo), cashew fields are often infested by weeds (Ea H’Leo, Lak). On steep slopes it is preferred to apply no tillage techniques to avoid erosion.

Intercropping: Most farmers who own a larger plot of cashew, often intercrop with different food crops such as beans, maize, cassava,… for own use and in some instances, on better soil types for sales as well (e.g. beans in Ea Sup). The plant remains are left on the field. Besides risk spreading and food supply, intercropping with leguminous species such as beans has the advantage of enriching the soil with nitrogen, while leaving the plant remains on the field after harvest reduces the erosion risk on steep slopes and improves the soil structure.

Irrigation: Irrigation is not commonly practiced in Dak Lak province. Although it is advised by WASI and AEC to irrigate the young seedlings during the first and second year, cashew plantations that received no irrigation appear to do well in Krong Ana, Ea Sup and Ea Kar. Some farmers irrigate during the first and second year, starting in February with a 1 month interval. The volume of water used is unclear.

Fertilizer management: The application of fertilizers is very variable. Minority farmers often don’t apply any fertilizers at all, stating that they will apply inputs once the tree generates yield. Other farmers use a general NPK formula (often 16:16:8) once or twice per year at a rate of 1-5 kg per tree. Farmers integrate the fertilizer in the soil at the edge of the trees’ canopies. Application is given once or twice per year, in the latter case in June and September. Literature suggests that the NPK formula is not in line with the tree requirements. Optimally NPK 4:1:1 should be applied (see p 32).

Pest and disease control: The most common diseases in Dak Lak are summarized in Table 4. Despite the high occurrence of pests and diseases, farmers seldom apply pest control measures (pesticides or IPM). In Ea Sup farmers received technical training on pest control from AEC and the Farmers’ Union… Other farmers hire professional companies to assist with pest management. In the latter case pest control is mechanized and covers the entire field, rather than a focused treatment of affected plants.

Table 4 Common pests and diseases in Dak Lak province

Common name	Symptoms
Stem borer *(Plocaederus obesus)*	This is a serious pest, which is capable of destroying the cashew tree. Main symptoms of attack are yellowing of leaves, drying of twigs, presence of holes at the base of stem with exuding sap (Picture 6).
Bud borer *(Alcides sp.)*	A reddish-brown mirid bug which normally appears at the time of emergence of new growth and panicles. Nymphs and adults suck the sap from tender nuts (Picture 7).
Fungal bud and fruit disease (*Anthracnose)*	The fungus Colletotrichum gleosporioides is the causal agent of anthracnosis. Black or dark brown necrotic spots or lesions occur on leaves, apples and nuts. It is particularly prevalent during the rainy season and can completely kill the first flush of new shoots and persist to kill varying amounts of later flushes as well. The severity of the disease varies from year to year and place to place depending on environmental conditions (Picture 8).
Tea mosquito *(Helopeltis Antonil* S.)	The pest can take the form of black lesions on petioles or on the leaf midrib, or black angular spots on the leaf surface. Typical feeding damage on stems appears as a discolored, necrotic area or lesion; similar lesions also occur on fruits and developing nuts. When Helopeltis feeding pressure is sufficiently intense, the whole shoot dies and this damage is typically called ‘Dieback’. In very serious cases, the entire tree looks burnt (Picture 9).
Leaf miner *(Acrocercops sp.)*	Young plants in the nursery and in the orchard are more affected by these pests. Caterpillars of this silvery gray moth mine through the tender leaves, thus, severely damaging them (Picture 10).
Leaf Roller *(Lepidoptera)*	Minor pest, caused by insects whose larvae feed on young leaves and web leaves together (Picture 10). When populations are high and rain showers are sparse, leaf rollers can defoliate the whole tree also feeding on the inflorescences. Especially young trees are vulnerable.
Termites	Termites attack the roots and the trunk of cashew trees. They burrow on the bark of roots and branches especially of old trees. They build their soil mounds or nest on dead parts of the tree (Picture 11).

Source: FAO

Picture 6 Stem borer

Picture 7 Bud borer

Picture 8 Fungal bud and fruit disease (Anthracnose)

Picture 9 Tea Mosquito

Picture 10 Leaf roller and leaf miner

Picture 11 Termites

Harvest: The harvesting period varies regionally and from year to year but is generally from January to May, with the peak in March (Picture 12). Harvesting is done manually by collecting the fresh fruits that have fallen on the ground. The fruits are collected within 24 hours mainly by household labor. The fruit should not be left on the ground longer than a day as the onset of fermentation of the apple will negatively influence nut quality. Subsequently the apples and nuts are separated and the nuts are dried for at least 48 hours. The apples are not systematically used for consumption in the form of jam or wine. They are either fed to animals or left in the field for composting. Drying is a crucial process for quality; rewetting of nuts after and during drying must be strictly avoided. As soon as rain approaches, the nuts are to be covered by canvas. In general, drying conditions for cashew nuts are excellent in Dak Lak as hot and dry weather is given at the right times of the year. Properly dried nuts can be stored for 2 years before being shelled.

Picture 12 Flower set, fruit set and cashew apple

3.1.4 Production costs and revenue

In Table 5 an overview is given on the costs and revenues per hectare over the useful lifespan of the plantation i.e. 30 years. Cashew trees normally start bearing after 2 years and become fully productive by the 10th year, where after they continue bearing for another 20 years (Purseglove, 1968; Haarer, 1954). The average production per tree is about 7.5 kg.

The figures in the table are conservative, i.e. the farmgate price for dry nuts in shell is set at 10,400 VND or 0.65 USD per kg. Further, labor cost is estimated at 2 USD per manday (the labor requirements are based on a 1 ha plantation and vary depending on the productivity of the plantation). The initial investment costs are approximately 320 USD per ha (including 2 labor days and 25 seedlings for infilling of cashew trees that did not survive during establishment of the orchard in the first year). In the current situation where farmers receive approximately 0.65 USD per kg NIS, a producer would be able to recover his investment costs after 9 years. If prices are 0.85 USD per kg NIS the recovery time would be 7 years. The benefit-cost ratio after the productive lifetime of the plantation is 1.59. In reality farmers do not often hire external labor, which may change the overall picture. Assuming no opportunity cost for family labour, the benefit-cost ratio after 30 years would be 3.96. The average net benefit per hectare over the entire lifespan of the orchard is approximately 385 USD.

