Australian Government
Australian Centre for International Agricultural Research

Final report

Small research and development activity

project

Papua New Guinea coffee and cocoa policy linkages

date published

November 2007

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project number

PLIA/2005/148

ISBN

978 1 921434 03 7

published by

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Canberra ACT 2601
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Glossary

ADB	Asian Development Bank
CIC	Coffee Industry Corporation
CMB	Copra Marketing Board
CPL	Coconut Products Limited
DAL	Department of Agriculture and Livestock
FAO	Food and Agriculture Organization
KIK	Kokonas Industri Koporasen
MTDS	Medium Term Development Strategy
NGOs	Non-government organisations
PNG	Papua New Guinea
UNDP	United Nations Development Program

Executive summary

- The payoffs from technical research and extension services in developing countries are often constrained by policy and institutional settings and the wider economic environment. That is, constraints from the operating environment can impact on the incentives of the target groups to take-up the outputs of that research.
- Understanding the policy environment is important to ensure that the technical research takes the impact of policy into account or endeavours to change policies that act as constraints. This principle applies equally to activities funded by industry, government and the donor community.
- The objective of this scoping paper was understand the operating environment of the coffee and cocoa industries in Papua New Guinea (PNG) including market structures and key constraints. Given this overall picture, this scoping paper would then make recommendations on further studies that could address usefully address key policy or other constraints.
- Coffee and cocoa are important cash crop industries in PNG. They provide the only means of generating cash income for a large proportion of the population.
  - They are produced in multi-product systems with subsistence crops. But importantly for smallholders, there is no specialisation.
  - Decisions and choices used in these systems are complex — designed to deal with risk — but are rational.
- PNG's coffee and cocoa industries are faced with a difficult environment in which to operate. There are numerous policy and institutional constraints that affect the incentives and decision making of smallholders and other industry stakeholders.
  - The comparative advantage of PNG in the production of these commodities is obvious, given the industry's capacity to produce competitively within these constraints. Particularly, these crops and the production systems in use allow smallholders to manage risk far better than any alternatives.

  - Policy makers should bear this in mind when considering options for support of traditional tree crops over non-traditional activities that are viewed as opportunities to increase incomes or reduce dependence on purchased foods.
- The key impediments to economic activity in these sectors have been well documented in the literature and by research ACIAR projects. These are roads, law and order (lack of security) and problems associated with land tenure and tribal conflict.
- In addition, we suggest the following factors could be added as binding constraints: capacity to hold money (more so than the availability of credit), and falls in health status that have directly affected ability to supply labour.
- The combination of these factors probably overwhelms many other issues that would be considered significant impediments in countries with better developed markets.

Value chain analysis

It is a commonly held view of coffee and cocoa that smallholders do not receive an adequate share of the export value. A key finding of this scoping study was that the value chain for both commodities is highly competitive and reflects the true economic costs and risks of doing business in PNG.

- In the case of cocoa, the smallholder price is on average 70 per cent of the export price. The processing and trading margins are thin, with operators relying on volumes to cover costs.
- For coffee, the smallholder price for parchment coffee represents around 80 per cent of the average fob price, while the red cherry price (in parchment equivalent) accounts for nearly 90 per cent of the equivalent fob price.
  - On average, processors work on a profit margin of 2 or 3 per cent: depending on shifts in the market, this margin can be negative.

Quality

Quality is widely cited as a problem for both commodities and is strongly linked to the structure of incentives along the value chain. A recent trend in activities by both industry bodies and by donors is to move away from research into factors that constrain yields towards improving quality-focused by capturing premiums or, more often, avoiding discounts.

- Cocoa produced in PNG is a relatively homogenous commodity —with a high proportion of output being graded at fair-to-average quality or equivalent to 'bulk' export category.
  - Smoke damaged or partially fermented beans, identified as a significant problem in previous studies, are being sold but with appropriate discounts in most cases which could be avoided by smallholders with appropriate quality control.
  - There is no apparent premium for wet bean over dry bean although some exporters prefer to use of commercial fertmentaries.
- Quality is more important for coffee. The current discount is around 12 US cents per pound relative to the world spot price for smallholder coffee. This translates to around 15 per cent and is not substantial given the formidable impediments identified above.
- The market is currently finding a number of ways to improve quality for both commodities using nucleus estate models and other direct arrangements between smallholders and processors.
- The current 20 per cent premium for fresh cherry over parchment coffee reflects the benefits to the processor in terms of quality assurance of having more control over production chain.
  - Many processors and traders are now attempting to capture premiums though organic or fair trade certification which requires working directly with smallholders.
- The main quality issue that is not being addressed by the market is smallholders who are located away from major centres, where it is not feasible to either sell fresh cherry or have regular contact with a processor or trader. The key constraint here is the overwhelming problem of transport including time taken and cost.
  - There are a number of different approaches currently being tested within PNG by the Coffee Industry Corporation (CIC), a current ACIAR funded project and by other donors including the Asian Development Bank (ADB) and the European Union (EU).
  - These approaches involve forming smallholders into co-operative groups and/or different vehicles of providing extension such as contracting out extension and asking smallholders for small payments.

Institutions

- While the key constraints dominate all behaviour, the relevant institutions also impact on profitability through regulation, imposition of levies and provision of research and extension activities.

  - These institutions are also the main vehicle of delivery of collaborative research.
- Donors should be aware of the strengths and weaknesses of these institutions in both completing research and the championing the proceeds.
  - Also, their impact on a day-to-day basis in terms of imposing levies cannot be underestimated.
- Institutions for both commodities, through collaborative work with donors, have been addressing the quality and smallholder problems through a combination of regulation, encouragement of co-operative groups of smallholders and alternative extension models.

Recommendations for further work

- The core outcome from this scoping study is that it is difficult to identify one single area of research with the potential to further identify or explain the policy and institutional environment that, when addressed, could realistically lead to an increase in production and incomes of smallholders and a greater uptake of existing research.
- This conclusion is the consequence of the observation that the main impediments faced by agricultural industries are so pervasive and inter-connected that only effective and concerted action by the PNG government, and by donors, over a sustained period can address the problems.
- Given this, it would be difficult to see how ACIAR acting unilaterally could act to release any one of these constraints. This especially given its charter of collaborative technical research. These constraints should continue to be actively considered during the design phase of ACIAR projects.
- The scoping study identified two potential project areas that would usefully contribute to activities by both ACIAR and more widely other donors and non-government organisations (NGOs).
  - A study that compares and contrasts the relative success of the rehabilitation of the Bougainville cocoa industry — particularly looking the role of institutions, private sector and donors. This could encompass the impact of regulation and extension delivery in promoting smallholder production.
  - A study that would detail and quantify the agricultural potential of an area which would demonstrate the payoffs to smallholders and to other stakeholders from improving road access, security etc. This could be used by donors to engage the PNG government.
- Separate project proposals will be developed for the PNG program.

1 Introduction

In May 2004, ACIAR's Board of Management approved a strategy where the Centre would make greater use of pilot or scoping studies that assess policy issues before making major technical research investments. The Board also felt that it may be important to have research on these important policy issues and their economic implications undertaken alongside or integrated with the technical research.

Understanding the policy environment is important to ensure that the technical research takes the impact of policy into account or endeavours to change policies that act as constraints. The logic of this decision was reinforced in a recent review of ACIAR's research on agricultural policy (Pearce 2005), which argued that policy settings have the potential to be a major influence on the effectiveness and impacts of particular technical research projects. The review pointed out that policy settings could negatively affect the incentives that shape the willingness of producers to undertake the investments associated with adopting the results of technical research.

Policy distortions can also lead to situations where the introduction of new techniques that have counter-intuitive and sometimes counter-productive effects. Undertaking policy and related economic assessments at the same time as the technical research can therefore be important to ensure maximum uptake and adoption of the technical results.

It is with these considerations in mind that ACIAR wishes to undertake a scoping study of the policy environment facing the coffee and cocoa industries in Papua New Guinea (PNG). ACIAR has a significant involvement with these industries (box 1.1), which are important cash crops for PNG, and are affected by some of the formidable challenges that face agricultural development in the country.

ACIAR's 2005 Country Profile for PNG identifies some of these challenges, listing poorly developed infrastructure, weak market signals and services, poor product quality, population pressure and future impacts of HIV/AIDS on the farming sector. However, it is evident that a broader

range of policy and institutional factors impact on the development of cash crops and the willingness of farmers, processors and traders to invest in new ways of doing things and in the associated physical and human capital. This report aims to highlight these factors and how they could influence the outcomes ACIAR's research investments in PNG's coffee and cocoa industries. It will also look at how ACIAR can structure its research projects taking into consideration constraints in PNG's policy settings to maximise the adoption of research results.

1.1 ACIAR and PNG's coffee and cocoa industries

Coffee and cocoa are PNG's second and third largest agricultural export products. They account for a significant part of the cash income of rural people in the country. ACIAR has had a number of projects dealing with these commodities, and in its operational plan for 2005-06 identified interventions in cocoa and coffee marketing, quality management and crop protection among its priorities for research collaboration. There are currently four active projects directly dealing with these commodities:

- ASEM/2002/041 — Improving productivity and the participation of youth in the Papua New Guinea cocoa, coconut and oil palm industries;
- PHT/2003/015 — Enhancing PNG smallholder cocoa production through greater adoption of disease control practices;
- ASEM/2004/017 Assessment and improvement of quality management during post harvest processing and storage of coffee in Papua New Guinea; and
- ASEM/2004/042 — Assessing and extending schemes to enhance the profitability of the PNG coffee industry via price premiums for quality.

Completed projects include:

- PHT/1995/136 — Cocoa fermentation, drying and genotype product quality assessment; and
- ASEM/1997/118 — Socio-economic monitoring and evaluation of research and development of the PNG cocoa and coconut smallholder sector.

2 *Market characteristics*

It is important to understand the physical and economic structure of cocoa and coffee production in PNG in order to identify the constraints facing producers and the implications for ACIAR research projects in these industries. This section will look at the characteristics of coffee and cocoa production in PNG.

Another consideration for ACIAR is how growers in PNG respond to price changes and how this could affect the adoption of technical research results. The PNG subsistence sector is often represented by perfectly inelastic supply for both food and cash crops. The key cash crops in PNG are copra, cocoa and coffee - all tree crops with long lives in (usually) no or low input systems. However, supply of these cash crops is actually highly elastic. Box 2.1 discusses this further.

Coffee

Coffee, along with cocoa and copra, is one of the main tree crops grown in PNG. According to the 2000 census, almost 47 per cent of rural households were engaged in coffee production. As is the case with the other major tree crops, coffee production from plantations has declined significantly since the 1980s. PNG's coffee industry has increasingly moved towards a smallholder-based system. Yields in the smallholder sector are generally poor, and compare unfavourably with both plantations and other countries in the region. There is some conflict regarding the extent of quality issues in the coffee industry. However, anecdotal evidence suggests that poor quality of some shipments may be damaging PNG's reputation on export markets. Between 1999 and 2003, the share of coffee exports in total agricultural exports fell from 27 per cent to around 14 per cent.

2.1 **Supply functions for tree crops**

A widely held view of subsistence agriculture is one of unresponsiveness to immediate markets and more generally the wider economic environment. However, within a certain range of supply, production from tree crops in PNG is highly price responsive. This responsiveness comes about through two components.

- Increases in land planted in response to periods of sustained high prices or in response to increase need for additional income by small holders.
  - This response will be asymmetric because of the productive life of trees and is conditional on the availability of land.
- Changes in production resulting from changes in area harvested, rather than changes in yield. The presumption here is that the main factor is the percentage of area planted that is harvested, rather than incomplete harvesting of all area planted.

Labour required for tree crops has a surprisingly high reservation price. This means that it usually takes a high return to that labour for the entire available crop to be picked. In many years, there is often a large amount left on the trees where prices are insufficient to compensate growers for the marginal costs of transporting and distributing the output. These costs are often high in PNG, particularly in regions where road and other transport infrastructure are poor and unreliable.

There is a stepped supply function for these crops. Supply is fairly unresponsive at prices that yield a return to labour at or below the reservation price. Above this price, supply is fairly responsive until the yield limits of current trees planted is met. Above this level, additional output requires investment by planting more trees. It takes from 3–5 years before trees become productive, so smallholders must make risky long-term decisions in order to significantly expand production.

This aggregate response is a function of three parts of micro behaviour:

- supply of female labour is highly unresponsive to return while it is very elastic for men;
- law and order problems seriously undermine the security of potential proceeds from picking crops; and
- spatial dimensions and a lack of transport infrastructure mean that the price needs to be quite high for the pick rate to approach 100 per cent.
  - Smallholders in areas adjacent to roads would be more likely to pick their entire crop at a low price than smallholders in more remote areas.

The resource base

It is extremely difficult to get an accurate measure of land planted to coffee in PNG. Best estimates put this figure at around 70 000 hectares. Over 60 000 hectares are now accounted for by smallholders, while the share of total coffee area accounted for by plantations has decreased from around 30 per cent during the 1980s to around 11 per cent currently.

Since the 1970s land planted to coffee has probably doubled. This increase has been in response to price increases and smallholders' income requirements. We know that in PNG that most coffee is shaded which is consistent with a no input high-risk production environment (see box 2.2).

2.2 **Why PNG has shaded coffee**

PNG is characterised by coffee grown under shade or in areas with high levels of cloud cover, based on a production system using no low purchased intermediate inputs. This is because unshaded coffee requires higher levels of external inputs: the conditions under which sun coffee is grown encourages coffee leaf rust, which, without fungicide use, lowers yield. Also, because of direct sunlight, weeds tend to be more of a problem and grow faster, which without herbicide use or additional labour effort, reduces yield. Unshaded coffee also often requires more fertilisers, because of the higher levels of metabolism and production of the crop. Coffee in some highlands areas is not grown under trees where cloud cover provides sufficient shade to effectively operate a shaded system. Some species of shade trees can fix nitrogen, enriching the soil. These trees can also provide litter, which act as natural mulch, reducing the need for fertilisers and herbicides. They also provide habitats for some natural enemies of pests, and wild life and help prevent soil erosion.

In the short term, increased costs of inputs for unshaded coffee can mean that the increased yields do not translate into increased profits for the smallholder. In the long term, sun coffee is also more costly than shaded coffee because the productive life of the trees is much shorter. Sun coffee trees' productivity declines after 6-7 years, while shade coffee trees have a longer life but with lower productivity.

Kimani et al (2002).

An Arabica cultivar is generally used in PNG. It has compact growth, good quality and high resistance to Coffee Leaf Rust (CLR) (World Bank 1997). There are conflicting reports of productive tree age across countries. For instance, a Brazilian researcher suggests a productive life span of just 15 years. But it is suspected that these are high yielding, high input and unshaded trees.

Low-input shaded coffee Arabica trees should have a significantly longer life even at the yields observed in PNG throughout the 1970s and 1980s. A presentation in 2001 suggests current tree ages in PNG of up to 50 years and that good maintenance practises are a significant constraint for the smallholder sector (Gimbol 2001).

> Trees in the small holder sector are between 25 and 47 years old. Some plantation trees are equally old while others are much older. If the tree stock is not replenished or brought back into full production capacity through rehabilitation and replanting, the industry is in danger of facing eventual decline. There are very little or no re-investments in the plantations, while trees in the blocks are relatively young as they were promoted and planted in

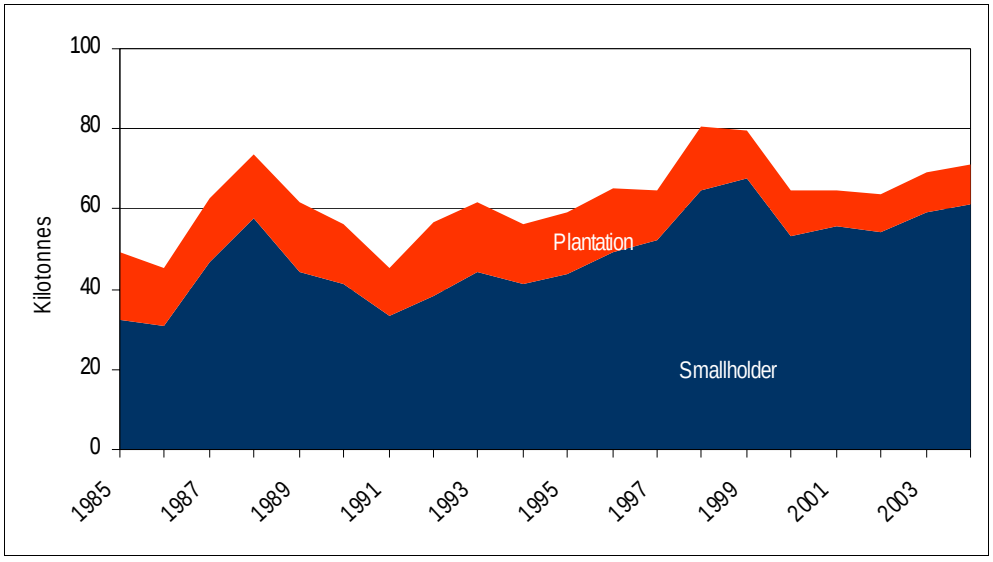
the 1980s. The corporation's effort to convince small holders to prune their aging coffee trees is ongoing.

