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project

The potential for cashews in eastern Indonesia

SADI-ACIAR research report

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prepared by	Mr Ian Baker
contributor	Julian Witjaksono Assessment Institute for Agriculture Technology, South East Sulawesi
approved by	Mr David Shearer

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The Australia–Indonesia Partnership (AIP), comprising $500 million in grants and $500 million in highly concessional loans over five years, was announced in January 2005. The partnership supports Indonesia's reconstruction and development efforts, both in and beyond tsunami-affected areas. Assistance involves long-term sustained cooperation focused on economic and social development projects and Indonesia's programs of reform and democratisation.

ACIAR is committed to the partnership through the management of a component of the Smallholder Agribusiness Development Initiative (SADI), which aims to improve rural sector productivity and growth in four eastern provinces—East Nusa Tenggara, West Nusa Tenggara, South East Sulawesi and South Sulawesi.

This initiative will improve incomes and productivity for farmers and agribusiness in response to market opportunities, through a process that is underpinned by improved adaptive research and development capacity.

ACIAR's role in the initiative is to strengthen province-based agricultural research and development capacity that is market and client-driven, and effectively transfers knowledge to end users. A key part of this approach is delivered through market-driven adaptive projects which are priorities for smallholders, farmer groups, agribusiness, government and other supporting agencies.

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1 Acknowledgments

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Importantly, the author would like to thank the farmers, collectors, processors and others involved in the commercial cashew industry in South East Sulawesi who gave their time and input freely during the compilation of the report.

2 Executive summary

Cashews are a major crop throughout eastern Indonesia, with an estimated 300,000 smallholders involved in the production. Most of the crop is exported as nut in shell (approx 50,000 ton/yr) and processed kernel (approx 3500 ton/yr). Additionally there is a growing domestic market in Indonesia.

The cashew industry in eastern Indonesia involves a significant percentage of smallholders at or below the poverty line. There are a variety of strategies that may have impact at the smallholder level, but the capacity of the smallholder to change practice must be clearly understood before proceeding to a program of intervention.

Possible strategies to improve the viability of the smallholder cashew farmer in eastern Indonesia could include:

- a varietal selection program using introduced material, focused on larger nut sizes, Australia has the widest genetic material in the world with most being freely available
- pests at flowering are likely to be causing large yield losses, the extent of losses needs to be clarified and then there may be a role for a green ant IPM strategy in reducing insect pest problems at flowering and there may be a role for soil applied insecticides in controlling insect pest
- intercropping options could be developed to increase farm income
- canopy management for young trees and mature trees needs to be developed, especially for mature trees
- impact on yield and branch dieback, of widely varying natural levels of soil fertility needs to be clarified, with soil and climate maps the preferable way to plan cashew development programs
- introduction of village based roasters to expel cashew nut shell liquid, and improved nut crackers will improve the outturn of current home based processing.

3 Introduction

This report is part of ACIAR's contribution to the Smallholder Agribusiness Development Initiative (SADI) in eastern Indonesia. The concept for the scoping study arose from a series of priority setting workshops.

This scoping study operated from a supply chain approach, looking at ways income could be increased for smallholders as part of a supply chain. This analysis operated from the position of researching issues in profitable sustainable supply chains, rather than an identification of technical constraints. There are many technical constraints the only ones that matter are those that support profitable and sustainable supply chains. A number of project concepts were developed, identifying research required to make the supply chains work to the benefit of smallholders.

Analysis of the current situation operated from an understanding of the technical, marketing and economic issues faced by each crop. It rapidly became apparent that for some situations, it was difficult to improve incomes in the existing supply chain, despite many researchable problems. Adoption of improved technologies in this supply chain is unlikely, as margins are low for all in the chain.

Developing a new supply chain at a higher price provides the market pull in terms of price for farmers and others to invest and adopt new technologies. Farmers will adopt new technologies where there is sufficient price pull. These benefits will spill over to existing supply chains e.g. if a farmer adopts new production systems to improve quality to meet high priced export markets, the portion of the crop sold into domestic markets also benefits from this technology.

The analysis also looks at the economic situation faced by a family farming enterprise, particularly in relation to the ability of the farm to generate sufficient revenue to maintain a standard of living similar to the rest of the population. It is a very high priority to generate economic wealth at least equal to the rest of the population and create an environment where incomes can rise along with the rise of incomes in Indonesia.

Successful implementation requires strong involvement by all members of the supply chain as active participants in the research. These initiatives will fail if researchers proceed in the absence of input from as many participants in the supply chain as possible.