Table 5 Costs and benefits for 1 ha of cashew over the useful life of the orchard (in USD)

		Item	1	2	3	4	5	6	7	8	9	10	11-20	21-25	26-30
Costs	Investment	Land preparation/clearance	100												
		Design planting holes	100	4											
		Seedlings (200/ha)	50	6.25											
		Mulching	60												
	Inputs	Organic fertilizers	125	125	125	125									
		Inorganic fertilizers	20	40	60	60	60	60	60	60	60	60	600	300	300
		Pesticides	1	3	4	4	5	8	10	10	12	12	120	50	42
	Labor	Weeding	40	30	30	30	20	20	20	20	20	20	200	100	100
		Fertilizer and pesticide	40	52	56	56	58	60	60	60	60	60	600	300	300
		Labor cost harvest/nut	0	0	6	8	16	30	60	90	120	150	1500	300	180
		Other	10	26	28	28	28	28	28	28	28	28	280	140	140
		Total cost	**546**	**286.3**	**309**	**311**	**187**	**206**	**238**	**268**	**300**	**330**	**3300**	**1190**	**1062**
Income		Production NIS (minimum)	0	0	100	300	500	700	900	1100	1300	1500	15000	6000	3500
		Price per kg NIS	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
		Total gross income	**0**	**0**	**65**	**195**	**325**	**455**	**585**	**715**	**845**	**975**	**9750**	**3900**	**2275**
		Total net income	**-546**	**-286**	**-244**	**-116**	**138**	**249**	**347**	**447**	**545**	**645**	**6450**	**2710**	**1213**
		Cumm. net income	**-546**	**-832**	**-1076**	**-1192**	**-1054**	**-805**	**-458**	**-11.3**	**534**	**1,179**	**7,629**	**10,339**	**11,552**

Remarks: 1 ha = 200 trees

Year 1-2: unproductive; Year 3-10: increasing productivity (0.1 to 1.5 t/ha); Year 11-20: stable productivity (1,5 t/ha) ; Year 21-25 and 26-30: declining productivity (1.4 to 1.0 t/ha and 0.9 to 0.5 t/ha respectively)

Table 6 depicts the production costs for NIS, broken down over the development stages of the cashew tree in USD per ton. On average over the entire lifetime of the plantation (i.e. 30 years) the production costs are 242 USD/t. It is clear that the production costs are initially high because of the investment costs and relatively low productivity (year 1-10) and then gradually decrease during the full productive stage, while at the end of the useful life time production costs increase again, because the productivity decreases while management costs remain relatively stable. Assuming no opportunity cost for family labour, the average production cost for 1 ton of NIS would be more than three times lower i.e. 72 USD per ton NIS.

Table 6 Costs and benefits of 1 Mt of NIS in USD

		Item	Development stage (year)				
			1-10	11-20	21-25	26-30	1-30
Costs	Investment	Land preparation/clearance	15.63	0.00	0.00	0.00	3.24
		Design planting holes	16.25	0.00	0.00	0.00	3.37
		Seedlings (200/ha)	8.79	0.00	0.00	0.00	1.82
		Mulching	9.38	0.00	0.00	0.00	1.94
	Inputs	Organic fertilizers	78.13	0.00	0.00	0.00	16.18
		Inorganic fertilizers	84.38	40.00	50.00	85.71	46.60
		Pesticides	10.78	8.00	8.33	12.00	7.73
	Labor	Weeding	39.06	13.33	16.67	28.57	17.80
		Fertilizer and pesticide	87.81	40.00	50.00	85.71	47.31
		Labor cost harvest/nut	75.00	100.00	50.00	51.43	73.79
		Other	40.63	18.67	23.33	40.00	22.01
		Total cost	**465.82**	**220.00**	**198.33**	**303.43**	**241.79**
Income		Production NIS (minimum)	6,400.00	15,000.00	6,000.00	3,500.00	30,900.00
		Price per kg NIS (USD)	0.65	0.65	0.65	0.65	0.65
		Total gross income	**650.00**	**650.00**	**650.00**	**650.00**	**650.00**
		Total net income	**184.18**	**430.00**	**451.67**	**346.57**	**408.21**

Remark: Investment costs have been discounted over the crop’s lifetime

In comparison, the average production cost per ton of Robusta green beans is about 392 USD at conservative coffee prices of 8,500 VND/kg. This is 38 % higher than for cashew production. The revenue, on the other hand, is about 144 USD per ton green beans (Plattner, 2004), while a ton of raw cashew nuts can fetch 408 USD/t. Important to notice is that Robusta coffee can yield more per hectare (up to 3.2 ton green beans) than cashew (up to 1.5 ton NIS). Therefore the average annual net revenue per hectare of Robusta coffee (468 USD/ha) is 22 % higher than the net revenue for cashew per hectare (385 USD/ha).

3.2 Collection

Collection of raw cashew nuts is done by small, medium and large collectors, as well as by collectors that depend on state-owned processing factories. In case farmers live close to the processing company the dried raw nuts are delivered at the factory gate. Medium collectors (e.g. in Ea H’Leo) have a turnover of 8 to 10 t per day (i.e. 300 – 500 t annually). Farmers and smaller collectors deliver to the medium size collector. Upon delivery the quality of the NIS is checked visually for (i) moisture content and (ii) percentage of floaters.

The quality control is rather subjective. If the collector finds the moisture content too high, the price will be reduced. No objective measurement is done though. To evaluate, the percentage of nuts without kernel a sample (undefined quantity) of dry NIS is submerged in water. Depending on the percentage of floaters a bonus or penalty is added to the base price. This threshold figure may differ from one collector to the other (5 – 15 %; processing companies in Ea Kar and Ea Sup and private collector/middleman in Ea H’Leo respectively). In Ea Kar and Ea Sup the collector/processing companies (state-owned and private respectively) foresee a bonus price if the percentage of floaters is lower then 5 % and rejects when the percentage exceeds 7 %. Remarkably, the number of floaters may give a false indication of actual product quality, since 40 % of the floaters may have kernels. Upon purchase the collector will further dry and/or upgrade the quality through manual removal of foreign matter and floaters if required.

Between farmgate and factory gate often multiple collectors/middlemen are involved (up to 7). The more remote the production area and/or the longer the distance to the factory, the more collectors are involved. Since competition between collectors is high, they often assist producers on-farm in separating the apple from the nut during the peak harvest period (e.g. in Ea Sup).

