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2 Executive summary

Cocoa Pod Borer (CPB) (*Conopomorpha cramerella*) was first detected near Keravat, ENBP in March 2006. Since then, CPB has been detected in Poro, West Sepik Province (June 2006) and at Bogia, Madang Province (April 2008) (Report to CPB Review Committee, 22 June 2008). In 2006 an eradication programme was implemented in ENBP which ended on 16 January 2007. However, CPB re-emerged within the eradication zone in late February 2007. Since then, CPB has been spreading rapidly in the province and the response has switched from an eradication mode to a management mode.

Cocoa Pod Borer (CPB) is the single largest threat to the economy and society of East New Britain Province (ENBP) with social and economic impacts potentially worse than those resulting from the 1994 volcanic eruption at Rabaul. CPB is causing enormous hardship to families and communities by undermining people's capacity to earn a living, to meet their needs in education and health and to maintain their general quality of life. It contributes to crime, conflicts in the family and community, and reduces the viability of village and town businesses. These negative impacts are intensifying as CPB spreads throughout the province. Presently, some cocoa households in CPB areas are being partly subsidised with income from relatives in non-CPB affected areas, but this income is evaporating as CPB disperses throughout the province. Without a major intervention to raise smallholder investment of time and labour in their blocks together with the widespread adoption of CPB management techniques by smallholders, the cocoa industry in ENBP will collapse.

Cocoa is the largest single source of income in the province, and its loss would have severe repercussions on the ENBP economy as the negative multiplier effect takes hold. With a conservatively estimated multiplier for cocoa of 1.47, other sectors of the economy will not be immune to the loss of cocoa income. This means that for every kina lost due to CPB, there would be a loss of K1.47 in local income throughout the economy of the province. If 25% of the crop were lost to CPB, there would be a reduction in provincial income of K41 million per year. If CPB were to lead to a 75% reduction in crop (in parts of Southeast Asia, crop losses due to CPB have been up to 90%), K123 million in total income would be lost from the province. Assuming an annual household income of K5,000, a 25% loss of crop due to CPB would result in the loss of 8,200 jobs, while a 75% loss of crop would result in 24,000 job losses. The data from surveys in CPB-affected areas in November 2008, indicate that the rate of crop loss is currently at the high end of the scale.

Without a major turnaround in the situation, the outlook is gloomy. The economic and social dislocation being experienced by cocoa growers in CPB-affected areas observed in November 2008 is likely to spread to other communities and other sectors of the economy as income and consumption decline. Schools and businesses in villages and towns, for example, were already feeling the impact of CPB through deferred and non-payment of school fees and large falls in business turnover.

If the cocoa industry in ENBP were to collapse, the infrastructure to sustain a cocoa industry would become run-down. This would make it difficult to revive the industry when CPB-resistant material becomes available from CCIL.

Growers and their families in CPB areas have responded to CPB and the loss of cocoa income in several ways:

- Abandoning cocoa production.
- Expansion of other income sources, especially food gardens for home consumption and sale at local markets.
- Establishment of food gardens in cocoa blocks, which often involves the removal of some cocoa trees.

- Diversification into new livelihood activities such as pig production and the cultivation and marketing of tobacco (*brus*).
- Reliance on relatives (*wantoks*) in non-CPB areas for cash remittances and access to cocoa or copra income.
- Theft, especially of food crops from gardens for consumption and sale.
- The arrival of CPB in ENBP coincided with an inflationary period of rising prices of store foods. This helped cushion the impact of CPB on rural households because they were expanding garden production for sale at local markets at the same time as the demand for garden foods was growing in response to rising store prices. However, as CPB encroaches into new areas and more cocoa growers switch to food production for sale, the market for garden produce is likely to become saturated. This process will be exacerbated as the amount of cocoa income circulating in the province contracts. With over 70% of ENBP households being involved in cocoa production, the situation is extremely serious.

Cocoa Management Response of Growers

Most smallholder cocoa growers follow a system of low labour inputs, particularly for block maintenance. Labour input is partly determined by the quantity of ripe, healthy pods that are easily accessible for harvesting.

Younger cocoa stands are more open, trees are shorter and more accessible for harvesting, and pest and disease rates are relatively low. Younger cocoa stands tend to receive higher labour inputs — the ***farming*** *production strategy*. Harvesting groups tend to be larger (both men and women working) and dry bean processing is more likely to occur.

Conversely, old, overgrown and over-shaded cocoa blocks have tall cocoa trees, high levels of pests and diseases, and access for harvesting is difficult. Growers switch to the low labour input ***foraging*** *production strategy,* under which production drops to very low levels. Very small quantities of cocoa are harvested usually by women working alone, and the harvested cocoa is sold locally as wet bean to meet short-term needs (there is not enough crop harvested for dry bean processing). Harvesting visits are typically an hour or two during which one or two baskets of cocoa are harvested (Curry *et al*. 2007).

The risk with CPB is that growers will adopt a permanent ***foraging*** production strategy of very low labour inputs. While the foraging strategy may work for old cocoa blocks carrying high levels of Black Pod, it is unlikely to be a viable strategy for managing CPB-affected blocks. This is because the amount of ripe, healthy crop available for harvesting is likely to be negligible. The returns to foraging for small amounts of cocoa are likely to be so low that cocoa blocks will eventually be abandoned. The November 2008 survey revealed that most growers responded to high CPB infestation rates by either abandoning their blocks or adopting the low labour input foraging production strategy. Only a tiny minority of growers had effectively implemented the CPB management practices recommended by NGIP-Agmark[1] and CCIL (IPDM). These growers had been able to achieve effective control of CBP and were harvesting good yields of healthy pods.

<u>The survival of the cocoa industry in ENBP depends on smallholder farmers moving to a higher labour input system of production. While this is easy to recommend, it is more difficult to devise strategies to achieve this. The success or failure of introducing a new high labour input system of cocoa production in ENBP will ultimately determine the future of cocoa production in the province.</u>

[1] Dr Ho Cheng Tuck and CABI have supported and trained NGIP-Agmark staff in CPB control techniques.

The Way Forward

This report makes a number of recommendations which are discussed throughout the report, especially in Chapter 7. Before listing these recommendations it is important to emphasise that any successes in encouraging small farmers to adopt the high input farming system necessary for the survival of the cocoa industry in ENBP will be well rewarded by greatly enhanced yields. It is conceivable that the arrival of CPB may be the trigger that shifts smallholder production to another level where productivity and incomes are much higher than in pre-CPB days. Indonesia successfully made this transition with cocoa production increasing more than three-fold since the arrival of CPB. This point must be kept in mind when thinking through strategies to respond to CPB.

The theme of the industry response to CPB should be '*Restoring Livelihoods*' to acknowledge the breadth of the response required and that cocoa provides only one part of the solution.

The main recommendations contained in this report are:

1. Develop a Strategic plan for agriculture in response to CPB.
2. Establish a Project Implementation Unit to coordinate extension efforts and to raise funding from donors (or from levies) to sustain these programmes.
3. Develop an integrated and coordinated approach to extension involving government, commercial and community organisations.
4. The farming community to be directly involved in extension delivery and CPB monitoring.
5. Distribute small hybrid clones free to farmers in return for removing old cocoa stands.
6. Promote income and livelihood diversification such as coffee as an alternative crop to cocoa for growers not willing to make the transition to high input cocoa growing.
7. Amend quarantine regulations to allow the removal of CPB hotspots.
8. CCIL Breeding to immediately initiate a crossing programme to develop CPB-resistant/tolerant material, and, as a shorter-term measure, assess all recent and planned cloned and hybrid releases for CPB tolerance.
9. Encourage growers to report to CCIL, CPB tolerant cocoa found amongst their own stands, and, following evaluation and approval from CCIL, this material to be budded on their own blocks while waiting for CCIL to develop new CPB-resistant/tolerant material.
10. The Cocoa Board should immediately relax regulations prohibiting the sharing of village processing facilities, and fast-track the approval of small fermenting boxes for use by growers in CPB areas.

3 Introduction & background

> We are like foreigners now with CPB. We are starting again and surviving on garden foods. Our lives are finished now. We don't know what to do or what road to follow. (CPB affected grower, Vudal settlement block)

This study was undertaken in response to a request from the East New Britain Cocoa Pod Borer Response Coordinating Committee (ENBCPBRCC) for a socio-economic impact assessment of Cocoa Pod Borer[2] (CPB) (*Conopomorpha cramerella*) on smallholder livelihoods and on the economy of East New Britain Province (ENBP). The ENBCPBCC also sought an appropriate developmental model for the province, with the intention of attracting investment in cocoa and other areas of agriculture.

CPB (Plate 1.1) was first detected near Keravat, ENBP in March 2006. Since then, infestations have been identified in Poro, West Sepik Province (June 2006) and at Bogia, Madang Province (April 2008) (Report to CPB Review Committee, 22 June 2008). In 2006 an eradication programme was implemented in ENBP which ended on 16 January 2007. However, CPB re-emerged within the eradication zone in late February 2007 and by late June 2008 there were six confirmed CPB outbreaks outside the eradication zone (Figure 1.1). Since then, CPB has been spreading rapidly in the province. Appendix 1 provides a chronology of CPB detections and spread in PNG until early November 2008. When the CPB eradication programme failed, it was replaced with a "management mode" programme involving the promotion of weekly harvesting and intensive cocoa block management including centrally coordinated pod breaking and pod burial. NGIP-Agmark has supplemented this model amongst its smallholder growers at Tokiala with its "synchronised high management mode and contingency planning" model, which also promotes regular insecticide application and the diversification of income sources.

However, as this report makes clear, CPB is undermining the low labour input system of cocoa production which has served PNG smallholder cocoa producers for many years. Crop losses from CPB in combination with other pest and disease losses mean that smallholder growers can no longer maintain a low input system of production if they wish to continue to produce cocoa. Production can only be maintained with a switch to a high input system of production in which inputs and yields are both increased. As argued in this report, if a high input system is not adopted, CPB will be a much greater threat to the society and economy of ENBP than the 1994 volcanic eruption in Rabaul. The window of opportunity to address CPB is closing rapidly and action is urgently required to prevent a major contraction of the ENBP economy and the social dislocation and disorder that would inevitably accompany the destruction of livelihoods of such a large proportion of the province's population.

3.1 Cocoa production in PNG

Cocoa was introduced to ENBP about 1880 by German traders, and the industry developed slowly until the 1950s when the Australian Administration promoted its cultivation amongst villagers. It is now one of the four major export tree crops cultivated in the 14 coastal provinces of PNG. Cocoa plantings occupy some 129,000 hectares or 27% of the total area of 476,000 hectares under export tree crops. It is cultivated by about

[2] CPB has a lifecycle of about one month. The moth lays its eggs on immature pods and after 2-3 days the larvae hatch and burrow into the pods where they feed for about two weeks. Larval feeding causes crop losses from several effects: clumping of beans making removal from the pod difficult or impossible; appeareance of premature ripening so immature pods are harvested; and reduced weights and quality of beans (Day 1989 cited in Beevor et al. 1993, 134).

151,000 coastal households (*The 2000 National Census*). Using an average family size of 7 members per household (Omuru *et al*. 2001), this equates to just over a million people in PNG who are dependent on cocoa for their livelihood.

Production of cocoa in PNG has been dominated by smallholders since the late 1970s, with contributions from the plantation sector declining steadily through time to the present[3] (Figure 1.2). This situation is attributable to five main reasons:

1. The plantation land acquisition scheme initiated by the national government in 1978.
2. High costs of production coupled with low commodity prices, especially from the 1980s onwards.
3. Lack of land for further expansion.
4. Agro-climatic factors.
5. Lack of capital and managerial skills.

Plate 1.1. The Cocoa Pod Borer Moth (*Conopomorpha cramerella*) is about the same size as a mosquito.

[3] The downward trend in plantation production from the 1990s onwards was compounded by lack of production from Bougainville plantations which ceased production because of the Civil War. Before the Civil War, plantations on Bougainville produced about 36% of the total cocoa production in the country (Omuru and Lummani 2001).

