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Australian Centre for International Agricultural Research

Final report

project

The potential for cashews in eastern Indonesia

SADI-ACIAR research report

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Australia Indonesia Partnership
Kemitraan Australia Indonesia

ACIAR's participation in the Australia–Indonesia Partnership

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.

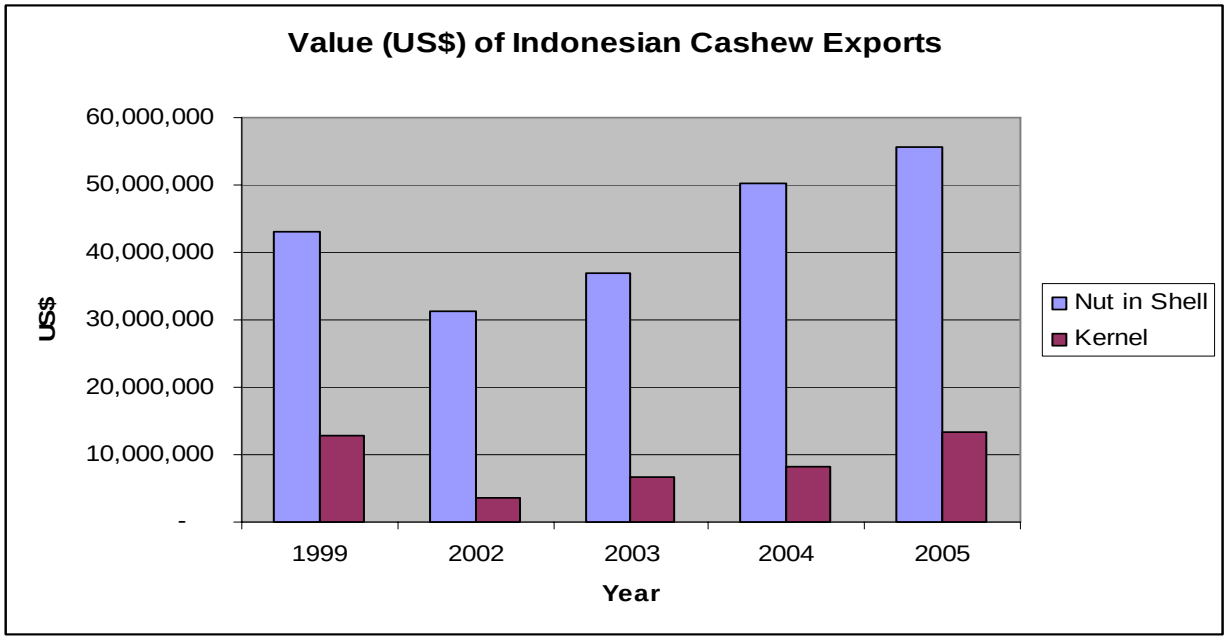
4 Current production

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

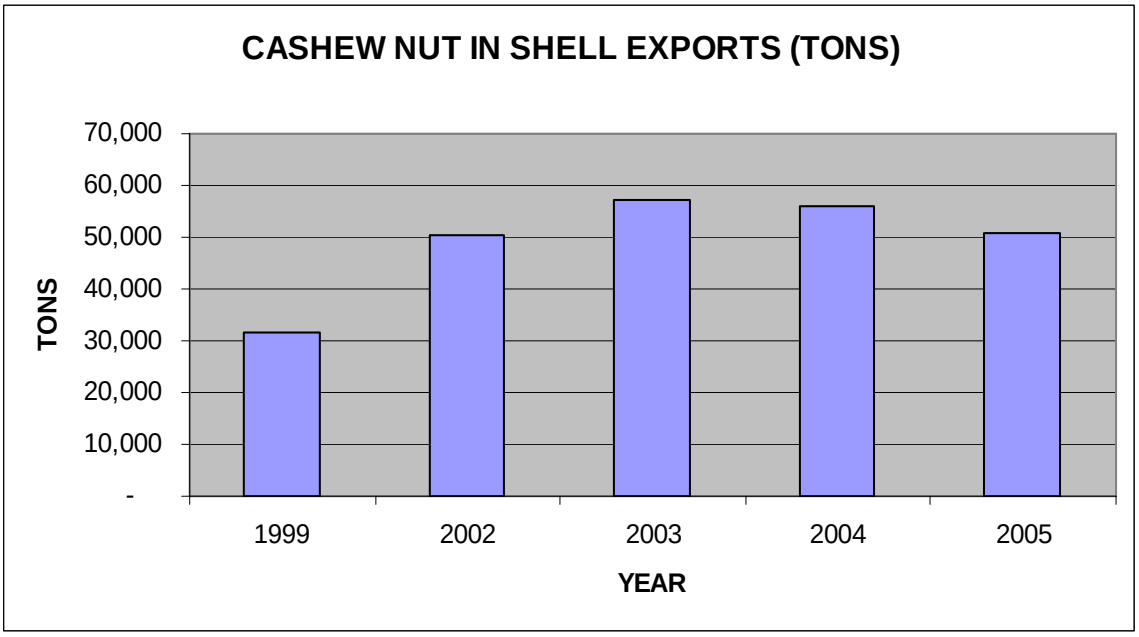
Source: Dinas Perkebunan Sulsel and BPTP Sultra

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

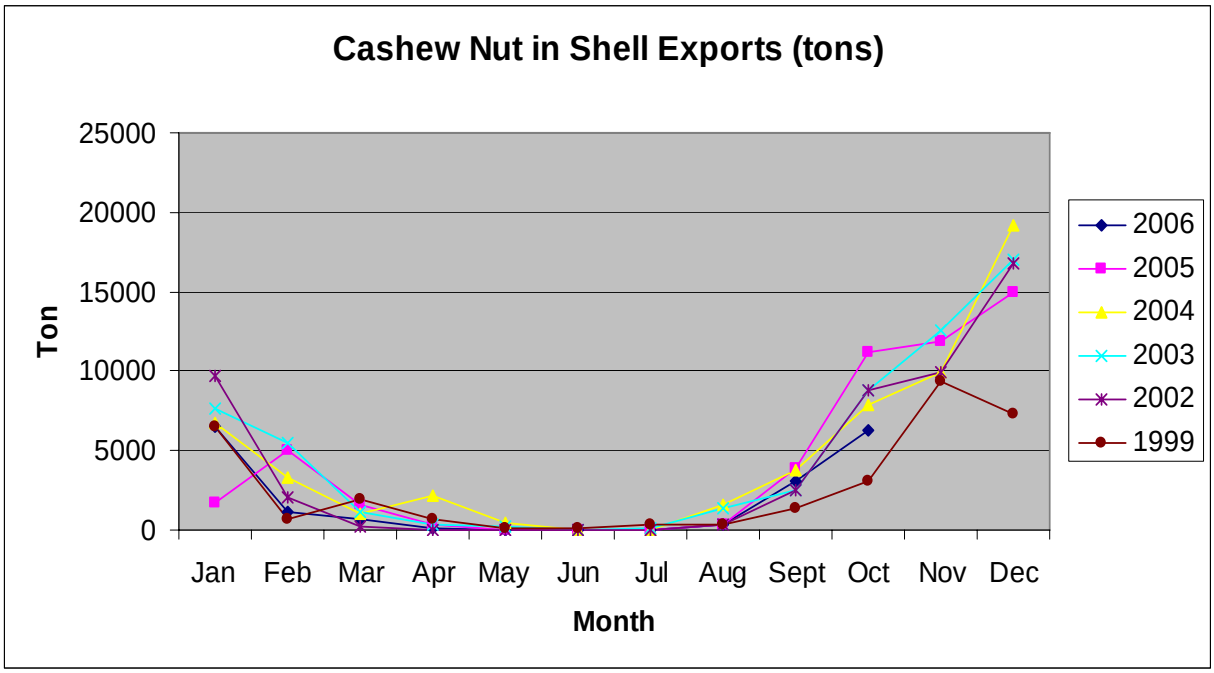
Indonesia is a significant producer of cashews exporting most of its nut in shell production to India and Vietnam for processing (Figure 2). Most is exported in the months around harvest October - January (Figure 3).

Figure 2: Cashew nut in shell exports from Indonesia.



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

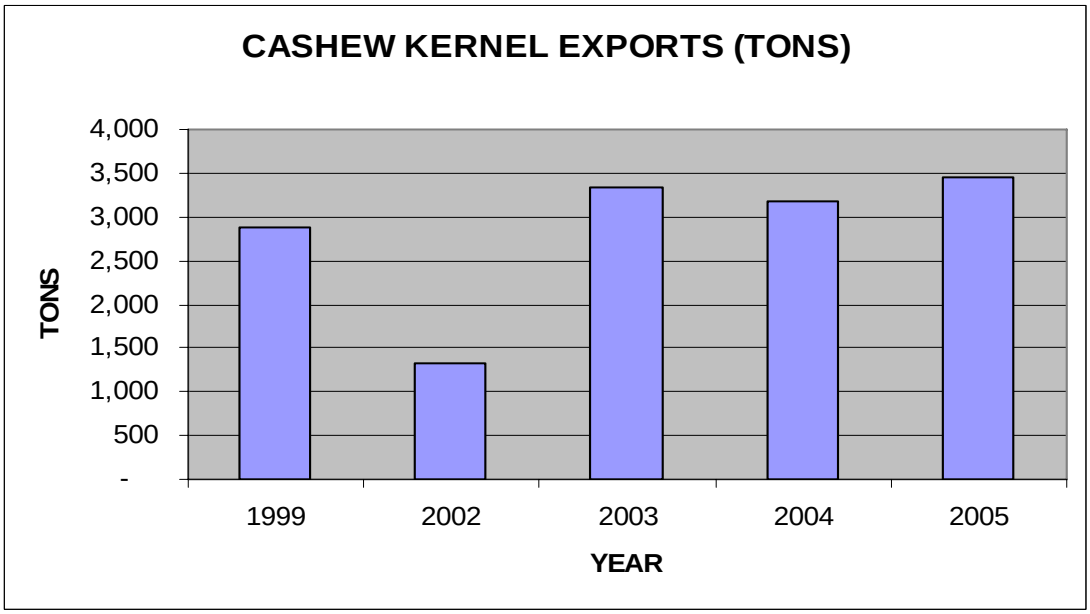
Figure 3: Monthly exports of cashew nut in shell



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.

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date published	April 2008
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approved by	David Shearer

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ACIAR's participation in the Australia–Indonesia Partnership

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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2 Executive summary

Mangoes are one of the major fruit crops throughout Indonesia and are an important component of the horticulture industry in Nusa Tenggara Barat (NTB). They are particularly important in the drier, poorer areas of eastern Indonesia as a drought tolerant, secure source of income.

Current markets are heavily supplied with the Harumanis variety with little opportunity to develop new market opportunities in either export or out of season markets in other areas of Indonesia.

Through early flowering, it is possible to extend the season, making a longer season for the same production and thereby increasing prices to farmers.

Good out of season export opportunities exist for the variety Gedung gunci, which is grown exclusively in Indonesia. This variety needs to be properly evaluated for its performance as an export and domestic supermarket variety.

Appropriate production technologies such as bagging, post harvest fruit fly treatments, post harvest fungicide treatments, and better control of sap marks at harvest will improve quality, especially in the context of developing export capability.

Other varieties should be introduced and evaluated for adaptation to the unique lowland tropical conditions in Indonesia, for domestic supermarkets and export.

Export will be dependent on building a national capacity to develop access protocols in government, including disinfestation research. This also includes the capacity to manage chemical registration and MRL issues for access.

Indonesia has strong competitive advantages in export. An initial requirement will be to assess export issues and opportunities in both phyto markets and non-phyto markets. The development of an export supply chain must include exporters.

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 however 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 of the technical, marketing and economic issues faced by each crop was conducted. 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, for example 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 increase relative to the increase in incomes across 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 potential participants in the supply chain.

The results of the analysis arose from visits to farmers, governments and private sector players in the three provinces, as well as in other areas of Indonesia where similar crops are grown. Three visits were conducted during February to June 2007. A series of project development workshops were held at the end of the consultancy to develop project concepts from the scoping mission. These workshops included a wide range of participants.

4 Production areas and characteristics

Mangoes are one of the major fruit crops in NTB (Table 1) along with jackfruit, citrus and banana. Mangoes are cultivated in all areas of NTB, but the best quality and the majority of production comes from the drier areas and as such is primarily distributed in the drier areas of north Lombok and in the dry areas of Sumbawa. It is relevant to note that these drier areas are also the poorest areas of NTB and in terms of the national economy are amongst the poorest areas of Indonesia.

Table 1: Mango tree numbers and production in NTB

	2005	2004	2003	2002
Tree Numbers	619,943	793,968	1,451,905	1,659,291
Production (tons)	66,012	54,754	39,010	31,527

Source: BPTP NTB

The size of holdings varies from single trees in house gardens that are sold to traders, to the largest farms of around 500 trees. There is no data available on farm size at a provincial level.

The number of mango farmers is probably over 5 000, the largest number of fruit tree farmers in NTB.