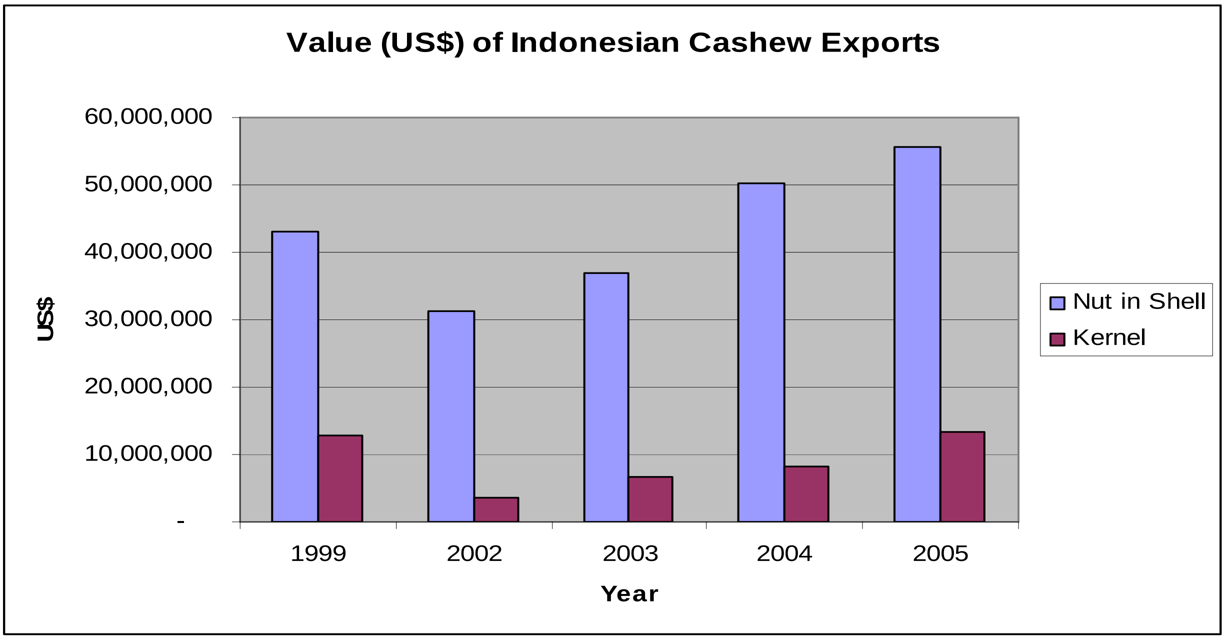
4 Current production

The Indonesian cashew industry appears to have started in South East Sulawesi in the 1980's and spread to the other areas subsequently.

Cashews are a large crop in Indonesia with approximately 400,000 farmers in the provinces of South East Sulawesi, South Sulawesi, NTT and NTB. Exports of nut in shell and kernel are approximately US$70 million (Figure 1), much larger than any fruit export. There is also a growing domestic market.

Indonesia is a significant global producer of cashews.

Figure 1: Value of Indonesian Cashew exports (US$, Nut in Shell and Kernel)



Source: Foreign Trade Statistics, Statistics Indonesia. www.bps.go.id

Cashews are exported nut in shell to India and some to Vietnam. Indian and Vietnamese traders converge on the main production centres in November - January seeking supplies. Exports are via Surabaya or Makassar. There are a number of large companies involved in cashew trading and processing (Olam, Aeromas, Camextra, Phoenix Mas are examples).

Cashew is grown in the poorest driest areas of eastern Indonesia. It is very drought tolerant, and very sensitive to rain at flowering and harvest. In these areas, farmers have a precarious existence with few crop options and a high risk of crop failure. They grow dry rice and corn for food. These annual crops fail if the wet season is poor, erratic or with periods of no rain of 1-2 weeks, all common occurrences. They depend on more secure options such as livestock, cassava, mangoes, cashews, kimiri (candle nut), and tamarind, especially in seasons when rice and maize fail. These areas are all areas of few employment opportunities.

For the wetter areas of eastern Indonesia there are more farming options, and more secure options such as wet rice, field crops like soybean, mung beans, tobacco, irrigation resources, employment in nearby towns, and higher value fruit crops like mango, rambutan, durian, and mangosteen.

Many of the people in these drier areas were moved there under transmigration programs, trying to survive in a new environment.

Cashew is a critical important horticulture crop in eastern Indonesia, in terms of:

- the number of growers
- the value of the industry
- export earnings
- the economic importance to the smallholders of the drier areas of eastern Indonesia

Data for area and production are shown in Table 1.