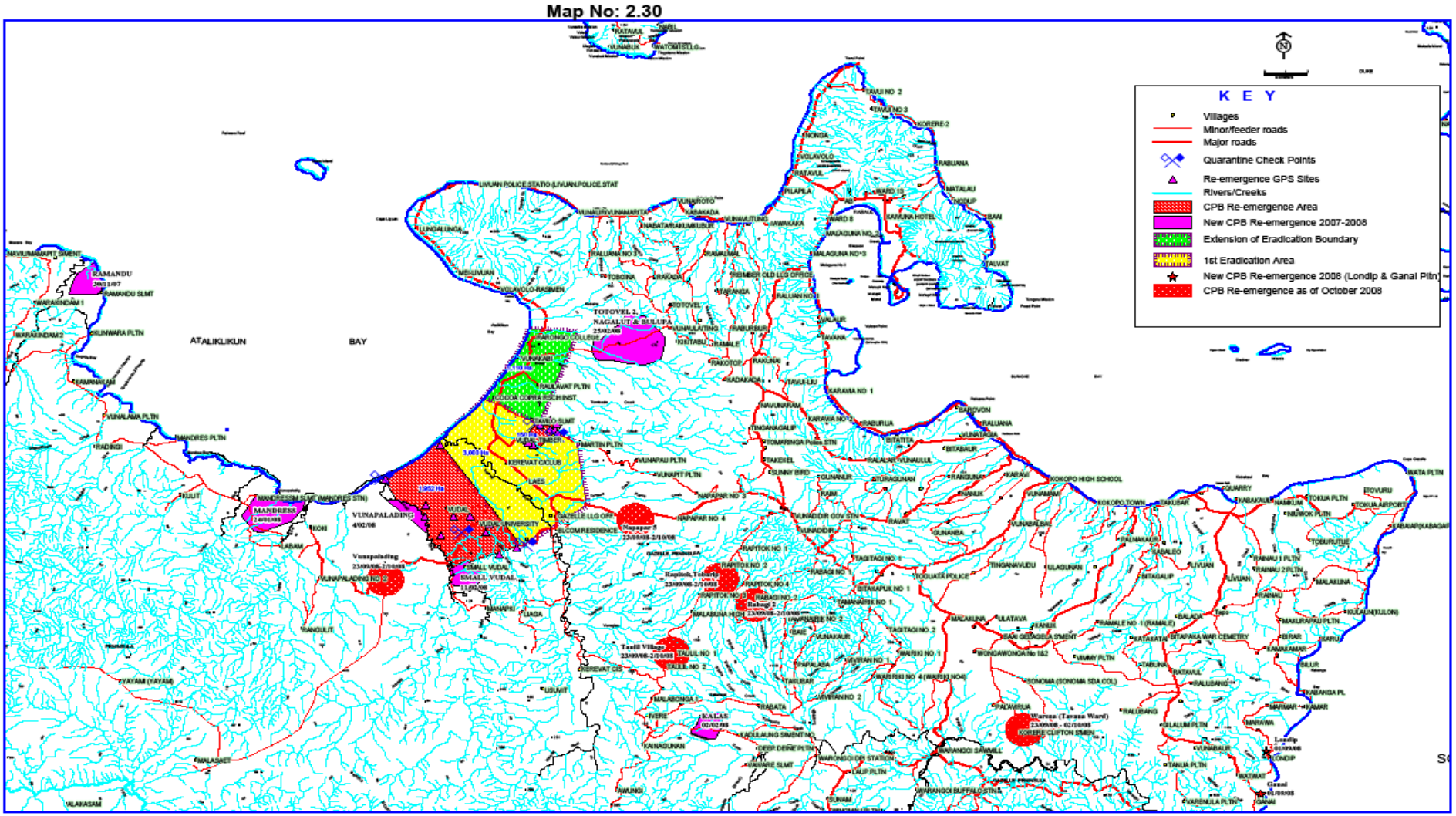

Figure 1.1. Known areas of CPB infestation in ENBP as at 16 October 2008.

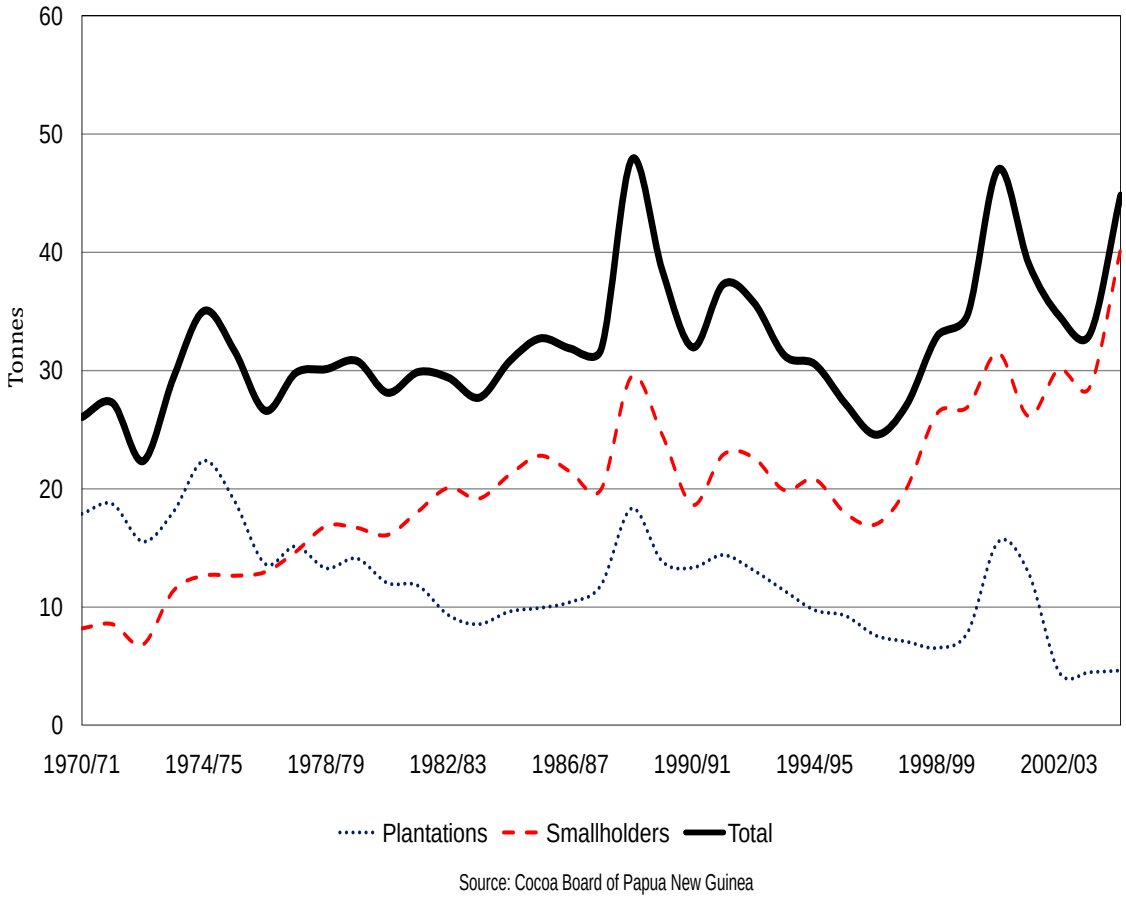

Figure 1.2. PNG cocoa production by sector: 1970/71 to 2007/08.

Cocoa Production in ENBP

ENBP produces just over half of the total national output of cocoa, 87% of which comes from 23,000 smallholder farmers and their families (over 70% of total households in ENB). Generally, ENBP's cocoa production path (Figure 1.3) has followed closely the overall trend in national cocoa production (Figure 1.2). Two phases of cocoa development in ENBP can be discerned in Figure 1.3. The first phase was up until late 1980s when production did not go much above 10,000 tonnes. The second phase was from the late 1980s through to the present when annual production for the most part was between 17,000 and 20,000 tonnes with drops in production associated with the 1994 volcanic eruption and the 1997 drought. The annual rate of growth in output over this second phase was very low at 0.02% per annum[4], despite the introduction of new planting materials during this period.

[4] Average annual production was calculated for five years at the beginning of Phase 2 (1988-89 to 1992-93) and for the last five years of Phase 2 (2003-04 to 2007-08). The increase in production over this period was 0.259%. Using the mid-point of each five year period (1990-01 and 2005-06) the annual rate of growth in production of cocoa was only 0.02%.

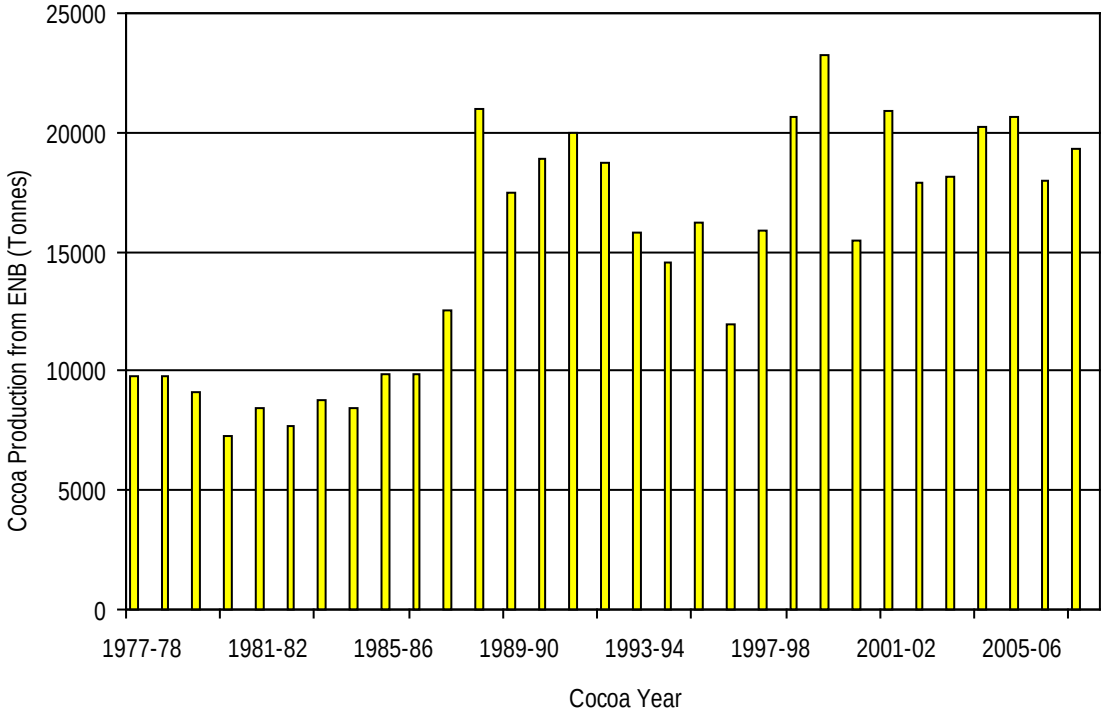

Figure 1.3. Cocoa production in ENBP (1977-78 to 2007-8)[5]

Plantation cocoa yields and production costs

Average cocoa yields for plantations in PNG have declined since the mid 1990s compared with yields of 0.9 tonnes per hectare and above in the late 1980s and early 1990s (Table 1.1). Decreases in yields over the years of the surveys (1989, 1993, 1995 and 1997), were accompanied by increases in cocoa costs per year (Table 1.1).

Table 1.1. Plantation cocoa yield and production costs by year.[6]

	YEAR							
	1989	**1990**	**1992**	**1993**	**1995**	**1996**	**1997**	**1998**
Dry bean/ha	0.92	0.63	0.90	0.53	0.49	0.59	0.38	0.52
Cost/ tonne	K1,538	K1,516	K1,270	K1,422	K1,550	K1,548	K2,561	K1,823

Low commodity prices, especially from the 1980s onwards, as reported by Omuru and Lummani (2001), have accelerated the depletion of the capital base for most plantations and delayed replanting of senile cocoa trees. Today, few cocoa plantations operate successfully on a commercial basis. Small village growers now produce most of the crop and it is with them that the future of the cocoa industry resides. Some major cocoa traders (e.g., Agmark Pacific) have recognised this and have begun working in partnership with smallholders to ensure a secure future for the industry. Efforts in this regard are especially directed at addressing adverse market and biophysical circumstances aimed at improving profit margins for farmers through reduced transport costs and improvements in cocoa yields.

[5] Source: Cocoa Board of Papua New Guinea
[6] Source: Omuru and Lummani 2001

Smallholder cocoa yields and production costs

For smallholders, information on cocoa yield is thinly scattered. The available historical yield data accessed at the time of writing this report show that they vary relatively widely from region-to-region (Table 1.2). This is to be expected as yields reflect what smallholders produce under different levels of farm management and in different agro-climatic conditions around the country.

Typically, an average farmer in the main cocoa producing provinces of ENBP and Bougainville achieves yields of between 300 to 400 kg per hectare (Table 1.2). Yields may fall as low as 80-200 kg per hectare in poorly managed farms, especially if there are adverse agro-climatic factors (e.g., bad weather, poor soil fertility, etc) or physiological factors (e.g., after a peak production year when trees are stressed and need time to recover).

Table 1.2. Yields of smallholder cocoa producers in PNG (tonnes/ha dry bean).[7]

Area Surveyed	1974	1989	1994	1998	1999	2007
Gazelle Peninsula	0.296	0.320	0.356	0.401	0.620	0.366
Bougainville	0.332	n.a	n.a	n.a	n.a	n.a
Madang (NCR)	0.250	0.100	n.a	n.a	n.a	n.a
Madang (Karkar)	n.a	0.080	n.a	n.a	n.a	n.a
ESP	n.a	0.170	n.a	n.a	n.a	n.a
Oro	n.a	0.320	n.a	n.a	n.a	n.a

Costs of production for cocoa smallholders also vary amongst regions. These variations, as reflected in the historical cost data (Table 1.3), depend mostly on accessibility and production level. The main input is labour, with a current imputed cost of K15.00 a day[8].

Table 1.3. Smallholder cocoa costs of production (Kina/tonne).[9]

Province	Labour Days/Tonne (Wet Beans)	Kina/Tonne (Wet Beans)	Labour Days/Tonne (Dry Beans)	Kina/Tonne (Dry Beans)
ENBP	152	101	221	362
East Sepik	202	100	279	451
Karkar	n.a	174	n.a	n.a
Madang	300	245	481	1,144*
Oro	131	64	218	429

**inflated due to low yields coupled with high capital costs.*

The latest information on smallholder cocoa production costs are reported in Omuru (2001) which profiled smallholder yields and costs in ENBP. The per tonne production cost was K578.36 in 1999, of which transport was a major component at K182.66, followed by 'sundries' (K130.89). Other costs were processing (K101.91), harvesting (K84.81) and field variable costs (K78.10). By international comparison, smallholder cocoa producers in PNG are relatively low cost producers. This is attributable to their low input cocoa farming system which allows them to obtain reasonable returns on their labour.