5 Season and climate

The season of production is from October to the end of December with the earliest production in the wetter areas and later in the drier areas. The difference in harvest time is only 1-2 weeks. Flowering generally occurs July-August. Timing of production is similar to most other mango areas of Indonesia, limiting opportunities for trade in Indonesia.

The climate for production is generally favourable in the drier areas of North Lombok and Sumbawa with 2-3 months of little or no rain.

In the areas of central and west Lombok (around Mataram), rainfall at harvest and at flowering is more likely, which impairs quality. This is commonly recognised in the market place and as such plantings are fewer in these higher rainfall areas.

The two key climate issues for mango production are:

1. Temperature and rainfall at flowering
2. Rainfall at harvest.

Cool temperatures at flowering increase flowering however rain at flowering severely impairs production and increases fruit rot. Rain at harvest reduces quality (increases skin marks) and increases fruit rot and fruit fly incidence.

Varieties of mangoes differ considerably in their adaptability to high, dry season temperatures at flowering. The varieties grown in the region flower the best during the higher temperatures of the dry months. Harumanis, the main variety in the region, is no exception and is a relatively consistent producer during the dry seasons. Both mango farmers in the region and in northern Australia agree on its performance. This adaptation is a very important consideration in selecting varieties that will be adaptable to this region. From the climate data in Table 2, there is a high probability of rain at harvest in all areas therefore varieties need to have good tolerance to anthracnose. The probability is higher in less favourable areas on Lombok around Mataram and Central Lombok. This factor will also be very important in establishing good quality fruit, which varies year-to-year depending on the extent of rainfall at harvest (dry = good quality, rain = poor quality). It is also relevant in considering varieties adaptable to the region. It is clear that Harumanis has good resistance to anthracnose, based on discussions in NTB and experience with the variety in northern Australia. Resistance to anthracnose will be an important characteristic of suitable varieties.

Table 2: Climate data for Desa Santong (10yr average)

Santong	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Rainfall mm	327	379	239	188	64	49	27.5	10	38	69	184	271
Rain days	17	20	18	15	8	5	4	2	3	8	14	17

The occurrence of any rain at flowering is a major constraint in mango production, through the increase in the incidence of post harvest diseases. Harumanis appears to have relatively good resistance to anthracnose at harvest but is still undoubtedly affected. This factor has to be considered in any attempts to manipulate the time of flowering, which will be limited to flowering in the drier months.

The occurrence of rain at harvest has a negative impact on quality. As skins are softer and less tolerant of marking, skin marks, including marks caused by mango sap, and other marks such as wind rub, will occur more prominently. It is interesting to note that farmers and researchers are not aware of many quality issues including the impact of sap on mango skin. One of the larger farmers was aware of the problem, but not aware of the systems to prevent this damage.

For the drier areas, tree crops represent a very important part of the agricultural economy, as tree crops have greater resistance to the variability in rainfall than annuals. The absence of irrigation in these areas means that farmers have to rely on more drought tolerant production systems like tree crops and cattle. While most will grow dry land rice in the wet season, wet seasons vary in their reliability and short periods of drought can severely reduce rice yields. The current wet season is an example of a poor wet season with rice crops failing throughout the drier areas of east Indonesia.

6 Production technology

There appears to be very little use of ‘normal’ management systems such as:

- irrigation
- nutrition
- canopy management
- pest control
- manipulation of flowering.

In part this is because of three issues:

- Low prices do not encourage management investment.
- Farm size is too small to utilise better technology and too small to have sufficient capital to invest in better production or post harvest technology such as spraying, cool rooms and packing lines.
- Smallholders simply use mangoes opportunistically rather than being committed to the crop. Almost all have another source of on-farm or off-farm income and will grow other crops.

Some farmers may use nutrition or supplements, either organic or inorganic (1 kg/tree). Nitrogen and potassium are the two main elements used however there appears to be no use of the elements calcium, zinc or boron, which are recognised as key elements in mango production.

Most trees are grafted and planted at reasonable spaces (8m x 8m) of around 150 trees per hectare.

Soil analysis of the main production areas indicates that the production areas do have good levels of natural nutrition especially calcium and the cation ratios. Magnesium is high in the drier area of north Lombok (Table 3), creating an unfavourable Ca: Mg ratio, impacting on productivity and quality.

Table 3: Soil analysis of mango site in NTB (Site – Basuki)

	% K	% Na	% Ca	% Mg
1	0.23	0.10	1.02	0.43
2	0.56	0.16	1.37	0.72
3	0.23	0.10	0.83	0.51

Despite very low management, yields appear to be reasonable at around 100-150 kg/tree. Accurate yield data is not available but discussion with farmers indicates yields are reasonable and also fairly consistent each year despite the variation in dry season temperatures and rainfall. This reflects the importance of the characteristics of the main variety Harumanis. This is the main management input farmers have - the genetics of the variety.

Harumanis, the main variety throughout Indonesia, is a good sized variety (3 fruit/kg) that has excellent eating quality, is not too vigorous in growth, is a consistent producer at around 100 kg/tree, and is classified as a mid season variety compared with other varieties. It is long in shape with persistent green skin when ripe. This is a peculiarity of Indonesian varieties and one that limits the penetration of Indonesian production into world markets. Indonesia should be a large exporter of mangoes, as they are produced out of season to the main producers in India, Thailand and Philippines. However is not due primarily to the green skin of Harumanis.

Harumanis may develop more yellow colour if ripened at lower temperatures than ambient (less than 20C). The variety Madu is commonly used for home consumption. It is also green skinned but smaller and may be more productive. Golek is less common.

There is very little use of any post harvest management including:

- harvesting systems to control sap burn
- post harvest chemicals for fruit fly and anthracnose
- cool chains
- packing
- grading for size and quality.

In many cases the farmer sells the fruit before harvest and a trader will pick the crop. In this system there may not be any benefit to the farmer to invest in pre-harvest management that improves size and quality grades. There does not appear to be any concern about fruit being picked immature, probably because there is no price advantage to do so.

The marketing chain is rapid with fruit sold quickly. One issue is that Harumanis is widely believed to have green skin when ripe. This may be due in part because it has never been subject to cool temperatures during ripening. It is well recognised that high temperatures during ripening (above 20C), are not favourable for development of yellow skin colour. Harumanis is tolerant of low levels of post harvest management in that it has reasonable resistance to fruit rot.

There is no recognition of the impact of sap at harvest on skin browning, an important issue in all mango varieties. Discussion with leading farmers indicated they were aware of the problem but did not have any real system to control sap burn. While sap burn may not be as important as in Australia, it is important to acknowledge that Harumanis does incur skin damage from sap burn. Minimising sap burn will become important in developing export capability.

An issue that may be of relevance is that mango harvest occurs at the same time as the planting of rice and there may be some conflicts in labour use. Similarly as the cost of living rises and the need to increase family income forces at least one member of the family to work off-farm, there may be an increasing use of traders to harvest crops with the fruit being sold off the tree.

7 Current market situation

Mangoes are sold into local markets near production centres. Seasons are similar in Lombok to Bali and East Java so there is little opportunity to sell out of season or early season to other areas of Indonesia. Mangoes mature a little earlier in the wetter area of west and central Lombok by 1 or 2 weeks and these growers may receive higher prices, albeit for a short period. Prices after this time rapidly drop to around Rp1000/kg or less. In-season market price is around Rp1500/kg.

Most fruit is sold on the tree to a trader who picks, packs, transports and sells the fruit sometimes to another wholesaler, or to the market. The mark up in the supply chain from tree to consumer is around 100%, normal for most trading (from Rp800 /kg to the farmer to Rp1500 /kg at the market). Some larger farmers (500 trees) pick the crop and sell it themselves, but this is not common, as farmers tend not to have access to transport.

There is no apparent processing. There is little opportunity to sell into the developing supermarket trade as there is only one Hero store in Mataram. Mangoes from South Africa (Kent) were on sale for around Rp21000/kg in March at the Hero supermarket in Mataram. Elsewhere in Indonesian supermarkets have not attempted to compete with wet markets in the fruit and vegetable business with 80% of supermarket fresh fruit sales originating overseas.

Current market prices in the main season, from late October to December, are so low that many farmers are considering removing trees. There appears to be little interest in new plantings. For many farmers in the drier areas, there are no options for land use other than mangoes and cashew. For farmers in the wetter areas there is a range of options to use the land more profitably e.g. rambutan, mangosteen, rice, field crops. This is probably the only reason farmers in the drier areas are not removing trees - they have little other option.

The current oversupplied situation appears to be common throughout Indonesia including South Sulawesi, Bali, East Sulawesi and NTT. Discussions with mango farmers in Bali also indicated the poor mango market with farmers earning similar prices.

There are small quantities of mango exported from Jakarta. In 2000 some 430 ton were exported, rising to 940 ton in 2004 and 918 ton in 2005. This is a very small quantity given Indonesian export potential. Clearly export potential is constrained as Indonesia has considerable export advantages having:

- low prices
- a large production base
- a Nov-Dec season compared to June-July for most of world production

- a close proximity to major markets in north Asia, and south Asia where most of the world's mangoes are consumed
- the advantage of being a southern hemisphere producer compared to most mango production occurring in the northern hemisphere. Southern hemisphere production is around 5 million tons while northern hemisphere production is over 80 million tons. Other southern hemisphere producers are South Africa, Australia and Brazil. Major Northern hemisphere producers are India, Philippines, Thailand, China, Pakistan, and Mexico.

Investing in the current supply chain thru the domestic wet market appears to be difficult. There is little financial incentive in the chain for growers or for traders. Growers are highly unlikely to invest in new production technology. Traders are unlikely to invest in grading, standards, food safety, cool rooms or ripening if as there is no price premium due to oversupply.

Mango farmers need to operate in a new or parallel supply chain that is more profitable, or else they will pull out trees. If other profitable chains can be identified there may be sufficient profit for farmers to gain benefits from using new technologies developed through research.

8 Economics of production

The total gross sales per hectare for mangoes are around Rp12 million at the farmer level. This is similar to the gross income from one crop of wet rice, though the costs of inputs for mango are currently lower, as there are effectively no inputs. However rice farmers will usually get 2 or 3 crops per year. For this gross sale per hectare all the farmer may have to do is pick the crop and cut weeds in the orchard, maybe a total of 2-3 months labour. In this context the Rp10-12 million gross sales is effectively a wage, and for two months work a good wage. However in these drier poor areas there is often little other employment so this may represent the total family income – essentially a poverty income.

The income from mangoes is based on the farmer doing very little, in some cases not even harvesting, leaving them free to carry out other work on or off their farm. Many mango farms are less than 1 hectare. Most farmers grow other crops so their family income per year would be considerably higher. However the low return per hectare is a significant constraint to encourage any investment in higher inputs for production and post harvest management.

For farmers in the poor dry areas of north Lombok and Sumbawa this may be their only crop, as cropping options in these areas are limited. Many need to seek off farm income to survive, making it difficult to improve the standard of production to meet the requirements of new markets. To commit the total area of land they own, which may only be one hectare to mangoes, represents a significant decision.

In social terms, the current mango situation is difficult. It must be remembered that mangoes are one of the largest tree crops in NTB. For farmers in the dry areas, where options are limited, this becomes a significant social issue. In these drier areas, tree crops are a very important part of the agricultural system. Farmers in the drier areas of eastern Indonesia have fewer cropping options than the wetter areas. Annual dry cropping of rice or other field crops is at risk if wet season rainfall has periods of no rain. If these crops fail, as they do, then farmers are in a very precarious situation. They become very reliant on cattle, cassava, or drought tolerant tree crops like mango and cashews to provide a living for the year. For farmers in the wetter areas where two crops of wet rice are possible, the risk of failure is much lower. They also have other income sources that are more reliable due to rainfall, and higher value horticulture.

9 Future prospects

It is clear the key constraint to developing mango production in the immediate future is the poor market situation. This is a significant constraint, limiting the adoption of better technologies, and limiting the growth of the crop into new markets. Low prices are the most severe constraint for producers to adopt better management practices. More importantly low prices for mangoes pose a significant social risk for farmers in the poorer districts of eastern Indonesia.

Engaging in a research program in this environment is difficult unless the program is based on a significant change in market prices.

The options for developing an export industry are very limited as it is unlikely the existing variety, Harumanis, has any export market future because of its green skin colour when ripe. This is reflected in the low level of current exports (940 ton 2004, 918 ton 2005). However there may be a future for this variety in processing as it has excellent eating characteristics.

Exporters in Jakarta have attempted to export Harumanis to the Arab states. Importers are not interested in Harumanis, as consumers are not familiar with a green skin variety, even though its taste may be very good.

The time difference in production around Indonesia does not appear to be sufficient to offer higher priced market opportunities within Indonesia, particularly for the farmers of NTB. It appears there may be some eco-zones in South Sulawesi that can produce mangoes in June-July and these are worthy of further investigation, as prices for mangoes at this time will be high throughout Indonesia.

There appears to be no mango fruit processing in NTB. It appears there is little juice processing in Indonesia other than fruit stalls selling fresh juice. Even in Java it appears there is no processing with significant quantities of juice concentrate imported for tetra packs.