Table 1: Area and production of cashews in South Sulawesi and South East Sulawesi

1. South Sulawesi

	2003	2004	2005
Area (ha)	79,108	68,156	67,148
Production (tons)	32,39	25,248	24,557
Farmers	96,230	82,897	82,915

2. South East Sulawesi

	2003	2004	2005
Area (ha)	90,900	92,690	90,900
Production (tons)	31,000	33,000	35,000
Farmers	90,000	95,000	100,000

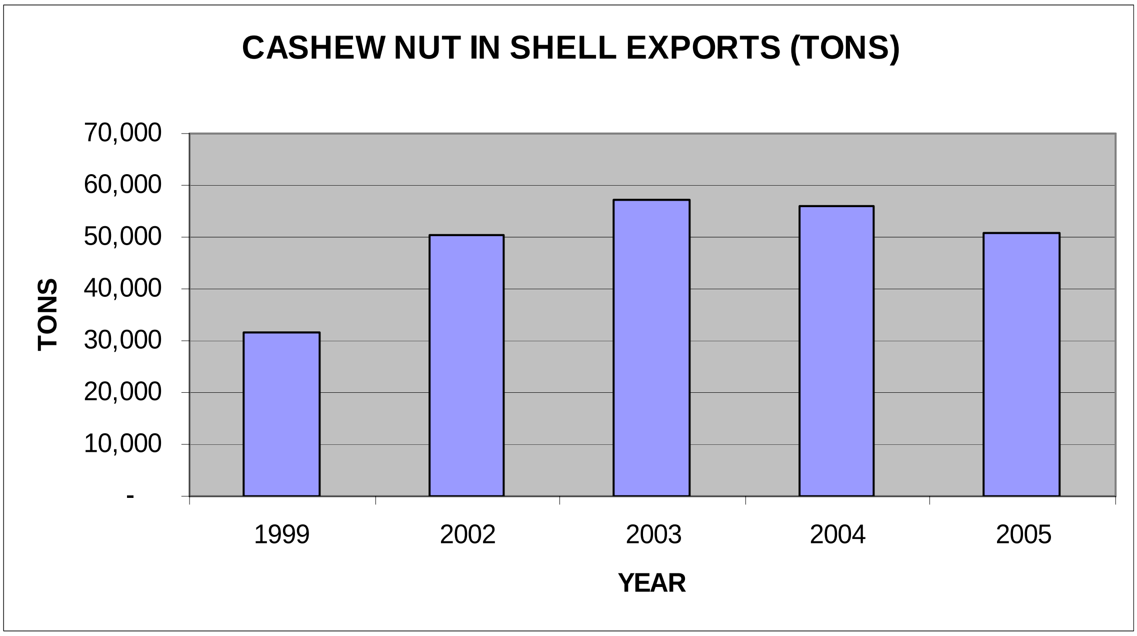
Source: Dinas Perkebunan Sulsel and BPTP Sultra

The data may not be very accurate but is a reasonable reflection of the importance of cashews in eastern Indonesia. After cocoa it is probably the largest tree crop and for the people in the driest, poorest areas it is the largest crop and one of their few secure crop options.