Currently abandoned coffee blocks with trees 30 years and older are being rehabilitated successfully. Because of the extended productive life of shaded coffee trees, particularly Arabica, plus the limited pressure on land in most regions except in the Southern Highlands, most of the area in PNG that has been planted to coffee should be either still in production or could be economically rehabilitated. On the face of this evidence, there appears to be significant potential in PNG for increasing yields and harvesting rates.

Structure of production

Production in PNG is now largely smallholder based. In 1985, around 65 per cent of coffee in PNG was produced by smallholders. This figure has increased to over 85 per cent. Chart 2.3 shows how the production has moved from the plantation to smallholder sector.

2.3 **Coffee production from plantations has declined**



Data source: PNG Coffee Industry Corporation (pers.comm. October 2005).

Average yields per hectare picked have probably been in decline since the 1970s when there was a concerted attempt to provide extension to smallholders on the benefits from tip pruning, and basic tree and block management (see Densley 1976). In the mid-1970s, smallholder yields were around 1 tonne per hectare and 1.3 tonnes per hectares for plantations. Recently the CIC (2002) stated that:

> …yields estimated at 700kg green bean per hectare for the most efficient producer, considering that crop husbandry and maintenance is minimal, fertilizer application and other yield-enhancing inputs is practically nil.

Evidence now suggests that average smallholder yields are around 300kg, falling to 100kg per hectare for blocks in some areas. Pruning is one of the best ways to sustain yields and extend the productive tree life — understanding why this basic management is not taking place is a major challenge for all stakeholders in the industry.

The decline in observed yields probably applies more to plantations than to smallholders because of their response to economic realities.

- It is likely that plantations use both hired labour and purchased inputs. One of the reasons for the decline in production by plantations is that systems based on purchased inputs are inherently risky in PNG in terms of both cost and reliability.
- Production by both smallholder and plantations would have declined because of general declines in soil fertility, ageing of trees, poor pest control and general mismanagement.
- In addition, there have been a number of land disputes where traditional landowners have been 'reclaiming' abandoned land.

There are good reasons why smallholder production is based on no-input systems. This is the result of rational responses to the economic environment that producers face and the risk associated with making decisions to use inputs or investment. These factors will be explored more in the next chapter.

Location

Coffee production is centred mainly on the Eastern and Western Highland districts, which produce over 75 per cent of PNG's coffee. Table 2.4 shows the distribution of coffee production in PNG for 2002. Although this data is now dated, the composition of production should be reasonably representative of the current situation. Since 2002, the significance of *Robusta* coffee, grown in provinces with lowland areas, has increased albeit off a low base.

The concentration of production in the Highlands, around the centres of Goroka and Mt Hagen, raises significant issues in relation to the Highlands Highway and the implications of its deterioration on coffee growers. Growers and processors near the highway suffer from uncertain and costly transport, while access roads to the highway are extremely poor in some

areas, non-existent in others. This affects smallholder decisions, because produce often needs to be physically carried to brokers, which is risky and labour intensive.

2.4 **Distribution of coffee production 2002**

	Production	*Share of total production*
	No. 60kg bags	%
Western Highlands	500 647	47.0
Eastern Highlands	313 051	29.4
Simbu	103 095	9.7
Morobe	83 920	7.9
East-Sepik	17 533	1.6
Enga	30 171	2.8
Southern Highlands	14 150	1.3
Oro	1 282	0.1
Madang	153	0.0
Central	221	0.0
Total	**1 064 223**	**100.0**

Source: PNG Coffee Industry Corporation (pers.comm. October 2005).

Coffee production chain

Production at farm level, however, is just one component of the coffee production chain. Like most commodities, coffee requires an integrated approach to manage quality assurance – even if production is largely based around smallholders in PNG.

Chart 2.5 summarises our understanding of the coffee production chain in PNG. In the case of plantations, land is combined with hired labour and other purchased inputs. For smallholders, family labour is combined with land but with few other purchased inputs.

The first step post harvest is the separation of ripe red cherries from overripe coffee cherries, dirt, sticks and leaves. Separation can be done by winnowing, which is commonly done by hand using a large sieve, or by flotation which is most often used commercially. Overripe coffee cherries, undeveloped coffee cherries and sticks and leaves float in water. Ripe coffee beans and green coffee cherries are dense and sink. Both the ripe and green cherries can be then processed using the natural (dry) process or can be sent to for wet processing.

Dry processing

The oldest and simplest method of processing is dry processing using the sun. The coffee cherries are spread out in the sun, either on large concrete

or brick patios or on matting raised to waist height on trestles. As the cherries dry, they are raked or turned by hand to ensure even drying. It may take up to 4 weeks before the cherries are dried to the optimum 12.5 per cent moisture content, depending on the weather conditions. On larger plantations, machine-drying is sometimes used to speed-up or finish of the sun-drying process.

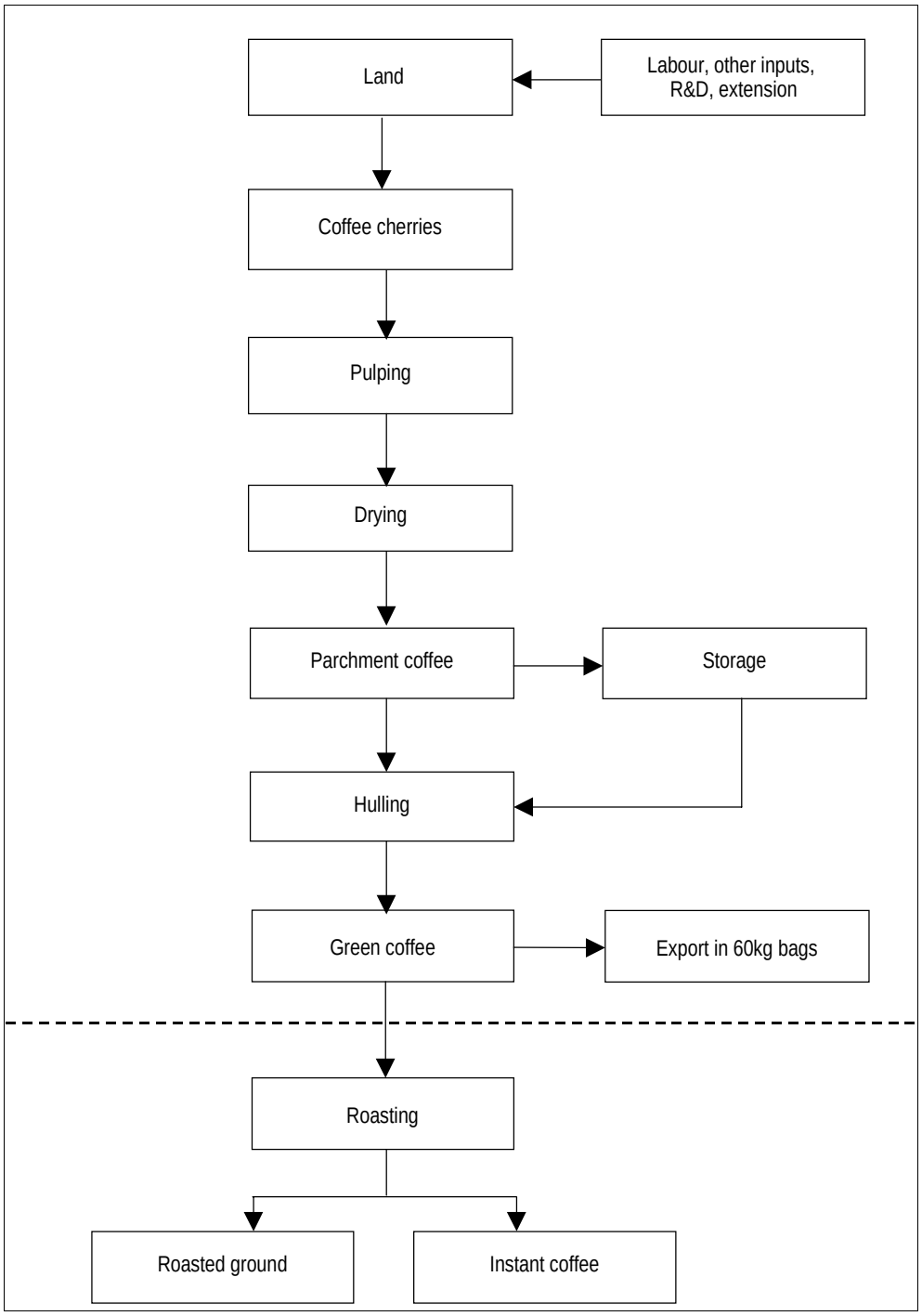
Dry processing is not officially recognised by the CIC in PNG and is not naturally suited to PNG due to high rainfall and lack of flat land for drying. Dry processing is not overly common in other countries, and is largely limited to countries where rainfall is scarce and long periods of sunshine are available to dry the coffee properly. Brazil, Ethiopia and Yemen all use dry processing to some extent.

Wet method

It is generally accepted that the wet method is required to achieve the best quality results. There are generally two types of wet processing plants: the small village business or the large private factory. This stage can be performed in small buildings made of timber, brick or iron — at a village level. Villages may also process cherries by immersion in running water at a nearby river. At plantation or factory level, cherries are processed in large concrete vats. These operations would be located nearby a regional centre and be highly capital intensive.

Red berries are pulped using water, then left to ferment for up to 48 hours. The pulping is done by a machine, which squeezes the cherries between fixed and moving surfaces. The flesh and the skin of the fruit are left on one side and the beans, enclosed in their mucilaginous parchment covering, on the other. The clearance between the surfaces is adjusted to avoid damage to the beans. The pulping operation needs to be done within 24 hours of harvesting to avoid any deterioration of the fruit, which might affect the quality of the beans. The pulped beans are then sorted from the imperfectly pulped cherries on vibrating screens.

2.5 **Coffee production and wet processing chain in PNG**



Source: CIE.

The next stage is fermentation, where the mucilage is removed. The pulped beans are placed in large fermentation tanks in which the mucilage is broken down by natural enzymes until it is dispersible and can be washed away. This process generally takes between 24 and 36 hours. When the fermentation is complete, the coffee is thoroughly washed with clean water

in tanks or in special washing machines. The wet parchment coffee at this stage consists of approximately 57 per cent moisture. To reach the optimum 12.5 per cent the parchment is then dried either in fresh air and direct sunlight or by mechanical dryers. In general, smallholders would dry parchment in sunlight while factories would use mechanical dryers. Estates use both mechanical dryers and sun drying to minimise costs.

Therefore getting coffee from the cherry to the parchment stage is a fairly intensive process. A significant problem is that cherries are often not harvested at the optimum time. Following harvesting, there are several stages where mishandling can seriously affect the final quality of the coffee and so returns for that coffee. Smallholders in particular do not have the capacity to follow best-practice, especially the requirements for processing the cherry within 24 hours and access to capital and the large quantities of clean water required.

Storage and dry processing

The dried cherries are stored in bulk in special silos until they are sent to the mill where hulling, sorting, grading and bagging take place. Parchment coffee can be stored for up to 12 months given that they have been dried correctly during processing and placed in a dry location. To this stage, 5kg of fresh cherry makes 1kg of parchment. Parchment can be stored both by smallholders and by processors or traders. This is useful for smallholders who don't have access to savings facilities.

Parchment coffee is then hulled (the dry processing step) producing a green bean, which is split into two equal semi-circular halves. The green beans are sorted by weight and size and the poor quality beans are removed.

Exports

Around 97 per cent of PNG coffee is exported to international traders and consumers overseas. The remainder is processed locally by roasting green beans (see chart 2.5). It is likely that only very small amounts of instant coffee are manufactured in PNG. In the past, coffee was exported exclusively in 60kg bags. However, this has begun to shift with more bulk shipments being carried out each year. The main shipping port, Lae, is approximately 300 kilometres from Goroka.

The coffee value chain

The next step is to develop the production chain into a value chain that describes the important economic features of producing and exporting coffee. All parts of the value chain are inter-dependent in determining the cost-effectiveness and quality of green coffee bean quality that is exported from PNG.

Chart 2.6 shows our understanding of the coffee value chain. At farm level, the inputs for smallholders are land and family labour. For plantations, inputs apart from land would include hired labour, management and limited inputs such as fertilisers and other chemicals.

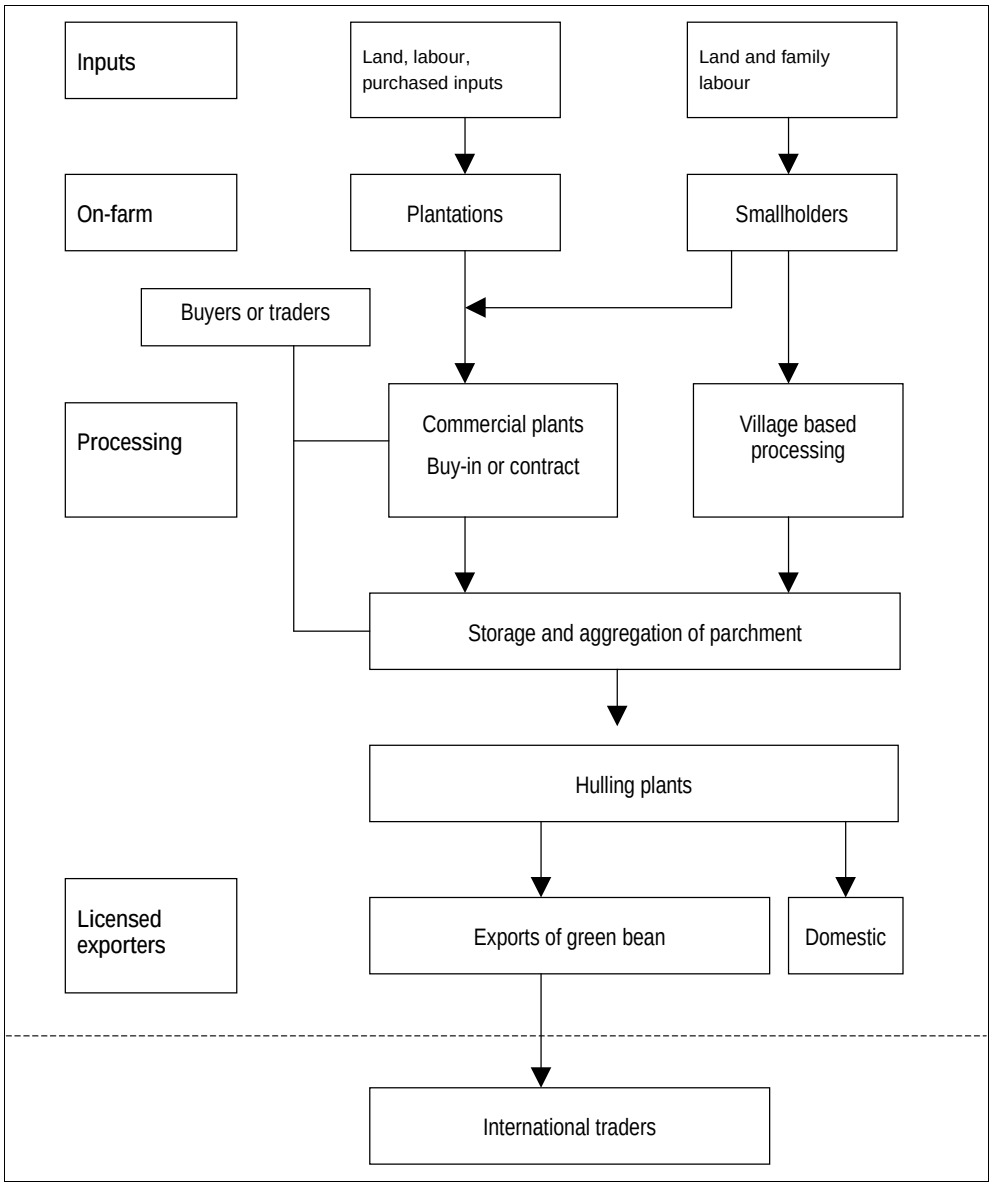
The next step is to process the coffee cherries into parchment. This can take place on-farm, within the village or on plantations, or in commercial plants located in the centres of the regional coffee areas. This decision would depend on:

- the proximity of the growing area to suitable processing facilities (regional centre) or to passable feeder roads for sale to coffee buyers;
- the capacity of smallholders to process cherries themselves; and
- trade-offs between prices received for fresh cherries and for parchment if processed on own-account.