One possible option is home processing or drying. There is a large tobacco industry in central Lombok that is very well supported technically by the buying companies. These farmers all have access to drying flues for tobacco. The temperature of drying (60-70C) is the right temperature for mango drying. As it is not commonly available, Prices for dried mango in Indonesia are high at around Rp100 000/kg retail. It is not commonly available. The recovery rate is 10%. It is feasible to dry mango, without preservatives and keep it for some months, longer under refrigeration.

Most dried mango on the world market comes from Philippines and Thailand that add large amounts of sugar, destroying the flavour. It wholesales in Australia for around Rp55 000/kg whereas good dried mango sells for around Rp120 000/kg. The excellent flavour of Harumanis makes it very suitable for drying. In Indonesia dried mango will sell well and it has the opportunity for export.

There are a number of options for future development:

1. Extending the season to spread out production.
2. Evaluating new varieties.
3. Developing export supply chains.
4. Exploring processing opportunities for Harumanis.

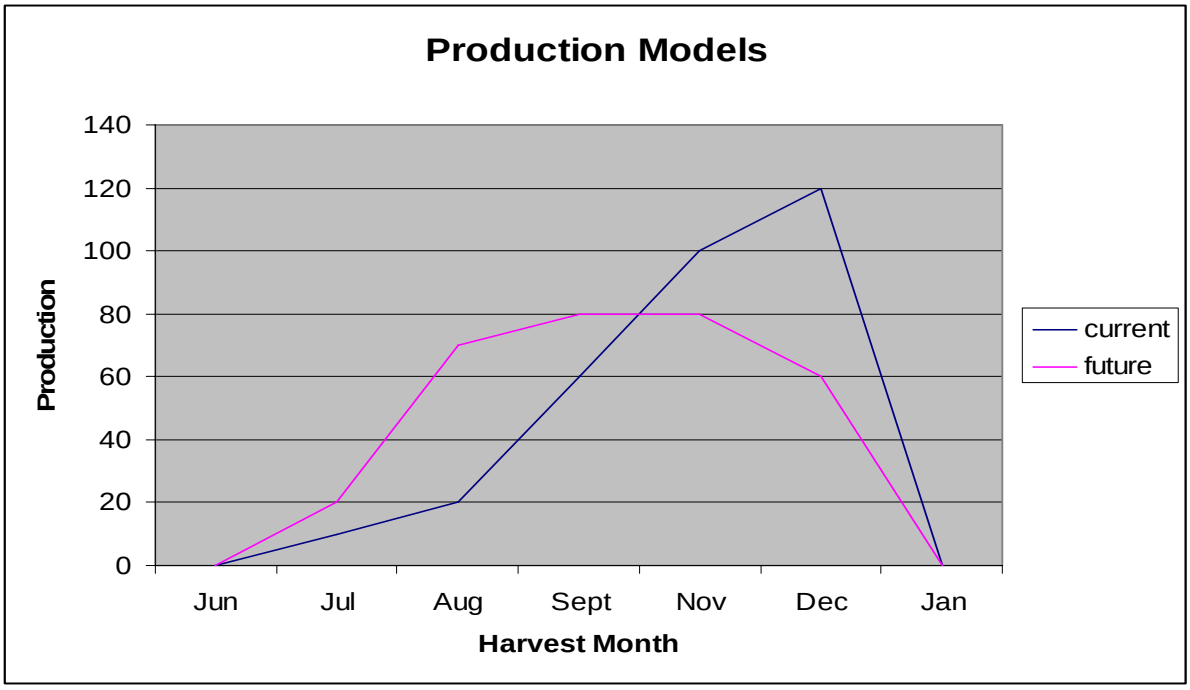
9.1 Extending the season

Lengthening the season for Harumanis by making flowering and harvest earlier extends the season with the result that daily domestic wet market supply is reduced, and prices increased. Current supply is October-December. Paclobutrazol offers the opportunity to extend supply from August-December. The experience of the only farmer in Lombok to have tried this is that the prices early in the season rose to around Rp4 000 /kg rather than < Rp1 000 /kg.

Harumanis appears to be very responsive to paclobutrazol. This is used in most mango producing countries but farmers in NTB are not aware of its benefit. There has been a small amount of research conducted in Lombok in 1 season on 1 site only trialling paclobutrazol at low rates. The results are very promising with flowering and harvest advanced by 1-2 months. Discussions were held with 1 large farmer who had similarly tried paclobutrazol in 1 season with a similar result at quite low rates.

Paclobutrazol has the potential to double the current supply period of around 2.5 months to 5 months. With the level of total production remaining the same (at least for some years), the impact is that the weekly supply is significantly reduced, increasing prices. For early adopters of the technology, there are very large benefits, with prices as high as 4,000Rp/kg. The possible impact of paclobutrazol is demonstrated in Figure 1.

Figure 1: Models for current and future monthly production in response to paclobutrazol



There are a number of issues with using paclobutrazol that require research at a local level including:

- dosage rates for each variety, tree age, and soil type
- time of application
- repeat dose applications
- adjunct treatments e.g. cincturing, potassium nitrate sprays.

It has implications for the time of flowering, size of crop and possibly fruit size. As the climate for flowering and harvest is changed, there are impacts on fruit quality.

There are limits to the use of paclobutrazol to control harvest time, imposed by the effects of rain at flowering and at harvest. It is likely that the commercial impact of paclobutrazol will be limited to flowering no earlier than May with harvest no earlier than August.

Paclobutrazol offers the opportunity to move a much greater proportion of the crop earlier, spreading the season and increasing prices. Prices are primarily determined by daily supply. If supply drops, prices can rise by four fold. Provided paclobutrazol does not lead to a significant increase in plantings, i.e. an increase in total production, then current production by farmers will benefit considerably in price. Over time it is possible that plantings will increase, but in the transition farmers who adopt the technology will benefit considerably. Widespread adoption may take up to 10 years.

Paclobutrazol fits into the current system as it is easily applied as a manual soil drench (1litre mix) around the tree trunk. It is available from the major agricultural supplier in Mataram at the price of 160 000Rp for 250cc. Applications rates around 5-10cc/tree appear to be effective. This is a cost per tree of 6,400Rp/tree. The financial implications for an average tree producing 100kg/tree at a higher price of around 2 000Rp compared to currently 1 000Rp is clearly significant. In the long term it should be possible to increase sales per hectare to 24 million rupiah from the current 12 million.

There are other research techniques to extend the flowering including:

- cincturing
- foliar spray of ethrel (available in Mataram) approx 60days before flowering
- foliar spray of paclobutrazol after pruning
- foliar spraying potassium nitrate in the period just prior to flowering
- combinations of the above and with paclobutrazol.

These various techniques are used around the world to extend the season and have had a significant impact in most countries. Depending on the response of the predominant variety, the impact can be very considerable. In Australia, paclobutrazol is widely used with potassium nitrate sprays just prior to flowering. Some growers combine this with cincturing about two months after harvest, and ethrel sprays around 60 days before flowering. In Thailand, on the variety Nam Dok Mai, a mixture of pruning + paclobutrazol + potassium nitrate has seen Thailand significantly extend its season. Philippine growers have used potassium nitrate sprays for many years to ensure earlier flowering of their variety Carabao.

This appears to be a reasonable short-term strategy with a high degree of success. Research can be conducted in a demonstration system with farmers at relatively low cost and a large potential impact within the existing supply chain. Earlier flowering benefits will directly benefit farmers.

9.2 New varieties

Another option for research in Lombok, that will have significant long-term impact, is the introduction of the variety Gedung gunci. This variety has been widely planted in West Java. It is apparent at least one farmer in Lombok has introduced this variety with around 200 trees, most up to five years with one tree ten years. This enterprise has extended to grafting and selling trees (Rp 5 000/tree)

It appears to be very suitable to the climate, with similar characteristics to Harumanis but with the yellow skin colour when ripe, necessary to develop for international trade. This variety appears to have:

- excellent eating characteristics
- similar resistance to anthracnose when ripe
- yellow when ripe with a very attractive pink blush over a large portion of the fruit
- similar consistent production to Harumanis
- even earlier than Harumanis without the application of paclobutrazol
- fruit size a little smaller than Harumanis

Initial sales price in Lombok is approximately Rp4 000/kg. This variety has significant potential to change the nature of mango production in Indonesia. It represents an access into the higher priced, growing domestic supermarket trade and is probably the best opportunity for mango exports from Indonesia. For it to be successful it has to have good agronomic characteristics and perform along the supply chain.

This variety is worthy of proper evaluation of its performance. This includes:

- post harvest life – stored at a range of temperatures
- susceptibility to anthracnose (and other rots) – test in high rainfall seasons
- yield
- consistency of yield over time
- response to flower inducers (paclobutrazol, potassium nitrate, ethrel, cincturing)
- fruit size distribution and impact of better nutrition on size
- quality classes
- define nature of defects and solutions to minimise
- sap burn susceptibility
- any pest/disease susceptibility.

From discussions with researchers in West Java, it appears this variety has not been assessed formally, though it has been widely planted in West Java.

A part of this program should include its distribution to farmers for them to evaluate and its distribution to a range of markets to test its performance. This needs to be part of the formal evaluation of the variety. Selection of a variety is not done by scientists but by the market place. A key part of farmers and traders input is to identify problems and for researchers to deal with the problems identified.

This may include through BBI (Govt. nursery – Balai Benih Induk) and must include Dinas Pertanian staff at the Kabupaten, Kecamatan and Desa level. The focus should be in the dry areas of North Lombok and Sumbawa.

This program will take some time to develop – however it fits well with the principle of a supply chain project either for export markets or for domestic supermarkets. It could be sped up initially by sourcing significant quantities of plants from west Java at a relatively small cost.

It may be that the development of Gedung gunci would focus initially on the domestic supermarket trade, while the necessary resources are put in place for developing export capability. This gives the project the opportunity to learn about the variety's performance in the trade. The project would be sped up considerably if it included an introduction component in NTB and a supply chain component in West Java that was extended to NTB as production increases.

9.3 Developing export potential

Indonesia may be able to take advantage of its considerable advantages in mango production in export markets if it can successfully make the change to exportable varieties.

Indonesia has some advantages in the world market including:

- price competitiveness
- period of supply in Asia different to the main producers in India, Thailand and the Philippines
- closeness in proximity to large markets in Asia, South Asia, and the Arab states.

The principle of introducing new varieties to the Indonesian mango supply chain applies whether it is for Gedung or for other varieties. It is clear Indonesia will not be able to export Harumanis mangoes, despite its significant advantages in the market, unless it makes a move to a new variety. Existing varieties are not marketable in world mango markets, based on the experience of Jakarta wholesalers.

Indonesia needs to embark on a selection program to test varieties that are suitable for the production system and export. The conditions for mango production throughout Indonesia are peculiar in that temperatures at flowering are higher than in most other countries. This will exclude many varieties, as they will fail to flower in the equatorial climate due to a lack of cold to initiate flowering.

The first step in developing this variety will be to prove its agronomic potential, but along side this evaluation there must be support given to ensuring its performance in the supply chain. No variety is perfect; all have problems that have to be managed appropriately.

The success of the variety will be determined by the ability of support services to deal with problems as they arise and ensure all in the supply chain perform their roles in managing the variety appropriately.

A relevant example is the development of the variety Calypso in Australia. The introduction of this variety has been technically supported in the field and in the market place to ensure problems are resolved and all in the supply chain have the resources and information to ensure the customer is delivered with a great product. The supply chain is closed to one wholesaler, though it is sold through a wide range of retail outlets. Their supply chain is managed externally by a third party, which ensures consistent communication up and down the supply chain.

Gedung gunci appears to be worthy of this level of support. There have been some attempts to export this variety from Jakarta by sea to the Arab states (12-14 days), which have proven unsuccessful due to the incidence of rots on arrival (apparently due to rain at harvest). This is despite the wholesaler making use of good post harvest handling technologies including packaging, forced air cooling, CA reefer containers, post harvest fungicide and hot water treatments. Despite this apparent initial failure, there are other technologies that could be employed to deal with the issue of rots caused by rain at

harvest. The exporter made one attempt to export but could not sustain the effort to deal with the issues that arose. To be successful this variety (as for any variety) needs to be supported technically throughout the supply chain to ensure its success.

The creation of new export market outlets will have a flow on effect in terms of domestic marketing with a portion of the crop achieving higher prices. It will also prepare growers to be better able to service the growing domestic trade thru emerging supermarkets, which will have higher requirements, though may not necessarily pay higher prices. It is likely Gedung will have a place in the local supermarket trade as a point of difference to Harumanis in the wet market. It is unlikely supermarkets will compete in the very low priced Harumanis mango market.

The current export position with mangoes is difficult to resolve in the short term due to:

- wrong varieties for export
- the time and expense to develop access protocols
- some essential chemicals not registered for use in Indonesia
- no size or quality standards
- no widely accepted and simple HACCP (Hazards and Critical Control Points) program required as part of food safety
- the cost of implementing protocols e.g. Vapour Heat Treatment (VHT)
- unfavourable rainfall distribution in production areas that currently grow exportable varieties.