3.3 Processing

3.3.1 Overview

Two types of processing companies exist in Dak Lak i.e. private and state-owned. Most processing companies are very new in Dak Lak, established in 2004-2005, some of them still in the experimental phase (e.g. Ea Sup). Some remote cashew areas do not have processors in the neighbourhood (Lak and Ea H’Leo) (Table 7).

Table 7 General information processing companies

Processor	Type	District	Design capacity t/y	Real production t/y	% of design capacity
722	SOE	Ea Kar	12,000	8,000	67
Ngoc Tuan	Private	Ea Kar	8,000	2,000	25
Thanh Cong	Private	Ea Sup	unknown	experiment	Unknown
Dak An	Private	Krong Ana	3,000	620 (8 months)	21
Chu Quynh	SOE	Krong Ana	> 2,000	400	20

3.3.2 Processing steps

In Vietnam, only the cashew nut is processed and used economically; the cashew apple is not used for further processing but only dumped, used as garden compost or cattle feed. Vietnamese industry representatives stated that ripe cashew apples are quickly contaminated with soil and bacteria after dropping from the tree and are not considered safe for food processing (von Enden, 2004). Presently, there appears to be hardly any know-how for cashew apple processing available in Vietnam; it seems that further investigations should be done for industrial use of cashew apple processing. As long as cashew prices are high, however, it seems to be unlikely that farmers investigate into new ventures as the income from nuts is already very rewarding. Nevertheless, derived products from the cashew apple could increase the total benefit by 40 % (personal communication P. Untied). Figure 4 depicts the structure of the cashew fruit and Table 8 gives an overview of potential by products from cashew and an indication of its current use in Dak Lak.

Figure 4 Structure of the cashew fruit

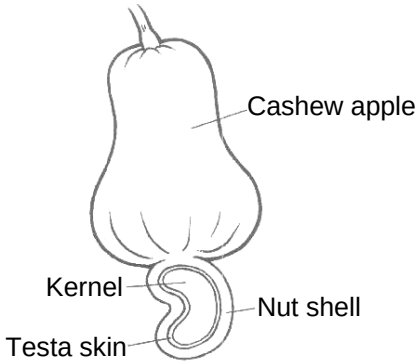


Table 8 Cashew and its potential products (USAID, 2002)

Input	Output	Description and Uses	Use in Dak Lak
Nuts	Kernels	Raw nuts are processed by drying, soaking, steaming/roasting, shelling, decorticating.	Yes
Apple	Prunes	Cashew prunes, produced by boiling the cashew apple in molasses, is very similar to dehydrated prunes or dates.	No
	Juice	The cashew fruit is pulped by grating or pounding and the juice is pressed out and strained. Cashew Juice has five times more citric acid than orange juice and is thus a good source of preservation acid medium when mixed with other fruit juices or vegetables	No
	Wine	The juice of the cashew apple can be processed into wine using the conventional method of producing fruit wines. The alcoholic content averages 18%.	No
	Pulp	The fibrous pulp obtained after extracting juice from the cashew apple can be used as animal feed or dried and processed into diet fibre biscuits	No
Shell	Cashew Nut shell Liquid	Extracted from the cashew shell, CNSL is used in the manufacturing of paints, varnishes, resins and brake linings	Yes
	Fuel	After extraction of the shell liquid, the shells are used as processing fuels	Yes

Source: von Enden, 2004

Upon arrival at the factory gate, the dry nuts in shell are checked for the moisture content and properly dried until a moisture content of 5 – 10 % (if necessary) for immediate processing or temporary storage (buffer stock). At first instance the nuts are graded into four size categories (A, B, C and D; A being the largest). The grading machines are locally designed by the Technical University in Ho Chi Minh City (Picture 13, Figure 5).

Subsequently the nuts are either steamed or soaked in water and roasted. Both techniques are available in Dak Lak. Most processors apply the soaking and roasting technique (80 % of the visited processors), while only Chu Quynh Company in Krong Ana applies the cleaner steaming method (Picture 14). Graded nuts are initially rewetted by soaking them for 10 to 15 hours in concrete containers (Picture 13). The moisture in the shell will facilitate the rupturing of the cells containing shell oil while retaining it in the shell. The moisture makes the kernel slightly rubbery and limits breakage of the kernels. During roasting or steaming the caustic shell oil and acrid fumes are discharged. Kernels must be protected from contamination by the shell oil because it causes blisters in the mouth and throat when eaten. Roasting takes 1 to 1.5 minutes (Picture 14). Most companies recycle energy, by burning 5 to 10 % of the nut shells to fuel the roasting or steaming process. Both in steaming and roasting the smoke is filtered by water to reduce release of toxic oil.

Picture 13 Grading and soaking in concrete tanks (from left to right)

Picture 14 Steaming and roasting machinery, oil remains and oil outlet (from left to right)




After roasting/steaming, cashew nuts are air dried about 1 hour before shelling. Shelling is the most difficult and laborious operation in cashew processing. Shelling in Dak Lak is entirely done by hand, mostly by women and ethnic minority laborers (Picture 15). Large scale mechanical shelling machines are difficult to design because of the irregular shape of the nut, hardness of the shell and brittleness of the kernel. Skilled workers can shell up to 60 kg of NIS per day, while an average of 20 kg/day is common.

Picture 15 Shelling and detail of shelling equipment





After shelling, kernels are dried on racks in ovens at 70° C for 4 to 6 hours (Picture 16).

Picture 16 Drying of kernels


The testa become dry and can be easily removed afterwards. Remaining traces can be removed with knives (Picture 17).

Picture 17 Testa removal


As soon as kernels are cleaned from remains of the testa, kernels can be graded (Picture 18). After grading, kernels need to be dried to around 3 % moisture before they are released for fumigating and packaging. Drying is especially necessary to extend freshness and prevent fungal and other infections.