5 Exports

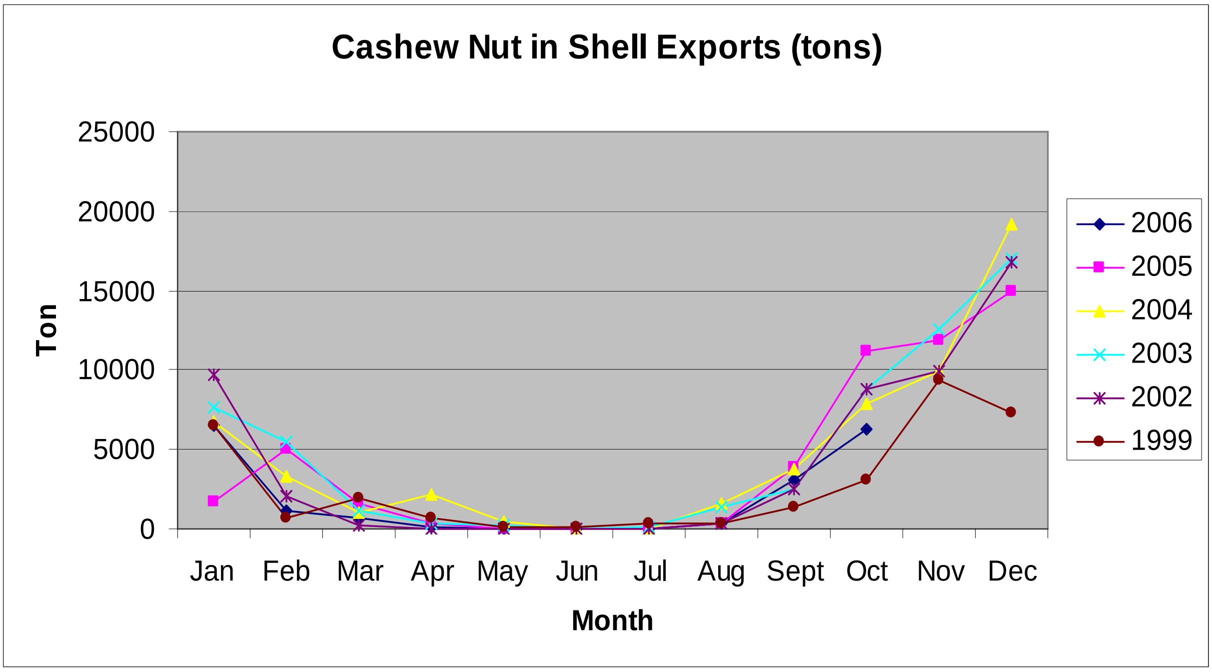
Indonesia is a significant producer of cashews exporting most of its nut in shell production to India and Vietnam for processing (Figure 2). Most is exported in the months around harvest October - January (Figure 3).

Figure 2: Cashew nut in shell exports from Indonesia.



Source: Foreign Trade Statistics, Statistics Indonesia. www.bps.go.id

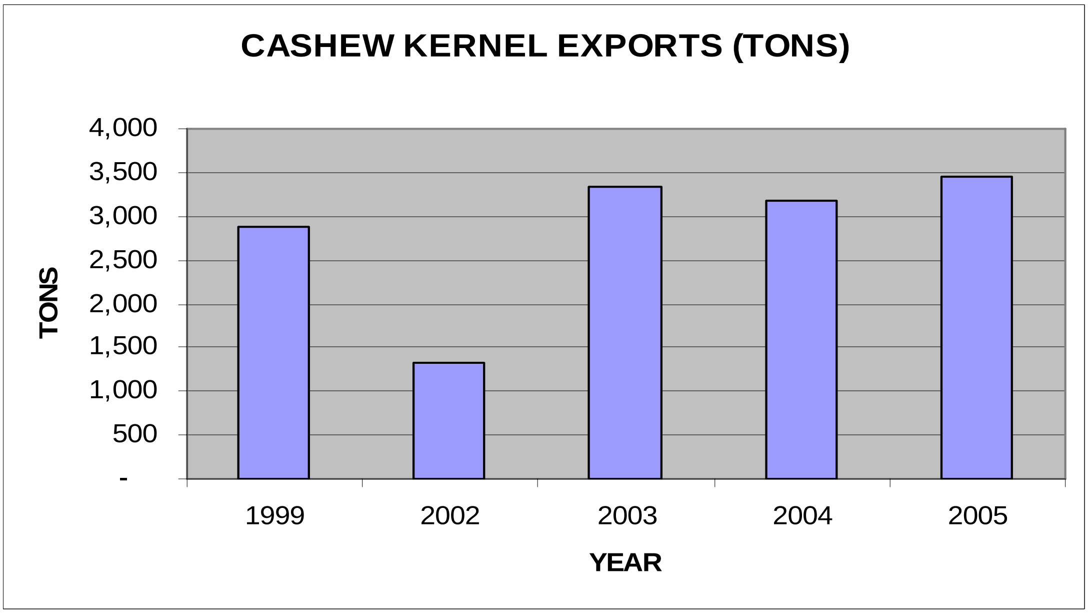
Figure 3: Monthly exports of cashew nut in shell



Source: Foreign Trade Statistics, Statistics Indonesia. www.bps.go.id

A significant quantity is processed domestically for both local consumption and export. The quantity of kernel exported is shown in Figure 4. Kernel is around 25% of nut in shells (NIS), making kernel exports around 25-30% of total exports.

Figure 4: Indonesian cashew kernel exports.



Source Foreign Trade Statistics, Statistics Indonesia. www.bps.go.id

Total exports of NIS equivalents (including kernel) exceeds 64,000 ton in 2005. It is difficult to quantify how much production is sold locally in Indonesia but it is significant. Indonesia does not import any kernel. Total production is substantially greater than exports.