Growers in remote areas may have little effective choice than to process the cherries themselves and walk the parchment coffee out for sale to parchment buyers who drive up and down the highway and its feeder roads. Independent parchment buyers are numerous local entrepreneurs who purchase parchment coffee either from the coffee markets of the major town centres or directly from the rural source. They then either sell the parchment coffee to the processing mills or have it processed to green beans which they then sell to the exporters.

A feature of chart 2.6 is the high degree of integration — to maintain quality assurance — exporters would want to maintain as much control over the value chain that is possible. This is emphasised by the fact that, at the smallholder level, red cherry trades at a significant premium to parchment — as much as 20 per cent. This reflects the fact that processors require for more control over the production process, but also that it is easier to pick up deficiencies in cherry than parchment.

2.6 **Coffee value chain in PNG**



Source: CIE.

Smallholders receive only a flat price for parchment, which reflects the potential for poor quality and the risks of collecting and distributing the parchment. Parchment is sold on a weight basis, often contaminated with soil or other materials, on a roadside or market. This often means that smallholders who produce better quality parchment, in terms of bean size and profile of defects, are not rewarded. This distorts the incentives for smallholders to put more effort into producing better quality parchment. However, the margins achieved by processors reflect not only the value added involved in processing to green bean stage, but also the cost and associated risks of marketing the product to end consumers.

Exporters can only buy green bean coffee. Most coffee is transferred from the processing mills to the exporters' premises where blending and or reconditioning are carried out to meet the final buyers' needs.

Value chain is competitive

A widely held view is that smallholders do not receive an adequate share of the export value of many cash crops. A key finding of this scoping study was that the value chain for coffee is highly competitive and both reflect the true economic costs and risks of doing business in PNG.

A simplified value chain for the PNG coffee industry is set out in table 2.7. The current market demonstrates a premium of fresh cherry over parchment of between 18 and 25 per cent. The smallholder price for parchment coffee represents around 70 per cent of the average fob price, while the red cherry price (in parchment equivalent) accounts for between 80 and 90 per cent of the equivalent fob price. This is due to the fact that many of the processing and transport margins are fixed on a per kilogram basis rather than in percentage terms. On average, processors work on a profit margin of 2 or 3 per cent. Depending on shifts in the market, this margin can be negative if the export price shifts quickly and they are holding significant amounts of bean bought in at the old export price equivalent or have purchased parchment that does not perform as expected.

In summary, the processing sector is highly competitive and bears the majority of the price risk of the chain. This simple analysis plus anecdotal evidence suggests that it is coffee growing is the scare factor in the supply chain.

2.7 **Price components of fob price of coffee**

Value chain stage	***December 2005***	***May 2006***
	PNG t/kg	PNG t/kg
fob price Y grade	*624*	*665*
Parchment at factory door	340	380
Green bean equivalent	425	475
% fob price	*68*	*72*
Cherry at factory door	80	95
Green been equivalent	400	475
Green bean equivalent	499	593
% fob price	*80*	*89*
% premium to cherry over parchment	*18*	*25*

Source: PNG Coffee Industry Corporation (2006) and CIE estimates.

Location of processors is important

Table 2.8 below shows where coffee processing is located in PNG. Most of the non-growing activities are centred on the major centres along the Highlands highway of Goroka, Mt Hagen and Lae.

Cherries need to be processed within 24 hours of picking. Chronic transport and access problems severely limit the effective areas from which factories can source cherries. Localities outside this area, or those areas that are accessible only by foot, have no option but to process their own cherries to the parchment stage.

It is likely that integration of coffee factories and export activities would lead to arrangements where cherries would be sourced from reliable producers. Factories would either purchase the cherries outright or process on a contract basis. The premium paid for cherry in table 2.8 shows the importance of growers' proximity to processing for the value chain.

2.8 **Location of major coffee processing facilities** [a]

Centre	*Factories*			*Coffee type*	*Province*
	Wet	*Dry*	*Exporters*		
	No	No	No		
Goroka	15	9	6	Arabica	Eastern Highlands
Kainantu	5	6	0	Arabica	Eastern Highlands
Mt Hagen	12	18	5	Arabica	Western Highlands
Banz	4	3	0	Arabica	Western Highlands
Lae	5	1	4	Arabica	Morobe
Bulolo	1	0	0	Robusta	Morobe
Kerowagi	1	0	0	Arabica	Simbu
Kundiawa	2	1	2	Arabica	Simbu
Wewak	1	0	0	Robusta	East Sepik
Wabag	1	0	0	Arabica	Enga
Yonki	1	1	0	Arabica	Eastern Highlands
Total	**48**	**39**	**18**		

[a] Licensed coffee processing factories and exporters as of January 2004.

Source: PNG Coffee Industry Corporation (pers.comm. October 2005).

Prices received from buyers by smallholders in outlying areas would therefore depend critically on how well those smallholders process the cherries to the parchment stage. Processing within a village setting is probably hit or miss in terms of quality or results in an increased risk of theft. These factors may explain why smallholders selling parchment receive the same relatively low price — because the quality of the product is unknown.

2.9 **Grades of coffee in PNG**

Grade	*Description*
AA/A	▪ Represents gourmet coffee from the plantation sector.
	▪ Bean size is greater than screen 17 (80mm+), uniformity is good with maximum 10 defects per kilogram. The raw bean is bluish-green in appearance.
X	▪ Also from the plantation sector, but is smaller in size.
	▪ Bean size is mixed, but generally over screen 14, with good uniformity and 15-20 defects per kilogram. The raw been colour is greenish.
PSC X	▪ Premium smallholder falls between the Y1 and X grade coffees.
Y1	▪ Has a mixed bean size and uniformity, up to 70 defects per kilogram and is greenish-grey in raw bean colour.
	– Nearly all smallholder coffee is classified into this grade.
Y2	▪ Distinguished by more defects than Y1
Y3	▪ Triage has a mixed bean size and uniformity, with a maximum of 3 per cent foreign matter, and is yellowish faded green in raw bean colour. It has no excessive foreign odours or flavours
Rob	▪ Robusta is grown in the lowland areas of Northern Sepik, Morobe and Madang.

Source: http://www.nghce.com.pg/png_coffee and PNG Coffee Industry Corporation (pers.comm. October 2005).).

Grades of coffee in PNG

There is a perception that quality a large constraint to prices received for coffee by smallholders.

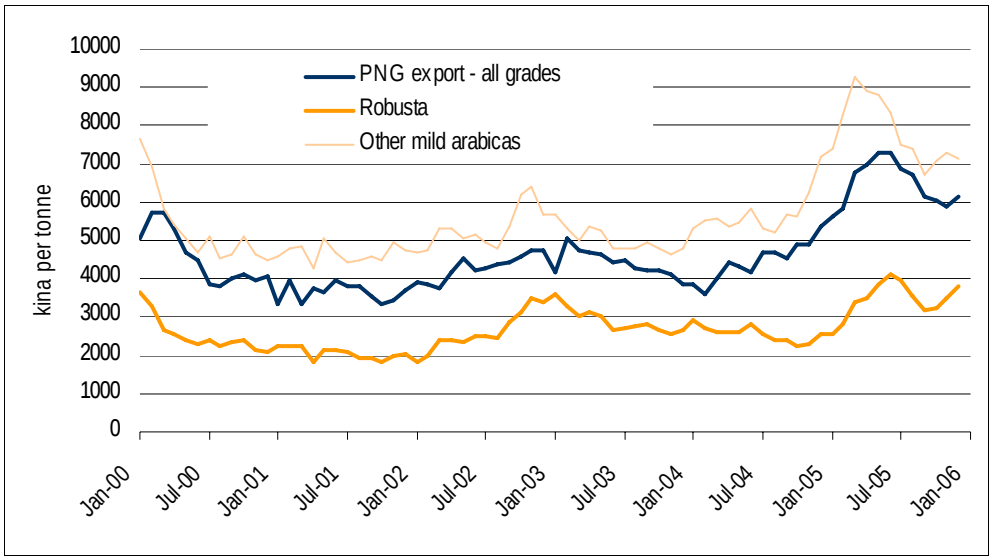
In PNG there are currently 11 grades based on size and colour of the bean, number of defective beans and with organic or fair trade certification. Table 2.9 lists some of the key classifications. The grading system appears to provide sufficient differences to reward smallholders for improvement in quality — that is to upgrade from Y1 grade to premium smallholder grade.

As expected Y1 grade has always been the major grade of coffee exported from PNG. In the 1997-98 season, Y1 represented 63.5 per cent of exports while PSC X accounted for 12.5 per cent, X grade 11 per cent, A grade 4.5 per cent, Robusta 4.5 per cent and Y3 grade 4 per cent. In addition, organic A, organic X and coffee exported under fair trade certification are also becoming important especially to the United States.

How PNG coffee compares to other countries

Anecdotal evidence suggests that increased returns are available from increasing the quality profile for PNG as currently it attracts significant discounts relative to coffee produced in other countries.

2.10 **Average PNG coffee price received and other coffees** [a]



[a] Other mild *Arabicas* excludes Brazilian and Columbian mild *Arabicas*.

Data source: Bank of Papua New Guinea Quarterly Economic Bulletin and International Coffee Organisation.

Chart 2.10 compares the average PNG fob return for coffee — across all *Arabica* grades and *Robusta* coffee — with the spot prices for *mild Arabica* and for *Robutsa*. While is comparison is indicative only, it is interesting to note that:

- *Robusta* sells at a 50 per cent discount to mild *Arabica* coffee in terms of world spot prices;
- after adjusting for the fact that between 5 and 10 per cent of PNG coffee is *Robusta*, the average export price for PNG *Arabica* is around 15 per cent lower than the world price of *Arabicas*, other than that from Brazil or Colombia.
  - From month-to-month this discount can vary considerably from no difference to 35 per cent.
  - But due to the composition of quality and the reliability of data too many conclusions should not be drawn.

The CIC reports that for the 2005 calendar year, the average discount on Y1 grade coffee was 12.9 US cents per pound which translates to 14.5 per cent of the average export price of 605.8 toea per kilogram for Y1 grade. However, organic and plantation grades attracted significant premiums.

This evidence, combined with the fact that most smallholder coffee falls into a grade lower than that for plantation and certified production, indicates that quality could be a significant problem for coffee. A key question is what is the trade-off between the additional effort required by the smallholder and processor versus the additional premium from better

quality? If this shortfall was easy to make-up, the market would have already adjusted by making the required quality improvements. However, given the nature of the constraints facing the value chain, an average 15 per cent discount reflects a highly competitive and efficient industry.

Institutions

The CIC was established in 1991. It incorporated the functions of three other statutory bodies — the Coffee Development Authority, the Coffee Research Institute and Coffee Industry Board. The CIC is based in the Eastern Highlands in Goroka and it has two main functions:

- smallholder extension and research; and
- industry regulation.
  - It was also responsible for the administration of the price stabilisation program when it was operational.

The smallholder extension and research program run by the CIC is effectively an extension of the Training and Visit system that was run under the Coffee Development Authority. The extension services provided by the CIC are generally regarded as good, with 'clear focus, deliverable extension packages, and well trained, motivated and adequately resourced staff' (World Bank 1997). The CIC estimates that 80–85 per cent of smallholder coffee growers are covered by its extension services, though this estimate may be optimistic.

Cocoa

Cocoa is the third largest export-earning crop in PNG after palm oil and coffee. Between 1999 and 2003, cocoa accounted for an average of 9 per cent of total agricultural exports. The overall share of cocoa also increased over this period from 5 per cent to 12 per cent.

The resource base

It is difficult to get a consistent estimate of the area of land planted to cocoa in PNG. Food and Agriculture Organisation (FAO) data suggests that around 99 000 hectares of land is currently planted to cocoa. However, FAO data is generally unreliable. The only reliable measure was in the 1970s, which suggested that around 80 000 hectares was planted to cocoa (Densley 1973). Production tends to vary with prices — when prices are higher more area is harvested, leading to higher production. So production

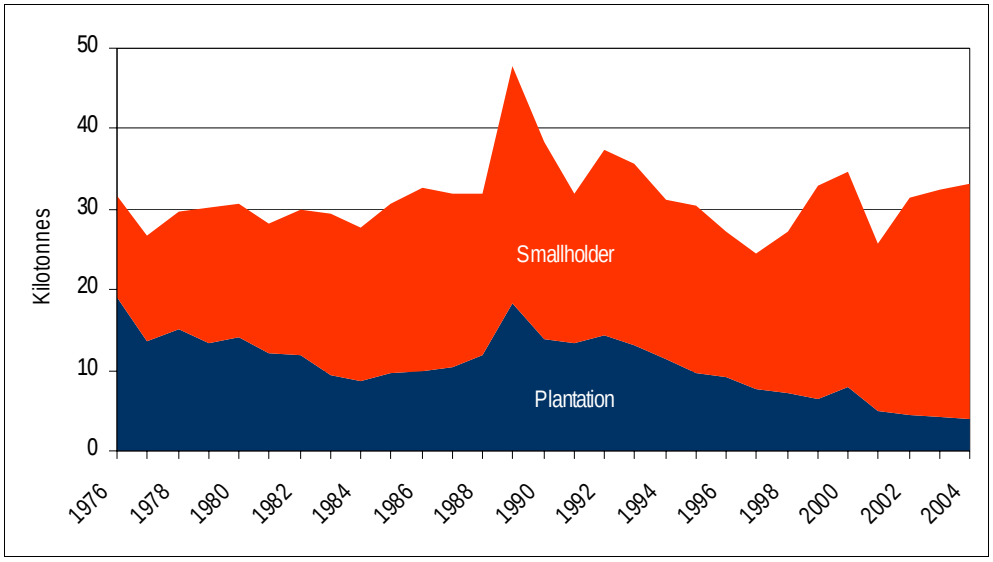
can vary significantly from year to year, but it would be reasonable to assume that area planted is reasonably stable. The average life span of a cocoa tree is around 25 years and trees take between 3 and 5 years to become productive.

Structure of production

Like coffee, production of cocoa in PNG has moved from a system where the majority of cocoa was produced in plantations, to a system dominated by smallholders. Chart 2.11 illustrates contribution of production in the plantation and smallholder sectors.

According to the Cocoa Board of PNG, the share of production from plantations was as high as 60 per cent in 1976. This figure has fallen to just 12 per cent in 2004. The reason for this decline is that the smallholder sector uses very little inputs, while inputs to the plantation sector have largely become too costly and risky.

2.11 **Smallholders now dominate production**



Data source: Cocoa board of PNG.

As with coffee, cocoa is produced using a largely shade based system in PNG. Unshaded systems require far more inputs, and as so aren't viable for PNG smallholders. Cocoa can be under-planted with other trees such as bananas, but these typically have a shorter life span than cocoa trees and need to be renewed. Coconut trees are long living and well established and using them as shade for cocoa trees even when they are not highly productive is common. In the 1970s, an estimated 75 per cent of cocoa was interplanted with coconut trees (Densley 1973). Because of this relationship,

it is also important to consider copra production in PNG, as the conditions and incentives facing growers in copra will affect decisions by cocoa growers. Appendix A outlines the key features of the copra industry in PNG.

Data sets available on total exports and production by province can be contradictory. Data available for 2003 suggests the East New Britain and Bougainville accounted for 70 per cent of total production in PNG of both export and non-export quality cocoa. As a proxy of production by province, table 2.12 shows the distribution of the 2 500 licensed cocoa bean fermentaries in PNG.