Indonesia does not appear to have the capacity to successfully negotiate access protocols nor are officials aware of the issues required to successfully develop access protocols. In discussions with key fruit exporters in Jakarta, all commented on the need for the government to develop access protocols for Indonesian horticulture. There are six issues for negotiating quarantine protocols:

1. Having good records of pest incidence.
2. Having the capability to conduct pest surveys by crop to create accurate pest lists.
3. Having a disinfestation research capability.
4. Having an inspection and monitoring capability to supervise protocols which foreign countries can trust.
5. Having insect rearing facilities especially in the case of fruit flies.
6. Having a legislative/regulatory power to enforce protocols.

The creation of these new export market supply chains would assist farmers in a number of ways such as:

- selling a proportion of their crop at higher prices i.e. an average higher price for the crop
- making it attractive to develop systems that are useful domestically particularly the growing supermarket sector
- taking fruit off the domestic market
- providing a price stimulus to allow the introduction of new production technology
- attracting new investment.

If we are to have a successful supply chain, all participants need to change and all need to make new investments e.g. production technology, cool chains etc. Developing new profitable supply chains that can adopt new technology with in the chain has significant spin off benefits for other markets e.g. domestic markets.

So farmers who are adopting new production technology for a new supply chain will still sell a portion of their crop to current standard domestic markets and this production will benefit from the adoption of new technology, e.g. better quality, better control of anthracnose. Similarly for collectors or traders, participating in a new supply chain that is sufficiently profitable for them to invest in new technology, will also use this technology in existing supply chains.

In Indonesian chains, more so than in other countries, other post-farm gate participants play an even greater role in determining the success of the chain and have taken over some of the roles and responsibilities of farmers e.g. the collectors are responsible for harvest, packaging, transport to wholesalers, roles that would normally be fulfilled by farmers in other countries. Thus the research efforts cannot focus on the farmer alone. Collectors are more than traders who operate on a commission – they buy the crop taking risks associated with market failure, quality etc. They invest in the crop in terms of harvesting and they absorb significant risks. In fact the farmer can opt to whom he sells his crop on the tree and in that sense he is not just a price taker. The collector bears a significant portion of the risk and the input costs. He may be financed by a wholesaler but he bears significant risk as much if not more than other participants in the chain.

This supply chain includes farmers, collectors, wholesalers and in some cases retailers. Successful farmers are part of successful and profitable supply chains, not just farmers. Nor should farmers be considered to have some preferential treatment in a supply chain – all are equal participants and for profit all must be successful. Each has specific roles to play in delivering the product to the consumer. Research is about researching a profitable supply chain.

The development of export, based on a new variety, must be based on a parallel supply chain, a new supply chain, not involving the current wet market supply chain. Exporters are prepared to invest, but if there is a lack of coordination and control the benefits of investing in and developing the supply chain will be eroded. It is unlikely the existing collectors will ever have the ability to understand the issues required – they may participate but under the control of a single exporter or group of exporters. This can be controlled with the introduction of a new variety.

This new supply chain will have the ability to invest in the supply chain. The introduction of new variety, combined with access protocols must be accompanied by a dedicated supply chain that includes private and public investment.

Introducing a new variety to the area should be under the control of the supply chain. This allows the participants to invest in the supply chain infrastructure (e.g. cool rooms) and allows the supply chain to open up communication, with investment back into dealing with problems. It allows the supply chain (the exporter directly or via a levy) to invest in technical support for participating farmers and collectors.

A good model for development of supply chains in Indonesia is the tobacco industry in Lombok. This is controlled by a number of large companies. They have a fully integrated supply chain with significant investment in the chain in terms of credit and technical support. Company support staff visits farmers at least three times a week. Each extension staff is monitored for the performance of their farmers to ensure they are meeting targets. The companies provide credit to growers. Sales are directly to the company. This is a good example of a profitable, closed supply chain with significant investment with little

input from public sector, which has passed on considerable economic benefits to farmers participating in the supply chain. It has allowed the supply chain to control production, quality and marketing.

The development of a mango export supply chain is a new concept in directing research for both ACIAR and for Indonesian organisations. It requires developing closer linkages with private sector players particularly marketers and exporters. In the case of exports, to be successful it may require supporting closed supply chains to ensure that all participants in the chain are using the appropriate technology.

9.4 Dried mangoes

The large existing production base of Harumanis is a significant advantage, in terms of volume and price. The main outlet in Indonesia is wet markets at very low prices. It is worthy to consider what can be done with this significant production base. Finding alternative market outlets for this production at a higher price will have a significant impact on many farmers. Harumanis has excellent eating characteristics. It is worthy to consider options for processing. This may develop into an export opportunity for processing.

The economics of the possible processing market deserves further evaluation. Indonesia has significant advantages in world export processing markets. These are currently dominated by the large producers in Philippines, Thailand, South America, and south Asia. Indonesia also has a large domestic market for processed mango.

The best initial option for NTB mango production may be dried mango. This simply involves on-farm processing, with little or no capital cost. Other options require large capital investment by large companies, which may already have sufficient processing supply from bases in Java.

The best initial area to develop the concept would be the tobacco farmers' of central Lombok, many of who also have mango trees. They have access to tobacco driers that operate at the same temperature as mango driers. Tobacco companies provide credit and extension services – one company up to 70 extension staff, who visit farmers three times per week. They are looking for other crop options to build closer relations with their farmers – especially as companies are exposed thru credit that they do not always get back.

This technology is simple. The dried product is likely to be very good. It has a reasonable life if dried sufficiently. It does not include any preservatives. Naturally dried mango is far superior to current dried mango from Thailand and Philippines that includes large amounts of sugar, disguising the unique mango flavour. Large amounts of sugar are added to extend shelf life. Dried mango from Thailand and Philippines sells for around $A8/kg wholesale in Australia whereas naturally dried mango sells for around AUD$20/kg. Harumanis will dry very well with excellent flavour.

In Indonesia dried mango retails for approximately Rp100 000/kg. At a 10% recovery this equals 10 000Rp/kg fresh. It is possible to peel and slice around 10kg fresh mango/man hour. It is conceivable that home processing is an economically attractive, technically feasible and a good potential market.

If a farmer sold dried mango at Rp50 000/kg, he could turn income for a tree yielding 100kg from the current 80 000Rp/tree sold into the wet market, to Rp500 000/tree sold wholesale into dried mango markets.

The issues will be to:

- develop a good linkage with a suitable trader
- ensure the process is technically feasible
- ensure the economics are feasible
- clarify the domestic and export market options
- deal appropriately with key food safety issues
- establish the post harvest life of the dried product.

This is potentially a fairly simple product development model that has a significant impact on farm income. Using the existing tobacco farmer extension system this project idea could be developed up at relatively low cost. Rolling it out to other provinces will take some investment. In central Lombok we have a system to assist with uptake, and the capital requirements in place in terms of a drier, to test and develop this market option.

The tobacco farmer infrastructure in Lombok has other potential benefits in developing supply chains for mangosteen and rambutan for export. One of the current tobacco companies is exporting mangosteen as many tobacco farmers in central Lombok also have mangosteen.

Australian Government
Australian Centre for International Agricultural Research

Final report

project

The potential for mangosteen in eastern Indonesia

SADI-ACIAR research report

date published	April 2008
prepared by	Mr Ian Baker
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Australia Indonesia Partnership
Kemitraan Australia Indonesia

ACIAR's participation in the Australia–Indonesia Partnership

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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Contents

1 Acknowledgments

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Particularly, the author would like to thanks one of Indonesian largest fruit exporting companies, Pt. Agung Mustika Selaras, a family owned company who gave freely to the development of this report, providing invaluable insight for the author.

2 Executive summary

Of the 4 provinces involved in the Smallholder Agribusiness Development Initiative (SADI), NTB is the only province with significant production of mangosteen, although it remains a relatively small industry compared to other horticulture crops in the region, such as cashews and mangoes.

Mangosteen is the only export focussed fruit industry in Indonesia with up to 8 000 ton/yr exported from all of Indonesia, almost all going to China. This has been developed solely by private exporters. Mangosteen growers are in a very profitable supply chain with incomes significantly above the poverty level and the general Indonesian population.

Developing a capacity to research, develop and negotiate access protocols is urgent. Current exports to China are in the absence of a formal protocol and are at risk. Exports to Taiwan have ceased presumably because of the absence of an access protocol. Also included required is the capacity to manage chemical registration and MRL issues for access.

There are pre and post harvest quality issues (gummosis, skin marks, size distribution, keeping calyx green), that could improve the % of fruit sold to export.

An evaluation of other export opportunities should be conducted for other phyto and non phyto markets, in consultation with exporters. Indonesia has strong competitive advantages in export.

The lack of post harvest cooling in NTB for export mangosteens is a constraint impacting on export price.

There is a need to develop a long term national capability in access protocol arrangements. Mangosteen is the most urgent protocol to resolve and probably the easiest as a good model to develop capability.

3 Introduction

This report is part of ACIAR's contribution to the Smallholder Agribusiness Development Initiative (SADI) in eastern Indonesia. The concept 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 the 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.

The results of the analysis arose from visits to farmers, government and private sector players in the three provinces as well as in other areas of Indonesia, where similar crops are grown. A series of project development workshops were held to develop project concepts from the scoping mission. These included a wide range of participants.

4 Current production

Mangosteens are grown in the wetter areas around Mataram (Namarda, Lingsa) and central Lombok. There are no mangosteens in the dry areas of north Lombok and Sumbawa (Tables 1 & 2).

Table 1: Mangosteen production and tree numbers in NTB from 2002 - 2005.

	2005	**2004**	**2003**	**2002**
Tree Numbers	7,290	8,763	9,462	12,449
Production (tons)	314	288	201	93

Source: BPTP NTB

Table 2: Mangosteen production and tree numbers in all Kabupatens of NTB (2005)

Kabupaten	Tree Numbers	Production (tons)
West Lombok	3,748	165
Central Lombok	1,910	85
East Lombok	1,237	44
North Lombok	11	1
Dompu	0	0
Bima	50	3
West Sumbawa	0	0
Mataram City	334	16
Bima City	0	0
Total	**7,290**	**314**

Source: BPTP NTB

Farm size is small varying from 1 tree in a garden to over 100 trees. There is no accurate data of farm size distribution. It is variously estimated that there are around 300-500 farmers. There is an active farmers association with around 300 members and 60% actively participating in monthly meetings. The association also runs a small credit service with members paying Rp50 000 to join and a monthly fee of Rp2 500. Farmers can access these funds as free credit for up to 6 months. The association is keen to develop direct sales to an exporter.

In relative terms it is clear that mangosteens are not as important as other fruit crops including mango, citrus and banana. Mangosteens are planted in the wetter areas of NTB where farmers have a wide range of reasonably secure cropping options. They are not planted in the drier areas of north Lombok or Sumbawa as mangosteens are not adaptable to long periods of drought. In these dry areas they may however produce earlier if irrigation is available.

It is interesting that they are not planted in South Sulawesi which has suitable areas, including areas that could produce in June and July, out of season to the rest of Indonesia.

5 Current markets

It appears a large percentage of the crop from NTB is sold to two major export consolidators who then sell to a number for exporters in Bali and Surabaya. The consolidators buy the whole crop then grade for size and quality with smaller and marked fruit going to the domestic market. Farmers get a set price of around Rp4 000 /kg. When there were three exporters the price was higher at around Rp7 000 /kg. In the only Hero supermarket in Mataram, mangosteens were on sale for around Rp20 000 /kg. In the wet market the sale price was between Rp4 000 - 5 000/kg. There are some sales into drier areas of east Indonesia that do not grow mangosteen, such as Sumbawa and Kupang.

The export opportunities for mangosteen from Indonesia are due to:

- there is significant production that can be exported
- there is a long line of supply
- Indonesia is very price competitive
- the quality issues are probably easier to deal with
- there is not as much international competition
- Indonesia has s supply window advantage over other international suppliers.