6 Processing

Processing is done by cashew farmers (especially in South East Sulawesi) but also by employed labour in the cities of Bau Bau, Kendari and Makassar. It is clear there are at least 3 companies with processing facilities for export including Camextra, Aeromas and Phoenix Mas. There is a large amount of processing in Bau Bau on the island of Buton. These processors appear to be based on roasting the nut then contracting cracking, peeling and grading. Many smallholders crack the kernel without roasting with significant reduction in quality due to cashew nut shell liquid (CNSL) contaminating the kernel. It may represent a health risk for the people cracking, as CNSL is a toxic phenol. Crackers (normally women) cover their hands in lime, or ash for protection. It is common for locally purchased kernels to have the caustic taste of CNSL.

Domestic retail kernel prices (Rp35 000/kg) are similar to world market trade prices (US$4-5/kg CIF Rotterdam), but less than retail prices in the major markets, closer to US$7-8 (Rp60 000/kg – 70 000/kg).

There is a reasonable strategy for farmers to increase returns by processing and selling themselves into the domestic market. A kilo of NIS is worth around Rp5 000/kg, equivalent to Rp20 000/kg as kernel based on 25% recovery, which the farmer can sell processed for around Rp25 000 - 30,000/kg. Labour in the industry is not being paid a reasonable wage for processing (much less than Rp20 000/day) but in an area where there is little other employment opportunity all members of a family can process kernel as a reasonable strategy to increase total family income. The issue is the quality of the product, especially if the kernel is not roasted to exclude CNSL before processing.

There are ways to improve the output of manual cashew processing using simple equipment. A better manual cracker is available, at low cost, from many Indian suppliers that improves the percentage of wholes.

The development of a system using small village based communal roasters would improve outturn significantly, reduce kernel contamination with CNSL, and reduce the likely health impacts of CNSL, particularly for the women and children commonly exposed. It appears there is already development of a system using a large central roaster owned by the exporter with cracking, peeling and grading contracted out to households.

7 Agronomy

Trees flower in June-July during the dry season for harvest in November –December. This is when most cashews are exported and when large numbers of buyers from India and Vietnam are present throughout the region purchasing cashews for export thru Makassar or Surabaya.

Productivity is very low at less than 500kg/ha at tree a spacing of 100 - 150 trees/ha. This equals around 3 kg NIS/tree. Gross sales per ha (at Rp5 000/kg) is around Rp2.5 million /ha. This is within the general yields obtained in Africa and India – though some yields are up to 1000 kg/ha. Most production worldwide is in a similar production system as in Indonesia. In Australia target yields are closer to 4-5 ton /ha using the full suite of production technology including selected clonal varieties, irrigation, pest control, nutrition, and canopy management. There are records of yields in Vietnam reaching – 2-3 ton/ha using selected varieties (imported from Australia).

At a gross sales per hectare of Rp2.5 million/ha, this is relatively low financial return compared to other crops in Indonesia and very low compared to the poverty level in Indonesia of around Rp8 million/yr. For this sale revenue the farmer probably works for around 2 months per year. However the opportunities for other work in these more isolated areas is limited. Many cashew farmers process nuts at home to earn extra income.

Table 2 shows the relatively poor economic situation that a cashew farmer is in. This highlights the economic issue facing cashew farmers in relation to the rest of the Indonesian agricultural economy and the general economy, in an economy with a rising standard of living

Table 2: Approximate income (Rp) comparisons - cashews

Mangosteen 1 ha	Mango 1 ha	Middle level public servant	Rice farmer per crop/ha	Poverty level	Cashews 1 ha
50 million	12 million	24 million	7 million	8 million	2.5 million

There has been a decline in productivity (kg/ha) over time in South East Sulawesi. This probably reflects the poor level of canopy management, a significant constraint. As a large number of trees are planted, at an age around 10 years, their canopies begin to grow into each other with the result that industry productivity declines significantly. As a new flush of plantings are made, productivity increases due to the increasing canopy area of young trees before they grow into each other. For productivity to be maintained with age, trees have to be pruned to prevent them from growing into each other (from around year 6-8). Once trees begin to grow into each other, they loose the bearing sides, with the top the only bearing surface i.e. from 5 bearing surfaces to 1. Once trees grow into each other and loose the branch structure to support crop bearing terminals, it is almost impossible to re-establish a good bearing canopy. It is better to remove the trees and start again. The difficulty in Indonesia is how to maintain a tree with 4 bearing sides and a top. In Australia, tree crops are mechanically pruned to maintain 4 (or at least 2) bearing sides plus the top. In Indonesia many orchards only have the top as the bearing area, reducing yield significantly.