Picture 18 Grading

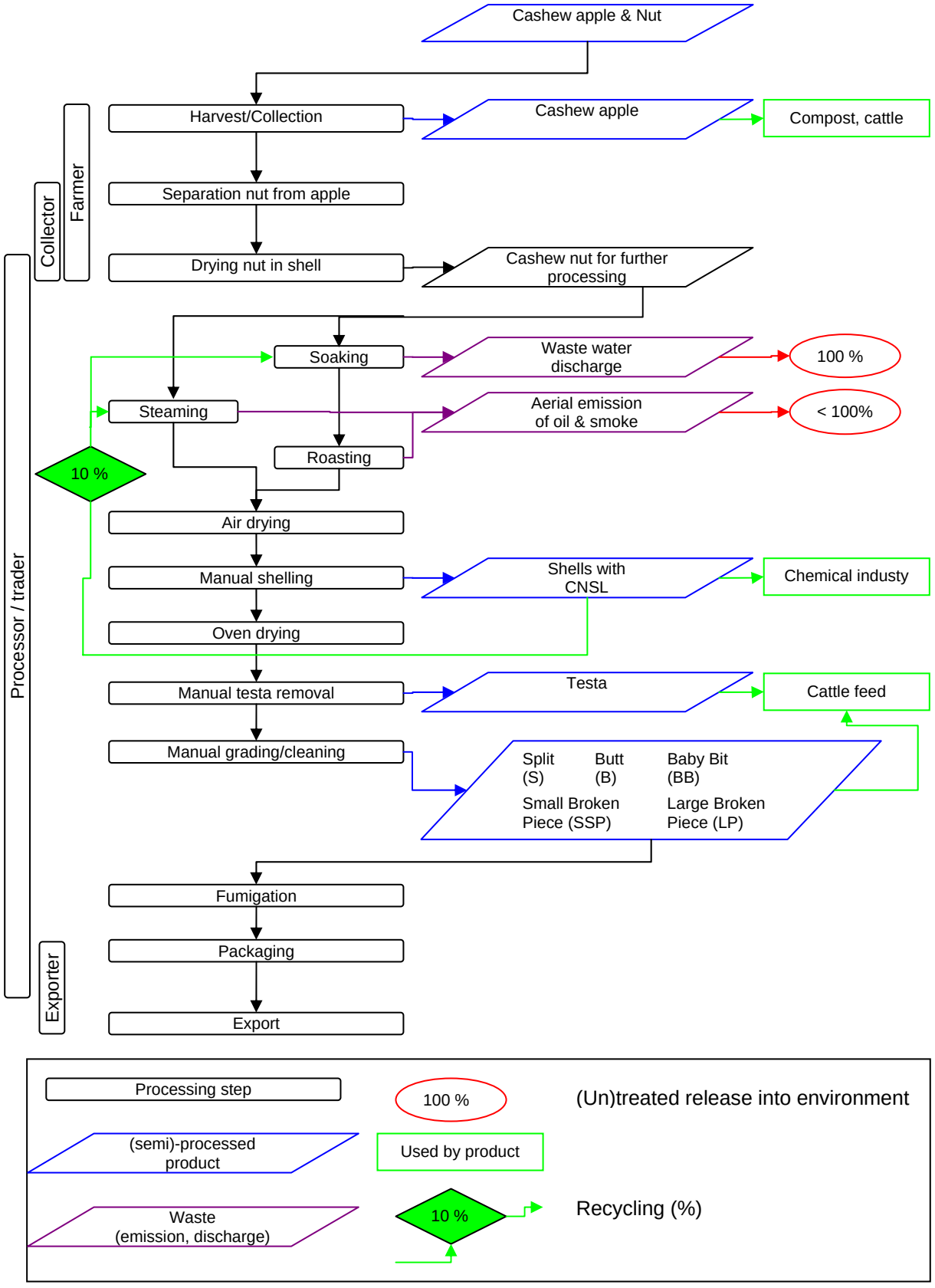



Although fumigation installations were available in Krong Ana state enterprise, they were not yet in use. Packaging material in all processing companies consists of basic thin boxes, for sales to local traders or for export (Picture 19). No further handling such as salting or vacuum packaging is currently done in Dak Lak.

Picture 19 Packing and storage



Figure 5 Overview of the processing steps from farm to export gate



3.3.3 By products and wastes

Several by-products evolve during cashew processing of which some are economically valorized while others are treated as waste and dumped. Below is an overview of the by-products and wastes produced during processing in Dak Lak province.

By products:

Cashew apple: See paragraph 3.1.3. Cashew apples are not industrially used. They are left on the field for compost or fed to cattle.

Cashew Nut Shell Liquid (CNSL): This is a caustic oil, which is released during the roasting or steaming process. It can be used by car manufacturers for brake linings as well as for varnishes and paints. According to the processing and extraction technique applied, different amounts and quality of CNSL can be extracted. Most processors in Dak Lak sell CNSL and shells to the chemical industry.

Testa: The testa are sold to the food processing industry to be mixed in animal feed.

Broken kernels: Both types are sold to the food processing industry to be mixed into cattle feed.

Wastes:

Water: Water used to soak or steam NIS is disposed untreated. The water is mostly drained into a pond and not directly released into waterways. Literature does not indicate toxicity of the wastewater nor negative influences for the environment. The water is only used once, hence recycling might be an option.

Smoke: The smoke from roasting contains large amounts of oil which is detrimental to the environment surrounding a factory. Trees have reportedly died as a result from oil covering leaf surface and blocking the stomata so that trees cannot take up CO_2 from the atmosphere. In addition, the oil is aggressive on the skin so that working conditions in cashew shelling need to be under good safety regulations to avoid health problems. In Dak Lak, both for roasting and steaming, the smoke which is released during these processes is conveyed through a filter, which reduces environmental pollution. Staff working in the steaming and roasting unit wear protective masks.

Recycling:

In all visited processing factories 5 to 10 % of the shells are reused (burned) to create energy for the steaming or roasting process. As mentioned above water is not recycled.

3.4 Trade and export

3.4.1 State owned companies

The trade and export market is still very new and young in Dak Lak province. As a consequence only a limited number of trading/export companies exist. Two companies (i.e. 722 and Ngoc Tuan Company, respectively state-owned and private) are currently exporting overseas, while the private company Dak An, which is operational since only 8 months, is exploring the possibilities for export. Cashew processors and exporters currently buy about 50 % of their production in Dak Lak while the rest is bought in Binh Duong, Dong Nai and Binh Phuoc. 722 company in Ea Kar is the main overseas exporter in Dak Lak. Main destinations are China (50 %) and the USA (30 %) and minor shares to Hong Kong, Taiwan and Singapore (20 % for the latter three destinations), while new markets are explored in Europe, in particular The Netherlands and Germany. The quality requirements for the USA are strict and require the company to apply vacuum packaging, while for other export destinations the dry cashew nuts are packed in tin boxes. All processing companies have a wide variety of products (e.g. 722 offers a range of 28 product types, i.e. different combinations of grades and qualities). 40 % of the export volume is transported to Ho Chi Minh City for direct export, while the remaining 60 % is bought at factory gate. When trading cashew, the processor/exporter follows daily world market prices in business magazines and through overseas contacts (by fax). These prices are compared to the price levels of competing traders and with price levels of the previous year. Although the company is a member of Vinacas, the price information received from this organization is not applied in the trade decision making process, since it appears outdated upon receival.