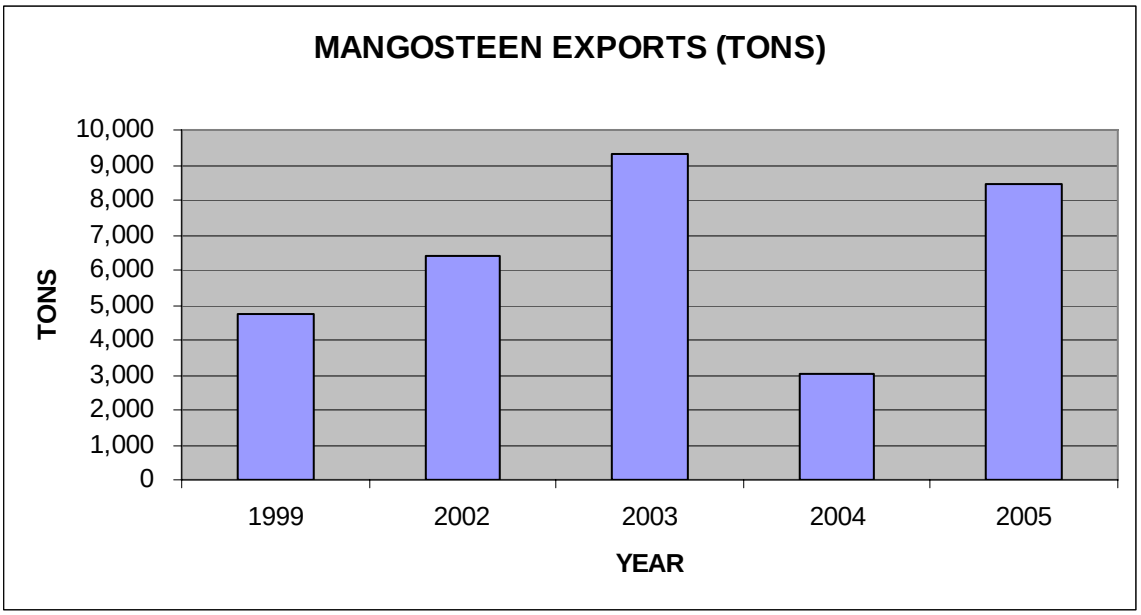
Mangosteens are exported via Bail and Surabaya based exporters. Some are Indonesians and some are Taiwanese. Fruit is shipped un-refrigerated from Mataram to Bayiwangi in East Java, then by cold container via Surabaya port to the export market. It was not clear exactly where fruit was going but growers believed Taiwan and Korea were the main markets. Discussions with large Korean tropical fruit importers confirmed there are no fresh imports but there are imports of Individual Quick Frozen (IQF) mangosteen from Indonesia but very small quantities and the quality is not as good as IQF mangosteens from Thailand. There is a Jakarta branch office of a Thai company that specialises in IQF mangosteen. The most likely outlet was mainland China for Indonesian IQF fruit.

Jakarta based exporters are selling to southern China. Their sales to Taiwan have stopped, though the reason is unclear. It is difficult to determine the destination of exports from available export statistics.

Export to these centres is likely to contravene importing country quarantine laws. Illegal imports into China are common practice in China, with customs officials easily bribed. Quarantine is more regulated in Taiwan and especially Korea. The risk is that these imports could be stopped very abruptly in the absence of a quarantine protocol. This has happened in China (Australian mangoes) and Taiwan (Australian stone fruit). China has recently imposed quarantine restrictions on the large Thai exports of mangosteen. An immediate cessation of the trade would cause significant disruption. There is an increased risk due to the large numbers of live ants and spiders (including eggs) observed under the calyx of mangosteen.

Indonesian exports of mangosteen are significant around 6,000-8,000 tons per year. This is the only significant fruit export (Figure 1).

Figure 1: Mangosteen exports from Indonesia.



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

Export fruit are packed in 8 kg plastic crates, surrounded by paper and graded for class and size. In Lombok there is no cool chain until well after packing. For Lombok exports, the cool chain starts in Bayiwangi, in East Java, which may be up to 4 or 5 days after picking. This could be a significant issue in keeping life adequate for sea freight journeys of 12-14 days, especially in keeping the calyx green on arrival.

In discussions with Jakarta based exporters, sourcing from West Java and Sumatra, it appeared prices paid to farmers were higher (Rp5 000-15 000/kg). In this supply chain,

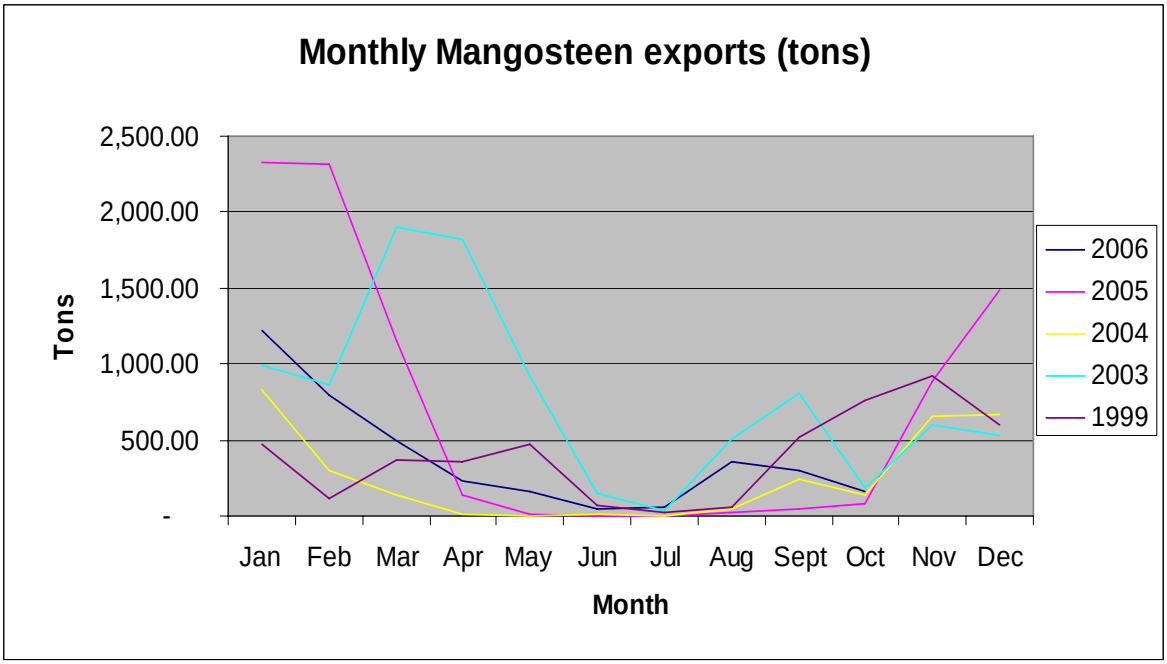
the cool chain starts at the farm with cool trucks and cool storage at the packing shed. The exporter emphasised the need to maintain the calyx green on arrival or price is discounted. This may be an issue worthy of further investigation. The sea freight journey from Surabaya is 12-14 days. Added to the time taken to collect, pack, and ship to Bayiwangi in the absence of cool storage may be causing problems, especially with the calyx drying.

Export prices in China are variable but around US$15/8kg (Rp16 875/kg CIF). There are other markets that will pay much higher prices for mangosteen e.g. Australia imports Thai mangosteen at around $A5-8/kg CIF wholesale Sydney markets (Rp35 000 – 55 000/kg). Thailand exports to Europe, Australia, and Japan. It is likely there are much better market options for mangosteen if the Indonesian government had the capability to successfully research and develop access protocols.

Sales may be worthwhile in Europe (Netherlands, Germany). There is no requirement for quarantine access protocols. Airfreight from Jakarta to Europe is around US$3/kg. Identifying the economics of further export options in terms of prices, costs and access issues is well worth further evaluation.

Indonesia has real competitive advantages for mangosteen export. They are only grown in any significant quantity in Malaysia, Indonesia and Thailand. The Indonesian season, Nov-Dec, is opposite to Malaysia and Thailand, June-July. Current mangosteen exports from Indonesia are over a long season of 8 months (September – April) (Figure 2). Indonesia has a large existing production base at cheap prices. Mangosteen quarantine issues are not difficult to resolve and the fruit has a reasonable post harvest life for sea freight.

Figure 2: Monthly mangosteen exports from Indonesia



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

Accessing Australia is worth considering as the precedent has been set with Thai mangosteens into Australia. The protocol requires methyl bromide fumigation. This may reduce quality and post harvest life. Wastage of Thai mangosteen imports into Australia is very high. They retail in many major chains at around $A2/piece. Indonesia has a major advantage in time of supply but also the shipping time to Australia is much less. It is possible to ship to Darwin from Surabaya in 3 days on a weekly service with a further 3-

4 days to Sydney by backload road freight rates. This is around half the current shipping time from Thailand. The other issue is to negotiate fumigation treatment on arrival rather than departure, as is done for many dry goods from Indonesia (furniture) and fresh pineapples from Philippines. This would significantly improve post harvest life

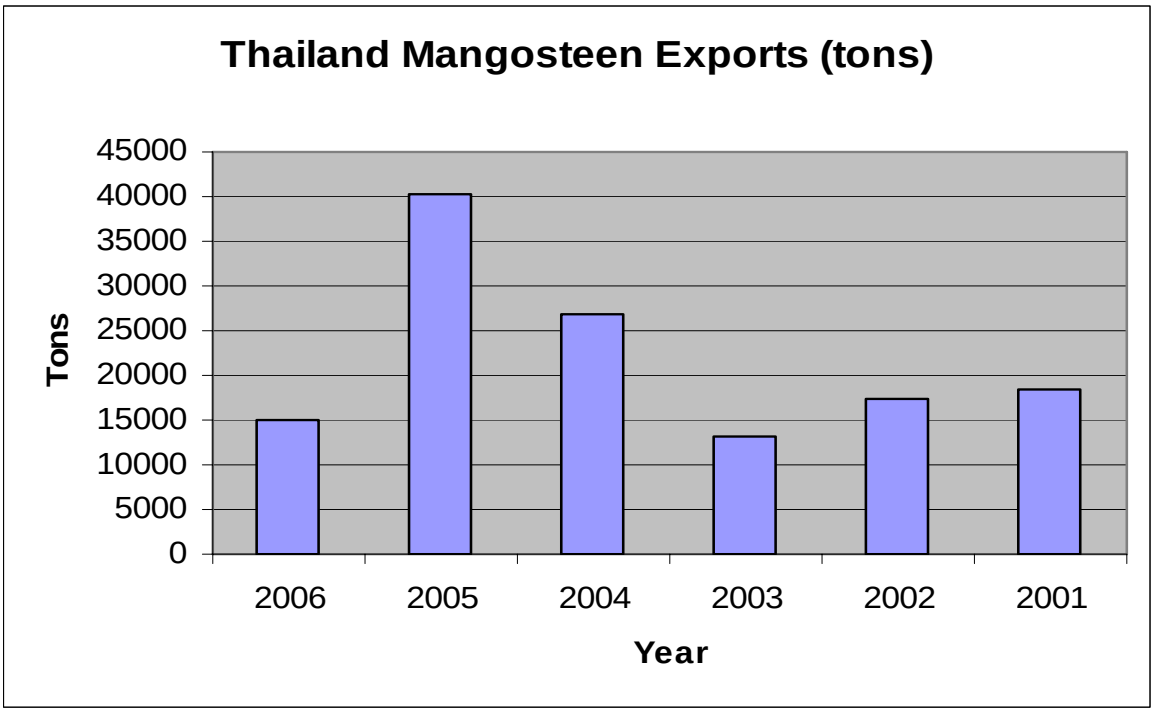
Access into Japan may require Vapour Heat Treatment (VHT) for fruit fly. It is unclear if there is a feasible market into USA and Canada.

It is unclear how much production from NTB is being exported but one exporter indicated that they were packing 3 ton of fruit every 2 or 3 days. At this rate it will take 6 days to accumulate sufficient fruit to fill a 40 foot sea freight container.

There are also reports that one of the large tobacco companies in central Lombok is involved with mangosteen exports. Tobacco companies provide farmers with credit. They also provide a high level of support for farmers, with extension staff visiting them at least 3 times per week. These companies are interested in closer links to their farmers to ensure they are financially stable, reducing the risk of credit default. Hence their interest in other crops the farmer may grow.

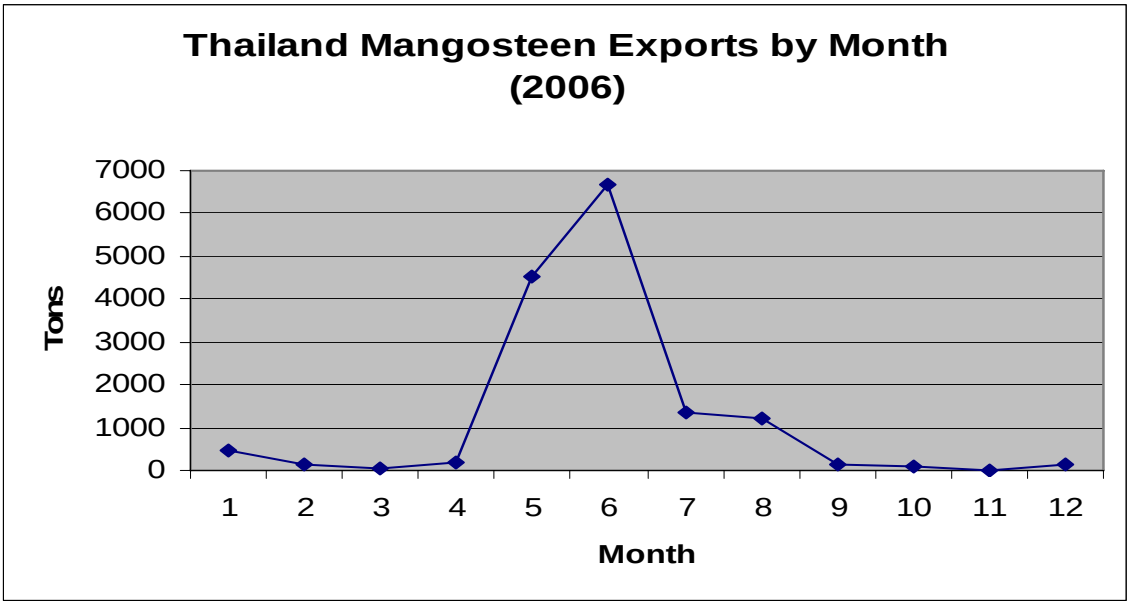
It is relevant to look at Thailand exports (Figure 3) of mangosteens that occur primarily over the months of May – August (Figure 4). Thailand exports some 15 000 – 40 000 ton of mangosteens. China accounts for around 80% of total exports (Figure 5). Taiwan was a major market until 2004 when exports virtually stopped from a level of around 5 000 ton only 2 years earlier. This also reflects the comments of Indonesian exporters that Taiwan has ceased to be a market over the last few years, possibly reflecting a quarantine or residue issue. Indonesia is emerging as a market for Thai mangosteens with around 1 000 ton imported in 2004 increasing to around 2 500 ton in 2005 but virtually ceasing to 2006. Vietnam is also an increasing market for Thai mangosteens. Significant quantities are also sold to Laos and Myanmar.