It seems difficult to devise a solution to this problem. Growers can try to remove trees as they start growing into each other but typically growers delay this decision until branch structure is lost or significantly reduced, so the remaining trees have difficulty re-establishing a 4 sided canopy. The problem is no matter what spacing trees will eventually grow into each other in the absence of pruning. The issue is to find a suitable system of pruning large trees.
Another issue is the lack of any pruning of young trees. These should be pruned in the first few years to encourage more branching and a greater density of terminals. Many cashew canopies in Indonesia have large gaps, effectively lost production. Training young trees may delay the onset of the time when they grow into each other. It will also increase yields in the first few years.

There are virtually no production inputs other than weeding and harvesting. The main input is the genetics of the plant and its care for the first few years. There is no input in terms of fertiliser, pruning, irrigation, pest control. In this context the site, in terms of climate especially rainfall distribution and the soils especially in terms of natural nutrition is a key input. In planning development programs site factors must be given considerable weight.

A number of production issues are relevant. A considerable amount of cashew production is in areas that are not suitable. Cashews must be grown in areas where there is a low probability of rain at flowering and harvest. A number of fungi attack flowers, and nuts deteriorate rapidly if rain occurs at harvest.

8 Variety research

It is difficult to get any significant yield increase in the absence of good genetic material. This is particularly important in a low input system like Indonesia where the major input that the farmer has is the genetics of the plant. Cashews are highly heterozygous.

There are two small programs running in South and South East Sulawesi to look at better yielding clonal varieties. In South Sulawesi, there has been a program run with PT Supinraya (Jalan Bacon of Makassar, a private seed company) to select improved clones. This has run for at least 10 years, based largely on identifying good local trees. There are 2 selections that the program has identified yielding round 6 kg at year 5-6. These trees may get to around 10 kg by year 10 and represent an improvement on local seed lines but are still low. Work in Australia with a very wide genetic base indicates yields at year 4-5 of 15-20 kg/tree from selected hand pollinated crosses, albeit under good management. Selections in Australia, under good management are yielding 50 kg /tree by year 10. The relatively low yields of clonal lines in Indonesia may indicate the impact of overriding factors such as pests (*Helopeltis*) and other management factors.

There is a similar program in South East Sulawesi that has a good number of grafted selections assessed for at least 10 years. However yields are still relatively low at around 10 kg/tree. This collection is planted on a single site that appears to have poor levels of natural nutrition for cashew (low calcium). The material includes some large nut varieties including material from Sri Lanka. Dinas Perkebunan has a site at the former Provincial Investment site that appears to have very high yields including some very large nut size lines (in a high rainfall environment). These trees are ageing and none of this material has been cloned. The large nut types are a popular seed source for farmers (sell at Rp100/seed = >Rp10 000/kg).

In general the effort to identify clonal material has been small and based on the fairly narrow gene pool in Indonesia. Australia has one of the largest cashew gene pools worldwide.

There do not appear to have been problems in propagation, but the efforts have been small. In Australia, commercial propagation is a problem with success rates as low as 60%. Once good clonal material has been identified it is likely there will need to be some work in propagation training.

One key issue in selection is what nut size? Clonal selections give the opportunity to produce larger kernel sizes. There is a price premium for larger kernels. There may be some loss of yield potential especially for very large kernel sizes. The world standard trade is 320 kernels/lb or 1.42 gram kernel size (5.68 gram nut in shell) sold at US$4-5/kg. The largest size traded is 180 /lb or 2.53 gram kernel (10.12 gram nut in shell) at a price of US$7.30/kg. Clearly there is a big premium for size, available in clonal selections. Table 3 shows CIF prices for a range of size grades and nut in shell sizes.

Table 3: Kernel size and price

World grade (Kernels /lb)	Kernel size (gram)	Nut in shell size (gram)	Price US$/lb	US$/kg	Rupiah /kg	%increase over average 320
320 high price	1.42	5.68	2.50	5.50	49,500	
320 average price	1.42	5.68	1.80	3.96	35,660	
240	1.89	7.56	2.3	5.06	45,540	27.8%
210	2.16	8.64	2.75	6.05	54,450	52.8%
180	2.53	10.12	3.3	7.30	65,340	83.3%

On this basis there is clearly a benefit for farmers in selecting larger nut sizes. For a farm producing 1 ton/ha nut in shell the difference in return is substantial. Assuming the same number of kernels per ha and a premium price to farmers for large kernels based on the higher price for larger kernels, the benefits of a clone with larger kernels is very significant (Table 4).