The processing/export company mainly buys from independent collectors. Since competition between collectors is fierce, it allows the company to negotiate better prices. Collectors try to sell their NIS as soon as possible to avoid quality loss during storage at risk of fetching lower factory gate prices. This occurs despite the fact that collectors could store their NIS for up to two years if it is properly dried. Farmers also deliver at factory gate, but the producers are not contractually liaised to the factory.

Risk spreading strategies include the purchase of large quantities by the beginning of the season and storage at factory gate. This allows the company to estimate the required work force and provide seasonal workers a better, longer-term contract. Whenever prices fall throughout the season the company will try to purchase larger volumes. Buying strategy also depends on the contract offers of customers.

Before export the quality is checked by CafeControl. So far the company has never faced rejects from overseas buyers.

3.4.2 Private companies

In contrast with the large state-owned companies there are smaller private processor/exporters in the market. The main differences in their approach is that the small private companies try to tie up with the producers, providing pre-financing for inputs, offering better farmgate prices, since speculating collectors are left out and offering producers seasonal work in the processing factory.

The advantages for the producers are (i) a more secure job perspective (risk aversion through off farm activities); (ii) better farm gate prices, since collectors are left out, and (iii) easy access to loans to improve the farmgate product quantity and quality. Advantages for the processor/trader are: (i) guaranteed and more consistent supply; (ii) improved quality assurance and (iii) access to better qualified and hence more efficient labor forces in the factory.

Currently 50 % of the production is for local sales and 50 % for Chinese niche markets; i.e. small private processors often sell to a narrow group of potential Chinese customers, who buy smaller quantities for their particular market segment. Since the quality and sanitary requirements of these Chinese buyers are not standardized, nor internationally recognized, this implies that CafeControl is not involved in quality checks for export. Both seller and buyer evaluate and agree on the quality (visual, subjective evaluation) and contracts are signed. On the other hand price negotiations are based on comparing sales prices with the state-owned factories and price offers made by Chinese buyers.

The risk management strategies are comparable to the large state-owned company. Initially the company will buy sufficient stock to guarantee minimum processing, while purchasing gradually more throughout the season, when prices are relatively low.

3.5 Price development along the supply chain

Table 9 depicts a calculation of the price development along the cashew supply chain from farmgate in Dak Lak province till export gate in Ho Chi Minh City. Cashew production is steadily increasing in Dak Lak, not only because of the provincial cashew promotion programme, but also spontaneously because of the extremely good farmgate prices in 2004 and 2005. Since the cashew sector is young and new in Dak Lak the situation appears quite different from the southern cashew producing provinces. After discounting all production costs, an average farmer in Dak Lak is able to earn 408 USD per ton raw cashew nut or over 1,714 USD per ton cashew kernel equivalent (at an FOB price of 4.700 USD/ton kernel; figure personal communication 722 company). This is 30 % lower than the value calculated for an average farmer in Binh Phuoc in 2005. The reason may be found in the fact that the average farmgate price is rather low. Some producers state that they receive 9,000 to 12,000 VND per kg NIS only (i.e. about 0.65 USD/kg), while others, more aware of the official price levels receive up to 14,000 VND per kg (0.85 USD/kg). If a producer receives the latter price the income that could be generated is in line with the calculations for Binh Phuoc province. In remote areas the farmgate price represents only 36 % of the export value, which is low.

Most farmers sell dried NIS to small collectors. Since price transparency appears an issue, collectors try to press the price level. Often there are more collector/middlemen in between farm and factory gate, sometimes up to 6. In Table 9 it can be seen that the middlemen take a large margin (i.e.169 USD/ton NIS; middlemen in Dak Lak only trade NIS). Since there are several collectors in between, the profit margin for an individual collector is likely to be lower than the figure depicted.

Highest costs throughout the processing chain occur during final processing. Especially labour costs are making cashew production expensive. In terms of margin, exporters gain an average 450 USD per ton exported kernel. The margin however must be calculated in such way because the exporters face the most risk of price fluctuations within the supply chain. Exporters in Vietnam always sell “outright” and take long positions. If prices collapse between time of purchase and time of selling, severe losses will be experienced. In 2004, the situation was very positive for exporters as prices were increasing throughout the year so that the exporter margin could be permanently widened. However, the risk that prices are falling are not at all covered or hedged; exporters are running large risks in a highly competitive and fluctuating market such as cashew.

The supply chain as presented below does not include processing to cashew for consumption (salted cashew, etc.). Quantities produced for Vietnamese consumers are very small and cashew processing is carried out entirely by processors/exporters. Skills in marketing for end products to consumers or skills in establishing viable marketing and distribution channels are hardly available at the level of exporters/processors.

Table 9 Price development, costs and margins from farm to export gate for cashew production in Dak Lak province

Values relate to Average Kernel Quality and NIS from Dak Lak province (figures reflect averages for producers, collectors and processors visited)