3.2 The ENBP economy

The ENBP economy is heavily reliant on agricultural production largely on customary land. Ninety per cent of the land area remains under customary ownership. Three per cent is held as freehold with the balance held under various forms of tenure including state leases (ENB Lands Office 2009). Using a 2009 provincial population estimate of 250,000 people, this equates to 0.86 ha of

[7] Sources: Godyn 1974; Yarbro and Noble 1989; George 1994; Omuru 2001; Omuru et al. 2001, Curry et al. 2007
[8] This is according to the deliberations of the PNG Rural Minimum Wages Board and the national government during February 2009.
[9] Source: Yarbro and Nobel 1989

arable land per person[10]. The main export crops are cocoa and copra, and each contributes significantly to the provincial economy (see Chapter 2 for further discussion). Their combined areas of cultivation total roughly 118,394 hectares[11] which is just over half of the province's 214,177 ha of arable land (World Bank Report 2007, 184). Both crops are cultivated in the four districts of the province and provide income for the majority of the people there. The incomes generated are used for paying head tax to the eighteen local level governments in the province and for meeting household cash needs such as school fees, store foods, clothing, travel, etc., as well as for meeting socio-cultural obligations.

ENBP cocoa growers receive relatively higher incomes compared with growers in other cocoa producing provinces. The smallholder household survey in ENBP by Omuru *et al*. (2001) reported an average cash income from cocoa per rural household of K2,867, equivalent to K410 per capita[12], a relatively high income by PNG standards. By comparison, Curry *et al*. (2007, 43), estimated an average annual household income of K2,271 (i.e. income from both dry and wet bean sales combined). These reported household incomes are well above the current rural minimum wage rate of K74.40 per fortnight (or K1,934.40 per annum). This minimum wage rate, other things being equal, provides less off-farm incentives for cocoa household members with better earnings from cocoa farms.

Much of the income from cocoa circulates within the rural communities in service of the cultural infrastructure at the village level (e.g., the use of cash in brideprice payments, death compensation, life-crisis events, etc.) before gradually being spent on store goods or school fees. This means that not only does the level of cocoa income determine villagers' quality of life in relation to the modern cash economy (e.g., purchase of store foods and other goods; farm inputs; medical treatment; education), but it also determines the quality of life associated with traditional cultural activities and practices.

The provincial economy has been experiencing economic growth, especially in the commercial and industrial sectors. The provincial centre of Kokopo, for instance, has grown into a major urban centre with new commercial buildings and housing developments in most parts of the town following the 1994 twin volcanic eruptions which largely destroyed the old provincial capital of Rabaul. These developments and infrastructural amenities have greatly enhanced the quality of life of the ENBP community. Accordingly, the people of the province enjoy relatively good transport and communication systems, educational and medical services, and a broad range of social facilities.

As ENBP experiences rapid development both commercially and industrially, its population is also growing rapidly, due to better health services and, as more people from outside the province are attracted by employment and business opportunities and the lifestyle ENBP has to offer, characterised by its relative stability in law and order and the hospitality of its people.

3.3 Outline of structure of report

The report is written as a series of questions and answers. Each chapter from Chapter 2 is headed by a question and is followed by brief summary answers to that question. These brief answers are immediately followed by a more detailed analysis and discussion of the question. Readers can

[10] The 2009 estimates for the ENB provincial population vary between 250,000 and 270,000. This variance is due to the distortion caused by out-migration after the 1994 volcanic eruption. ENBP Statistics uses 250,000, while a recent UPNG draft report uses 270,000 people. For the sake of consistency, the figures from The 2000 National Census were used here.

[11] This estimate is based on data from the 2000 national population census and in Omuru et al. 2001; Ghodake et al. 1995; Curry et al. 2007.

[12] Per capita income is a measure of the wealth of an area's population as well as an indicator of the economic health of that region. The per capita income per cocoa growing household in ENBP is determined by dividing the total income (K2,867) from cocoa production per household in the province by the number of household members (7 members) per cocoa growing household.

read at a glance the brief summary answers to identify the key findings from the research, or they can read each chapter fully as well as the appendices for more detailed information.

The core questions addressed in this report are:

1. What are the projected impacts of CPB on the cocoa industry and the economy of ENBP?
2. What are the current and projected impacts of CPB on smallholder cocoa production and village level socio-economies?
3. How is CPB affecting cocoa block maintenance and the harvesting practices of smallholders?
4. How are smallholder livelihood strategies being modified in response to CPB?
5. What are the main obstacles for the industry and other stakeholders in tackling the CPB threat?
6. What should the industry do in response to the CPB threat?

The answers to these questions are based on a socio-economic impact assessment of CPB carried out in November 2008 over a two-week period which coincided with the flush period in the north-west of the Gazelle Peninsula. The three research sites — the wards of Kareba, Tavilo and Vudal — were selected because they had high levels of CPB infestation and would therefore provide insights into the impacts of CPB on the livelihoods of families and communities and their capacity to respond to the CPB threat. The three sites also provided an opportunity to assess the effectiveness of intervention strategies to promote the adoption of CPB management strategies.

A total of 152 interviews in three wards were conducted with smallholder growers and their families. Each interview took between 30 and 45 minutes to complete, and questions covered such topics as the impact of CPB on harvesting, processing, cocoa block management and livelihood strategies.

In parallel with the household interviews, part of the research team carried out a farm management assessment which involved a physical inspection of the cocoa block including a pod count on a sample of 10 trees on each cocoa block. A full description of the methods employed in the survey is provided in Appendix 2.

Village and town business owners and operators were interviewed about their experiences of CPB impacts on turnover and other aspects of their businesses. Elementary, primary and secondary schools with student catchments in CPB areas were visited and their principals and/or senior teachers interviewed about the impacts of CPB on school enrolments and payment of school fees. The police station commander at Keravat was interviewed about changing patterns of crime in CPB areas compared with CPB-free areas. Many people within the cocoa industry — government and private sectors — were interviewed.

4 Projected impacts of CPB on the cocoa industry and the economy of ENBP

If CPB is not controlled effectively, the cocoa industry would be unlikely to remain viable in the province.
If the industry were to survive, but with a reduced production capacity, the impact on total income in the province would be severe and would equate to high numbers of job losses.
Assuming an average household income of K5,000 per annum and a conservatively estimated multiplier of 1.47, the job equivalent losses in the province under different scenarios of cocoa yield reductions are as follows:

Crop Loss	Numbers of Jobs Lost
25%	8,200
50%	16,400
75%	24,600

Without urgent attention the impact of CPB on the economy and society of ENBP will be catastrophic.

What is the contribution of cocoa to the provincial revenue base and national GDP?

ENBP contributes a sizeable portion of revenue to the provincial purse from various agricultural sources. The main ones are cocoa and copra[13]. Extrapolating from the performance of the provincial economy in 2007, agricultural exports generally contribute around K300 million (depending on crop prices) annually to national export revenue. This is approximately 2.8% (K0.33 billion) of the national Gross Domestic Product assumed to be around K12 billion. The provincial GDP per head is relatively high at K1,500 compared with the national average of about K720 or more per head.

Contributions to GDP from cocoa exports have been increasing recently because of good crop prices and better planting materials. The value of cocoa production from ENBP alone averaged K106 million during the period 2000 to 2007 (Table 2.1). This represents about 42% of the average value of the province's total agricultural exports of about K251 million per year since 2000.

Table 2.1. Estimates of export value of cocoa from ENB (2000/01 to 2007/08).[14]

Product	**Cocoa**	
Year	**Volume (Tonnes)**	**Kina FOB**
2000-01	15,433	49,512,922
2001-02	20,886	131,962,970
2002-03	17,901	114,645,463
2003-04	18,182	94,331,246
2004-05	20,227	90,799,003
2005-06	20,555	95,370,061

[13] Production figures obtained from the Cocoa Board of PNG have been used as proxy for exports from the province. This is because cocoa and coconut product export figures from the ENB Provincial Government Planning Office included shipments from the Rabaul Port of cocoa and coconut products from Bougainville and New Ireland provinces. To avoid overstating the total agricultural export value for ENBP because of Port-based derivation grants from agricultural products (including cocoa and coconut products from Bougainville and New Ireland) going to the ENBPG, the production based proxy export figures were multiplied by the kina unit export value (fob) to obtain the estimated export revenue for the ENBP.
[14] (Source: Cocoa Board of Papua New Guinea)

2006-07	22,400	123,720,800
2007-08	22,000	143,982,667
Average	**19,698**	**105,540,642**

Consistent with its share of total cocoa output in the country, ENBP has been responsible for around half of the national average cocoa export value of K200 million from mid-2000 onwards. Its estimated export earnings of K144 million in 2007-08 were about 48% of the total cocoa export value of K300 million in that cocoa year.

Population growth and the agricultural labour force

The '2000 National Census' (NSO Data Sheet, Table 2) reported that the population of ENBP was 133,197 in 1980, 185,459 in 1990 and 220,133 in 2000. The annual average population growth rate over this 20 year period was 2.5%. The ENBP government estimate for 2009 was 250,000 people.

Population growth can have both positive and negative effects on the agricultural sector. It is advantageous if it causes growers to adopt more efficient farming practices that result in higher productivity and incomes per person and unit area. The contrary is when it causes social tensions if the capacity of the provincial economy to absorb increases in population is exceeded such as when land shortages begin to emerge for food and cash crop production. Historically, the province has been able to absorb increases in its population, and this has been an important factor in the development of a commercial agricultural sector in the province, especially through the migration of workers for plantation agriculture. The active developments in its relatively diverse economy (e.g., timber, agro-industry, shipping, commercial developments and good social and educational facilities), still attract many migrants to the province, especially from less well-off areas in the Highlands and crisis-affected areas like Bougainville.

The agriculture sector is the largest employer of labour in the province. The current workforce of the primary sector (especially agriculture) is about 118,000 people, which is approximately 72% of private sector employment in 2007[15]. Wage labour is the primary input in cocoa and copra plantation production, while family labour is typically used in production of cocoa and coconut on smallholder plots of one to two hectares (Ghodake *et al.* 1995; Curry *et al*. 2007). Smallholder cocoa and coconut growers usually supplement their incomes with minor cash crops such as chilli, pepper, vanilla, nutmeg, etc., and they also cultivate food and other crops (e.g., betel nut and tobacco) for sale at local markets.

Cocoa is a major employer of rural people in the province and now provides direct employment to some 160,000 or more people (73% of the population). In addition to smallholder employment, many people are employed in the exporting, shipping and transportation of cocoa throughout PNG. The largest cocoa exporter, Agmark Pacific, with more than 60% of the domestic export market share, employs around 1,500 people inclusive of administration and plantation labourers, a large proportion of whom are employed in ENBP. The cocoa industry also provides work and spin-off benefits in the depots and buying points as well as at the industry's headquarters at Kokopo and at regional offices where about 45 people in total are employed. CCIL employs 30 highly trained and specialised local agricultural scientists, 15 research assistants and 20 support staff in cocoa research and development, with about 800 labourers in its plantations. A further 67 people are employed in the institute's Industry Services Division, responsible for bringing technology to cocoa growers throughout the country. In all, a substantial proportion of the employment in ENBP is directly or indirectly related to the cocoa industry.

[15] This figure was provided by the Provincial Department of Primary Industry (DPI).

Projected economic losses due to CPB

What are the projected income losses for individual cocoa farming families?

The CPB experience elsewhere indicates that rates of crop loss can be very high. In parts of Southeast Asia, crop losses have been reported at up to 90% (<http://www.new-ag.info/search>), and in CPB areas visited in ENBP for this assignment (Chapter 3), some farmers were losing nearly their entire crop.

To estimate CPB losses in cocoa income for the 23,000 cocoa growing households in ENBP we must first establish what the income level was prior to CPB. In 1999, Omuru (2001) estimated the average ENBP smallholder cocoa yield to be 620 kg (dry bean) per hectare[16]. With a dry bean price of K5.01 per kg (K3,106.20 per hectare), and an average smallholder cocoa farm size of 2.63 hectares (Omuru *et al.* 2001), the average cocoa farm household was earning K8,169[17] per year. Using this base annual income, the reduction in income, under three scenarios of crop losses — 25%, 50% and 75% — have been estimated (Table 2.2). Income losses per cocoa producing household range from an annual fall in cocoa income of K2,042 at 25% crop loss to a fall of K6,127 at a 75% rate of crop loss.

Table 2.2. Yield and income losses from CPB.

Proportion of yield loss (%)	Reduction in yield (kg/ha) from 620 kg/ha	Reduction in income (kina/ha)*	Estimated income loss per household (Kina)
25	155	776.55	2,042
50	310	1,553.10	4,085
75	465	2,329.65	6,127

** This is based on a 3-year average of delivered-in-store dry cocoa bean prices of K5.01 per kilogram multiplied by the reduction in cocoa bean yield.*

These projected income losses for individual cocoa farming families would be very difficult to recoup through other livelihood strategies. The evidence presented later in this report indicates that the majority of growers have not been able to make up their income losses through the adoption or expansion of other livelihood activities (see Chapter 3 for a discussion).