2.12 **Location of licensed bean fermentaries in PNG**

Province	***Fermentaries***
Western	0
Gulf	4
Central	5
Milne Bay	7
Oro	58
Morobe	26
Madang	296
East-Sepik	168
Sandaun	4
Manus	13
East New Britain	1570
West New Britain	81
New Ireland	105
Bougainville	161

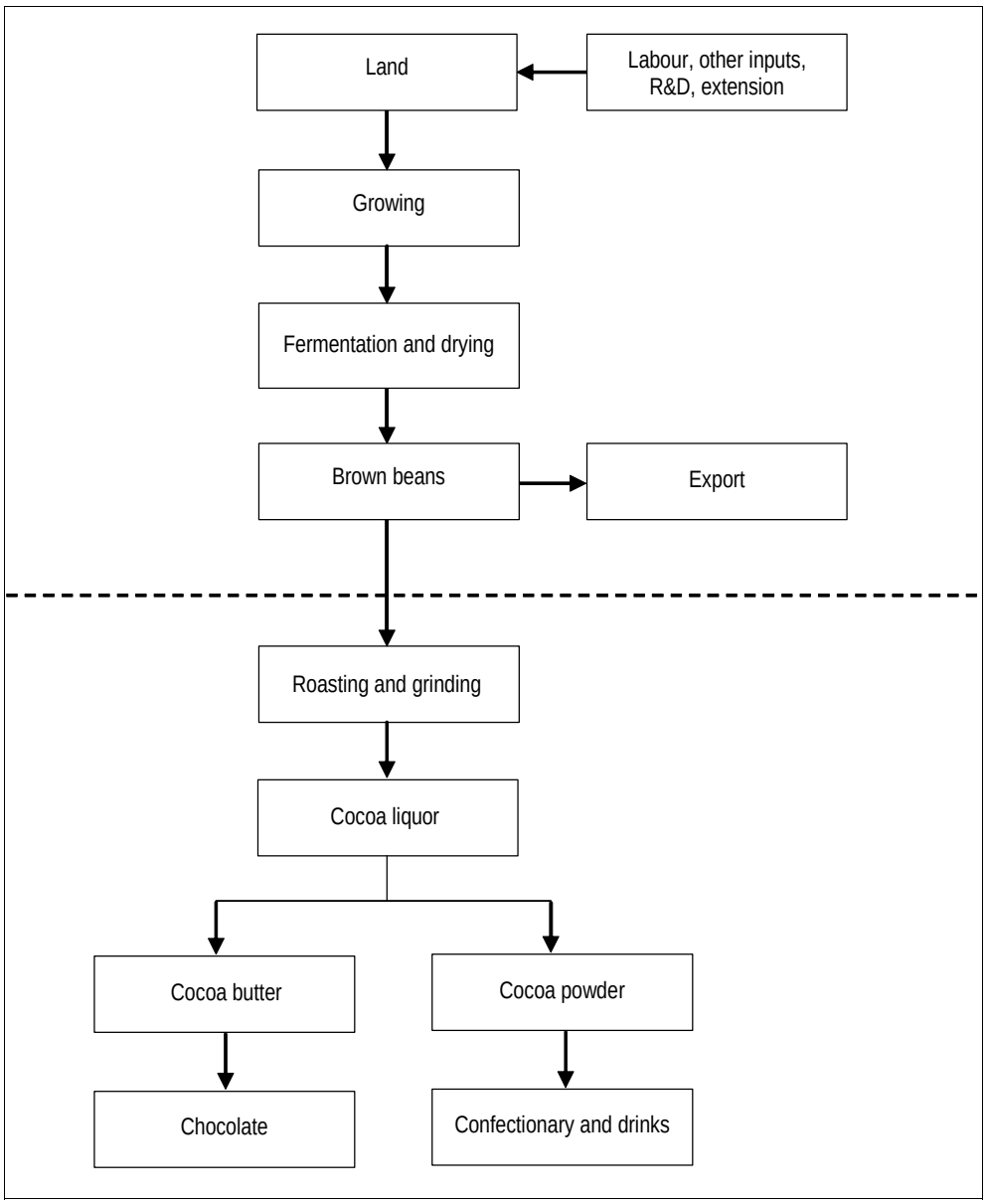
Source: Cocoa Board of PNG.

Cocoa production chain

Chart 2.13 summarises the production chain for cocoa, which for PNG ends with the export of cocoa beans to international traders and purchasers overseas. The production chain for cocoa is simpler than for coffee, but there are still areas where incorrect harvesting and handling can affect the final quality of the beans.

Pods containing cocoa beans grow from the trunk and branches of the cocoa tree. Harvesting involves removing ripe pods from the trees and opening them to extract the wet beans. The pods can be opened to remove the beans within a week to 10 days after harvesting. In general, the harvested pods are grouped together and split with a wooden club or machete.

2.13 **Cocoa production chain in PNG**



Source: CIE.

After extraction from the pod the beans undergo fermentation and drying before being bagged for export. How these steps are carried out is important for the overall quality and performance of the cocoa in later stages of the production chain. Fermentation can be carried out in a variety of ways, but all methods depend on removing the beans from the pods and heaping them together to allow micro-organisms to develop and initiate the fermentation of the pulp surrounding the beans.

On smallholdings, fermentation is usually done in heaps of beans for quantities from about 25–2500kg. Fermentation takes five days with some

growers mixing the beans on the second or third day. In PNG fermentaries must be licensed by the Cocoa Board.

In plantations or commercial fermentaries, fermentation is normally carried out in large wooden boxes that typically hold 1 to 2 tonnes of beans. The boxes must have provision for the liquefied pulp to drain away and for entry of air. Boxes can measure 3 to 5 foot across and be 3ft deep, but shallow levels (10-20 inches) of beans are preferred to promote good aeration. The beans can be covered with banana leaves or sacking to conserve the heat generated during fermentation. Beans can be transferred from one box to another each day to ensure uniform fermentation and increase aeration. The boxes can be tiered to allow easy transfer of beans. Commercial scale fermentaries like those in East New Britain are based on cascading boxes which ensure the best quality outcome in terms of flavour and acidity of the dry bean.

Drying

Cocoa beans are dried after fermentation in order to reduce the moisture content from about 60 per cent to around 7.5 per cent. Drying must be carried out carefully to ensure that off-flavours are not developed. If the beans are dried too quickly some of the chemical reactions started in the fermentation process are not allowed to complete their work and the beans are acidic with a bitter flavour. However, if the drying is too slow moulds and off flavours can develop. Research indicates that bean temperatures during drying should not exceed 65 degrees Celsius.

There are two methods for drying beans — sun drying and artificial drying. For sun drying the beans are spread out on mats, trays or on concrete floors in the sun with the beans are normally turned or raked to ensure uniformity of drying and the beans need to be covered when it rains. Artificial drying is used where there is a lack of pronounced dry periods after harvesting and fermentation. Artificially dried beans can be of poor quality due to contamination from the smoke of fires or because the cocoa is dried too quickly. Other artificial driers are platform driers using heat exchangers using oil or solid fuels as a source of power. Solar drying boxes have also been developed for PNG with some success. Smoke taint is the most common problem encountered in PNG cocoa.

Cocoa value chain

Chart 2.14 illustrates our understanding of the value chain for cocoa. Like coffee, the farm-level sector is made up of smallholders and plantations

with production proportions already identified earlier. Processing — involving fermentation, drying and bagging — can take place in either commercial plants or within a village context.

The decision to process the cocoa beans on-farm or by a commercial plant would depend on a range of factors including:

- the relative price received for white and brown bean by smallholders;
  - this would depend on perceptions of buyers and traders of the quality of beans processed by smallholders;
- the distance between the point of production and the commercial plant and so the cost of transport and processing.

Currently, wet bean is trading for around 1 Kina per kg, while dry bean is trading for around 3.50 Kina per kg. It takes around 2.8kg of wet bean to produce 1kg of dry bean. This means, at current prices, processing costs are around 60 to 70 toea per kg. Large processors are generally indifferent between buying wet and dry bean from smallholders — in contrast to coffee, where there is a clear preference for fresh cherry. This reflects in part the simpler processing in cocoa, but also the fact that processors can tell if dry bean has been processed incorrectly and can price it accordingly.

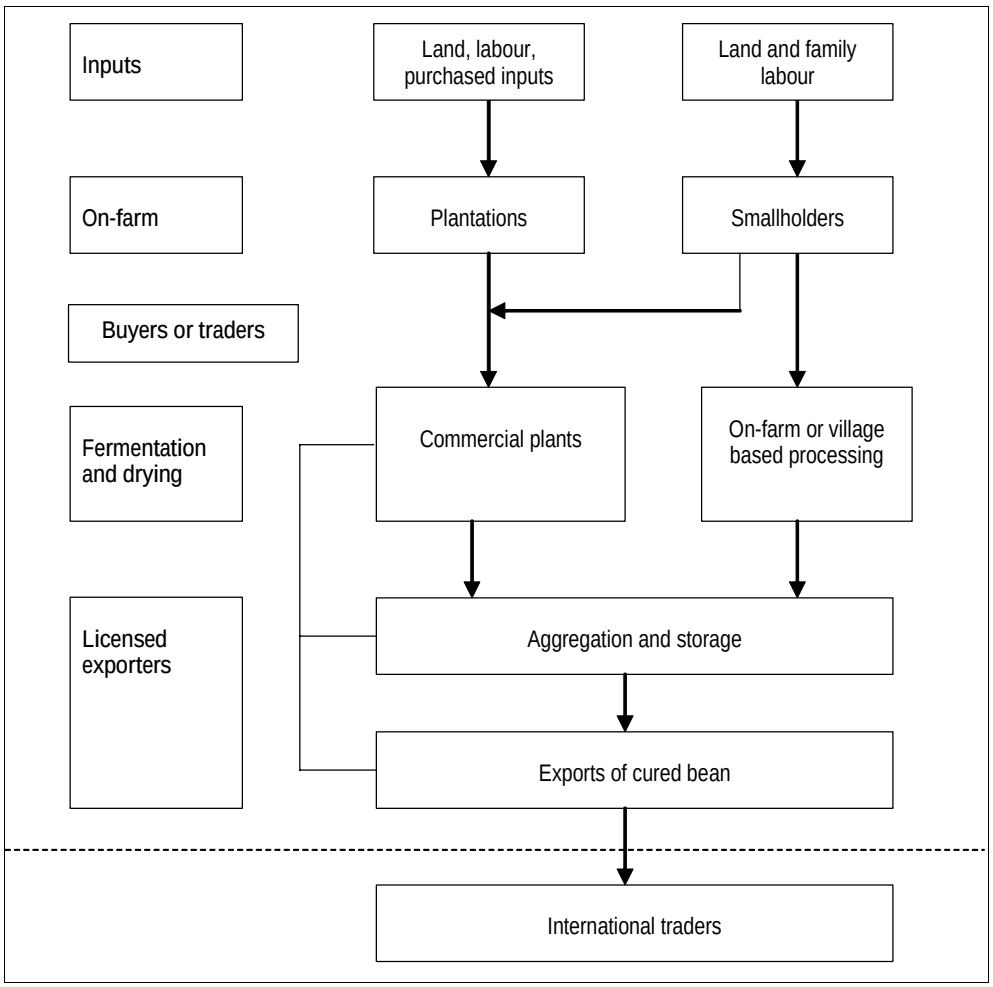
After processing, cocoa is purchased, stored and aggregated into lots for export by licensed exporters.

Table 2.15 summarises the key price points in the cocoa value chain for the bulk or fair-to-average export grade. The features are:

- that the price paid to the smallholders and plantation is around 70 per cent of the fob value;
- that the traders margin is a small part of the fob price; and
- there is no apparent premium paid for wet bean over dry bean as is the case for coffee.

Cocoa is a ‘commodity’ for which the largest marketer in PNG, who exports around 70 per cent of the crop, maintains margins by building volumes. There is no apparent premium for wet bean over dry bean principally for this grade because buyers and traders can detect lower quality beans, say through smoke damage, and discount them appropriately. The processing yield for PNG cocoa (dry bean from wet bean) averages around 38 per cent and can be as low as 33 per cent from smallholders and as high as 48 per cent from plantations.

2.14 **Cocoa value chain in PNG**



Source: CIE.

2.15 **Value chain for cocoa May 2006**

Value chain stage		***Average yield***	***Smallholder yield***
Export fob price	t/kg	420	420
Transport and port costs	t/kg	52	52
Ex-factory price	t/kg	368	368
Trading margin	t/kg	18	18
Dry bean price paid	t/kg	350	350
Less processing charge	t/kg	60	60
Price paid - dry bean basis	t/kg	290	290
Yield from wet beans	%	38	33
Wet bean price	t/kg	109	96
Share of fob value		70	70

Source: CIE estimates.

Grades of cocoa in PNG

The genetic input is a key step in the output quality of cocoa. The three main types of cocoa trees are Criollo, Forastero and Trinitario world-wide. Very few Criollos trees remain. Forastero is a large group containing cultivated, semi-wild and wild populations of which the Amelonado is most common. Recently large plantations throughout the world used Upper Amazon hybrids.

The Trinitario are a cross between Criollo and Forastero. Trinitario planting started in Trinidad and spread to Venezuela and then was planted in Ecuador, Cameroon, Samoa, Sri Lanka, Indonesia and Papua New Guinea.

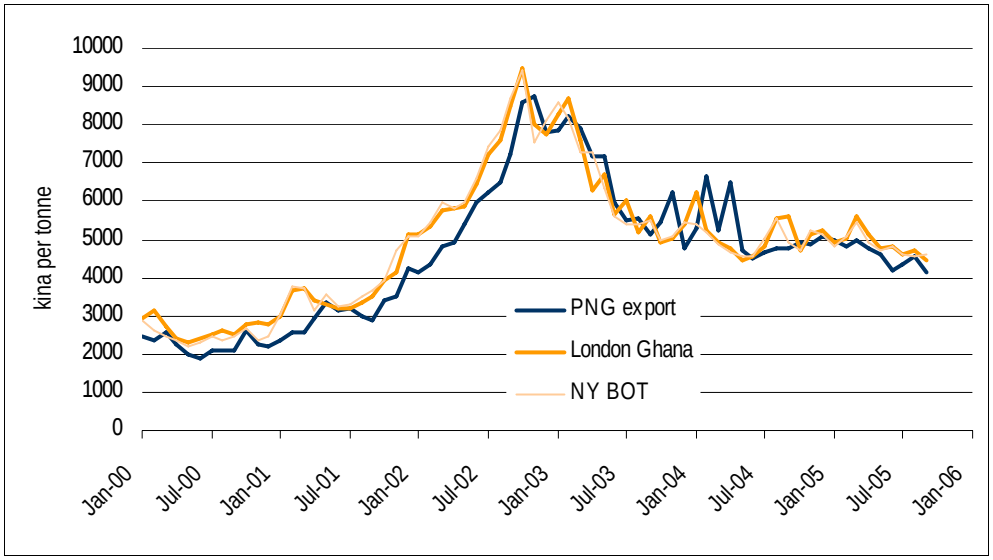
There are still small pockets of Trinitario trees in PNG, mainly in East Sepic and the North Solomons, but most trees in PNG are now hybrids or more recently from clonal stock.

Prices received

The world cocoa market distinguishes only two broad categories of cocoa beans: 'fine or flavour' cocoa beans and 'bulk or ordinary' cocoa beans. As a generalisation, fine or flavour cocoa beans are produced from Criollo or Trinitario cocoa-tree varieties, while bulk cocoa beans come from Forastero trees. The share of fine or flavour cocoa in the total world production of cocoa beans is just under 5 per cent per annum.

Chart 2.16 shows how the average export cocoa price for PNG compares to the London Ghana price and the spot price from the New York board of trade for bulk cocoa.

2.16 **PNG cocoa price received relative to other world indicators**



Data source: Bank of Papua New Guinea Quarterly economic Bulletin and International Cocoa Organisation.

There is very little difference between the price series — over the 5-year period PNG cocoa averaged 5 per cent lower than the Ghana price and slightly higher than the New York spot price. Therefore the quality profile from PNG would most likely be quite similar to that for other cocoa exporting countries.

Anecdotal evidence from the industry suggests that the quality of cocoa from PNG is good compared with that from other countries in the region. For example, cocoa from Indonesia is now largely not fermented which has impacted on its quality and average returns. Given the price differentials, cocoa appears to have many attributes of a commodity.

Premiums for quality

In addition to the evidence of grade premiums from the market, as reflected by observed prices, information collected from industry suggests that further quality premiums are available but very difficult to capture. In principle, there is a premium available for fine flavoured cocoa, from Trinitario trees for instance, over the fair-to-average quality grade. Industry sources suggest that this premium is potentially in the order of 5 per cent. But the small quantities available plus the additional costs of separate fermentation and distribution make achieving these premiums impractical to PNG.