Value Chain Actor	Value adding steps	Kernel equiv.		NIS		Percent of FOB Value
		USD/Mt	VND/Mt	USD/Mt	VND/Mt	
	Average FOB Price of 2005 VN exports	**4,700.00**	**75,200,000**	--	--	
Processor/Exporter	***Value FOB Ho Chi Minh City Port***	**4,700.00**	**75,200,000**	--	--	**100.0**
	Margin processor/exporter	450.75	7,212,000	--	--	
	Financing costs	34.00	544,000	--	--	
	Transport Dak Lak - HCMC Port	12.50	200,000	--	--	
	Charges: documentation, quality cert., harbour charge	86.00	1,376,000	--	--	
	Packaging incl. Material	130.00	2,080,000	--	--	
	Handling and loading kernel (fumigation, bags, …)	17.50	280,000	--	--	
	Processing Loss (foreign matter, etc.)	47.00	752,000	--	--	
	Cost soaking / roasting	16.00	256,000	--	--	
	Labour Cost peeling kernel (118 m/d)	236.00	3,776,000	--	--	
	Labour Cost shelling (65 m/d)	130.00	2,080,000	--	--	
	Labour Cost drying (5 m/d)	10.00	160,000	--	--	
	Labour cost grading (20 m/d)	40.00	640,000	--	--	
	Processing Cost NIS to FAQ kernel (energy roasting, drying, …)	20.00	320,000	--	--	
Local Trader/collector	***Value factory door Dak Lak***	**3,470.25**	**55,524,000**	**826.25**	**13,220,000**	**73.8**
	Margin Trader/collector	711.85	11,389,600	169.49	2,711,810	
	Transport dry NIS farmgate to processing factory	20.00	320,000	4.76	76,190	
	Handling and loading NIS	8.40	134,400	2.00	32,000	
Farmer	***Value Farmgate Dak Lak***	**2,730.00**	**43,680,000**	**650.00**	**10,400,000**	**58.1**
	Collection & Separation Apple / Nut	309.92	4,958,688	73.79	1,180,640	
	Production costs - weeding, pruning, …	273.46	4,375,392	65.11	1,041,760	
	Inputs, pesticide	296.14	4,738,272	70.51	1,128,160	
	Establishment costs (discounted over the plantation's life time)	43.55	696,864	10.37	165,920	
	Other (finance costs, …)	92.44	1,479,072	22.01	352,160	
Farmer margin	***All costs discounted***	**1,714.48**	**27,431,712**	**408.21**	**6,531,360**	**36.5**

Notes:

Exch. Rate VND/USD 16,000.00

Wet Nut to kernel: factor 4.2

Assumptions:

Processing loss: 1 %

Production costs at farmgate are discounted over 30 years, the useful lifetime of a cashew plantation; calculation is an integration of literature, interviews & expert input from Vinalimex.

Costs incurred from local traders/collectors are derived from interviews; transport costs are estimated based on figures from local exporters.

One middleman is assumed between farmgate and processor. In reality the chain is more complex with up to 6 middlemen invloved, reducing the margins per ton.

Processing & packaging costs are derived from interviews.

Farmgate price for dry NIS: 10,400 VND or 0.65 USD per kg

Processing gate in price for dry NIS: 13,220 VND or 0.83 USD per kg

Export price for dry kernel: 75,200 VND or 4.7 USD per kg

4 Sustainability evaluation

4.1 Environmental dimension

4.1.1 Biodiversity

Different land use systems were found in Dak Lak. Since cashew falls under programme 327, cashew is considered a forest plant, which is promoted to cover denuded sloping lands in agro-forestry systems. Besides, a nice example of intercropping cashew with coffee was discovered in Lak District. Both perennials are not competing since coffee taps nutrients from the topsoil and cashew from the subsoil. Cashew needs no further inputs when coffee is properly taken care off and besides increased biodiversity, the combined cropping pattern supports the reduction of evaporative losses and reduces irrigation requirements.

4.1.2 Agro-chemicals

Currently smallholder farmers hardly use pesticides, and hence this poses no immediate treat on the environment. On the other hand one should be careful with upcoming small scale private companies that besides agro-chemicals also provide the technical know-how. It needs further evaluation whether this kind of service provision is in line with the due sustainability concept as it may lead to increased use of agro-chemicals through promotion by these private suppliers.

4.1.3 Soil fertility

In general cashew is planted on less fertile soils, which forms no harm as long as the tree is sufficiently fed during its initial stage (i.e. application of a mixture of organic matter and NPK to the seedlings). Important to notice is that grafted cashew on fertile soils or on former coffee soils appears to suffer from an all too quick growth, making the stem to suffer under the weight of the canopy. Alternative varieties may do better.

Farmers of minority origin hardly use any fertilizers, while Kinh farmers apply up to five kg per tree per year. Although the amount of applied fertilizers forms no immediate treat, it is clear that farmers do not recognize the need to apply fertilizers over different applications. Sandy soils are porous and single or double application per year will lead to a washout of nutrients to the groundwater.

The use of organic matter during initial establishment of the plantation, in small planting basins is no general trend. This technique needs promotion, since it will reduce irrigation and fertilizer requirements during the immature period and guarantee a stronger tree development. Positive is that most farmers intercrop cashew with annual food crops and leave the plant remains after harvest on the field. This improves the soil structure and reduces erosion risks.

4.1.4 Water

Although irrigation is promoted during the first two years of cashew development, it appears that a good soil preparation (including organic matter) during the initial stage may reduce irrigation needs. Several producers admitted not to have used any irrigation at all. Positive is that cashew is a drought resistant crop that can strongly contribute to a reduction of the regional water consumption in Dak Lak.

Water consumption in processing factories is low and is discharged in a drainage pit, not directly into the river system. The chemical content of discharge water after soaking the NIS is unknown and the effect on the environment is unclear. So far water is never reused.

4.1.5 Waste

Farmers are presently focusing on the cashew nut. Apples are not utilised so far. The dumping of cashew apples does not provoke any environmental problems, however, it represents a by-product which has a potential for monetary valorisation.

Although the processing facilities in Dak Lak are equipped with locally made, outdated machinery (except the steaming installation), there appears to be a filtering system in place to reduce smoke emissions. It is unclear though which quantities of smoke are emitted annually as well as its chemical content.

Hardly any data on environmental impact of cashew processing are available, although the general public opinion claims that processing is environmental damaging. In order to monitor impacts and possible improvements, environmental monitoring and possible even Environmental Management Accounting (EMA) could be used to identify and improve the economic dimensions of environmental effects in cashew processing.

4.1.6 Energy

All processors reapply 5 to 10 % of the cashew nut shells to fuel the roasting and steaming process. Given the high content of toxic oil in the shells it remains unclear whether it will still be allowed to recycle the shells this way when environmental regulations become stricter. Currently most processors in Dak Lak are in their first processing year, and all of them are experimenting to increase the processing efficiency.

4.2 Social dimension

4.2.1 Discrimination

There was no discrimination observed in the cashew areas. Especially in state-owned processing companies, the employment and education of ethnic minorities is promoted. Gender discrimination was neither observed. All companies employ both men and women, although the share of women workers is often larger. However women are hardly found in higher positions in the Vietnamese cashew industry (722 company and Ngoc Tuan company are exception). Labor wages for ethnic minority and Kinh, or women and men are the same (see also 4.2.3).