What are the projected economic losses for the province?

Cocoa is the main income source for about 73% of the population and constitutes around half the value of ENBP's exports. Figure 2.1 shows the three year moving average of production from 1979-80 to 2007-08 and projected production to 2014-15 under the 0.02% annual growth rate in output described in Chapter 1. The graph shows the likely production trend into the future if CPB had not arrived in the province.

[16] The choice to use these data instead of the most recent data provided by Curry et al (2007) is based on the argument that the distribution of the farms was wider in the Omuru (2001) study.

[17] This figure is much higher than the average household income reported in Omuru et al., (2001) and cited in Chapter 1. This is because average cocoa prices (K5.01/kg) have been considerably higher in recent years than when the earlier study was undertaken.

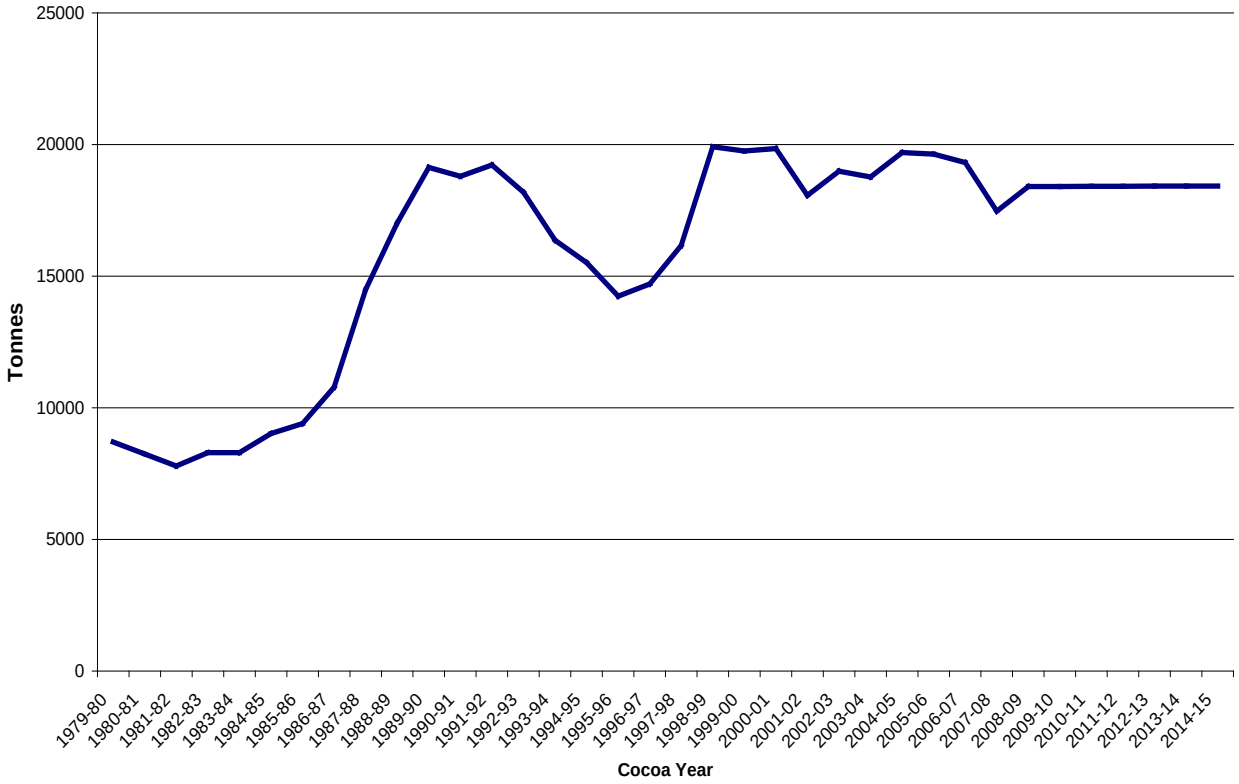

Figure 2.1. Annual cocoa production for ENBP projected to 2014-15 in the absence of CPB (three year moving averages for period up to 2007-08).

Using this baseline projection in Figure 2.1, we can estimate future production with the three scenarios of crop losses (25%, 50% and 75%) with three years to reach each rate of loss[18]. Figure 2.2 shows projected output if CPB were to result in a 25% loss of production. This would reduce production to around 14,000 tonnes per year which was the bottom of the trough in production experienced following the 1994 volcanic eruption and during the 1997 drought. However, for reasons discussed later in this report, this is the least likely scenario. It is highly likely that production losses will be much greater if high input farming, including the adoption of IPDM strategies and CPB management techniques, is not widely adopted by cocoa growers.

If CPB were to lead to a 50% loss of crop, annual production would drop below 10,000 tonnes by 2010 (Figure 2.3). This would take ENBP back to levels of cocoa production not seen since the mid 1980s. If production were to fall by 75% — quite possible given the experience in other countries and amongst growers surveyed for this study (Chapter 3) — production would fall below 5,000 tonnes per annum (Figure 2.4). It is doubtful though that output would remain at this level because the returns to labour relative to other livelihood options would be so low that few people would persevere with cocoa. Most would abandon cocoa production and the industry in ENBP would collapse. These issues are taken up later in this report.

[18] The three year build up to each rate of crop loss is a reasonable assumption given that the ENBCPBRCC announced on 23 February 2009 that CPB has been found in all the districts of the province.

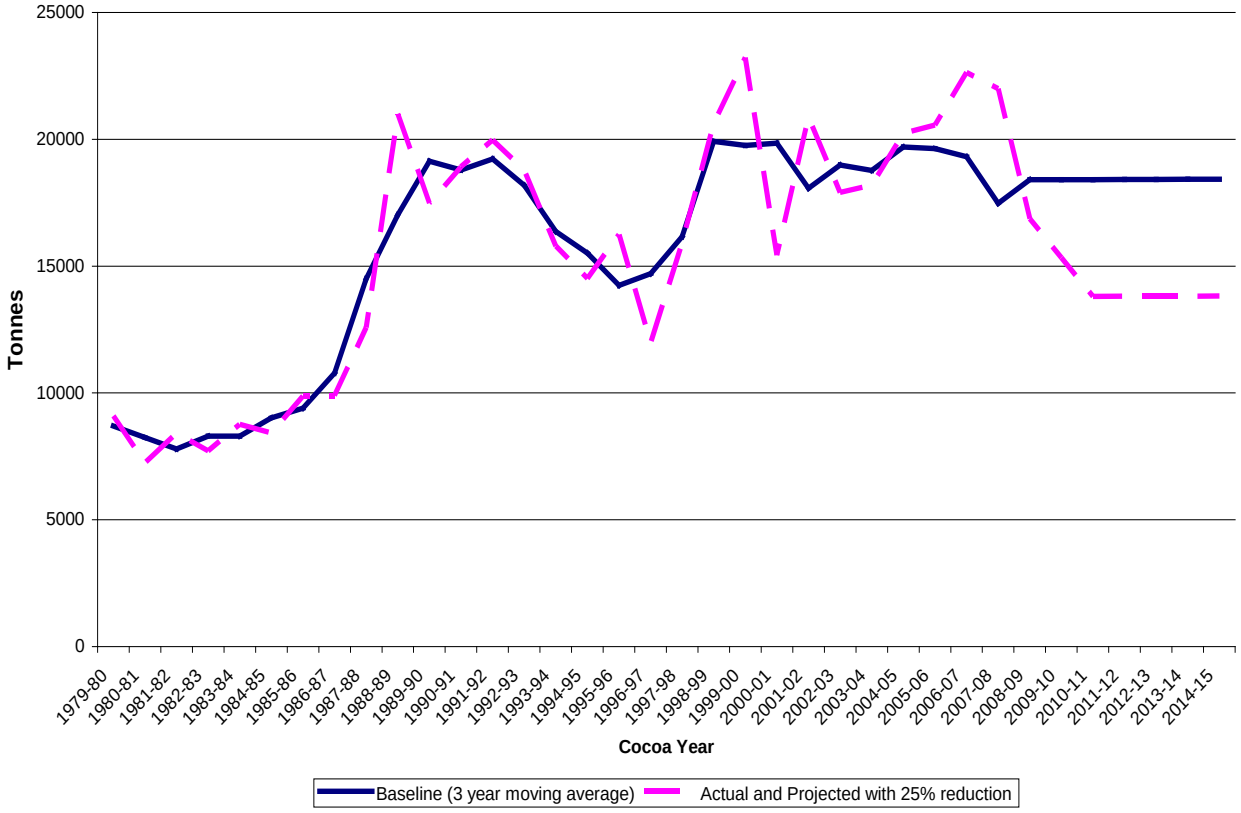

Figure 2.2. ENBP cocoa production trend with 25% crop loss plotted against projected baseline.

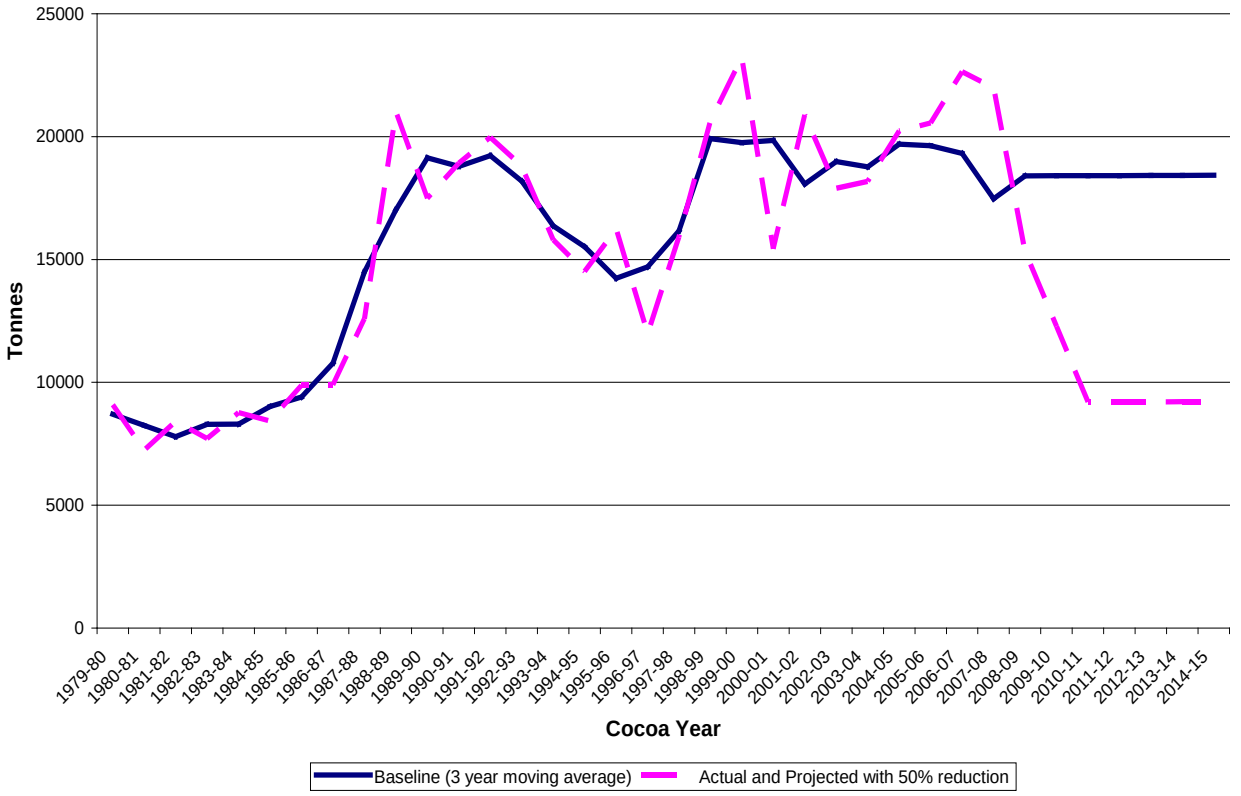

Figure 2.3. ENBP cocoa production trend with 50% crop loss plotted against projected baseline.