Institutions

The Cocoa Board was established in 1974, and is responsible for research and extension services, coordinating and regulating the processing, marketing and export of cocoa and related products in PNG. It also operated the Cocoa Stabilisation Fund until 1989 when funds were exhausted. The Cocoa Board, together with the Kokonas Industri Koporasen (KIK) funds the PNG CCI, which was formed in 2003 as a merger of the Cocoa and Coconut Research Institute and the Coconut Extension Agency. The CCI board is made up of representatives from both the Cocoa Board and the Coconut Industry Corporation, and there is also input from the Department of Agriculture and Livestock (DAL) and National Planning.

The role of the CCI in the context of the cocoa industry includes:

- inspecting export cocoa;
- providing extension services to smallholders; and
- providing direction on research priorities.

The CCI Board has faced significant problems in recent times. Managerial and funding capabilities at both the CCI level and further up at the Cocoa Board have limited the effectiveness of services provided by the CCI. Extension services provided by the CCI are generally limited. There has also been a recent outbreak of Cocoa Pod Borer on East New Britain in a CCI managed plantation. This disease has the potential to devastate the PNG cocoa industry if it spreads; however, quarantine action appears to have restricted the spread in this case. The CIC is funded by a 20 Kina per tonne levy on cocoa.

Statistics are poor

Both the coffee and cocoa industries — as with most industries in PNG — are plagued by absent or unreliable information. This is because the resources and infrastructure required to systemically collect statistics are not available and in PNG, the cost of collection would be very high. Therefore what is practically required is to combine available data with judgements about the market.

The last comprehensive data on the production, yield, age profile and land use of tree crops is from the mid-1970s prior to independence. Nothing has been collected systemically on land planted, numbers of bearing and non-bearing trees and yields since then. This presents a significant impediment to understanding the structure and incentives of these industries. A starting point for all of the ACIAR projects is field surveys to collect data — but this is often confined to data of direct interest to the project such as prevalence of disease and management practices.

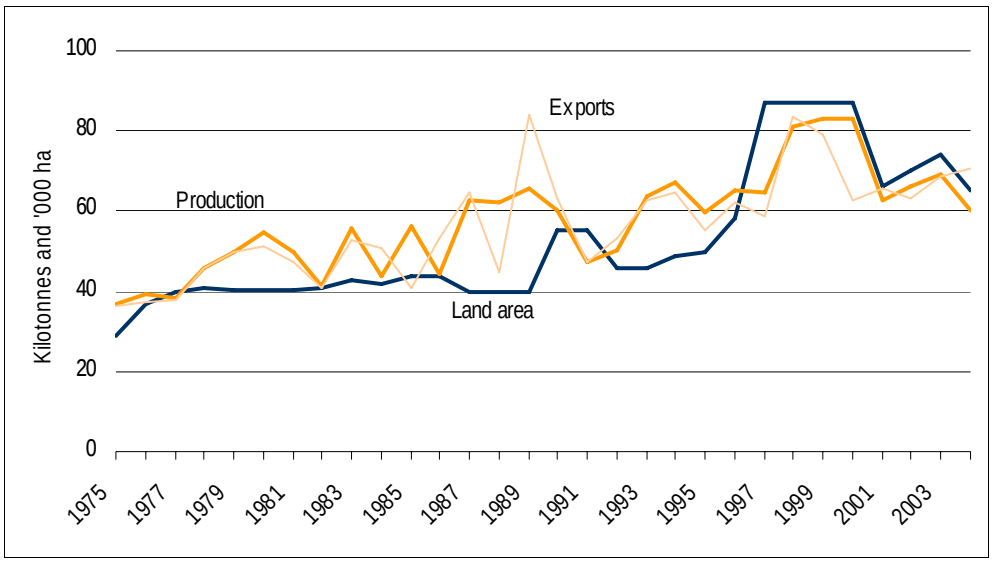
Since the mid-1970s and the work of Densley, only the FAO have put together a consistent time series of production, land use and implied yields for PNG coffee, cocoa and coconut. These figures were originally sourced from DAL. As already noted, without extensive surveys this task would involve making some judgement about trends or extrapolating trends from major production areas to other growing regions.

Care should be taken in interpreting the available statistics because they are often based on judgements. While these judgements must be made to obtain a ‘number’, users must also be careful to ground truth the results my matching the data with field experience. Otherwise the data becomes industry folklore. Chart 2.17 shows that:

- the FAO numbers may not be consistent with CIC receivals or official export data where timing differences of production, sale and export are very difficult to track ; and

- the yields used appear to have been assumed to derive the estimate of land usage.

2.17 **Production and area planted to coffee**



Data source: FAO (2006) and PNG Coffee Industry Corporation (2006).

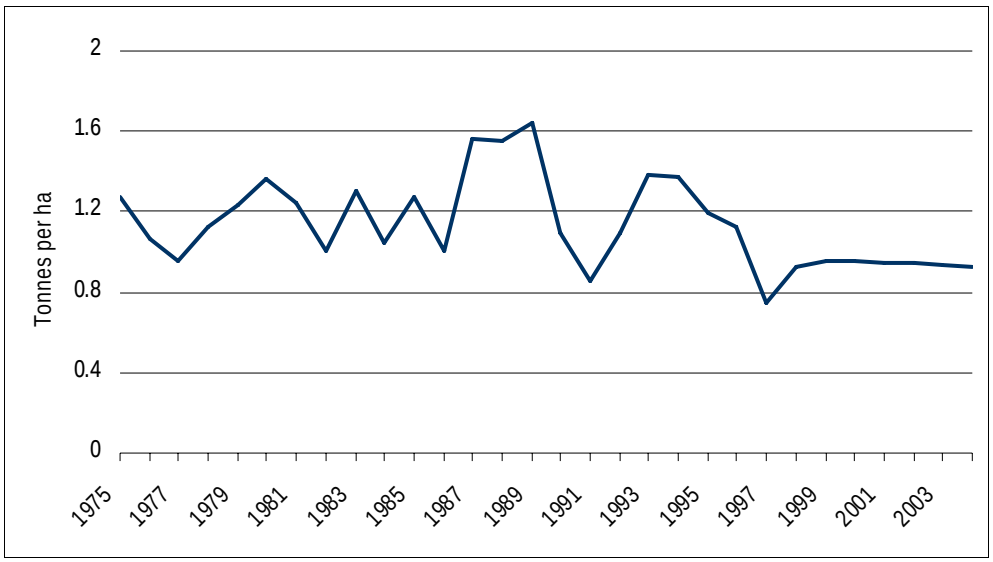
While the data is consistent with Densley for the 1970s, the implied yields for the late 1980s appear very high. For the mid-1970s, the average yield across smallholders averaged 1 tonne per hectare with plantations achieving 1.3 tonnes per hectare. During the late 1980s implied FAO yields peaked at 1.6 tonnes per hectare - which is not likely as the share of plantations in total production had fallen from over 30 per cent to 22 per cent during this time. Smallholders have never been equipped to achieve these yields based on their no-input shaded systems.

Chart 2.17 suggests that during the 1990s, landed planted to coffee increased dramatically by more than 29 000 hectares or 50 per cent in 1997. During 1997, there were two major developments: a profound drought which was thought to have severely reduced yields through 1997 and 1998 and an 80 per cent increase in the average price, compared with 1996 levels. Strong production and low yields from the drought could explain the increase in area recorded by FAO for 1997 by allowing for a 3 year lag planting and production lag after coffee prices doubled in 1994.

Chart 2.18 graphs the implied coffee yields from the FAO data which shows a fall in yield in 1997, consistent with a drought, with a mild recovery in 1998. Not only are average yields implausible, but also changes in yield from year-to-year.

Average yields of over 800kg appears very high given average yields between 300 and 800kg from smallholders in the major producing regions.

2.18 **Implied FAO yields of coffee**



Data source: FAO (2006).

The low yield results for the 1997-98 drought period also conflict with evidence that suggests that the drought, while resulting in dramatic falls in sweet potato production in the highlands, actually resulted in higher coffee yields due to the drier finish for coffee cherries. Hombunaka and von Enden (1999) conclude that the severe drought of 1997 almost certainly did not lead to crop failure but increased yield due to a massive flowering. In Aiyura, as a result of the drought, they observed that yields for June (the peak harvesting time) were 300 tonnes per hectare of cherry, up from 100 tonnes for the same time in 1997.

Between 1997 and 1998, CIC data shows that production increased by 25 per cent — which is consistent with the impacts of the drought on *Arabica* trees in the highlands. While it is plausible that additional planting's were the result of strong prices in 1994, where coming though — the FAO yields are both implausible and inconsistent with the evidence from industry.

The bottom line is that the land planted estimates are not reliable — and this data must be cross-checked through other methods such as surveys.

Key information deficiencies

The information deficiencies presented here are in the coffee industry, but the problems are not exclusive to coffee. What is required is, as part of

broader agricultural coverage, a well-stratified survey of coffee and cocoa production in PNG to determine:

- land planted to coffee and cocoa by province and district;
  - this would identify *Arabica* and *Robusta* coffee grown between highland and coastal areas;
  - it would also assist with the spatial dimension of coffee growing — where coffee is grown, what other activities it competes with for land and possible potential for expansion;
- age profile and yield of trees by province and district; and
- the profile of smallholders particularly the composition of subsistence crops that will be grown.

It is difficult to see how outcomes from R&D projects in the PNG coffee and cocoa industries can successfully be measured at present and then 'added-up' across growing regions to achieve a national results. There is no consistent baseline off which to measure outcomes, nor to compare projects in a portfolio approach to determine where the most benefits may lie.

3 *Policies and institutions*

Like other cash crops, coffee and cocoa are affected by some of the formidable challenges that face agricultural development in PNG. These challenges have been documented and discussed in academic, aid and policy circles over many years.

Some of these challenges lie in PNG's geography and climate, but many lie in the weakness of PNG as a state, and the consequences for delivery of government services and the development of the institutions that underpin market transactions. PNG is a 'weak state' not just because of limited human and institutional capabilities and poor governance, but also because the networks of social capital are not yet broad enough to generate effective consensus on strong collective action at the national level. The limitations of these networks also mean that the institutions that modern economies depend on to underpin commercial transactions and contractual arrangements are underdeveloped.

ACIAR's 2005 Country Profile for PNG identifies some of these challenges, listing poorly developed infrastructure, weak market signals and services, poor product quality, population pressure and future impacts of HIV/AIDS on the farming sector. Coffee and cocoa have also been affected in the past by unsustainable price support and stabilisation schemes. However, it is evident that a broader range of policy and institutional factors impact on the development of cash crops and the willingness of farmers, processors and traders to invest in new ways of doing things and in the associated physical and human capital.

These include, but are not limited to the following.

- Weak fiscal policy and systems of public expenditure management that have led to:
  - fiscal crises that have translated into unstable funding of services and into balance of payments crises with implications for the exchange rate and exporters returns;
  - long-running misallocations in funding of key government services that have starved agricultural agencies of non-wage operational

funding and under-provided for development and maintenance of transport infrastructure (see box 3.1); and

  - diversion of bank financing from productive private sector lending to financing government deficits[1].

- A poor and deteriorating law and order situation that deters farmers from harvesting cash crops[2] and traders from intermediating between farmers and processors/exporters, and deters all players from investment in cash generation activities. It has also prompted a withdrawal of banks from rural areas, increasing the costs of access to financial services.
- Poorly designed inter-governmental fiscal relations and allocation of responsibilities between central, provincial and district authorities that have contributed to the decline in delivery of public services, including extension services and infrastructure maintenance.
- Trade and protection policies that have favoured import substitution activities and reduced the competitiveness of all exports.
- Regulation and ownership policies in the transport and communications sectors that have led to high prices and poor service delivery.

Some commentators (Gosarevski et al 2004) have argued that the current system of land tenure, dominated by customary arrangements also impedes economic development and investment through its impacts on certainty of tenure and the collateralisability of property rights in land. This has also been recognised by the government, which identified 'ongoing land tenure constraints' as one of the main impediments to agricultural growth[3] (Government of PNG 2005). Box 3.2 discusses some of the land tenure issues that may impact on agriculture.

There are also constraints linked to the stage where PNG is in its transition to a modern market economy. People are discouraged from shifting comprehensively from subsistence activities by factors such as:

- the limited range of instruments for managing risk;

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[1] Although there have been some improvements in public expenditure management and fiscal outcomes in the last few years (Warner and Yauieb, 2005).

[2] It has been estimated that in 1997 around 30 per cent of the potential coffee crop was not marketed because buyers stayed away from crime-prone areas (Anderson and Parker 2004)

[3] Along with ' a collapsing road network, serious law and order problems' and 'a lack of access to credit markets and lack of extension services' (op cit).

- limited access to banking services, which limits the ability to save and borrow for investment;
- the constrained reach and effectiveness of mechanisms that would enable entry into and enforcement of contracts outside of narrow communities; and
- the limited reach of any kind of social services.

3.1 **Transport a major constraint**

Both coffee and cocoa are severely affected by the poor condition and limited reach of transport infrastructure in PNG. For coffee, the main constraint is the condition of the Highlands Highway and feeder roads. For cocoa, roads and ports (along with the deterioration in coastal shipping services) are the main problem.

The poor condition of the road network servicing the highlands of PNG is such that:

- for those parts of the road that remain passable, the costs of transport due to impact on vehicles is very high;
- parts of the functional network are occasionally cut off because of damage to bridges; and
- many feeder roads are not traversable at all by vehicles: coffee beans must be carried on foot to collection points on the main highway.

This means that manufactured production inputs (such as imported fertilizer) are very expensive. This deters coffee growers from adopting plant varieties and production techniques that require intensive application of such inputs. It also means that bean prices must be above a certain threshold to warrant the effort of harvesting for producers who are not adjacent to the functional parts of the highway.

Cocoa, grown in coastal and island areas, is affected by poor road infrastructure servicing ports, and the poor condition of the ports themselves. A number of areas have seen the complete closure of port facilities, and all are affected by the decline of commercial coastal shipping services. Cocoa has been hard hit by the deterioration in infrastructure in the North Solomons Province during and in the aftermath of the Bougainville Crisis, along with the destruction of Rabaul.

While the poor state of transport infrastructure is a proximate cause of major problems for the tree crop sector, the underlying determinants lie in the performance of central, provincial and local governments in planning, prioritising, funding and executing public expenditures. The variable quality of public expenditure management has in the past also led to periods of macroeconomic instability which have also impacted negatively on the tree crop sector.

3.2 **Land tenure issues**

PNG's current systems of land tenure have long been targeted in discussions of constraints on growth and development. Most land in PNG is under some form of customary land tenure: less than 3 per cent of the country's land area has been alienated by the State and is therefore available for occupancy under a formal leasehold arrangement under a Torrens system. But even this land is subject to claims from traditional landowners.

Most criticisms of customary land tenure systems start from the strong evidence that secure, transferable, individual property rights are an essential characteristic of a modern economy (Lightfoot 2005), and observations that such a system cannot easily be delivered by systems based on customary ownership. It is argued that customary ownership in PNG does not deliver the definite rights associated with individual land ownership in developed economies, that is the:

> …right to use the land; the right to exclude others from its use and enjoyment; the right to transfer it by sale, lease or gift; and, perhaps most notably the right to receive income from the property independent of use (Harding, cited in Curtin, 2003).

The lack of certainty over such rights makes it very difficult to use land as security for debt, denying entrepreneurs with a means of mobilising finance. (In PNG, it should be said that Banks are reluctant to offer mortgage finance over most alienated land as well.)

Only the state can purchase customary land, and there have been no additions to alienated land for some considerable time. That means that entrepreneurs that are not part of the group holding customary rights must negotiate 'informal' arrangements to access land. Such arrangements clearly occur, as evidenced by agricultural activity carried out by people who have migrated within the country. A small number of lease-lease back arrangements have also occurred where customary owners have leased land to the state and leased it back, thus gaining a registered title carries most of the rights of individual land ownership.

A number of commentators have pointed out that customary ownership cannot be equated with ownership on common with undifferentiated access (Lightfoot 2005), and in fact provides individuals and families within clans and tribes with reasonably clear and certain land use rights. Allen et al (2005) has argued that agricultural production on customary land has shown great dynamism. But it is still reasonable to think that without the certainty that formal individual title can provide, people will be cautious about undertaking many kinds of long lived investments (such as planting new coffee or cocoa trees, or building processing operations) on land subject to customary title. While the oil palm industry has found innovative ways of working within the customary system, it remains to be seen if the solutions can readily be adapted to other tree crops. More importantly, it is fairly clear that customary tenures have to be adapted to provide a clearer definition of land rights, powers and responsibilities where major changes are occurring in land use. For this reason, there is considerable effort being put into the vexed issue of registration of titles in customary land.