Table 4: Potential financial benefits from large nut clones

World grade (kernels/lb)	Potential yield at same nut number (kg/ha)	Gross sales/ha at standard price of 5000Rp/kg	Possible premium price Rp/kg	Gross sales/ha at premium prices Rp/ha
320	1000	5,000,000	5000	5,000,000
240	1333	6,666,667	6390	8,520,000
210	1524	7,619,000	7640	11,641,905
180	1778	8,888,888	9165	16,293,333

This is a potential, theoretical calculation only, but does demonstrate the significant benefits that could accrue from selecting a large nut size. The real benefits will be less because nut number will decrease as nut size increases, hence yield will not increase as much as in this calculation, and it is likely farmers will not realise the full price increase of a larger kernel. Despite this there are benefits for selecting a kernel size in the 240/210 range where the impacts of nut size on nut number (and yield) will not be as great. Selecting for a nut size in this range also ensures a larger proportion of nuts are at least in the 340 size grade, whereas selecting for 340 means a proportion will be discounted for small size.

In an environment where farmer returns are so low, compared to the poverty level, the benefits are significant.

One issue is that Indian traders tend not to favour larger nut sizes. Brazil has established the market for larger nuts. There may be market problems in the existing trading system selling larger nuts.

Another benefit of selecting for larger clones is the impact of larger nut sizes on reducing processing costs. This is significant. There have been many discussions about processing locally. The economics of local processing with existing production is debatable as the cost of processing is significant and the economics and economic benefits for employees are marginal. Local processing only works if local wages are kept low. However the out put of hand processing is greatly improved if larger nut sizes are processed.

A typical 180 ton kernel/year plant employs around 550 people. Total sales using 340/lb kernel size is around US$0.9 million at prices of US$5.00/kg. Labour costs, at a local wage of Rp20,000/day, are around US$0.6million (or US$3.40/kg).

For processing large kernels (180 kernels/lb), the labour cost declines to US$0.338 million (US$1.87/kg) and total sales revenue increases to US$1.314 million, due to the higher price for larger kernels (US$7.30/kg for 180 kernel/lb), substantially improving the profitability of local processing.

9 Pest and disease issues

Cashews are host to a number of serious pests at flowering including a number of flower sucking insects (commonly *Helopeltis*), caterpillars eating leaves and flowers, and fungal diseases especially anthracnose and powdery mildew. These cause significant yield reductions. The fungal diseases are very common if rain occurs at flowering or harvest. *Helopeltis* is endemic and a problem across all cashew areas worldwide. Discussions with those in the industry (including entomologists) indicated these pests were present (though not powdery mildew). Farmers and researchers indicated that blossom death was common. .No studies were available on the extent of these problems or the level of yield loss.

These are common problems worldwide. In a low input system it is very difficult to control these pests. They are easily controlled with chemical sprays, but this is outside of the capability and resources of smallholder cashew farmers in Indonesia. Work in Australia indicates that *Helopeltis* causes very large yield losses if uncontrolled, even at low populations. One *Helopeltis* can sting 25-50 flowers/day explaining the large impact of very low populations. There have been a number of different research programs in Australia looking at the impact of *Helopeltis*. A threshold level of damage in the 5-10% range caused a yield loss of 25-30%. Where the insect is not controlled at flowering, yield/ panicle is as low as 1 g/panicle compared to 30 g/panicle under pest control. Cashews can tolerate the presence of *Helopeltis* at nut set, but not at flowering.

Similarly insects that cause defoliation, primarily leaf eating insects cause significant yield loss. It is likely these insects are causing significant yield losses in cashew in Indonesia., As it has an impact primarily at flowering, there may be seasons when it is not a serious pest e.g. when the flowering period is short not allowing the pest to develop large populations.

In the Indonesian situation, effective pest control is difficult. However the impacts are likely to be large and this area is worthy of further evaluation. It would be worth firstly to quantify the impact of pests, primarily at flowering, on yield loss in Indonesia. Control options are difficult. In Australia insecticide spraying at flowering is effective and economical. Clearly it is not possible in Indonesia, unless a spray contractor system could be developed. Two other options are worth considering:

- use of soil applied insecticides like Regent, Furadan, Confidor, Actara
- use of biological controls especially weaver ants.

The chemicals are widely available in Indonesia (except Actara). In trees, they all give good insect control applied as a bark treatment, soil applied or trunk injection. They are all likely to be active against the range of cashew insect pests including *Helopeltis* and caterpillars and have a reasonable period of control (1 month +). They are easily and cheaply applied. They have limited environmental impact applied to soil/bark/trunk.