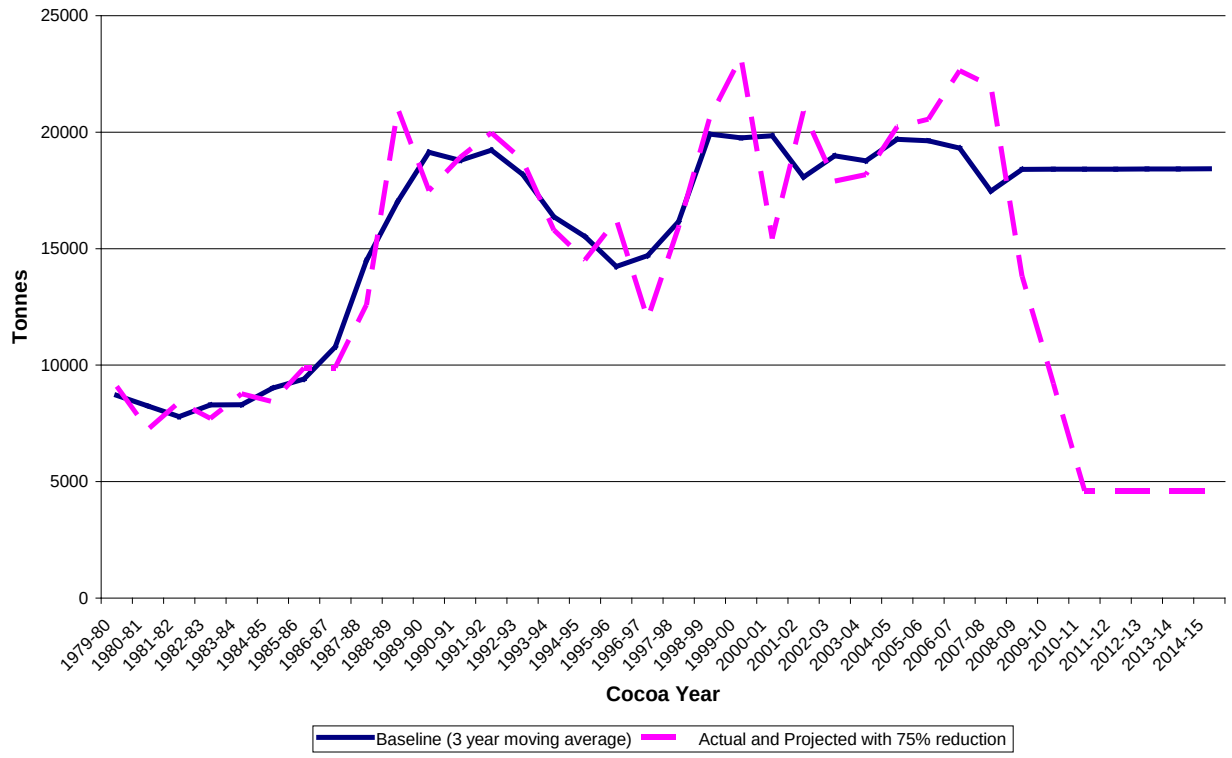

Figure 2.4. ENBP cocoa production trend with 75% crop loss plotted against projected baseline.

What effect does the economic multiplier have on the total economic impact of CPB on the provincial economy?

The projected total impact of CPB on the economy of the province can be estimated with the use of an economic multiplier[19]. Specifically, multipliers provide information about changes in the economy that reach beyond the initial action (e.g., a quantified increase or loss in production). Having some measure of the total economic impact from changes (e.g., new investments in different types of businesses or closure of a firm), assists economists and planners to formulate policies and make decisions in relation to appropriate areas of intervention in economic development programmes.

Multipliers are normally derived from an input-output model whether by commodity, industry, district, province or other. PNG does not have an up-to-date official input-output model. However, a crude income multiplier for the economy of ENBP can be estimated using a formula adopted from Hustedde *et al*. (2005). The income multiplier for ENBP based on this guide is determined by using the formula:

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[19] Typically, three types of effects are measured: (i) direct, (ii) indirect, and (iii) induced effects (Mundy and Purcell 2004). The direct effects measure the changes as the result of the initial expansion or contraction of business activity. Indirect effects occur when the original firm that made a change buys supplies from other firms, pays employees, or pays another business to transport products. These two effects together are used to calculate Type I multipliers, which show the sum of the direct and indirect activities associated with the original economic stimulus. Induced effects are the additional impacts of spending by workers who provide inputs or deal with the outputs of the business that made the original change.

Type II and Type III multipliers Economists use Type II and Type III multipliers both of which are designed to pick induced effects. They are labelled Type II or Type III depending on how the induced impact is measured (Miller and Armbruster). Type II multipliers are based on the assumption that the induced effects have a linear relationship between income and consumption spending. An x per cent increase in income will produce an x per cent increase in consumer spending. Type III multipliers calculate the induced impact as a nonlinear relationship where an x per cent increase in income will produce a y per cent change in consumer spending that is different and usually smaller than the percentage change in income (Dumas 2003). Practically, whether a Type II or Type III multiplier is used makes little difference when small, incremental changes in income are being considered. What is important is that the induced effects get included.

$$\text{Income Multiplier} = \frac{1}{[1-(MP_c x MP_s]}$$

Where: *MP*c = marginal propensity to consume

*MP*s = marginal propensity to save.

The marginal propensity to consume locally (MP_c) represents the proportion of total income that East New Britons spend locally. According to Hustedde *et al.* (2005), a crude estimate of the MP_c can be obtained by asking "what proportion of people's income is likely to be spent locally[20]? It is commonly assumed to be high at 0.80 for cocoa producers.

The marginal propensity to save (MP_s) is the percentage of money spent locally that becomes local income. Likewise, this can be estimated by asking: "what percentage of the money that is spent locally goes to labour-intensive services (e.g., cooked food sold at local markets, vehicle repair, tailoring, etc) versus external purchases (e.g., vehicles, televisions, mobile phones, kerosene lamps, farm tools and chemicals, etc)." It is assumed to be relatively low at 0.4. In other words, this refers to the proportion of income East New Britons spend on purchases with local labour content.

By substituting the numbers into the formula, the income multiplier for ENBP can be derived as:

$$\text{Income multiplier} = \frac{1}{[1-(0.8x0.4)]} = 1.47$$

Alternatively, another country's multipliers can be used as proxies. For instance, Pricewaterhouse Coopers (PwC) (2006) used multipliers for the "forestry, fishing and hunting" segment of the Australian economy in 1989-90 as a proxy for unique PNG multipliers. These were used as indicative benchmarks of the likely impact of the economic benefits which would accrue from an increase in the economic activity of the forestry industry. The total output multiplier used was 2.5 and income multiplier of 0.7. By comparison, Ghana, one of the major producers of cocoa in West Africa, has a relatively high overall multiplier effect of 2.44 for cocoa, derived from an input-output framework called Social Accounting Matrix or SAM (Aryeetey *et al*. 2000).

Another guide used in estimating the crude income multiplier was the technical report, prepared by Economic Consultants, ACIL Tasman (2002), in conjunction with Economic Insights Pty Ltd, for the PNG Gas Project. Their report drew on an input-output table prepared for Fiji islands in 1997 and, derived a Type II value-added multiplier of 1.38 for industries supplying government expenditure (Table 1, A1-52). This includes the cocoa industry as well (ACIL Tasman 2008, see p.A-15, Appendix Table 4: Increase in government current expenditures).

It might be said that the estimate for ENBP should approximate multipliers of about 2 or more, as in the countries noted above. However, as pointed out by Hustedde *et al.* (2005), multipliers are not automatically transferable from one place or period to another, because of conditions that can influence their size (e.g., population, geographic size of community, transportation networks, income changes, economic specialisation and time). They also cautioned that no matter how a multiplier is estimated, it tends to be inflated, stating that one thing required in making a good estimate is an ability to make some accurate guesses about the local economy[21]. In light of these remarks, it was thought that the conservative estimate of 1.47 was appropriate for representing the multiplier effects of the different scenarios of declines in provincial cocoa production.

[20] This question needs to be asked of people familiar with the community's economy to find the information needed for an income multiplier.

[21] The important point to note is that the size of the multiplier is sensitive to estimates of the MPc and MPs.

According to the income multiplier of 1.47, each additional Kina of cocoa income in ENBP leads to an additional indirect income of K0.47. In other words, for every Kina made from the cocoa industry, there will be an increase of K1.47 in local income. This principle applies in reverse when there is a fall in production. This means that for every CPB-related Kina loss in production, there will be a loss of K1.47 in local income throughout the economy of ENBP. Expressed in another way, the economic impact resulting from a one Kina loss in cocoa export activity associated with a unit loss in cocoa production, will lead to a loss of K1.47 in the local economy.

The total fall in local incomes, resulting from the potential drop in cocoa production from CPB infestation, has been calculated in relation to the three different scenarios posed above, namely 25%, 50% and 75% rates of crop loss due to CPB. These scenarios postulate the potential fall in production from a base production of 20,000 tonnes, which is the average annual cocoa production for the ENBP since 2000. The results are summarised in Table 2.3.

Table 2.3. Potential loss in local income from CPB related falls in cocoa production.

Proportion of change in annual cocoa production (%)	Drop in annual production (tonnes)	Potential fall in local income (GDP) (Kina)*	"Initial" multiplier effect of the fall in local income (GDP) (Kina)**
25	5,000	27,845,000	40,932,150
50	10,000	55,690,000	81,864,300
75	15,000	83,535,000	122,796,450

** Based on a 3-year average dry bean price of K5,569 per tonne.*
*** Total loss in local GDP at the estimated income multiplier of 1.47.*

Other things remaining the same, the analysis indicates that the annual total Kina value of the fall in the province's income due to CPB would be K41 million under the 25% crop loss scenario, K82 million with a 50% crop loss, and around K123 million under the 75% crop loss scenario (Table 2.3). The impact on employment is potentially devastating, particularly at the 50% and 75% crop loss scenarios. If we assume ENBP has an annual household income of K5,000, the employment equivalent losses under the three scenarios are:

- 25% fall in production — equivalent to the loss of 8,200 jobs
- 50% fall in production — equivalent to the loss of 16,400 jobs
- 75% fall in production — equivalent to the loss of 24,000 jobs

The data presented in the next chapter from surveys in CPB-affected areas in November 2008, indicate that the rate of crop loss due to CPB is currently at the high end of the scale.

Clearly, if a drastic fall in cocoa production were to occur, ENBP would be at risk of losing almost all of its revenue from cocoa and a sizeable portion of its local GDP. It appears from this crude economic analysis at the farm level and at the provincial scale, that smallholder cocoa growing communities will bear the brunt of the impact of CPB in terms of income losses. Because cocoa producing households make up over 70% of the total number of households in ENBP, the social dislocation and economic hardships caused by CPB will permeate the whole ENBP community.

In the next chapter we turn to consider the impacts of CPB on smallholder cocoa production and village level socio-economies.

5 Current and projected impacts of CPB on smallholder cocoa production and village level socio-economies

There has been a near total collapse of cocoa production in heavily infested CPB study sites. Without urgent attention the impact on the economy and society of ENBP will be catastrophic.

The main impacts of concern are:

- On average there is less than one healthy ripe cocoa pod per tree available for harvesting (152 blocks assessed).
- Cocoa blocks harvested in the two-week period prior to the survey had a slightly lower incidence of CPB and Black/Dry/Soft Rot pods, but this translated into only a marginal increase in the quantity of ripe healthy pods available for harvesting (from 0.76 to 0.89 pods per tree).
- Village families are finding it very difficult to meet the cost of school fees. Many are in arrears and some are withdrawing their children from school.
- People are spending much less on medical expenses, travel to town, store foods and supporting members of the extended family.
- There has been an increase in crime particularly the theft of easily harvested and portable garden crops such as bananas, and a rise in theft of betel nut and mustard.
- Village businesses which depend on patronage from the village community are struggling to remain viable with around a 75% reduction in turnover. A high proportion of village businesses has closed.
- Town businesses in Keravat have noticed a large drop in the stocking requirements of village tradestores in CPB areas, with more than a 50% reduction in the amount spent during each restocking trip. Tradestore restocking trips to Keravat are occurring much less frequently. The overall reduction in purchases of supplies from Keravat wholesalers for village tradestores is around 75%.
- As at November 2008, which was still early in the dispersal of CPB in the province, the impact of the pest in areas outside CPB areas was not large. However, as CPB spreads to all cocoa growing areas in the province, economic and social impacts are likely to be devastating if farmers continue with a low input production system.

To assess the impact of CPB on yields, cocoa production data for ENBP were obtained by LLG from the PNG Cocoa Board, Kokopo. Because spatial units were large (LLG level) relative to the area of CPB infestation in each LLG, a distinct drop in production was not discernible as a result of CPB except in Central Gazelle Rural LLG where the earliest outbreaks of CPB were detected (at LAES in March 2006) and where the pest has dispersed more widely. Figure 3.1 shows monthly production in tonnes as a three-month moving average from February 2005 to November 2008 for Central Gazelle Rural LLG. There has been a marked decline in production for this LLG since the arrival of CPB. In the ten months to November 2005, monthly production averaged 250 tonnes (before CPB); in the ten months to November 2008 average monthly production fell to 146 tonnes (after CPB), a fall of nearly 42%. It must be noted that not all cocoa growing areas within this LLG had CPB when these calculations were made.

Because the effect of CPB on production may be masked by other factors such as seasonal or year-to-year variations in yield potential, the data in Figure 3.1 have been shown in Figure 3.2 as a percentage of total monthly production in ENBP. There is a clear downward trend in Central Gazelle Rural LLG's share of total provincial production. The effect of the eradication programme can be discerned in the period from March to late 2006 when a widespread rampasan[22] exercise was undertaken in CPB areas and in surrounding buffer zones. This was followed by increased

[22] The removal and burial of all pods and cherelles.

yields in response to the heavy pruning, but production never recovered to pre-CPB levels. From July 2008 it was on a marked downward trend as CPB spread to other areas of this LLG (Figure 3.2). With CPB now dispersing rapidly in other LLGs in ENBP, a major fall in production in the province is certain.

The impact of CPB on yield potential can be discerned in the pod counts carried out in smallholder blocks surveyed in November 2008. The numbers of ripe healthy pods available for harvesting was very low (Table 3.1). This held across all height classes of cocoa trees (0-25 m, 2.6-3.5 m, >3.5 m) (Figure 3.3). While there was an abundant supply of immature healthy pods per tree, only a tiny proportion ripened in a healthy condition — by the time they reached maturity they were either affected by CPB or Black Pod/Soft Pod Rot (Figure 3.5).