Figure 3: Thailand mangosteen exports



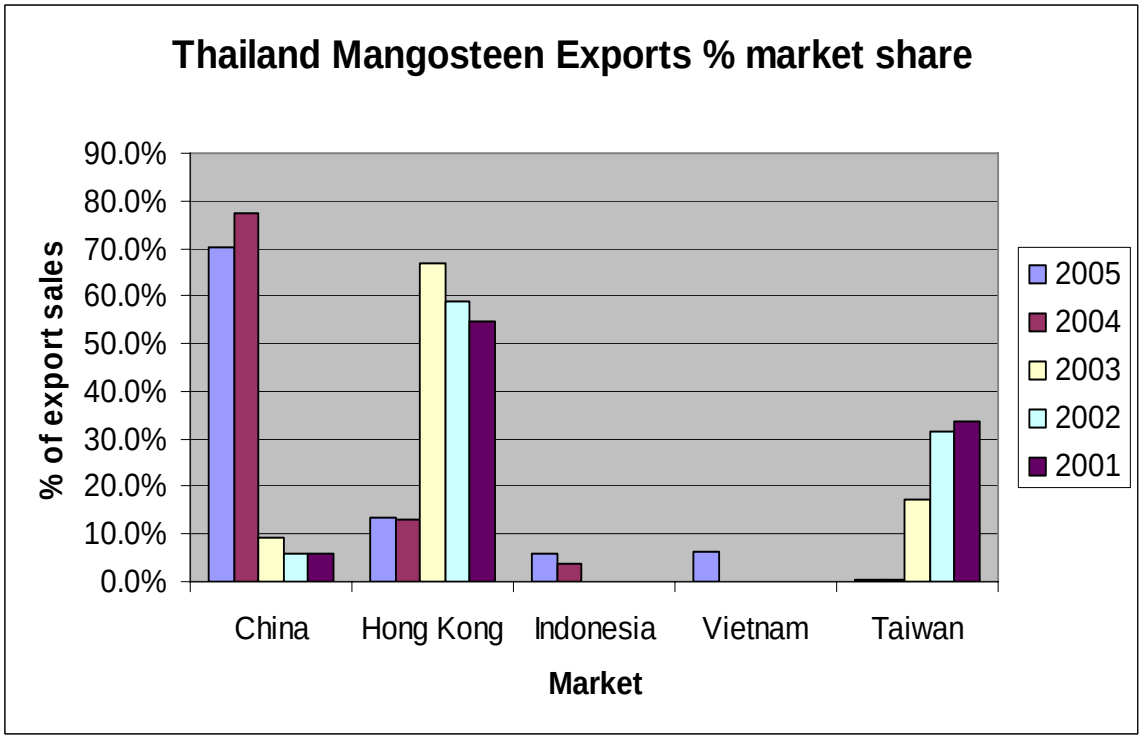
Source: Thailand Customs Export Statistics www.customs.go.th

Figure 4: Thailand mangosteen exports by month (2006)



Source: Thailand Customs Export Statistics www.customs.go.th

Figure 5: Thailand mangosteen exports by major importers.



Source: Thailand Customs Export Statistics www.customs.go.th

Very little is exported to EEC countries (possibly reflecting air freight cost), none to Canada, and only small quantities to Australia (228 ton in 2005 and 74 ton in 2006) and to Japan (319 ton in 2005 and 169 ton 2004). Discussions with the major Australian importers indicate there is a future for the crop in Australia at a wholesale CIF price of A$6-A$8/kg (Rp40 000 – 55 000/kg) for airfreight mangosteens. There were initial problems with quality and the quarantine protocol with mites and soil found on imports. The current protocol requires methyl bromide fumigation. Importers do not believe the quality problems are caused by fumigation but issues on farm.

The other market that Thailand has been selling into has been the Arab states though the volume is relatively small at around 100 ton per year. Interestingly there are virtually no sales of Thai mangosteens into Malaysia. There may be opportunities to sell into the developing supermarket outlets, of which many have stores in Indonesia.

6 Season and climate

The areas around Mataram and central Lombok have higher rainfall than other area of NTB with some rainfall during the dry season. Mangosteens are mainly in the lower elevations. Trees flower in July – August and are harvested from December to March. The harvest periods for the various areas of Indonesia is shown in Table 3. There is no seasonal advantage for NTB production in relation to other areas of Indonesia.

Table 3: Mangosteen harvest seasons in Indonesia

West Sumatra	Medan	Central Java	East Java, Bali, NTB	West Java
August - November	September - December	November – February	December - March	February – May

Soils are excellent, with a good cation balance (Table 4).

7 Production technology

There appears to be very little use of 'normal' management systems including:

- irrigation
- nutrition
- canopy management
- pest control
- manipulation of flowering.

In part, this is because:

- soils have excellent levels of natural nutrition (Table 4)
- farm size is too small to utilise better technology and too small to have sufficient capital to invest in better production or post harvest technology e.g. spraying, cool rooms, packing lines
- smallholders use mangosteen opportunistically rather than committed to the crop. Almost all have another source of on-farm or off-farm income. All farmers will grow other crops.

Table 4: Soil analysis at Batu Mekar in NTB

	% N	% P	% K	% Na	% Ca	% Mg
1	1.2	0.11	0.64	0.06	1.10	0.23
2	1.2	0.16	0.86	0.08	0.96	0.23
3	1.2	0.04	0.60	0.06	1.19	0.23
4	1.1	0.05	0.57	0.07	1.31	0.21

Some farmers may use nutrition either organic or inorganic (1 kg/tree). Nitrogen and potassium are the 2 main elements used. There appears to be no use of calcium, potassium, zinc or boron, recognised as key elements in tree crop production. BPTP NTB

has done a 2 year fertiliser trial indicating that yield was increased due to increased fruit numbers not larger fruit size.

Based on discussions with farmers and government staff it appears the average production is around 100kg/tree for mature trees, up to 150kg in years of good production (1 in 5 years) and as low as 70kg in poor years. Trees are planted around 8m x 8m, 150 trees/ha. Trees are often planted around the edge of house compounds, businesses, offices and schools.

The only input that a farmer makes after planting and looking after the tree until it reaches production, is harvesting. Some farmers may use some fertiliser either organic or inorganic applied once per year.

The capital input in planting the tree and maintaining until production is not insignificant. It appears farmers are still making new plantings of mangosteen, reflecting the positive outlook for the crop.

There was an indication that mangosteens planted around rice bunds flower and crop a lot earlier. Similarly single trees in house gardens flower earlier. Both these early flowering responses could be due to irrigation, an issue that may be worth exploring. The current harvest season is December - February similar to most other areas of Indonesia. Earlier harvests attract higher prices and have advantages for extending the export season. Paclobutrazol is not suitable for use on mangosteen.

There is little knowledge of the causes of skin marks that reduce quality or the yellow sap that occurs in the flesh (getak, or gumbosis). The gumbosis problem has many proposed causes, none of which have any research base. There was some evidence of some research done in Java that it is related to an insect sting that then allows the entry of *Fusarium oxysporum.* Published research in Thailand indicates it is related to water stress or over watering/excessive rainfall. Skin marks that reduce the proportion acceptable for export are thought to be related to shade from coconuts. It is more likely that an insect from coconuts is causing the problem.

Ants and spiders are an issue under the calyx. At one export packing shed fruit were being dipped in a solution before packing though it was not clear if this was washing water or had other chemicals added.

There has been some research in Lombok grafting mangosteen. This significantly reduces the time taken to first fruiting from 9 years to 2-3 years. However experience elsewhere shows he plants have problems with the rootstock taking over, plagiotropic growth, and slow growth rate reducing yield. Australia tried this many years ago but abandoned the concept.

8 Economics of current production

Mangosteen farmers are relatively well off. A one hectare mangosteen orchard of around 150 trees producing an average of 100kg/tree sold at a price of Rp4 000/kg gives a gross income of Rp60 million (Table 5). The only cost incurred is harvesting, usually done by the farmer and his family and a small amount of fertiliser (150 kg) at less than Rp1 million.

Table 5: Approximate income comparisons

Mangosteen 1 ha	Rambutan 1 ha	Mango 1 ha	Middle level public servant	Rice farmer per crop/ha	Poverty level
50 million	30 million	12 million	24 million	7 million	8 million

Clearly mangosteen farmers are in a relatively good economic position, though they have had to wait over 10 years to achieve this level of income. The rice farmer probably crops his land at twice with rice and once with a field crop, increasing his income per year to around Rp20 million.

This is based on mangosteen growers receiving a market price for export of around Rp4,000/kg. Developing further supply chains will increase this price even further. In Sumartra the price paid for mangosteens in an export supply chain is between Rp10,000 and 15,000/kg.

9 Future prospects

The current mangosteen market situation is good, based on a developing export market. Looking at Thailand exports, there are opportunities to follow their markets and increase export volumes significantly. New plantings are continuing though the area is restricted to around Mataram and central Lombok. The long time to fruiting deters many from planting but for those who do, the returns are good for mature trees.

Indonesian mangosteens have performed well as a crop for export because the crop has less post harvest constraints. World production is limited to Indonesia, Malaysia, and Thailand. Thailand has developed significant exports for mangosteen into a range of markets including Japan and Australia. Indonesia has significant export advantages including:

- long supply line of at 6-8 months
- counter seasonal to Malaysia and Thailand
- close to the developing market
- high production available at a cheap price.

The question is – is it worth investing development funds in a crop for which there is a good return. The key issues are:

- current export is occurring without formal access protocols and is at risk especially the high number of ants and spiders under the calyx
- the mangosteen model is a model that can be used as a model for research in a profitable sustainable supply chain for other fruit crops
- there are other market opportunities for mangosteen that could be developed if there were suitable access protocols
- mangosteen offers the opportunity to build capacity for dis-infestation research and negotiating access protocols.

One issue is that exports from Lombok are at lower prices than prices quoted to farmers in Sumatra and West Java by exporters in Jakarta. This may be due to the markets sold to, or it may reflect the poorer post harvest life of mangosteens from Lombok, which results in the calyx drying, reducing landed price. Similarly Jakarta based exporters indicate that they had variable outturn which may reflect the level of post harvest management. The major successful Jakarta exporter emphasised the importance of maintaining the calyx green at arrival in the markets. He also emphasised the importance of having staff based in importing markets, such as China to managing the supply chain. Some Jakarta exporters are no longer exporting presumably because of supply chain problems.

The supply chain issues need to be clarified, especially keeping the calyx green until arrival. Lombok mangosteens are collected in Lombok then shipped to Bayiwangi in East

Java, then by cold container to Surabaya for exporter. It may take the exporter 2-3 days to get a shipment together and pack it, followed by a 1 day sea journey to Bayiwangi, a total of 3-5 days without cool storage. Clearly there are some cool storage issues that need to be investigated and may require some investment.

The key initial issue is to ensure that the access into existing markets is formalised. This could provide a model for government to start to build the capacity to develop formal access protocols. This may not be difficult for mangosteens as the quarantine issues are probably simpler as mangosteens are not grown in the target markets. This should include China, Korea and Taiwan.

In some countries there is a very high market price and developing demand for mangosteens. The mangosteen farmer group in Lombok is keen to see an expansion of the number of exporters. They indicated when there were 3 exporters in Lombok (now 2), prices to farmers were much higher.

Some analysis of Thailand exports should be conducted as to their economic feasibility for Indonesia. Thailand sells primarily in June – September, complementing Indonesia supply in October to April. There may also be linkages that could be developed with Thai exporters. Anecdotal evidence indicates that there are Thai and Taiwanese importers buying mangosteens in Sumatra, Lombok and West Java, particularly when prices in China are high.