Donor activities

An important institutional factor that needs to be considered by ACIAR is the activities of other donors in the coffee and cocoa area. Based on consultations, there appears to be three major donors aside from ACIAR:

- The EU
- AusAID
- The United Nations Development Program (UNDP).

The EU is currently a major donor in the coffee industry, with around 14 projects active. It is involved mainly in projects in research and extension, including projects on waste management, on-farm processing and a project looking at the effectiveness of mobilising growers into collaborative groups. In the cocoa industry the EU funds projects mainly through the Common Fund for Commodities.

AusAID, as well as funding ACIAR, is also involved in research projects in PNG. A major project in recent times has been the Bouganville Cocoa & Copra Drier Rehabilitation Project. This project was funded by AusAID in concert with the UNDP Cocoa Rehabilitation Project, and has contributed to a recovery in cocoa production in Bouganville following the end of the crisis in 1997. Production is expected to exceed pre-crisis levels in 2006.

Donor funding undoubtedly plays a significant role in the coffee and cocoa industries in PNG, however it is difficult to get a clear idea of exactly what projects are currently being undertaken. There are some examples of projects presented here; however past research results are not well disseminated or easily available. In theory, donor activities should be complementary and a coordinated approach is the best way of achieving this. However, in practice, there appears to be little coordination between donors. This is a significant issue for ACIAR to consider, because it is vitally important that there is an understanding of what has been done in the past and what has worked. Without a clear idea of what research has been done by other donors, ACIAR risks repeating past failures and proliferating poor transparency and accountability in partner organisations.

Another concern related to transparency and accountability is the ability of collaborating partners to absorb donor funding. There is some concern that the level and timing of funding can overwhelm local institutions and provide incentives for misappropriation and other corrupt activities.

4 *Implications for ACIAR research projects*

To the extent that ACIAR's research agenda is aimed at changing farmers behaviour, it is important to have a thorough understanding of the environment that farmers operate in and how policy and institutional factors influence their incentives and decision making.

Policy and institutional constraints are not unusual phenomena in the developing countries targeted by ACIAR's support. But the breadth, depth and apparent intractability of constraints in PNG may be greater than usually encountered.

How could these constraints affect ACIAR's decisions regarding support for research in the coffee and cocoa sectors? There are three main areas that could be affected:

- the extent to which the uptake of the results of technical research is affected by constraints on producers, processors and traders in the product value chain — this has important implications for choices about the directions of technical research;
- the scope for useful research into specific policy and institutional constraints; and
- the ability of potential partners to make a credible contribution to research activities.

This study deals mainly with the first two areas. This is not because the impact of policy on the capacity of research institutions is unimportant. Indeed, the fundamental survival of some key research institutes, such as the National Agricultural Research Institute (NARI), has been jeopardised in the past because of government responses to fiscal crises and the consequences of serious breakdowns in the instruments of public expenditure management and control[4]. Rather it is because evaluation of the capacity of collaborating institutions is an integral part of the ACIAR's project assessment process.

[4] A recent evaluation of the Australian Contribution to National Agricultural Research System (Young, Wilson and Omot 2005) pointed out that the Government of PNG withdrew all funding for NARI in 1998 and 1999, and it was only because of support from donors that the institute continued operation.

Incentives and the adoption of research

A major concern for ACIAR is that it has invested considerable money into the PNG coffee and cocoa industries for little observable benefit. To assess this properly is close to impossible: what would the market look like if ACIAR were not involved? To make a judgement about this we have to consider the whole economic environment facing the value chain for these commodities, including impediments and constraints, as well as activities by other donors and non-government organisations (NGOs).

A key to understanding this phenomenon is understanding the incentives that are faced by smallholders — the major target of ACIAR funded research — and how these incentives affect decision making and the propensity to adopt research results.

Low input systems will persist

The current structure of the coffee and cocoa industries in PNG has evolved for good reasons. Smallholders and other industry stakeholders in respective value chains have adapted to the difficult economic and policy environment in which they operate. The movement of price signals up and down the value chain is seriously affected by the policy environment, which distorts the incentives facing smallholders. Within this, households are making complex decisions about the role of cash crops within a quasi-subsistence setting. Constraints and distortions impact not only on the ability of smallholders and other industry stakeholders to adopt new technology, but also on their desire and willingness to adopt.

The constraints presented in chapter 3 affect entrepreneurs involved in all stages of the value chains for coffee and cocoa, and impact on the willingness of all growers, traders, processors and exporters to adopt new technologies, regardless of the type of enterprise and organisational structure that has been adopted. The combined impact of the various policy and institutional challenges is to deter investments and production systems that are vulnerable to the high levels of uncertainty. The cost of inputs, both labour and imported goods, and the reach and dependability of the transport network within PNG restrict the scope for their use. Production systems that require tight control over extensive areas of land, or in which quality is dependent on capital intensive processing, timely delivery and careful post harvest handling are hard to operate successfully in the environment that prevails in PNG. As a consequence:

- plantation production of coffee and cocoa has continued to decline; and

- smallholders have increased their share of total production, but they are afflicted by many of the same constraints that distort their incentives and ultimately restrict the impact of research.

Smallholders utilising lower yielding but more robust technologies and who manage risk by also engaging in subsistence food production have found ways to adapt to the uncertainty of the operating environment.

Impact on choices

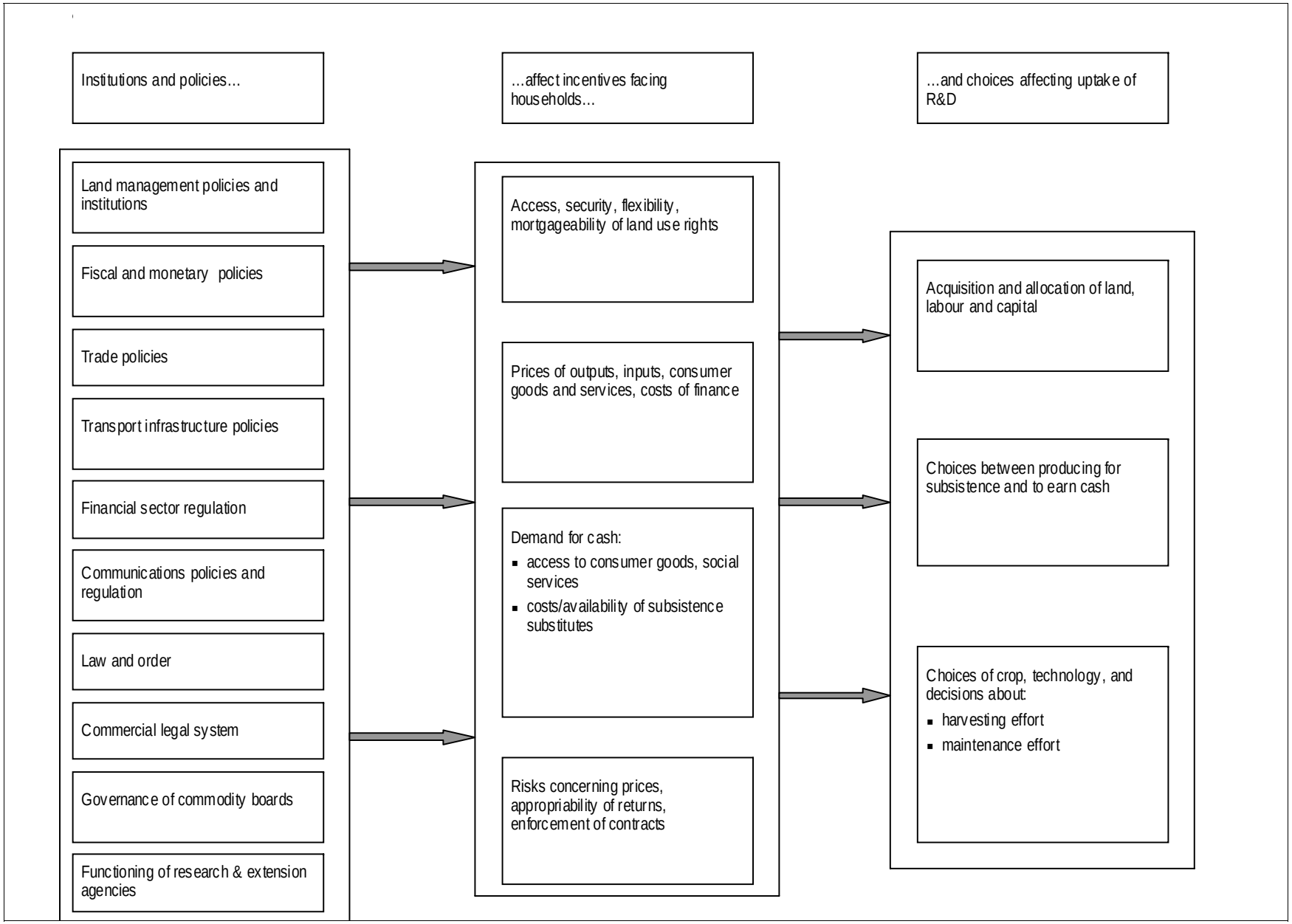
One way of thinking about the implications of policy and institutional constraints on the potential uptake of technical research is to examine how they affect the choices that households make about ways of generating the means of meeting needs and aspirations. The constraints influence household consumption, savings, and investment generally, and in turn impact on decisions about how to allocate resources across alternative production and income generation options. Poor road and transport infrastructure severely limits the scope of markets in PNG. This combined with poor access to banking and savings, limits householder's scope to spend cash and lowers incentives to participate in cash generating activities.

The constraints influence household decisions about how much effort and resources to put into cash generation and subsistence activities, and the sort of production technologies to use. They also affect the flow and timeliness of market information, and the benefits of greater specialisation. Ultimately these constraints shape the price and other incentives that face households and other players in the value chain, and thus how they value the costs and benefits of adopting the results of research and development targeted at their sectors. Chart 4.1 illustrates the linkages between institutional and policy factors, the structure of incentives and the choices that affect the uptake of research and development.

No financial instruments to deal with risk

Virtually all of the choices made by smallholders in PNG, often viewed as irrational, are shaped by the requirement to manage risk. This is because that financial instruments that can be used to manage risk, such as savings, are not readily available or are prohibitively expensive. One mechanism used to deal with risk is 'investing' in the tribal system.

4.1 **Institutions, policies, incentives and R&D uptake**



These cultural factors play an role important role in incentives and choices — with the wontok based system placing particular pressure on the distribution of the proceeds from cash cropping. There is often an expectation on smallholders to share cash earned from coffee and cocoa within the clan. A lack of banking facilities increases this pressure, as it removes a viable option for saving cash to pay for ongoing expenses and future labour requirements.

Poor on-farm practices such as not keeping the blocks free of weeds and lack of tip-pruning remain significant constraints to improving productivity in a technical sense. It is no secret that improving block management is a key factor in improving yields, but not enough is known about why smallholders have not taken these practices up. A lack of extension services may explain some of this, but it appears there are cultural and other factors as well.

Lack of specialisation a necessary strategy

Risk plays a part in smallholder choices, particularly given the low probability that individuals are able to capture many of the benefits of increasing effort. Contrary to conventional wisdom, smallholders value their labour highly and allocate time across crops and social activities. With significant risks associated with securing the returns from increasing productivity, it is not surprising that many smallholders are reluctant to increase effort.

Allocation of labour and land across both a cash and subsistence crop is a universal approach to risk. There would be little or no incentive for smallholders to specialise in a crop and rely on trading with others for remaining needs.

People in the highlands particularly are very exposed to price and production risk because of their almost complete dependence on two crops: coffee and sweet potato. Even given their diversification, failure in production in either one of these crops can have severe consequences. During the 1997-98 drought, when sweet potato production was directly affected, there were two offsetting factors. Increased coffee yields in combination with good prices improved purchasing power for store goods including rice. In addition, highlands people used wontok relationships to move to less affected areas.

Impact on transmission and collaboration

Another way of thinking about the implications of constraints on the uptake of R&D is to examine how they impact on the conduct of R&D and the transmission of information of results and information about the opportunities that are being created. This touches on matters such as:

- the institutional structures for the conduct and funding of industry R&D and industry outreach;
- the resources and capabilities of research organisations;
- the availability of information about the industry that might help in making judgements about relative returns from different types of research; and
- the costs of making information available to stakeholders and their willingness to pay for this information.

The general weakness of institutions in PNG is well documented. But it is a problem that is not easily solved. Weak institutions with poor leadership and governance tend to discourage the most promising people and reduce the human capital pool from which to draw future leaders. This makes it difficult to break the cycle of institutional failure and improve performance. This is an issue for ACIAR, as it is a collaborative body by definition. ACIAR evaluates the capacity of collaborating institutions during the project assessment stage, but the institutional problems in PNG are pervasive. Given ACIAR's position, there is little choice but to accept a certain level of institutional weakness. However, recognising the potential weaknesses in institutional bodies could help to mitigate potential future problems, and where there is the option of collaborating with different institutions including NGOs, they should be seriously considered.

Research and extension projects along the value chain currently supported by institution and donors can be thought of comprising two distinct parts:

- provision of technical assistance including research into post-harvest handling including processing and transport; and
- transfer of business models - advice on how parts of the value chain should structure themselves into commercial or quasi-commercial units.

The public good aspect of providing technical assistance is clear: without involvement of institutions or donors, this type of research may not be completed simply because of lack of funding or the inability of individuals to capture the benefits.

The recent trend is towards research that attempts to reorganise industries structures into alternative business models. Particularly, this is focused on increasing incomes of smallholders by capturing premiums from the value-chain. These alternatives include building smallholder cooperatives or transferring nucleus estate or other grower-trader arrangements from one sector to another. These activities may provide a convenient vehicle for delivery of extension services.

The potential benefits of such activities by institutions and donors are highly questionable for several reasons.

- They may impact directly on existing commercial arrangements along the value chain and represent the transfer of intellectual property between parts of the industry.
- Institutions and donors compel smallholders into (many times arbitrary) cooperatives but providing a business model with unclear incentives. This exposes participating smallholders to the risk of bad business practices, such as corruption or theft.
- Regardless of intention, institutions and donors simply do not face the same set of incentives as commercial operators They can set up these structures and simply walk away if they do not work at the end of the project. Businesses have a vested interest in maintaining long-term relationships along what are highly-competitive value chains.

Recognising the role that the commercial sector players in PNG, ACIAR should also consider involving commercial operators on certain projects, where their management skills could be highly advantageous.

Other constraints plainly impinge on the ability of the coffee and cocoa institutional bodies to perform their functions properly. The most obvious constraints are law and order issues and poor transport infrastructure. Extension services are limited to those areas accessible by road, which means that many smallholders do not receive extension services. Law and order issues make extension and other industry services risky in some areas of the country.

The capacity of institutions in PNG that may collaborate in research, both to deliver outcomes on projects and to provide extension services that so many smallholders rely on is a crucial factor for ACIAR to consider. There is no silver bullet however, and similar to other issues, the best way of dealing with it is to apply a consistent and rigorous method of identifying issues in the early stages of projects, and structuring projects so as to limit the impact of policy and institutional constraints.

Institutional and social constraints

One of the aims of the consultation process was to establish why previous ACIAR research, particularly the proceeds from project PHT/1995/136 had not been taken-up by smallholders. The key outputs from this project were:

- so-called mini-box fermentaries; and
- solar dryers.

The objective of this project was to improve the quality of cocoa by developing a more effective system for fermentation for small quantities produced by smallholders and to reduce smoke damage and smallholders' dependence on wood-fired dryers. Neither of these outputs were taken up for different reasons.

Under the prevailing (and current) laws in PNG, fermentaries must be approved and licensed by the PNG Cocoa Board through the CCI. While virtually all industry players acknowledge the mini-boxes as a worthwhile development, the Cocoa Board did not officially approve the mini-boxes for use. This would have involved amending the legislation which should have been facilitated by the Department of Agriculture Livestock. No one consulted could articulate why this legislation had not been amended and so why it was not possible to licence the mini-boxes. This is why they are not in use anywhere in East New Britain or mainland PNG.

This contrasts with the recent experience in Bougainville where the government and institutions have minimal impact (see box 4.2). During a rehabilitation project funded by AusAID and UNDP, mini-boxes were re-introduced with success and evidence from the industry suggests that they are currently in use.