Table 3.1. Mean numbers of different pod types per tree (n=1,520).

Pod Type	Mean Number of Pods per Tree	Per cent of Total Number of Pods
Ripe unharvested	0.7	3
Immature healthy*	13.3	54
Black/Dry/Soft Rot Pods	6.0	24
CPB-infected	4.9	20
Totals	24.9	100

** Immature healthy pods are healthy pods that will ripen within the next three months.*

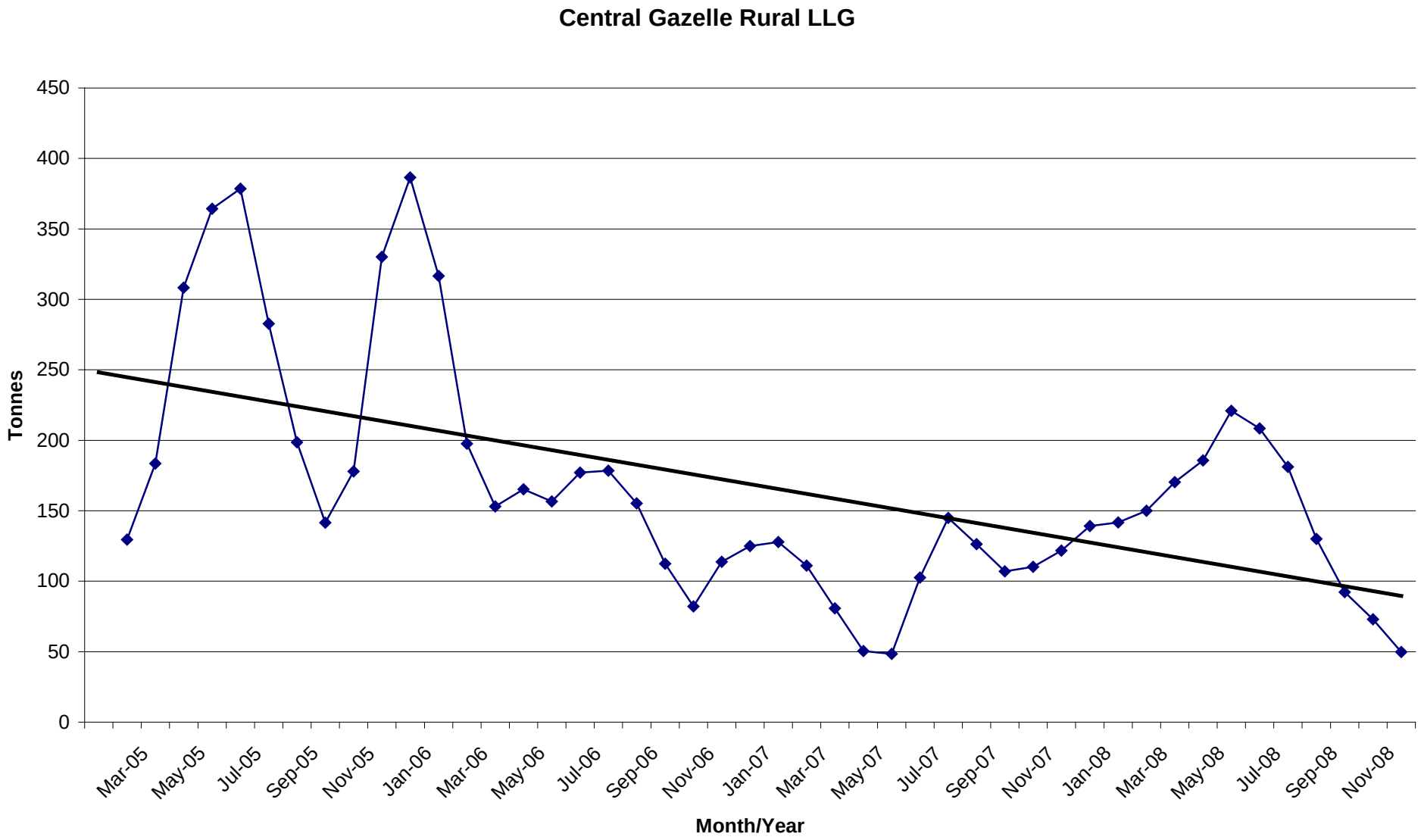

Figure 3.1. Total monthly production of dry bean for Central Gazelle Rural LLG (Source: PNG Cocoa Board).

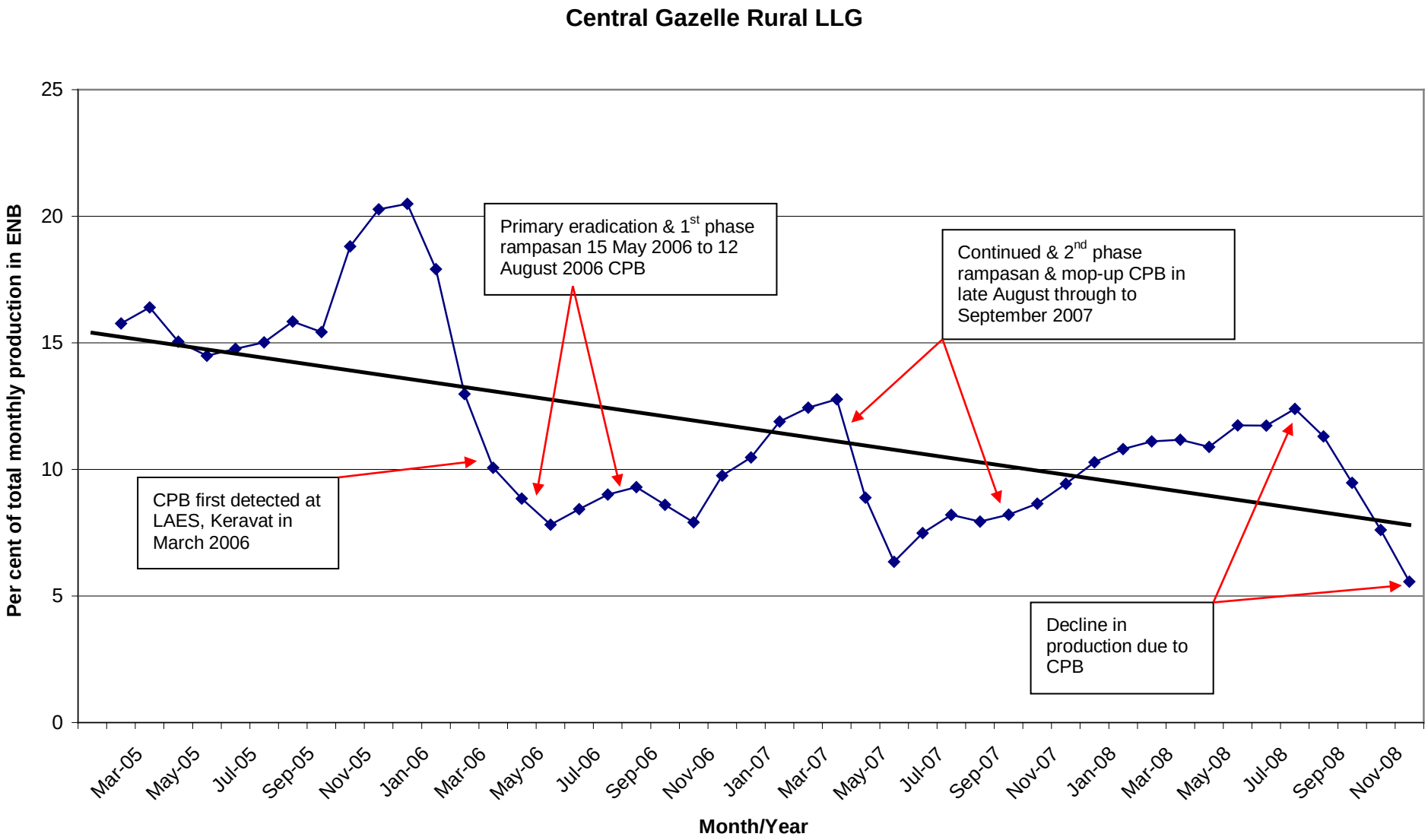

Figure 3.2. Total monthly production of dry bean for Central Gazelle Rural LLG expressed as a percentage of total production for ENBP (Source: PNG Cocoa Board).

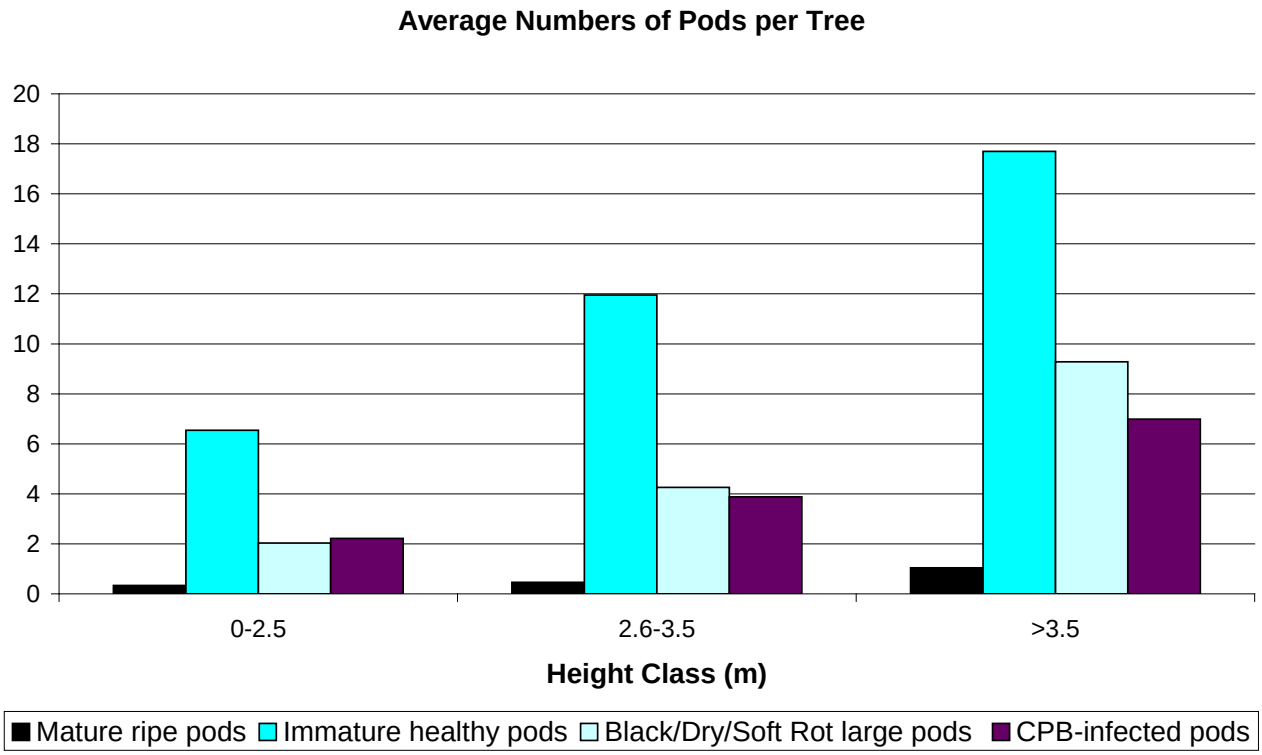

Figure 3.3. Mean numbers of pods per tree by height class.[23]

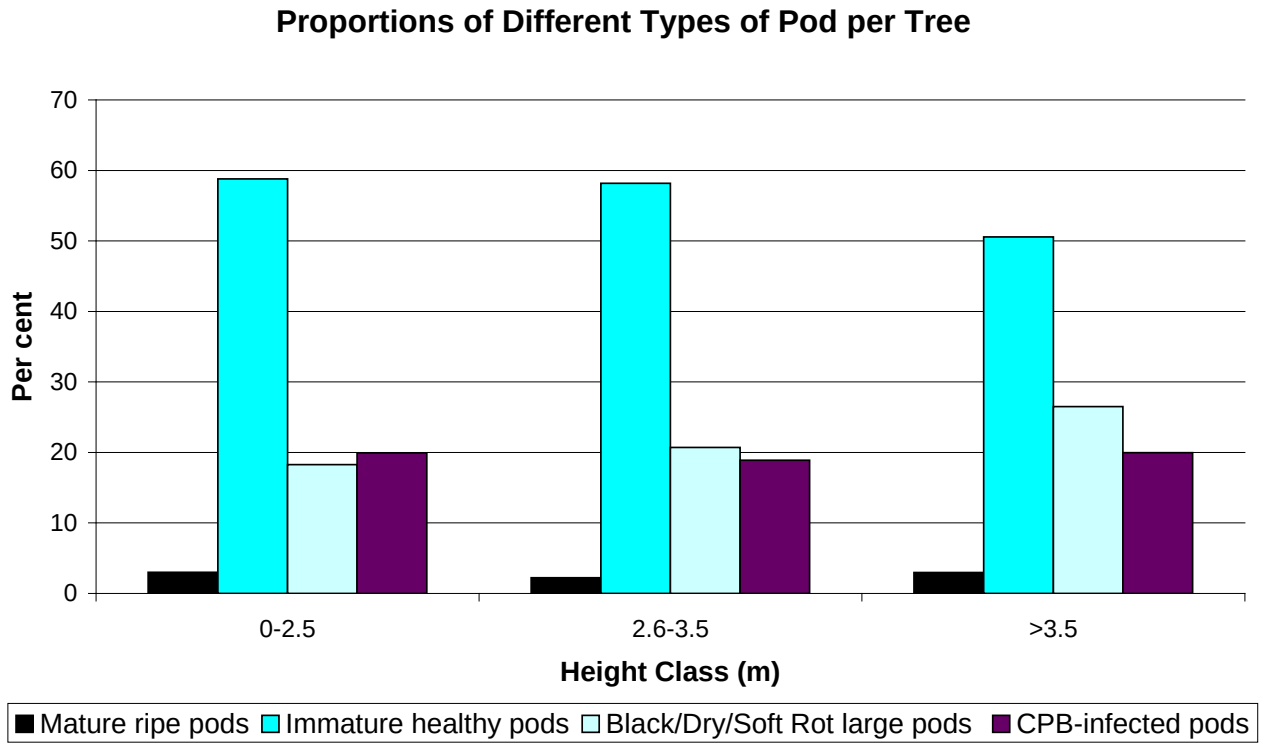

Figure 3.4. Proportions of different types of pods by height class.