4.2.2 Right to childhood and education

Presently, child labour is not a problem in Vietnam. Labour is affordable and available so that there is no pressure to employ children in processing. Children in Vietnam have a special stranding and labour laws protect children and childhood. Although it is difficult to estimate the average age of the factory workers in the cashew sector, the general trend seems to be that the workers are rather young. In some particular cases children were temporary employed in the factory, although this seems not to affect their ability and right to attend school on a regular basis. In some poorer regions teenagers drop out of school early and join the factory to earn an income.

4.2.3 Working conditions

The labor forces in processing companies are mainly seasonal workers. A limited number of people are employed for a longer period. Depending on the difficulty of the work and the maximum average weight a skilled worker can process, the wages may differ. Shelling is rewarded by an average of 2,200 VND/kg (20 kg/manday), testa removal by 2,700 VND/kg (12 kg/manday) and grading by 450 VND/kg (50 kg/manday). Multiplication of respective aforementioned figures by the average volume a worker can handle per day, daily wages are on average 44,000; 32,400 and 22,500 VND. Besides the fact that cashew production is promoted as a poverty alleviation crop for ethnic minority, also its processing is promoted for minority groups as a means to gain extra income from the product. E.g. 90 % of the employees in Krong Ana state-processing factory are of ethnic minority origin. Employees work 8 hours per day. The processing factory runs 7 days per week, and since workers are paid per kg, they normally work 7 days per week.

The working conditions vary from processor to processor. At the better end workers are provided protective masks and gloves and clean clothing (e.g. 722 company), while in other situations workers appear to have the free choice to bring their own dust masks, since the company does not provide them. All processing companies foresee drinking water and the working places are well ventilated and illuminated. With respect to hygienic conditions most companies are not in line with international regulations such as the HACCP Programme (Hazard and Critical Control Point Programme), which allows to:

- Analyze potential hazards associated with food safety.
- Identify critical control points.
- Establish preventive measures with critical limits for each control point.
- Establish procedures to monitor the critical control points.
- Establish corrective actions if a critical limit has not been met.
- Establish procedures to verify that the system is working properly.
- Establish effective record keeping to document the HACCP system.

The main shortcomings in this framework can be summarized as:

- Since most cashew processors are new in Dak Lak province, many of them have no sound record keeping system, monitoring all critical processing steps, neither are processors familiar with setting up such a monitoring system.
- Since these record keeping systems are not in place, no critical control points have been identified yet and hence the processing steps cannot be monitored accurately.
- Many small private processors sell to China, where quality and sanitary requirements are lower compared to the EU or USA.
- Small private processors do not have quality labs in place to assess food quality, neither do they have qualified staff to run such labs.

In order to get better access to the European and American market, HACCP is a must, and training needs are urgent since most processors are eager to access the international market.

4.3 Economic dimension

4.3.1 Market information

Prices can be discussed freely, but information on prices is limited, in particular in more remote areas. Hence the middlemen appear to make relatively high margins. On the other hand collectors and processors apply the floating technique to determine the % of kernels. This technique is tricky, as 40 % of the floaters, may still contain kernels. This allows middlemen to negotiate with producers a price for a certain quantity of kernels (e.g. 1 kg), while in reality the useful product may be 40 % higher. Most producers are not aware of this.

4.3.2 Market access

Producers in poor and remote areas (e.g. Lak and Ea H'Leo) are entirely dependent on private collectors since there is no market available in these areas.

Market access for processors and exporters also remains difficult, because of a lack of information and a lack of know-how on international quality and food safety regulations.

4.3.3 Quality

Quality control depends entirely on the export market. A majority of processors sells to Chinese niche markets, where quality standards are not objectively defined. Those who export to the USA have their quality control done by CafeControl. Since most processing companies are new, little experience is available on the effect of processing on the final kernel quality. Hence in depth training and retraining for staff of processing factories is key.

At farm level, there appears no perception on quality. Collectors will buy all, and if the product does not fulfill the minimum quality requirements, the collectors will preprocess

themselves (e.g. grading, removal of foreign matter and drying) before selling on to the processor.

4.3.4 Supply chain

The supply chain appears rather long, and seems related to the distance between the cashew producer and the nearest cashew processor. As a consequence there are many speculating middlemen in between. This reduces traceability of the cashew flow.

5 Conclusions and recommendations

5.1 Long-term intervention and research

Currently many different cashew varieties are on the market, provided by private companies, state enterprises, WASI, DOST and AEC.

- Set up a (or revise the existing) province wide well-coordinated research programme, starting with the 5 varieties approved by MARD, plus additional varieties in all agro-ecological regions suitable for cashew production for at least 5 years. Selection of cashew varieties should focus on high quality kernels (final product), pest resistance, quick development and high efficiency (low input vs. high yield).
- Upon selection of new varieties, the province should assure that the varieties are certified, and that they can only be sold by recognized institutes and private companies.

The current selection of preferential cashew development regions/districts appears to be the result of small scale land use planning, blurring the reality.

- Continue land surveying at larger scale (soil mapping per commune, district), to enable more detailed land suitability evaluation, particularly in remote, hilly areas (e.g. Lak, Ea H'Leo) with high residence of ethnic minorities.

5.2 Extension and technical advise

At present different service providers (VINACAS, DARD, AEC, AES, private companies, WASI, DOST and state-owned enterprises) provide training to farmers. The technical advice provided appears not consistent and through private companies, information on e.g. pesticide use may be biased because of an inherent economic benefit. Moreover it is unclear when, how often and for whom trainings are provided. Budget allocation as well as human resources availability appears insufficient to reach sustainable cashew development.

Organize a stakeholder workshop with input from VINACAS, DARD, AEC, WASI, DOST, private (processing) companies, state-owned enterprises and producers to:

- Define, prioritize and agree jointly on the current extension needs for cashew development in Dak Lak.
- Set up a task force to outline training modules and training packages for specific target groups and agro-ecological regions (e.g. minorities residing on barren sandy hills) in consensus between all stakeholders.

Develop training packages with a main focus on: design and management of nurseries and clonal gardens, cashew planting (density, variety, and spacing), pest management, intercropping and soil erosion control, pruning and harvest and processing aspects at farm gate. Irrigation management is advised to be discouraged, since the cashew tree is naturally drought resistant. Attention should be drawn on good initial planting conditions (planting holes + addition of organic matter) and timing (early rainy season).

Convey training materials from the provincial AEC to the district AEC through training of trainers and provide trainings to farmers in farmer field schools on a regular basis.