As part of the ACIAR project, solar dryers developed by the project were installed, and subsequently rehabilitated several years later after falling into disuse. Today, the dryers still remain scattered around communities in East New Britain, but have again fallen into disrepair. The consultation revealed that the dryers were initially used but were not maintained: vegetation was allowed to grow over the dryers and they became mouldy. It is suggested that the main reason for this outcome was that the dryers were set-up in a village context at no cost. Therefore no individual or family had the incentive to complete the required maintenance. In this case, a better approach may have been to sell the dryers at a small nominal cost to smallholders who wanted them as was the case in Bougainville. It is also noted that some solar dryers are being rehabilitated by modifying them to use wood as well.

4.2 **Rehabilitation of cocoa in Bougainville**

A key message brought home during the consultation process was the success of AusAID's cocoa rehabilitation project in Bougainville. Since the Bougainville uprising, the province has been alienated from the rest of PNG, resulting in the autonomous region. The collapse in economic activity and social structures resulted in the majority of the population retreated to pure subsistence. This was despite the vast potential of extensive coconut and cocoa plantation areas from Buka south along the east coast.

Recent recovery in the cocoa industry has been remarkable. What were the key elements of the rehabilitation?

- Smallholders were desperate for income and have been short of store goods and fuel for a long time. Media reports also showed children collecting copra to pay for school fees.
- A program sponsored by AusAID and UNDP that involved rehabilitation of cocoa blocks and distribution of cocoa seedlings. Trevor Clarke, an Australian who had been involved in the East New Britain industry, co-ordinated an extension program for smallholders.
- A driving force behind this recovery was Agmark - a commercial trading company that was responsible for purchase and export all of the production from Bougainville. There were no apparent quality issues with production with 95 per cent being fair-to average quality – the equivalent of the bulk grade.
- Virtually no involvement by the CCI and the PNG government in the industry. Levies are not collected and no regulations or export inspections enforced. In addition, the legislative requirement for CCI approval of fermentaries did not apply.
  - Smallholders were desperate for drying capacity and so developed the 'bonnet' dryers.
  - Mini-boxes developed by ACIAR in 1995, but not approved by CCI, were introduced to Bougainville with significant success.
  - There was also reports that smallholders where willing to pay a small nominal cost towards the cost of the mini-boxes.

Scope for research into constraints

This report has attempted to summarise the major policy and institutional constraints that PNG's coffee and cocoa industries face. The core outcome from this scoping study is that it is difficult to identify a single area of research with the potential to identify or explain the policy or institutional environment that could realistically lead to an increase in production and incomes of smallholders and a greater uptake of existing research. As outlined earlier in the report, the major constraints faced by the coffee and cocoa industries are:

- a lack of roads and other transport infrastructure itself caused by the lack of social and institutional capacity to provide the required maintenance;
- law and order and security issues;
- problems associated with land tenure and ownership;
- lack of access to banking and the scope for savings and cash management;
- poor governance and corruption within institutions;
- health issues especially HIV/AIDS and tuberculosis that affect ability to supply labour; and
- the absence of trust and social capital across the boundaries of wontok groups which inhibit the scope for contracts and so specialisation.

These constraints are no secret, however resolving them is not a simple task. It is difficult to see an area where ACIAR could possibly do anything meaningful to remove constraints faced by the coffee and cocoa industries. A large majority of the issues are national issues that will take a significant period of time to resolve. Only effective and concerted action at all levels of society over a sustained period will be able to address these problems.

The PNG coffee and cocoa industries have shown remarkable resilience in the face of the constraints they face. ACIAR does have some scope to promote transparency at the industry level, as it also has scope within its collaborative framework to promote institutions that display positive transparency and governance characteristics.

The next issue for this report to consider is the prospects to either adapt existing project proposals to cater for identified constraints or to propose new research that could ease these constraints or inform stakeholders about the costs of the constraints.

Refining existing research approaches

As noted, the clear trend across institutions and donors has been towards projects that aim to improve quality, through better extension and marketing, in preference to more fundamental research such as that on yields, diseases and post-harvest handling.

Whilst quality and business structures are important, in our view, there are potentially larger gains to be won from increasing productivity. The consultation process revealed that one reason why research into yields or

pests had not been adopted was that the initial research conducted was not appropriate in the first place. That is, the initial research had not been informed by any economic analysis concerning the payoffs from research alternatives or accounted for the constraints faced by those who would adopt it. Rather, the research had been science driven. One example is cocoa breeding that focused on yields whereas many believed it should have focused on pest resistance for low-inputs systems.

One of the problems in attempting to improve quality is that there are many unknown factors. The major variable is not only how much you can improve quality, it is how much of a price premium can be achieved for that improvement in quality. Better quality often involves higher costs, and many times the market will not pay a sufficient premium to warrant the quality increase. One obvious exception is the premium from organic or fair trade certification, but this has been largely market driven.

Recommendation

Better informed project selection and design cane be achieved by using a before-the-fact economic framework that accounts for the constraints faced by participants along the market chain. While ex-ante evaluation of costs and benefits is often not worthwhile because of data deficiencies and the unknowns, the process of enunciation of the mechanisms through which benefits will come about and identification of constraints would be helpful. In PNG, this may lead to a reorientation of research effort.

Potential for further research

Given the policy and institutional context, and the concern that ACIAR research is not being adopted, this section outlines suggestions for further research that would lead to better uptake of the outputs of ACIAR projects.

Agricultural statistics

As outlined in this report, the availability and quality of statistics in PNG is poor. Good decisions are based on good information. Good physical and economic information on agricultural production and the economic units behind this production is essential to good decision making not only for government but also donor agencies. A number of agencies currently work in this area, such as FAO, but are limited in their effectiveness.

A comprehensive survey or agricultural census has not been completed since independence mainly because of cost, lack of relevance for policy makers in government and lack of capacity to plan and execute such an exercise. A full agricultural census is out of the question due to its size and scope. We note that most recently, the ADB has scaled back a full survey of incomes and expenditures to a demographic and health survey due to cost and political timing. Also the World Bank and AusAID recently made a decision not to go ahead with a planned household income and expenditure survey.

A lower cost option would be carefully structured stratified survey, in conjunction with other donors, which would inform about basic parameters such as areas and yields of both subsistence and cash crops. For some institutions and donors, more detailed information such as numbers and ages of trees and yields would also be useful. Because of the strong linkages between agricultural production and household expenditures it would be sensible to conduct a concurrent household expenditure survey.

ACIAR does not have sufficient leverage to conduct this exercise on its own, but could possibly be involved in partnership with AusAID, ADB or the World Bank. A serious consideration in the planning stage would be the capacity of the collaborating institution in-country, as the most obvious partner would be the National Statistics Office, which already has its resources stretched preparing and releasing censuses.

Recommendation

This type of project would be required to seriously engage the government of PNG to refocus on agriculture. If such work were to be contemplated, ACIAR should be a junior partner with support from the wider donor and NGO community.

Extension

Extension and training is universally identified as a key ingredient in improving the performance of smallholders. Consultations in PNG revealed that extension services in coffee and cocoa were limited, largely owing to the remoteness of many smallholders, but also to limitations of funding and capacity within the institutional environment. One of the causes of these limitations is that the PNG government remains distracted by developments in mining and by other major projects and so fails support agriculture as set out in its Medium Term Development Strategy (MTDS).

Several options for improving extension services are now being trialled in PNG. One model that appears to have been reasonably successful is where extension services have been 'contracted' out to a private provider. This model has been used in the rehabilitation of Bougainville and by an ADB project in the highlands. Under this model a large part of the costs of extension services are met by donors and the industry bodies, but smallholders are also expected to contribute a small amount towards the provision of the service. This has appeal, as it has the potential to motivate smallholders and means that they are less passive in the training and extension process.

Another option currently being explored is a cooperative or collaborative approach, where smallholders are grouped together on a village or clan basis. In many cases this requires the direct involvement of the village chief or a highly motivated individual within the village to be the main contact and dispersal point for the information. This approach is still being tested, and could be problematical given the significant security and trust issues that are typically present in the village setting.

The nucleus estate model where the estate or processor delivers extension services has also proven successful in the palm oil industry (see box 4.3).

Many projects have attempted to transfer these lessons to other sectors with limited success. This is because commodities like coffee and cocoa do not have key characteristics of palm oil including centralised production and planning around alienated land. Because of these features, oil palm companies can also use innovative approaches including lease and lease back land schemes and card payment systems. These characteristics are not easy to replicate in the coffee and cocoa industries, but there are notable exceptions in the coffee industry where large commercial operators are providing extension and financial services to nearby smallholders similar to the nucleus estate model.

4.3 **Oil Palm in PNG**

Of the range of cash cropping options available in PNG, tree crops have remained an important source of income for smallholders. However, as has been explored in this report, coffee and cocoa producers are not particularly competitive internationally because of the complexities of the economic environment they face. However, if there is an exception to this rule, it is the oil palm industry. It is regarded as a far more viable industry than either coffee or cocoa. It is also highly competitive with producers in Indonesia and even exports genetic materials. There are several possible reasons for this:

- processing of production is centralised, where smallholders supply fruit to a mill operated by a nucleus estate company;
- processors provide smallholders with access to credit and extension services;
- growers receive price signals more readily than in other industries; and
- oil palm has benefited from a reasonably coordinated approach to land, where alienated land was subdivided into smallholdings with the clear intention of developing an oil palm nucleus estate-smallholder scheme.

The major difference between oil palm and other tree crop industries in PNG appears to be the coordinated, centralised processing that is facilitated by the nucleus model. There are clear advantages in centralising processing; particularly that it assists in maintaining a consistent product standard and quality. In PNG's oil palm industry, effective communication and extension services also assist this process by alerting producers to any problems with their produce and ways to rectify these problems.

Allowing grower's access to credit through processing companies provides oil palm smallholders with a major advantage over smallholders involved in other tree crops. A major constraint in the adoption of new technology by smallholders in other industries is a lack of access to credit. The nucleus estate model provides credit to growers by taking advantage of the incentives of processing companies to secure supply and ensure product quality.

In addition to providing extension and credit to growers, some estate companies 'also take responsibility for transporting smallholder fruit to their processing mills' (Koczberski et al, 2001). Access to transport is an extremely important consideration. Coffee smallholders in PNG suffer distinctly from a lack of transport infrastructure, particularly as a majority of producers are situated in the highlands and largely dependant on the highlands highway. This lack of transport facilities also severely affects communication to coffee growers. While oil palm smallholders are kept well informed through regular contact with estate companies, coffee smallholders are often isolated for long periods of time due to impassable roads. Consequently, smallholders often only receive a low price for their produce simply because there is no way of assuring buyers of the quality of the produce.

The clear implication of the success of oil palm in PNG is that it is not easily replicated in other industries. That is not to say that some of the characteristics that have assisted oil palm production are not amenable to other industries. However, some characteristics inherent in the coffee and cocoa industries make it unlikely that the oil palm production system could be widely adopted by the coffee and cocoa industries. The major restriction facing these industries is that are geographically dispersed and so cannot reap the benefits of large scale processing, and the associated provision of information and extension services. The major lessons from oil palm in relation to the coffee and cocoa industries are the importance of efficient post harvest handling and good communication and information flows to growers. It is clear that both these issues are major constraints on the coffee and cocoa industries and the challenge is how to improve them, largely within the current industry structure.

Recommendation

Poor uptake of past research results is a major motivation for this scoping study, and at least part this has been due to inadequate extension services. ACIAR projects based around improving smallholders incomes by the provision of extension and marketing services for coffee and cocoa are already in place. This is also in context of the significant resources currently committed to similar projects by the CIC, the EU and the ADB all of whom are trying different extension models.

ACIAR, through current projects, already has a stake in area. These projects should take a monitoring and evaluation approach to measure their relative success and effectiveness against each of the approaches used across extension providers.

Bougainville rehabilitation

Many positives have come from Bougainville in the past 5 years. A study that compares and contrasts the success of the rehabilitation of the Bougainville cocoa industry would be very useful, particularly looking the role of institutions, private sector and donors. This could encompass the impact of regulation and extension delivery in promoting smallholder production.

Bougainville has been the subject of large amount of donor resources as a result of the conflict that has impacted significantly on both human and physical infrastructure. This case study would also highlight the requirement for income as a key driver for smallholder production. In terms of scope, the study would compare and contrast the major cocoa producing area of Bougainville and Kokopo on East New Britain. It would also look at the incentives in each region to adopt introduced research and capacity to supply and use extension services. Such a study would gain some insight into the benefits of alternative extension models currently in use.

Recommendation

A separate proposal will be developed for ACIAR for the PNG program.

Improving food security

This scoping study has taken the view that it is not sensible to consider coffee and cocoa as stand alone commodities. They are part of a complex multi-product system used by smallholders to hedge risks against a range

of possible adverse events. Poor market access and lack of trust are just two reasons why smallholders must not specialise especially when resources such as their own labour are scare.

If ACIAR's objective was to increase production of coffee and cocoa, and so incomes, one way of achieving this is to improve smallholders food security. In the highlands particularly this comes down to production and trade in sweet potato. In coastal areas, access to fishing provides a valuable mechanism to reduce risk although it is noted some islanders are deficient in carbohydrates.

There have been a number of projects funded by ACIAR and other donors on directly improving food security. Suggestions from the consultation process included research on improving the transportation and storage of sweet potato, which would allow smallholders more flexibility in specialising in either the production of cash or subsistence crops.

Recommendation

No direct recommendation other than suggest vigilance for research opportunities to improve food security especially in sweet potato and other smallholder staples.

Agricultural potential

Studies have attempted to describe and even quantify the constraints and opportunities facing on PNG agriculture. A recent study claims an over-valued exchange rate as the major impediment to the sector (see box 4.4). Rather than taking this unrealistic view, this scoping study has identified a number of impediments that raise the costs and risk of doing business in PNG, especially for smallholder agriculture, such as roads and other infrastructure, security (law and order) and land tenure. These priorities have already been identified in the key strategic documents of both the PNG government and the donors.

Publicly, the PNG government has made statements supporting economic growth and particularly growth in agriculture. These statements have been in the context of the MTDS which sets an target of 5 per cent growth per year. However, better fiscal management and very robust commodity prices in minerals have diverted the government's attention from agriculture especially in the provision of associated infrastructure such as roads (the Highlands Highway) and ports.

4.4 **Attributing blame or shooting the messenger?**

In 2006, the PNG Institute of National Affairs (INA) released a report that identified the constraints and opportunities faced by the agricultural sector. This involved:

- reviewing and assessing the performance of key commodities relative to Malaysia and Indonesia;
- identifying factors that explain differences in performance; and
- draw conclusions about options available and the relative merits of these options.

The key finding concerning performance was that growth of export agriculture was generally weak except, for palm oil, when compared with growth in production, land area and yields in Malaysia and Indonesia.

In terms of barriers to performance, the study found that performance was constrained by lack of profitability. And that this was in turn caused by an insufficient depreciation of the exchange rate in offsetting rising costs. The report suggests as raft of policy initiatives including:

- change macroeconomic and exchange rate policy and tariff reductions; and
- more effective scientific research and reform of regulations governing financial institutions.

What this report contributes

This report takes a myopic approach to analysing an important problem, partly because of its terms of reference, but also because of poor knowledge about the country and the lack of an economywide approach.

- Comparison of performance 'indicators', by commodity, between countries tells us nothing about relative constraints or incentives that influence choices in PNG.
  - Key factors such as geography, climate, infrastructure, the structure of production and the ability to access markets was not considered but implicitly assumed to be the same across the countries.
  - This analysis in based on FAO data. While being the only consistent source for this data, much of is assumed or derived (see earlier chapters) an must be used with care.
  - The conclusion that oil palm performed well compared to Malaysia should be of little surprise given the same company operates in both countries.
- The report lacks an economywide view by not acknowledging the impacts of other sectors of the exchange rate. Monetary policy plays but a small part.
  - High world prices for copper, gold and oil and expanding in resource development all increase the value of the kina.
  - As does the inflow-of aid from the donor community and other NGOs.

Does this report imply that PNG would be better off without mining or foreign aid? Current government practices actually downward pressure on the exchange rate such as direct or indirect expenditure on a range of imported goods and services.

The bottom line is that the report contributes nothing to an informed and rational debate about how to support economic development through sustained agricultural growth in PNG.

What is needed is an advocacy piece that would demonstrate the gains to the economy and to smallholders from the required reforms by quantifying the scope of potential in agriculture to expand outputs and incomes. This could be used to build and sustain support for rebuilding infrastructure within PNG government and supported by donors.

A study that would detail and quantify the agricultural potential of an area which would demonstrate the payoffs to smallholders and to other stakeholders from improving road access, security etc. This could be used by donors to engage the PNG government.