It would be worth looking at the economics of exporting mangosteens into countries other than China. There are no quarantine access issues into Europe or Canada, though Europe does require Eurepgap certification. Exporters did not see that as a significant constraint. Probably a bigger constraint is air freight cost to Europe, as mangosteens will not survive sea freight times to Europe (2-3 weeks). Air freight rates into Europe are around US$3/kg. It still may be worth exporting to Europe depending on sale prices in Europe.

There may be other markets that could be developed requiring some analysis e.g. the Arab States and supply out of season into supermarkets Singapore, Malaysia and Thailand. There may also be opportunities to look at supply to Indonesian supermarkets. However their pricing may be driven, at least in part, by the low prices in the wet markets. It was interesting to note that the Mataram Hero supermarket was selling mangosteen for Rp20 000/kg in the season.

The next step is to look at other export market opportunities, with more difficult access issues e.g. Australia, Japan and USA. This requires more detailed economic and marketing analysis and quarantine dis-infestation research. In Australia, Thailand mangosteens wholesale at A$5-8/kg (Rp35 000 – 55 000/kg). Air freight prices into Australia from Jakarta and Denpasar are around US$1.50-2/kg (Rp13 500 - 18 000). Mangosteens could be easily sea freighted to Australia at much less rates and for quite quick journeys, particularly through Perth or Darwin (approx 7 days).

The current Thai protocol into Australia is easy to replicate for Indonesia using methyl bromide fumigation. It would benefit the post harvest life of mangosteen if this could be done on arrival as is done for furniture imports from Indonesia and has been agreed to for Philippine pineapples into Australia.

Similarly Thailand sells mangosteens into Japan for prices around Rp50 000/kg. Air freight into Japan from Denpasar and Jakarta is around US$1.50-2.00/kg (R 13 500 -18 000).

Some relevant production research issues include the development of ways to increase the percentage of fruit suitable for export from the current 30% with hopefully a price

benefit to the farmer. This may be hard to realise in the current supply chain where the farmer sells the whole crop to the exporter at one price. If exporters started a program of benchmarking suppliers for quality and size they may see the benefit of paying more to some and less to others. This could be part of an initial research effort to identify the causes of defects done in association with exporters. A benchmark program for suppliers to exporters is the basis for developing traceability, an essential part of future food safety programs including Eurepgap. Exporters will be aware that some growers are better than others, and may well be responsive to this concept leading them into the concept of different prices for different quality.

Developing a grade standard and a grade standard poster (already done in Australia) could be a first start. This needs to be developed with both farmers and traders and should even include input from exporters. Involving the whole chain in developing standards educates the chain in the defects and their causes. One issue in many chains is that the trade does not understand the causes of defects and takes a conservative position to minimise risk e.g. they may think this is a rot etc but it poses no risk.

This leads to the development of research strategies to reduce skin marks. The first step is to identify the causes of defects. This is a difficult detective task. Many of the marks may be occurring due to mites early during fruit development. Farmers mentioned that mangosteens grown near coconuts have more skin marks. Achieving a larger percentage of larger fruit for export may be a function of nutrition especially potassium, and or irrigation.

The issue of the yellow sap in the flesh occurs with mangosteens everywhere but has never been the subject of any intensive research. It is a significant issue but has never been researched successfully.

There may be some benefit in central Lombok of using the existing, large extension infrastructure in place for tobacco farmers who also grow mangosteens. Tobacco farmers often get credit form the companies and sometimes default. Companies are interested in ensuring their farmers are in a good economic situation including that they are profitable from other crops as well.

Australian Government
Australian Centre for International Agricultural Research

Final report

project

The potential for passionfruit in eastern Indonesia

SADI-ACIAR research report

date published	April 2008

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approved by	David Shearer

Australia Indonesia Partnership
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ACIAR's participation in the Australia–Indonesia Partnership

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

2 Executive summary

Passionfruit, known as markissa in Indonesia, is a small horticulture crop, grown predominately in South Sulawesi. It is a crop of regional importance associated with a high level of regional pride rather than of significant economic value.

Production is currently concentrated in highland areas of South Sulawesi, largely because of the traditional varieties being grown. There is a significant amount of land use pressure on this production base due to the introduction of high value vegetable production.

There are 2 peaks in production, one in July-August and the second in December - February, with little production outside of these times. Almost all of the production is destined for the processing sector, which is largely concentrated in Makassar.

Contract relationships between growers and processors are poor with growers' returns low when supply is high.

New varieties could be evaluated that allow production in lowland areas close to the processing hub of Makassar, which will spread the supply window for processors. New varieties for highland areas should also be evaluated to improve quality of product.

With root diseases identified as a serious constraint which causes rapid deterioration of planted material, resistant rootstocks are available that should be evaluated in South Sulawesi.

It may be possible to have varieties and rootstocks released in a closed supply line through processors, linked to contracts between farmers and processors. Contracts based on a set price and volume (matched to processing capacity) should be the basis of trade between wholesalers and processors. The varieties and rootstocks are the basis of these contracts.

Other market opportunities for processed passionfruit in Indonesia and overseas should be explored.

3 Introduction

This report is part ACIAR's contribution to the Smallholder Agribusiness Development Initiative (SADI) in eastern Indonesia. The concept 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 the 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.

In some cases it is recommended that closed supply chains be considered for improvement. This means beneficiaries are limited to those who are participants in the supply chain. Closed supply chains can be criticised as undemocratic, excluding some to remain in less profitable markets. Only after much deliberation, the analysis came to the position that in some situations, closed supply chains are the best way to ensure profitable, sustainable chains. In a free market situation where access to technology is open to all, two outcomes can result:

1. the supply chain becomes oversupplied and no longer profitable with no one benefiting.
2. there is no control of the technology in the supply chain. Some fail to use the appropriate technology, comprising the viability of the chain.

Closed supply chains offer the opportunity to ensure the chain remains profitable and sustainable, at least for some, as against no one financially benefiting if the supply chain is open. So in some cases the analysis has recommended a variety be developed and released through an exporter or processor who controls the level of production appropriate to the market to maintain sustainable prices for all in the chain.

The results of the analysis arose from visits to farmers, government and private sector players in South Sulawesi and other areas of Indonesia, where similar crops are grown.

Passionfruit has arisen as a crop of interest in South Sulawesi. It is a very small crop in terms of production, number of farmers and value. It is a crop for which people of South Sulawesi are very proud.

However it is an important product of regional pride, as most people from South Sulawesi identify passionfruit as an industry they have developed and unique to the region.

It appears to be grown primarily for processing though excess requirements are sold on local fresh market.

4 Current production

Passionfruit is grown in highland areas above 700m. Most production is now in Malakaji and Toraja. Malino was formerly a large centre for production but it is clear that more profitable temperate vegetables have taken over from passionfruit. Some farmers remain in Malino, but its proximity to Makassar, where there is a good market for temperate vegetables means that passionfruit has little or no future in Malino.

Most of the passion fruit are trucked to Makassar for processing, a journey of up to 12 hours and a cost of around Rp500/kg.

There seems to be around 100-200 farmers, very small compared to the large fruit crops such as mango, citrus and banana. The total quantity of production seems difficult to determine but discussions with processors indicated there is around US$1 million of production.

There are 2 seasonal peaks in harvest from December - February and June- July.

5 Production Technology

All of the passionfruit sold for processing is *Passiflora edulis* (like variety Nelly Kelly in Australia).

It is grown from seed. Formerly single wire trellises were the main production system but more is now grown as single plants over a large tree.

Vine life seems to be a maximum of 3 years, formerly up to 8 years. Inspecting vines in Malino and Malikaji, it was clear that root rots and nematodes were common. Processors spoke of up to 50% of vines dying in 3 years in Malikaji.

There may be some use of organic or inorganic fertilisers.

Fruit are picked, packed in sacks and transported to processors. There do not appear to be any problems with post harvest losses at the processing factory. Processors complained that there was a small percentage of immature fruit (observed <10%).

There are some problems with A*lternaria* leaf disease. No one was aware if viruses such as woodiness virus were prevalent, though previous reports indicate woodiness virus was not present. Yields seem to be around 4-5 kg per plant for 2m spacing and around 2 kg at 1m spacing.

There is no extensive use of chemicals for pest and disease control. Most farms are now small though there may be larger farms in the areas more distant from Makassar. Much Passionfruit production is now from single plants planted against trees in gardens. Some farmers in Malino formerly had up to 10,000 plants (2-3ha), producing around 40-50 ton/year.

6 Current market situation

Fruit are sold to a number of processors (10-20), mostly based in Makassar though there are some in the production regions. One attempt was made some years ago to establish a large processing facility in Malino, with a focus on greater export but this attempt failed.

Excess fruit are sold on wet markets. Fruit are collected by collectors then consolidated for shipment and sale to a processor.

There are many conflicting stories on prices from growers and processors.

In essence, when fruit are in plentiful supply in season, it is likely prices are very low (as low as Rp400-500/kg). Farmers indicate they need at least Rp2 500-3,000 to make passionfruit a profitable agribusiness.

Processors indicate they are prepared to pay up to Rp3 500 /kg as a fixed price contract. Processors indicate their biggest constraint is insufficient supply. This does not fit well with complaints of growers in Malino they couldn't sell fruit and complaints from growers of very low prices (Rp500 /kg).

Given that the crop has 2 seasonal peaks it is likely that production exceeds processing capacity in the season. One of the largest processors (with a claimed 40% market share) can only handle around 10 ton/day. During the field visit in late February there were only very small quantities being processed at this facility. Importantly, processors do not have storage facilities. Passionfruit does keep for some time (1-2 weeks) without good post harvest handling.

Most passionfruit juice sales seem to be in Makassar, through supermarkets, airport gift shops and hotels. It seems the juice is a popular gift for visitors to Makassar. The former large processing plant in Malino supposedly had markets in Europe and Australia. Passionfruit puree is only a small market worldwide, supplied mostly from Brazil.

There is a passionfruit processors association in Makassar. They were planning to deal with their supply problems by convening a meeting of growers, collectors and processors to fix a price of Rp3 500 /kg. Processors complain there is a large lack of supply.

Some processors had made initial contacts with juice processors in Jakarta.

The processing technology is fairly simple. The product was very good quality. It is sold in a range of forms from ready drinks to concentrates in 1-2 litre pack sizes.

7 Economics of current production

In comparative terms, passionfruit is not very attractive compared to temperate vegetables that can be grown in elevated areas. At best prices of around Rp2 500/kg, it seems passionfruit can return around Rp30-40million in gross sales/ha whereas vegetables (3 crops/yr) can net around Rp30 million/ha, with significantly less price fluctuation risk.

It seems the future of passionfruit in highland areas is under threat from low prices, root rots and increasing demand for temperate vegetables.

8 Future prospects

The issues for passionfruit seem to be related to poor coordination between processors and producers, with producers suffering in the peak of the season and the processor benefiting. In the low season, for approximately 6 months, processors have no supply.

Processors seem willing to negotiate fixed price contracts at a good price of Rp3 500 /kg. This allows for a price to growers of around Rp2 000-2 500 /kg after freight (Rp500 /kg from distant areas) and a margin for the collector.

There clearly needs to be some better contract relationships between farmers and processors in terms of price, quantity and quality. There do not appear to be any serious quality problems in the supply chain other than a small percentage of immature fruit. This can easily be benchmarked and a price discount applied.

For processors there are at least 6 months of the year their facilities are not used. If their supplies could be made more even then it may be that they could sustain better prices and develop market opportunities.

For growers, the issues of vine life, and root diseases are significant and can be solved with resistant rootstocks, which are available in Australia. Clearly this requires a move to grafted plants. Passionfruit are easy to graft. Grafted plants offer a way for processors to control their supplies, by controlling the availability of grafted plants, and ensuring they get better production from farmers, no longer suffering significant losses due to root disease.

Over production and a poor relationship between production and marketing is a common problem in Indonesia. If a closed supply chain, controlled by the processor, could be developed, then all benefit – the growers in terms of a set contract price and better production, and processors at a sustainable price and guaranteed supply.

Passionfruit varieties have made major shift away from edulis types (Nelly Kelly) to hybrids that are generally more productive. The Panama Red types can also be grown in lowland areas, offering processors the opportunity to source supplies closer to their facilities, avoiding competition from more attractive temperate vegetables and most importantly over a different supply period to existing supply. Panama Red types in the lowland would also have peaks in production but these will be different to the peaks from the highland areas, giving processors a longer processing period.

Evaluating the performance of Panama Red types, on resistant stocks, offers processors to exert some control over production, matched to processing capacity, if they have control over the release for these varieties, in a closed supply chain. If large numbers of growers access these varieties in a free and open market, the existing situation will be replicated - oversupply and poor prices to growers.

Market opportunities for processed juice or pulp outside of Makassar need to be developed into Jakarta fruit producers and international markets. It is interesting to note that the largest juice producer in Indonesia is the Berri group from Australia. There may be opportunities to develop markets in Australia and Indonesia through this group. Indonesian juice processors are innovative with products like sirsak. The market is also responsive to new products. Passionfruit from Makassar is a “brand” already with some level of recognition in Indonesia, especially in the higher income groups that travel.