5.3 Cost benefit analysis

The current allocation of public funds for cashew development and in particular technical assistance provision by AEC, appears limited. To estimate the budget needs to implement a fully fledged training programme it is advised to:

- Carry out a cost/benefit analysis (either province covering or in a representative pilot project), to assess the costs involved in the transition period to implement cashew production and to evaluate the long term benefits for the province for all pillars of sustainability, i.e. environmental, social and economic.
- Based on such study an accurate estimate can be made for an intervention budget and allocation over the stakeholders as required[3].

5.4 Support to evaluate the processing efficiency

The study revealed that many processing companies are new and inexperienced. Most of them struggle with decision making. For example it appears difficult for processors to make a good advance estimation of labour needs and capacity needs.

Technically spoken, new processors are facing difficulties in deciding on specific requirements for each processing step, e.g. the time required for soaking, the temperature needed for roasting in function of the moisture content of the NIS,…The current study was unable to reveal shortcomings and formulate improvements in this sense. Hence it is advised to provide new processors with the necessary processing know-how and suitable instruments to evaluate the efficiency of each step during the process. Environmental management accounting may be a tool to improve the processing efficiency while paying attention to energy reduction or recycling of wastes.

5.5 Training on labour skills

Since factory workers are seasonally employed and paid per kg of processed product, the quality of the kernels may be jeopardized. It is hence advised to search for a strategy where a pool of producers is linked to a processing company. That way the workers could be employed for processing purposes during the off-season. Having the same workers allows to train and retrain them on a regular basis.

5.6 Support to assess international markets

Currently only a limited number of processing companies (e.g. 722) is directly exporting to overseas clients. Some smaller processors do direct export, but mainly into Chinese niche markets. Information on international export regulations and potentials for foreign market access are required. It has to be explored how Vinacas could be involved to facilitate this overseas market access.

5.7 Support to food safety and hygiene management

Since most processors are not yet exporting to USA or Europe, neither international export quality regulation nor food hygiene regulation are put in place. It is therefore advised to:

- Train processing companies on product quality and food safety.
- Train processing companies on international HACCP standards.

[3] An initial cost estimate for training needs could be made, based on the experiences of the pilot projects of RDDL in Ea H'Leo and Lak (PTD) and PPP in Krong Pach (ToT and FFS for coffee). Extrapolation over the potential number of beneficiaries, their social background and specific needs, this cost scenario could be cumulated to estimate the provincial needs.

5.8 Support to increased market transparency

Small-holder producers apparently have little or no knowledge on market prices, making that collectors bargain aggressively to buy under the market price. As a consequence the collectors make large margins. Two options are open to improve this situation.

- Put in place an advertisement campaign to inform producers about price levels as given on radio and TV, as well as in magazines.
- Create a production model where farmers are directly linked to the processing company or through an agent of such company, to shorten the supply chain promote improved farm gate prices.

5.9 Training needs for processors

- Support to improved risk management
- Training and retraining of workers to improve processing skills
- Training on quality and hygiene requirements for overseas export
- Development of a processing exporters handbook on good managerial practises

5.10 Implementation of a PPP pilot case

To facilitate expansion of activities in an organized and well-coordinated way, it might be useful to start with the implementation of a pilot project in Dak Lak. Preferentially such project is a joint initiative with involvement of the private and public sector. The main objective of such project would be to jointly develop an extension approach for small-holder cashew producers and create through input of the private sector a marketing channel for cashew. Since pro-poor programmes have high priority in Dak Lak, such a cashew project is best implemented in a remote, rural area, with a poor indigenous population.

6 Proposed action plan for GTZ projects RDDL & SME

	Activity	Specific activity	In cooperation with
GTZ RDDL	Develop a training curriculum on GAP for cashew production with special focus on ethnic minorities. The training curriculum should be well illustrated with pictures. Set up a proper ToT programme and organize FFS	Planting density, intercropping, organic matter application	WASI, Provincial and district AEC
		Nursery management	
		Maintenance of clonal gardens	
		Promotion of pest resistant varieties	
		Pest management	
		Fertilizer management[4]	
		Pruning and thinning	
		Harvesting and proper drying	
	Product diversification	Support to promotion of by-products from the cashew apple to generate extra income	DARD, District authorities
	Support to price transparency	Promote existing media for awareness raising on daily market prices in remote areas	DARD, District authorities
	Study tour for ethnic minorities	Organize a study tour either to Ea Sup, Ea Kar or a southern province to train producers on GAP	DARD, District authorities, WASI, Provincial and district AEC
	Workshop	Support to a stakeholder workshop to elaborate an Action Plan for Cashew development in Dak Lak with short term and long term goals and the allocation of the required budget	All stakeholders

[4] Application of 10-15 kg of farm yard manure or compost per plant is beneficial. The current fertilizer recommendations for cashew is 500 g N (1.1 kg urea), 125 g P_20_5 (625 g rock phosphate) and 125 g K_2O (208 g Muriate of potash) per plant per year. The ideal period for fertilizer application is immediately after the cessation of heavy rains and with available soil moisture. During the 1st, 2nd and 3rd year of planting 1/3rd, 2/3rd and full doze of fertilizers should be applied and 3rd year onwards full quantity is to be applied.

	Objective	Specific activity	In cooperation with
GTZ SME	Develop a processing / exporter handbook	Technical requirements for all processing steps	Local processor, CafeControl
		Description of risk management strategies	
		Overview of food safety regulation and hygiene requirements	
	Assist in efficiency improvement for processors	Implement an environmental management accounting system for selected processors	Local processor + advise from Tan Lam extension group (EMA for coffee)
	Support to processor/producer model	Develop a model where a pool of producers is linked to the processor and receive regular training on improved shelling, testa removal and grading	Local processors, producers
	Support to quality and hygiene improvement	Elaborate on a training curriculum on HACCP and quality requirements for overseas export	CafeControl
	Support to risk management	Elaborate on a training curriculum to risk management for exporters	-
	Support to by-product use for the local market[5]	Support to awareness raising on the potential value of the cashew apple	Private local processor
	Support to product diversification for the local market	Elaborate on an information and training programme on modern packaging and branding	Private local processor
	Workshop	Support to a stakeholder workshop to elaborate an Action Plan for Cashew development in Dak Lak with short term and long term goals and the allocation of the required budget	All stakeholders

[5] A starting point could be the organization of a workshop where representatives of a Thai company, specialized in cashew beverages (i.e. Cashewy) and representatives from a Cambodia based GTZ project working on by-product use for cashew, give an overview of advantages, potential markets, branding and marketing of cashew apple products.

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