[23] Immature healthy pods" are healthy pods that will ripen within next the three months.

How does the rate of harvesting affect the supply of ripe healthy pods?

The average number of pods per tree carrying CPB or affected by Black/Dry/Soft Pod Rot was lower for blocks harvested in the two week period prior to the survey (Figure 3.5). This amounted to a 30% reduction in the incidence of Black/Dry/Soft Pod rot and a 15% drop in the incidence of CPB-infested pods. But this did not translate into an increased supply of ripe healthy pods for harvesting, with only a marginal increase from 0.76 to 0.89 pods per tree (Figure 3.5). General observations revealed that many growers who claimed to have harvested within the previous two weeks had not fully harvested their blocks and were 'forage' harvesting small quantities of cocoa (one or two baskets) to sell as wet bean for immediate consumption (see Chapter 6 for further discussion).

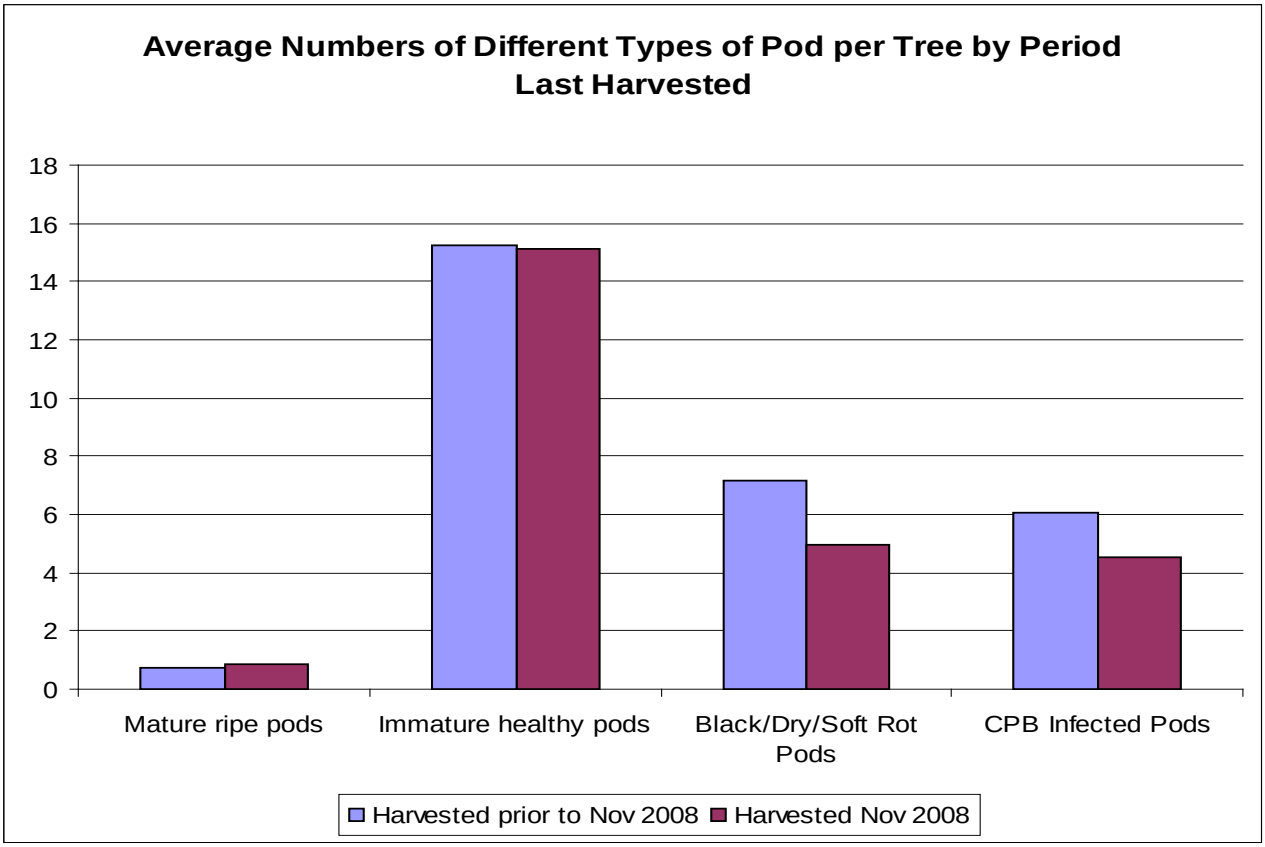

Figure 3.5. Average numbers of different types of pod per tree by period last harvested (blocks that received recent heavy pruning are excluded).

How has the importance of cocoa as an income source changed since the arrival of CPB?

Before the arrival of CPB, cocoa was the highest ranked income source for 100% of men and 87% of women (about 12% of women ranked local markets as their most important income source) (Figures 3.6 and 3.7). The populations in the three study sites were all highly dependent on cocoa income prior to CPB. Since the CPB incursion, cocoa income has been replaced largely by the production of garden crops for sale at local markets for both men (60%) and women (84%). Some men (22%) and women (6%) claimed that cocoa remained their most important income source after the arrival of CPB (Figures 3.6 and 3.7). While some of these families are coping fairly well with CPB through the successful implementation of CPB management strategies, it cannot be assumed that all men and women reporting cocoa as their top income source in the post-CPB period were earning a reasonable income from cocoa. It is highly likely that some of them had not been able to switch to alternative income sources and were thus experiencing severe income stress from the reduction in cocoa income.

While income from local markets is now the top ranked income source for both men and women, this does not mean that lost cocoa income has been fully compensated with income from other sources such as local markets. Total household incomes were much less than they were when

cocoa was the primary income source. Nearly all growers and their families reported severe financial stress, which is evident in the discussion below on the turnover of village businesses and the reduced capacity of families from CPB areas to pay their children's school fees.

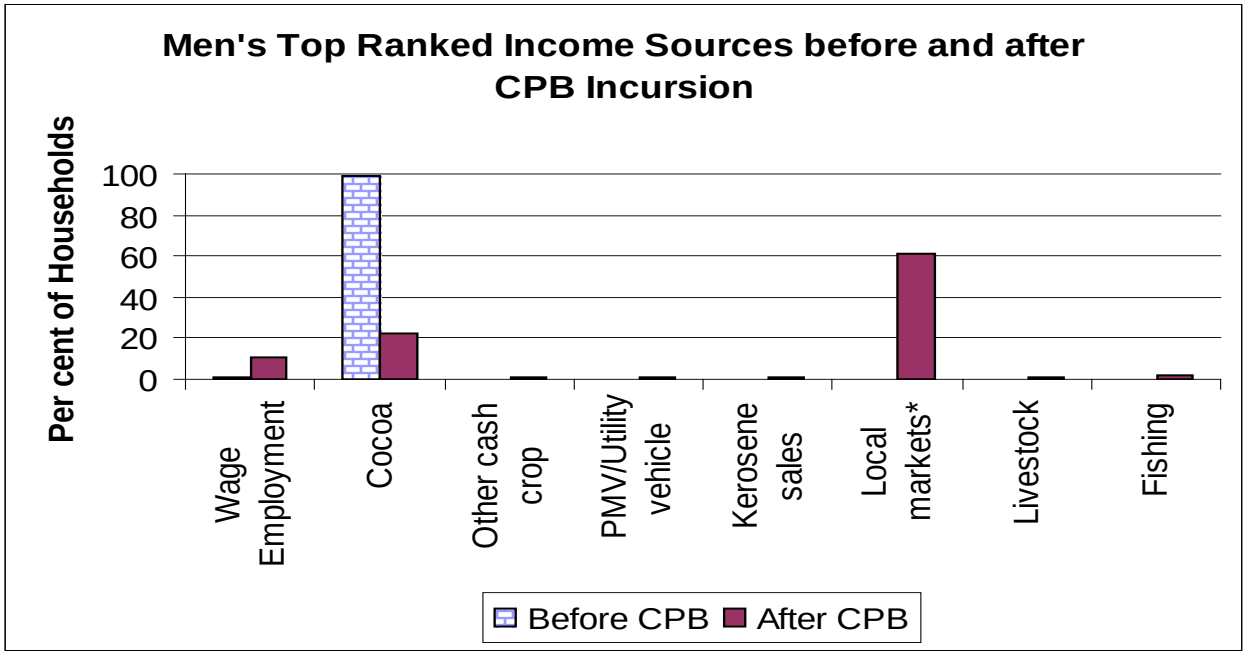

Figure 3.6. The top ranked source of income for men before and after the arrival of CPB.[24]

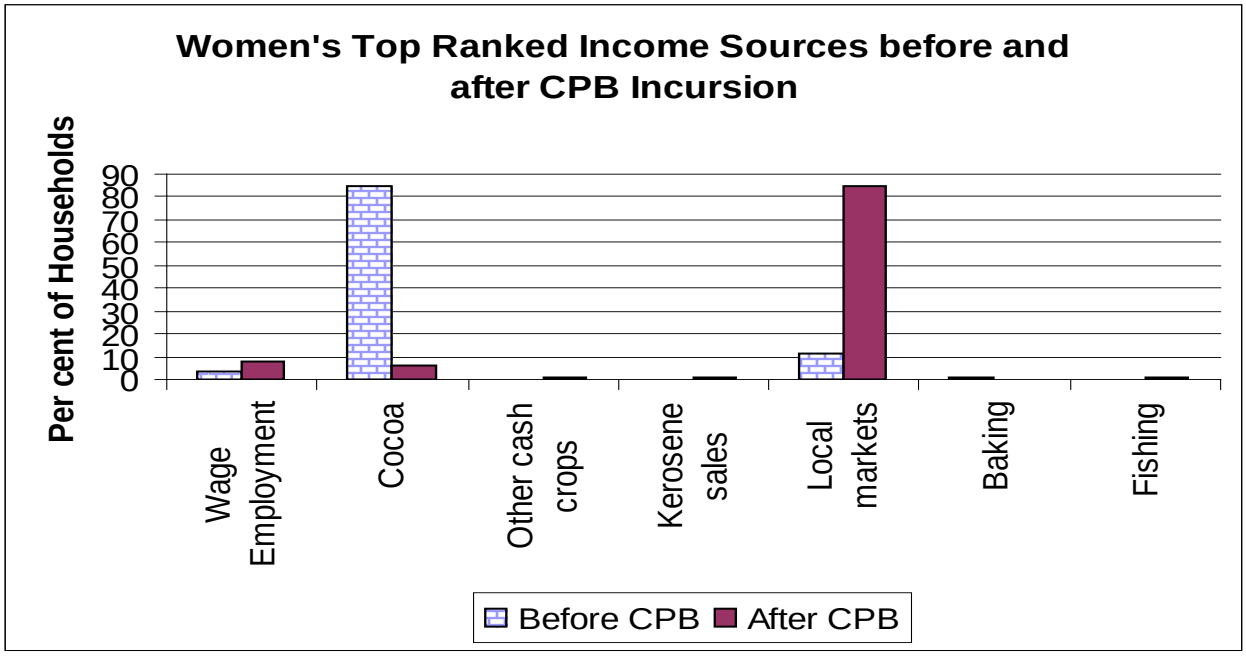

Figure 3.7. The top ranked source of income for women before and after the arrival of CPB.

What is the impact of reduced cocoa income on the payment of school fees?

There is no doubt that CPB is eroding the capacity of parents to pay school fees for their children. In the qualitative section of the survey, education costs were mentioned by all families with children of school age. Eighty-one per cent of families with school-age children said they were struggling to pay school fees. These claims were validated during the discussions with school principals and

[24] The vast majority of sellers at local markets are women. These items are produced by men but marketed on their behalf by female members of the family.

teachers. All the schools visited as part of this exercise reported higher levels of outstanding schools fees for students from CPB areas than for students from non-CPB areas. The schools recognised the dire financial straits of parents from CPB areas and were attempting to accommodate parents by accepting late payment of fees. This presented a difficult situation for schools because some students had fees outstanding for two years and the loss in fee revenue meant two schools were forced to postpone urgent renovations. At one elementary school the teachers who were paid by the community rather than the government, had to accept a 50% reduction in pay to K50 per fortnight because of the loss of fee revenue[25].