If sufficient supply could be guaranteed then it would be worth considering export opportunities.

There may be some opportunity to look at processing technologies more appropriate to international markets e.g. puree, pulp. Current processing, while effective for the local market in concentrates and fresh drinks may not meet international market requirements. The current fresh drink has a limited life, requiring refrigeration. A link with a company like Berri may assist in both markets and processing technology. This also includes a move to international food safety standards.

Australian Government
Australian Centre for International Agricultural Research

Final report

project

The potential for rambutan in eastern Indonesia

SADI-ACIAR research report

date published	April 2008
prepared by	Mr Ian Baker
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Australia Indonesia Partnership
Kemitraan Australia Indonesia

ACIAR's participation in the Australia–Indonesia Partnership

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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.

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Importantly, the author would like to thank the farmers, collectors, processors, exporters and others involved in the commercial rambutan industry in Nusa Tenggara Barat and Indonesia who gave their time and input freely during the compilation of the report.

2 Executive summary

Rambutans are grown throughout Indonesian, particularly in the wetter areas. Total production volume and number of farmers is less than mango and cashews with the domestic wet market the only outlet. Prices are still reasonable and farmers are in a reasonable sound economic situation.

Export opportunities need to be investigated in conjunction with exporters. Indonesia has a strong competitive advantage in export markets with out of season to the other major producers in Thailand and Malaysia.

A capability to develop access protocols and conduct appropriate dis-infestation protocols is required. In addition to the ability to access new markets, the development of pre and post harvest technologies to improve the percentage of high quality fruit to meet export requirements is essential.

Post harvest handling capability for export needs to be raised in terms of cool chains and packaging, using technology already developed in Australia and Thailand.

It may also be important to evaluate the use of paclobutrazol to extend the rambutan season earlier for both domestic and potential export markets.

3 Introduction

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

The report takes a supply chain approach, looking at ways income could be increased for smallholders as part of a supply chain. The 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 the 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 increase 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.

The results of the analysis arose from visits to farmers, government and private sector players in the three provinces as well as in other areas of Indonesia, where similar crops are grown. Visits were conducted over the 3 periods during February to June 2007. A series of project development workshops were held at the end of the consultancy to develop project concepts from the scoping mission. These included a wide range of participants.

4 Current production

In NTB, rambutans are grown in the wetter areas around Mataram, Central and East Lombok. They are not grown on Sumbawa as it is too dry. Additionally, they are grown in the wetter areas of NTT, South and South East Sulawesi. South Sulawesi is interesting in that there are eco-climatic areas that could produce rambutans out of season to the rest of Indonesia. This is a significant opportunity.

The level of plantings and production in NTB is shown in Table 1.

Table 1: Rambutan production in NTB

	2005	2004	2003	2002	2001
Tree Numbers	159,800	107,455	207,751	231,815	107,642
Production (tons)	7,836	4,910	4,098	2,910	8,270

Trees are grafted varieties mostly one single variety. It appears to be a version of Binjai or Aceh, probably introduced many years ago as a seed than as propagated material. There appears to be only one variety grown in Lombok. Many regional varieties exist in Indonesia and each area believes their variety to be the best. There are a large number of rambutan varieties in Indonesia, Malaysia and Thailand. Australia has the best collection of all rambutan clones from all countries. Growers are very proud of their regional variety. There may be some benefit in looking at performance of a range of rambutan varieties for productivity, post harvest and consumer acceptance but the differences are not great. Australia is in the best position to supply a wide range of rambutan varieties. One key issue if an export sector develops is to find larger varieties with most fruit above 40 gram.

Rambutans are grown in areas of higher rainfall and are not drought tolerant. Rainfall distribution is important to rambutan production as trees are not irrigated. Production is located in areas with a short dry season around Mataram and central Lombok. Farmers in these areas have a greater security of cropping and a wider range of crops they can grow than the drier areas of east Indonesia.

Farm size is small with the largest farms 1 ha (150 trees).

5 Production technology

There are little or no inputs other than the grafted variety, and minimal management in the establishment phase with a small amount of fertiliser used. The site has a big influence on production. Soil types in the production area are characterised by very good levels of available nutrition (Table 2).

Table 2: Soil analysis at Batu Mekar in NTB

Site	% N	% P	% K	% Na	% Ca	% Mg
1	1.2	0.11	0.64	0.06	1.10	0.23
2	1.2	0.16	0.86	0.08	0.96	0.23
3	1.2	0.04	0.60	0.06	1.19	0.23
4	1.1	0.05	0.57	0.07	1.31	0.21

There were some trees of rambutan in the drier areas of north Lombok around houses that are irrigated. It is interesting to note these trees are significantly earlier than normal production areas. There are always big financial and marketing benefits of earliness in horticulture, even in Indonesia. For rambutan farmers who can produce earlier for the Mataram market, (under irrigation in the drier northern areas of Lombok), prices are as high as Rp4 000/kg compared to Rp2 500 in the middle of the season

There are ants and mealy bugs present at harvest that are an issue for exporting. There is virtually no chemical use, other than maybe glyphosate for weed control. Large fruit size for export is an issue and this is related to variety, nutrition, crop load and irrigation.

6 Current market situation

All sales are into the local market with some sold to the drier eastern areas. There is no timing advantage for NTB over the other areas of Bali, Java and Sumatra. There are some imports from Bali early in the season at a higher price. Local market prices are around Rp4 000 - 7 000/kg with farmers receiving around 2,000-Rp2 500/kg.

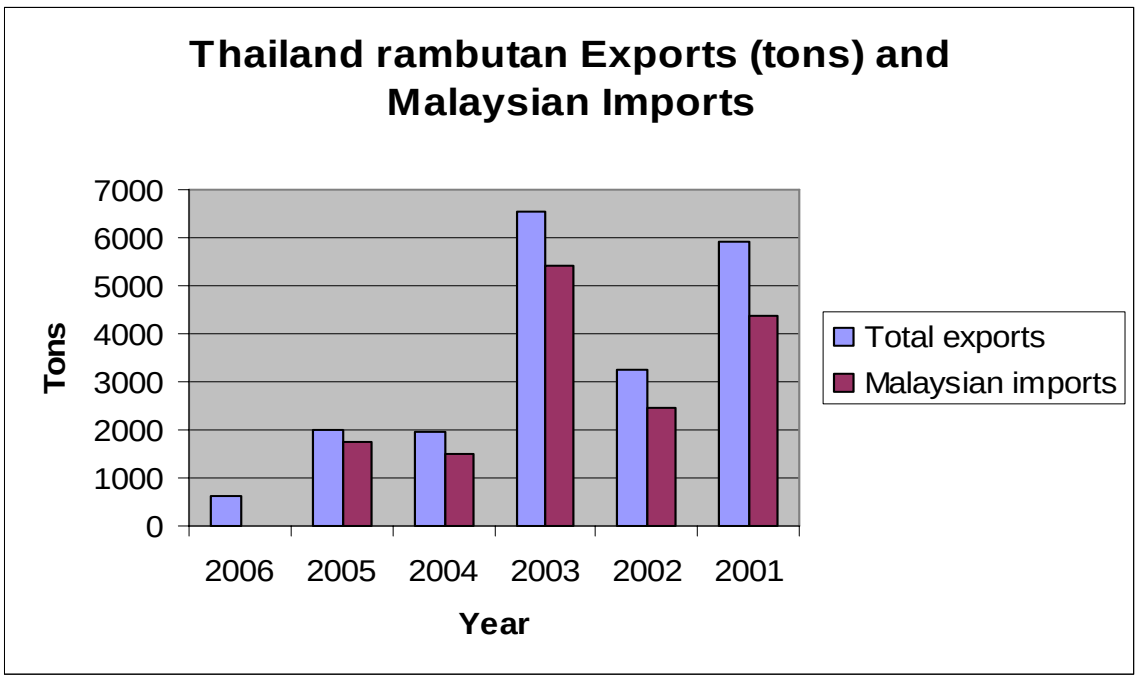
There is no post harvest cool chain or use of any significant intervention. Product is sold quickly minimising deterioration.

Fruit are often sold by the farmer on the tree to a collector who harvests the fruit. Farmers receive less as a result but the farmer may have another permanent job, using the rambutans to supplement income. One farmer with 35 trees (one quarter of a hectare) sold his crop on the tree to a collector for around Rp1.5 million, which equals around Rp6 million/ha.

Other farmers indicated they were paid around Rp2000 /kg. Trees produced around 100-150 kg/tree at a spacing of 8m x 8m (150 trees /ha). This gives a total sale income of around Rp30-40 million /ha. This is from virtually no inputs other than weed control and harvest, approximately 2-3 months work for the family. Fertiliser use is small as soils are good. Organic manure is often used once per year at minimal cost. This is a good family income for the amount of work required.

There are no exports from Indonesia. Thai exports (Figure 1) have declined from around 6,000 ton to less than 1,000 ton in 2006. Almost all were sent to Malaysia. This market has collapsed severely impacting Thai rambutan exports. It is believed the collapse of the Malaysian market is due to high residues of insecticides used to control fruit borers. Rambutans are opened with the teeth so residues on the skin are significant (like strawberries in Australia that require a much higher level of food safety than fruit where the skin is not eaten).

Figure 1: Tonnage of Thai rambutan exports, and the quantity of exports to Malaysia



Source: Thailand Customs Export Statistics www.customs.go.th

Small quantities of Thai rambutans are sent to China and Hong Kong (50-100 ton), UAE (50-200 ton), Taiwan was a market but exports appear to have ceased. Quantities sold into the EEC are very low, mostly to Switzerland, Netherlands and UK. Korea has recently emerged as a market with 150 ton imported in 2006. Very small quantities of Thai rambutans have been exported to Indonesia (7 ton in 2006) probably to supermarkets.

7 Future prospects

It seems difficult to intervene successfully in the current local trade. Local rambutans in season are cheap at around Rp5 000/kg in the markets (Rp2 000-2 500 to the farmer). There are some production and quality issues that could be researched, but in the absence of a better price pull it is difficult to see significant adoption.

The issue of earlier production is interesting to pursue. One farmer in the dry areas of north Lombok was able to sell early rambutan locally at a very high price because they flowered earlier in response to irrigation. Paclobutrazol is also registered in Indonesia for use on rambutan. In Australia it does move production earlier but this is not a big benefit. In NTB, earliness would be a considerable benefit. NTB imports early season rambutan from Bali at very high prices. Clearly there is a benefit to local farmers that could be realised with a small amount of research. Farmers were not aware of this role for paclobutrazol.

One issue that will emerge across all of horticulture is the food safety issue. Indonesian farmers and institutions are not prepared for the introduction of a food safety within the country. Rambutans will be the first crop affected as they will have a higher food safety requirement than others because the skin enters the mouth to open.

While farmers do not appear to use any chemicals, it is possible that the central government will follow international trends and force a national food safety program. This may come sooner than many think due to the increasing pressure from the rapidly increasing supermarket sector. This sector has to operate with good food safety due to its duty of care. All the international players in this sector are familiar with food safety as part of their business and part of their supplier requirements. They may force a national food safety strategy.

The key issue for Indonesia is can it develop an export market for rambutans? Selling a small proportion of the crop to the higher priced export sector has big spin off benefits for domestic supply, and is a platform for introduction of better technology across the whole for production, as better technology required for export will also be used for domestic supply.

The Thailand export experience with rambutans is not as good as for mangosteens, probably reflecting the difficulty of getting the post harvest issues resolved. Rambutans require cool storage from picking, packaging in MAP (Modified Atmosphere Packaging) bags to prevent spintern browning, and air freight.

One issue for export to some markets is that generally only larger fruit are sold. This means taking individual larger fruit from the bunch and packing individual fruit in plastic bags. This is a different style of marketing and will require some changes in handling logistics from the current system.

Developing export opportunities for rambutan will require:

- An analysis of the technical, economic and marketing issues in a number of potential markets.
- Identifying quarantine access issues including dis-infestation research
- Cool chain investment from the farm.
- Packaging systems to minimise skin browning.
- Harvest systems that minimise damage to spinterns.
- Grading specifications to meet specifications for export.
- Research to increase the % meeting export standards for size and quality.

Initial market focus will be on easy to access, non-phyto markets. This could follow the Thai example. It is possible that an opportunity exists in Malaysia and Singapore, considering the exit of Thai rambutans and the season in Indonesia is Nov-Dec compared to Malaysian and Thai season of June – July. The increasing supermarket sector in both these countries is clearly a target for a higher priced out of season product.

Entry into the Arab States, EEC countries, and possibly Canada is not under any quarantine requirement. Thailand sells around 100 ton /year into the UAE, and smaller quantities into a number of European countries. All of this has to be air flown so will be expensive. All of these markets are not familiar with rambutans. Given the cost of air freight to Europe (+US$3/kg), it is likely that all will be small markets demanding very high quality for a high priced product.

For all of north Asia – China, Taiwan, Korea and Japan, access issues will need to be resolved, though fruit could be exported to Hong Kong with no entry requirement.