In this context they are likely to have a role in other tree crops in pest control, integrating with other projects in other crops. They are currently registered for use on rice in Indonesia.

There is some relevant work on insect control at Australian universities and the University at Makassar has done some work on the role of weaver ants, particularly in relation to cocoa and *Helopeltis*. This work could be adapted to cashews.

This strategy may have a large impact on controlling insect pests in cashew in Indonesia and increasing yield for a relatively small project input, but adoption may be difficult.

10 Nutrition and soil management

There is a dieback that is common in some areas of South Sulawesi and South East Sulawesi. It is also common in Lombok and in Bali. The symptoms are bark cracking, gum exudation and finally death of the branch. These symptoms are typical of boron deficiencies, though death of branches is an extreme symptom.

Looking at a wide range of soil nutrient analysis, it is clear there is a wide range in the levels of natural nutrition, particularly the major cations (calcium, potassium and magnesium). In some situations the level of calcium was very low and in some magnesium was very high. In others there were high natural levels of calcium. High magnesium accentuates calcium deficiency. There was no analysis of boron level. Boron is intrinsically related to calcium nutrition.

Low calcium levels (or high magnesium) will be causing significant yield loss thru poor fruit set/panicle. This was observed in cashew panicles where there were less than 4 nuts/panicle even on good clonal trees. Low nut set could also be explained by high pest incidence. However the presence of symptoms that may be nutrition related, indicated that this could be a factor as well, in some sites. On one of the clonal sites at Onembute, low yields were evident even of the best clones, and the symptoms of cracking and gum exudation were clear.

There is a large variation in calcium levels due to the different geomorphology of soils. Soils derived from corals have high calcium while soils derived from basalts have low calcium.

There are reports in the literature from Vietnam of similar symptoms of cracking and gum exudation being caused by a trunk borer (*Plocaederus obesus).*

In the context of developing or revegetating cashew areas, two site selection issues could be incorporated into these programs:

- Identifying sites with low rainfall at flowering and harvest
- Identifying sites that have good soil cation balance calcium/magnesium/ potassium.

Local agencies run development programs to plant target areas of new plantings. For 2007, in South East Sulawesi, there is a program to plant 600 ha of cashew trees. This includes giving growers trees and fertiliser. These programs need to take site selection into account.

11 Intercropping

There are opportunities to increase farm income by intercropping, particularly when trees are young with field crops and as the inter-row area declines moving to a legume pasture for grazing goats or cattle. There are additional benefits of both to cashews in residual nutrition from other crops and from nitrogen fixed by legume pastures. Intercropping is practised but some research could improve intercrop systems e.g. pasture species in the lower light environments and the economic benefits would need to be clarified.

12 Current market situation

There are a number of different cashew markets operating all at different prices and returns.

1. nut in shell to India and Vietnam @ Rp4000 – 5 000/kg (Rp20 000 Rp/kg kernel equivalent)
2. processed kernels for export @ US$ 4-5/kg CIF (Rp36 000 – 45 000/kg) for 320 white wholes
3. processed kernels for domestic consumption @ Rp35 000/kg retail
4. lower grade broken and half kernel for domestic consumption.

Farmers appear to be getting a fair price for nut in shell and kernel compared to world prices.

The opportunity to increase farmer income through processing is on going, but does not give a farm family a big increase in family income. However in a purely economic sense the income from home processing of nuts is based on very low wage rates. It is still valuable given that the areas where cashews are grown, there are not many other job opportunities.

There are 2 significant issues with home processing that must be considered. Currently nuts are processed without roasting to expel cashew nut shell liquid. As a result kernels are inevitably contaminated with CNSL and those de-shelling are exposed to CNSL. This is a toxic phenol with a number of industrial uses, primarily in brake linings for drum brakes.

The development of a central village based roasting facility, as is done with rice milling, could increase local processing significantly, produce a better quality kernel and remove a dangerous product from the workplace. Generating significantly more local employment in areas where employment opportunities are limited is a significant advantage.

Similarly the introduction of Indian shelling tools should improve labour output substantially and improve crack out percentage of higher value whole nuts with benefits to home processors.

The world market for cashews is increasing. Indonesia is already a large producer of nut in shell for Indian and Vietnamese processors. The difficulty of operating in the world cashew market is the price situation. Greater opportunities may exist in trading in kernels domestically where there could be increasing consumption and some opportunity to increase prices closer to world kernel prices.

The local market has some advantages in terms of margin to local growers and the local specifications are not as tight as international markets such that halves and brokens may be able to be sold at a lower discount to wholes than on the international market.