While this is potentially a large study, it could be made manageable by focusing on a key centre such as Goroka or Kokopo. For example, how much could production and incomes increase if feeder roads to the Highlands Highway were to be rehabilitated and maintained over a sustained period.

It is suggested that ACIAR work in partnership with AusAID in this area - which would fit closely with their governance capacity building and infrastructure rehabilitation programs.

Recommendation

A separate proposal will be developed for ACIAR for the PNG program.

Appendix

A *Copra production in PNG*

Copra is a source of income for around 40 per cent of the people living in coastal mainland and island areas. It is a widely held view throughout PNG that the coconut sector is in terminal decline. This follows the collapse of the industry in 2001 and continuing low yields implying that the copra industry is, at best, only marginally internationally competitive. Nevertheless, the sector has been a significant contributor to exports and livelihoods at a district level.

The resource base

Coconut palms account for between 250 000 and 265 000 hectares of land in PNG. This area appears to have changed little since the early 1970s accounting for up to 5 per cent of arable land in PNG and a very significant proportion of coastal mainland and island areas suitable for growing crops.

Because the age of productive 'tall' trees is around 60 years (around 40 years for hybrids), sustaining the long term productivity of the sector requires ongoing replacement of over-mature or senile trees. Poor economic conditions in the industry are a key factor for the failure to re-invest - resulting in aging of trees and falling productivity. In an FAO report on the prospects for coconut timber it was reported that in 1993, of 260 000 hectares of coconut trees, approximately 30 per cent or 78 000 hectares were senile. It is quite likely that this estimate is low because the major coconut areas were planted by German colonialists.

Sometimes, very old palms still produce surprisingly high yields. However, in commercial coconut production it is doubtful whether the maintenance of old coconut plantations is economically preferable to the substitution of the plantation by new, improved planting material at an earlier age. Gradual replanting of parts of the plantation over a number of years may be economically preferable and will facilitate future re-plantings as the plantation consists of different age groups.

The earliest age at which a coconut palm may start flowering is genetically determined, but the actual age of first flowering is also influenced by

growing conditions. Under favourable conditions, tall coconut varieties may start flowering at the age of 5–7 years, hybrids during the fourth year, and dwarfs during the third year of age.

Structure of production

Smallholders now dominate copra production. In 1976, plantations accounted for half of production. In 2000, the contribution had fallen to around 16 per cent reflecting similar trends in other export tree crops of relative high-cost high-risk operations. Table A.1 summarises the structure of the sector for 2000 prior to its collapse. As already noted, the islands account for around 70 per cent of production with Madang being the most important mainland-producing province.

A.1 **Profile of the PNG copra sector 2000**

	Smallholders		***Plantations***		***Total***	
	tonnes	%	Tonnes	%	tonnes	%
Western	0	0	0	0	0	0
Gulf	865	1	101	0	966	1
Central	775	1	17	0	792	1
Milne Bay	6368	5	229	1	6597	5
Oro	360	0	11	0	371	0
Morobe	2163	2	146	1	2309	2
Madang	18609	16	10251	45	28860	21
East Sepik	3691	3	189	1	3880	3
Sandaun	156	0	13	0	169	0
Manus	1653	1	38	0	1691	1
New Ireland	17364	15	1706	8	19070	14
East New Britain	32218	27	8749	39	40967	29
West New Britain	18739	16	1048	5	19787	14
Bouganville	15158	13	105	0	15263	11
Total	118119	100	22603	100	140722	100

Source: Department of Agriculture and Livestock and Kokonas Indastri Korporesen.

A characteristic of the PNG industry is its very low productivity in terms of copra yield per hectare when benchmarked against other countries. Yield is a function of variety, soils, climate and quantities of inputs applied. A survey conducted just before independence suggested that yields of copra were:

- 0.80 to 0.95 tonnes per hectare for plantations; and
- 0.5 tonnes for smallholders.

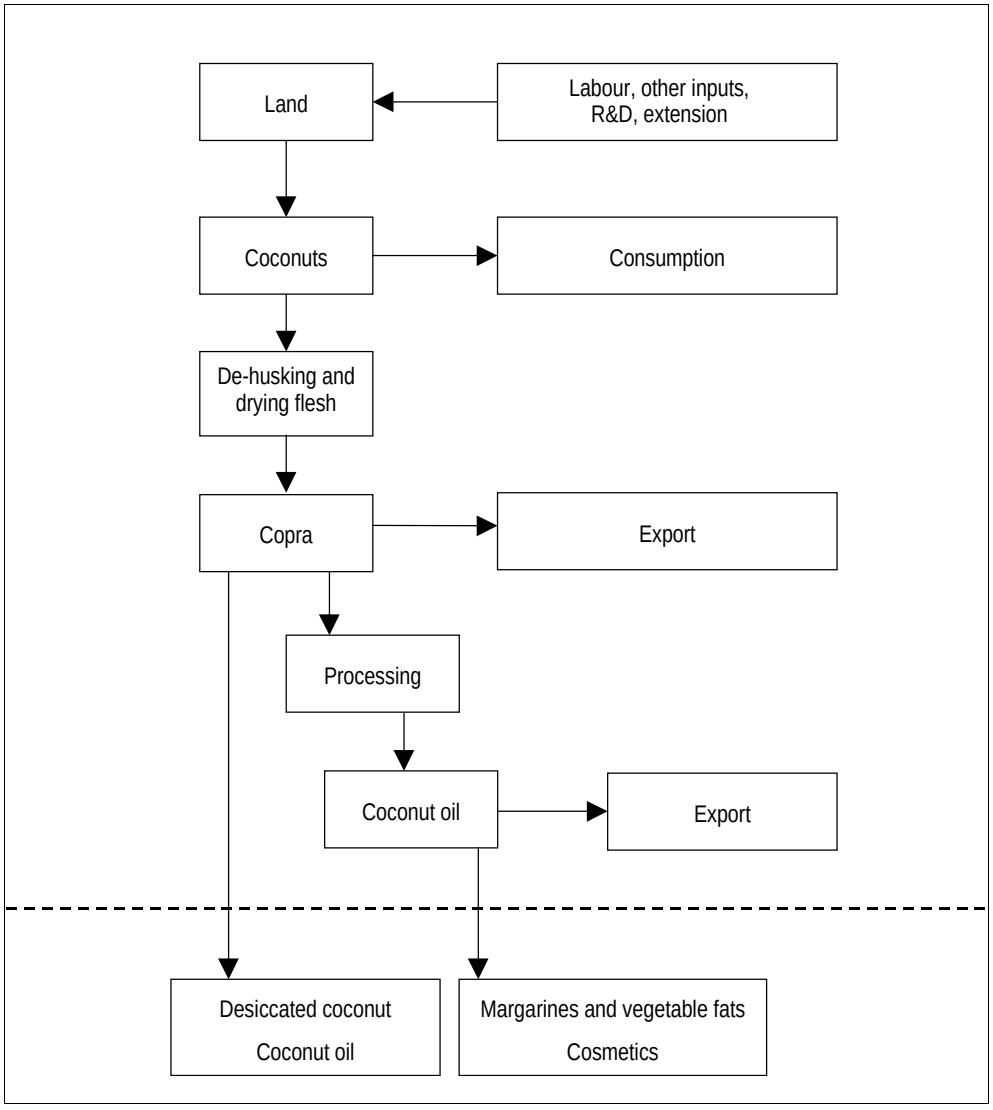
Dividing copra production for 1999 by 260 000 hectares, after compensating for the fact that the sector is now almost exclusively smallholders, reveals that average yields probably haven't change all that much since the mid-1970s. This is probably on the low end of the scale of smallholder yield

across other countries. In comparison average yields are 0.72–0.77 tonnes per hectare in India — presumably another low input country. Yields can be increased by the use of smaller hybrid varieties, but these are more risky propositions in terms of susceptibility to drought and their dependence on fertiliser and other inputs.

Yield is just one indicator of the economics of the enterprise. Other key factors that drive production include the unit cost of production especially in terms of labour effort and the scope for and return from alternative crops and risk. That is, the economics of continued production may still be worthwhile in a low input system.

Chart A.2 summarises the production chain for coconuts and the main

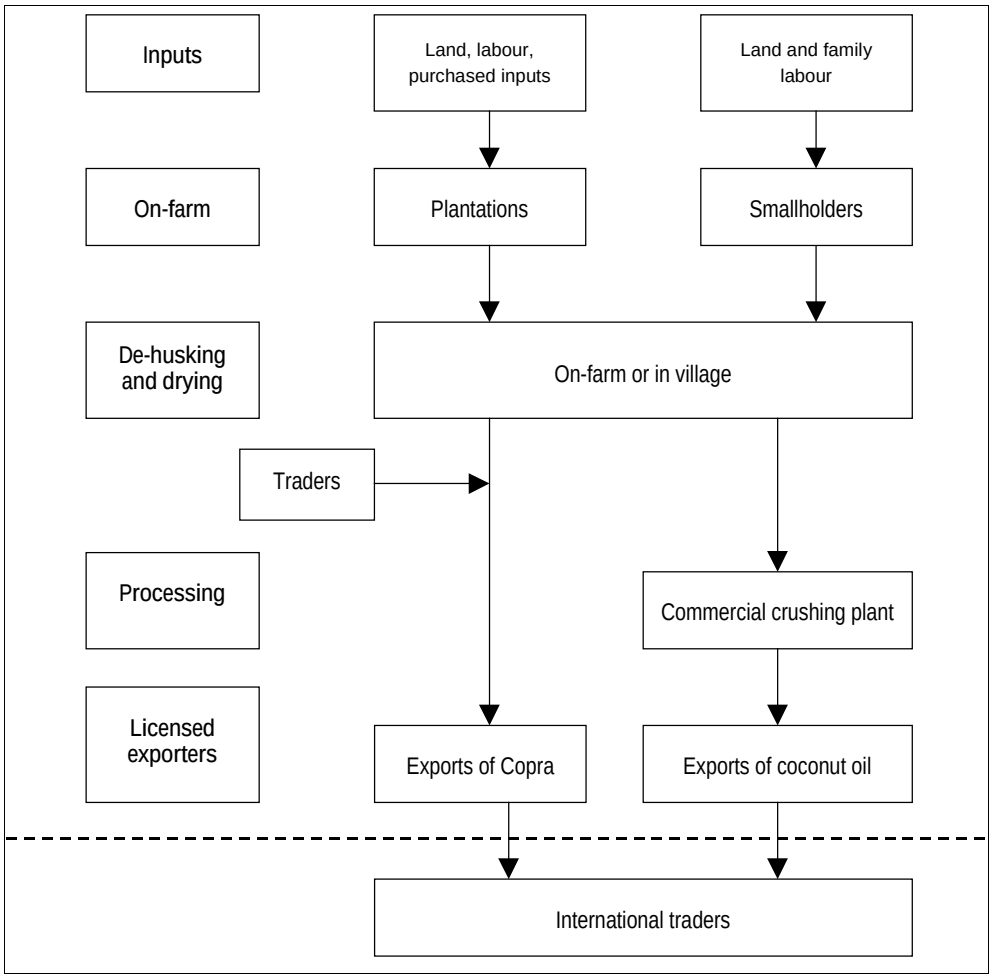
A.2 **Production chain for coconuts and copra in PNG**



Source: CIE.

products – copra and coconut oil – which are both exported. Household consumption of fresh nuts remains a very important use at the smallholder level. Chart A.3 is a stylised representation of the value chain from the farm level - comprising mainly smallholders - through to international traders.

A.3 **Value chain for coconuts and copra in PNG**

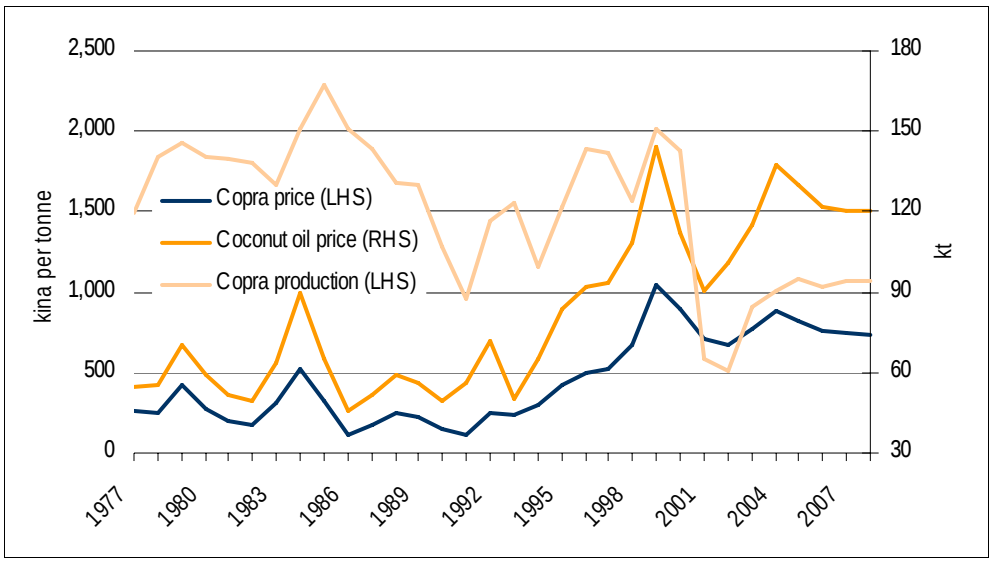


Source: CIE.

Situation and outlook

Chart A.4 summarises the historical performance of the sector and it's outlook. Production of copra peaked in the mid-1980s and up until 2000 has been highly variable. With the area under palms and age profile of palms stable, the harvest-rate of coconuts, especially in the smallholder sector, would have been a critical factor in determining realised copra production.

A.4 **Copra production and prices**



Data source: Bank of Papua New Guinea QEB Statistical Tables and Treasury estimates.

The harvesting rate, especially in the more isolated areas, isvery sensitive to prices received. It is interesting to note that in 1999, copra production of 151kt was just short of the 1985 peak of 167kt.

In 2001, copra production fell to 65kt or less than 40 per cent of the 1985 total. Chart A.4 also shows corresponding export prices, on a fob basis, for copra and copra oil over the same period. In 2000, world prices fell by around 30 per cent. But in 2001, international prices in nominal terms, copra and copra oil prices at the export level were certainly better then those received through the 1990s due to the impact of the devaluation of the kina. The devaluation would have also lead to higher costs in the ailing coastal shipping sector.

While low international prices and higher costs of coastal shipping were contributing factors, complete institutional failure of the Copra Marketing Board (CMB) was the principle cause behind this collapse.

Institutional impact on sectors performance

The CMB was established at independence for the marketing of copra. At that time there were good economic and social reasons for creating a monopoly marketing board:

- copra, unlike coffee and cocoa, is a homogenous product that is sold to a few buyers on the world market;
- there can be substantial economies of scale can accrue in marketing and processing; and

- many copra growers are located on relatively isolated islands that needed to be serviced: the cost of which could be cross-subsidised from the earnings of better located growers.

Most copra was sold through a network of middlemen, cooperatives and ship-owners who on-sold to the CMB.

The CMB appears to have performed satisfactorily through the 1980s, however during the 1990s the CMB became insolvent due to a combination of low international prices, deterioration in inter-island transport costs, poor management and political interference at a board level. The collapse of the CMB during 2001 was well documented in the media. In essence, insolvency leads to producers not being paid in full.

In response to the collapse, the government privatised the Board in 2002 with the *Indastri Koporesen Act 2002*. The Kokonas Industri Koporasen (KIK) expected to play a policy formulation role, with the private sector playing the marketing role. However, the copra buying coverage now no longer extends to village producers in many isolated locations.

The justification for the existence of the CMB does not extend to the KIK. Growers pay high levies (60 kina per tonne, currently) relative to the prices they receive to support an organisation that provides them with few benefits. Copra does not have the same regulatory needs as more complex commodities such as coffee and cocoa. The involvement of a third party regulator adds unnecessary costs. There are no major research issues for copra that requires industry levies and extension requirements are minimal. If the industry continues to decline, maintaining the overhead structure of the KIK will become even more burdensome for growers.

Downstream processing

As of 2003, there were 4 major players in the PNG copra market:

- Coconut Products Ltd
- New Ireland Growers and Exports Ltd
- PNG Coconut Commodities and Bogia Cooperative
- West Farm.

Coconut Products Limited (CPL) started crushing copra in PNG in 1997 at Rabaul. On average CPL crushed between 50 000 to 60 000 tonnes per year to produce 30 000 to 36 000 tonnes of premium grade coconut oil. Another newly established mill by The PNG Coconut Commodities began crushing in copra in Madang as well.

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