Parents with more than one child in school were finding it very difficult and the research team heard of instances of children being withdrawn from school because the parents could not afford school fees for more than one child. We were unable to quantify the numbers of students withdrawn from school because of their inability to pay fees.

We were able to obtain data on arrears in school fees for several schools:

- George Brown High School. Of 285 Grade 9 students, 36% of them had not paid their 2008 school fees by November 2008. Nearly all of these students were from CPB areas.
- Vudal Elementary School. In November 2008, 39% of students still had outstanding school fees for 2007. By the middle of 2008 the school had run out of money for stationery.
- Vudal Primary School. Only 55% of the 2008 school fees had been paid by November 2008 for 204 enrolled students.
- Keravat Primary School. The principal said that students with outstanding fees were mainly from CPB areas such as Kareba. Of 142 students from Kareba enrolled at the school, 35% had not paid their 2008 school fees. The proportions of students with arrears in school fees varied by the amount of school fees charged. For students enrolled in Grades 3-5 (annual school fee of K50), 22% were in arrears by November 2008. For Grades 6-8 (annual school fee of K100), 60% of students were in arrears.

Education is one of the highest priorities for parents, and they will sacrifice other expenditure to educate their children. For most parents, education is seen as a route out of poverty and a path to advancement. The fact that so many parents from CPB areas are in arrears with their children's school fees indicates the financial stresses affecting these families. Undoubtedly, the economic futures of children from CPB areas will be compromised as they cannot take educational opportunities. Without restoration of cocoa production in these areas or the introduction of alternative cash crops, the education of a significant proportion of the younger generation in ENBP will be constrained, thereby eroding the long-term economic potential of the province.

Is reduced cocoa income affecting the turnover of village and town businesses?

Village business proprietors reported large declines in turnover, and there were reports of many businesses closing. Village businesses which are fully or partly patronised by customers from outside the community were more resilient to the decline in cocoa income in the community. Such businesses included livestock production (e.g., chickens and pigs) which can be sold outside the village to formal sector workers or villagers from areas free of CPB (Chapter 5). Village businesses where the products can be sold at markets on main roads or town markets are less vulnerable to insolvency.

Conversely, businesses that were particularly vulnerable to insolvency were those that relied to a large extent on local patronage by the community. Hire cars and tradestores fell in this category. Prior to CPB, hire cars were used mainly for carting dried cocoa to exporters in town or transporting firewood to village fermentaries and dryers. One might anticipate that post-CPB they would be used for other purposes such as carting garden produce to markets, but PMVs largely fill this role. With the decline in cocoa income many cars have been taken off the road.

Tradestores, especially those away from main roads or plantation compounds, are extremely vulnerable. All 14 village proprietors interviewed for this assessment reported very large falls in

[25] *The wages of other teachers in the school were unaffected because they were paid by the government.*

turnover. One store owner at Tavilo listed five village tradestores in her neighbourhood that had closed because of CPB.

A typical description of the impact of CPB on a village tradestore follows. This store was insulated to an extent from the full impacts of CPB because there was a plantation compound within ten minutes walking distance of the store:

> Before CPB the store had plenty of customers and the store ran well. But when CPB arrived the customers dried up and cash flow went down. Store trade fluctuates on a fortnightly basis because the plantation workers get their pay and visit the store each fortnight. But ordinary growers do not come to the store anymore because they don't have any money. The shop is buying less stock now and we do not stock the fridge [cold drinks no longer sold].
>
> The cocoa growers keep asking for a credit but we don't like giving it because of repayment difficulties. … We only give credit to the plantation workers.
>
> Before CPB we would hire a car [single cab] and fill it up with cargo: cartons of tinned fish, bales of rice, 10 kg rice bags. We bought cargo from Tropicana in Kokopo. Now we buy stock in smaller quantities — a small number of 1 kg bags of rice in one bale. We restock the store at Keravat rather than at Kokopo, and restocking trips are made by bus rather than hiring a car.
>
> Before CPB … we would spend K3000-K4000 each restocking trip. Now it's about K800-K1000. We stock the store less often now. (Tradestore proprietor, Tavilo)

Because village tradestores rely to a large extent on local patronage for their survival, they are a barometer of the income situation in CPB-affected communities. An attempt was made to assess changes in turnover of stock pre- and post-CPB by examining the invoices for stock purchases. Only one tradestore appeared to have a reasonably full set of invoices covering the pre-and post-CPB transition period (most villages store owners had not kept their invoices). It became clear that some invoices were missing, so rather than attempting to assess the reduction in total turnover, the average amount of money spent per restocking trip was used. For this store, located near NGIP-Agmark's compound for plantation labourers at Tavilo, the average amount purchased for the store on each restocking trip fell by 40% from K1,355 to K819[26].

Table 3.2 lists the estimates of tradestore proprietors of the effects of CPB on their trade. The table also notes the likelihood of each store receiving patronage from outside the community. Village stores were those least likely to be patronised by customers from outside the local community. The average amount spent on each tradestore restocking trip fell by 62% (Table 3.2). With less money being spent on each restocking trip, village tradestore proprietors reported buying more of their stock from Keravat rather than from wholesalers in the more distant town of Kokopo. It was not possible to quantify the reduction in the frequency of tradestore restocking trips, but it was clear that there was a marked reduction. Some growers said that prior to CPB they made a restocking trip once a fortnight, but now they have reduced their restocking trips to once every three or four weeks. It is not unreasonable to assume that the turnover of village tradestores has declined by 75% following the incursion of CPB.

Many stores have closed and most of the remaining ones are barely viable. Store proprietors were carrying higher levels of credit given to customers who were struggling to make repayments. One store owner told how before CPB, credit granted to customers never exceeded K500 in total. At the time of the interview the store was owed K1400 by 32 customers (K43.75 per head). With high levels of outstanding credit, restocking had become a major problem. However, because

[26] This is fairly close to the store owner's own estimate (47% reduction) of the reduction in the value of stock bought on each restocking trip.

tradestores are prestigious businesses, it is likely that some of the surviving ones, such as the first Kareba store listed in Table 3.2, were being kept afloat with subsidies from other sources.

Table 3.2. Tradestore proprietors' perceptions of the reduction in the amount of money spent on each restocking trip since the incursion of CPB.

	Amount spent per restocking trip				
Ward	**Pre-CPB (Kina)**	**Post-CPB (Kina)**	**Per cent decline***	**Change in frequency of restocking trips since CPB**	**Other comments**
Tavilo	3000-4000	800-1000	74	less	Near plantation compound.
Tavilo	1800-2000	800-1200	47	less	Near plantation compound.
Tavilo	n.a.	100	n.a.	n.a.	Village store. Opened since CPB.
Tavilo	no data	no data		less	Village store.
Tavilo	1300-1400	400-500	67	same	Village store.
Vudal	1000-1100	300-400	67	less	Village store. Closed 2 weeks before interview.
Vudal	500-1000	300	60	less	Village store.
Vudal	2000-2500	1000-1500	44	less	Large village store.
Vudal	500-600	300-400	36	less	Village store.
Vudal	3000	1200	60	less	On main road.
Kareba	1000	200	80	less	Village store. Subsidised K50/ fortnight from wife's salary.
Kareba	1000	500	50	same	Village store.
Kareba	400	nil	100	n.a.	Village store closed.
Average reduction			**62**		

** Calculated using mid-point in range.*

To cater to the greatly reduced incomes of villagers, most tradestore operators had switched to selling goods in smaller quantities. One strategy is called 'repack' whereby the store owner buys in bulk and repacks the goods into smaller quantities to meet the lower budgets of village families. For example, before the arrival of CPB, rice was typically sold in 1 kg bags (*plastik*) and purchased from wholesalers in bales of 20 X 1 kg bags. According to store owners these 1 kg rice 'plastiks' will sit on the shelves unsold. Now most tradestores tend to buy rice from wholesalers in 20 kg bags and 'repack' it in 500 gram plastic shopping bags[27] (Plate 3.1). Similarly, sugar, salt and yeast (for baking) are 'repacked' for sale in small quantities[28]. Tradestore owners also reported buying smaller size cans of fish and meat as they claimed that larger tin sizes are very slow to sell.

[27] One 20 kg rice bag costs K74 at the wholesalers in town. This will be 'repacked' into 40 X 0.5 kg plastic shopping bags and sold at K3 each.

[28] A 500 gram bag of sugar will be repacked into 12 smaller units and sold for K1 each. The 500 gram bag costs K4.50 from the wholesaler.

Plate 3.1. Tradestore proprietor showing 'repacks' for rice and salt.

Two large wholsesalers in Kokopo said they had not noticed a drop in turnover as a result of CPB. A clerk in one of these stores, a major wholesaler, said she thought they had actually increased the supply of stock to stores in Keravat. These perceptions were complicated by several factors: 1) more village stores in CPB areas are restocking from Keravat because they are buying smaller quantities each time and cannot justify the cost of trips into Kokopo; 2) there is a gradual shift in business from Rabaul to Kokopo because of increasing ash from the volcano. Rabaul is where most Keravat shops bought their supplies previously, so the gradual switch to Kokopo wholesalers may be masking the drop in stock orders from Keravat stores; and 3) The Gazelle Restoration Authority (GRA) and other business enterprises in Kokopo are pumping money into the town which may mask the fall in spending from CPB areas.

While town businesses in Kokopo have not yet noticed a CPB impact on their turnover, town businesses in Keravat were adamant that there has been a large drop in the stocking requirements of village tradestores in CPB areas. Sales data provided by NGIP-Agmark for their agricultural supply store in Keravat reveal an overall reduction in total retail sales of 23% from the period March-December 2007 to March-December 2008. The catchment area for this store includes both CPB and non-CPB areas, so presumably the fall in turnover for CPB areas would have been greater than 23%.

The store supervisors in two other Keravat stores that supply stock to village tradestores reported large falls in the size of stocking orders from CPB areas and a reduction in the frequency of orders. One store supervisor estimated that supplies to village tradesores in CPB areas had fallen by more than 50%. The supervisor gave the example of a village store owner who used to spend about K1000 per fortnight on stock is now spending less than K500 once every three or four weeks. Both Keravat stores have introduced "six-packs" of goods whereby, for example, a carton of 24 tins of meat or fish (which was sold as a unit previously), is now sold as four smaller units of six tins per package.

While the store data for Kokopo had not shown a reduction in turnover as a result of CPB by November 2008, it was evident that Keravat businesses were feeling the impact of CPB on their

turnover. The sales data from the Keravat stores reinforce the data concerning the decline in turnover of village tradestores. It is likely the overall reduction in purchases of supplies from Keravat wholesalers for village tradestores in CPB-affected areas is around 75%.

The impact on both village and town businesses will intensify as CPB spreads throughout the cocoa growing areas of ENBP. Businesses that depend primarily on the income of cocoa growers for their turnover may experience severe financial pressures as their customer bases contract. With over 70% of the ENBP population depending on cocoa income, it is unlikely that any sector of the ENBP economy will be immune to the massive contraction in cocoa income (see Chapter 2) if farmers are unable to make the transition to high input farming.

6 How CPB affects cocoa block maintenance and the harvesting practices of smallholders

Overall, levels of cocoa block management were poor and not at a sufficiently high standard for the effective control of CPB. In response to CPB most growers have adopted a *forage production strategy* of very low labour inputs.

However, a small proportion of growers was managing their blocks well and had adopted CPB control practices. These growers were harvesting more crop and more often, processing larger quantities of dry bean, and were effective in controlling CPB and Black/Dry/Soft Pod Rot on their blocks.

The low levels of block maintenance and low labour inputs are characteristic of smallholder cash crop production in PNG and have been noted in other studies of smallholder cocoa production (e.g., Nicholls, 1989; Yarbro and Noble, 1989; George, 1994; Omuru *et al*. 2001; Curry *et al*. 2007). In this study, a substantial proportion of blocks was less than adequately weeded, pruned or managed for shade, though levels of block maintenance appear to be better than that documented in an earlier survey conducted in Livuan-Reimbar LLG villages in 2004/5 (Table 4.1; Figures 4.1 and 4.2).

Table 4.1. Block maintenance levels in Tabaule and Vunalaiting villages in Livuan-Reimbar LLG in December 2004-Jaunary 2005 (n=98) and from the November 2008 survey (n=152).[29]

	LEVELS OF MAINTENANCE (%)			
	Less than Adequate		**Adequate or Better**	
	Survey 2004-5	**Survey 2008**	**Survey 2004-5**	**Survey 2008**
Weeding	52	34	48	66
Pruning	76	38	24	62
Shade Control	72	43	28	57

There may have been an improvement in block maintenance levels in response to CPB, though there are difficulties comparing different villages through time (Figures 4.1 and 4.2). In 2004/5 there was a strong positive skew in the data showing most growers in Tabaule and Vunalaiting were clumped at the lower end of the scale on block maintenance assessment (Figure 4.2). In November 2008, average scores in the three CPB study sites were higher as reflected in the more bell-shaped curve in Figure 4.1. It is difficult to ascertain if this difference is due to the arrival of CPB and growers' attempts to cope with CPB through improved block management, or if other factors explain the difference. Since completion of data collection in November 2008, CPB has spread to Tabaule and Vunalaiting villages. A repeat survey in these villages would provide a more definitive answer to the question of whether the presence of CPB encourages growers to invest more labour in block maintenance.

[29] Source: fieldwork data November 2008 and Curry *et al.* 2007, 72-73

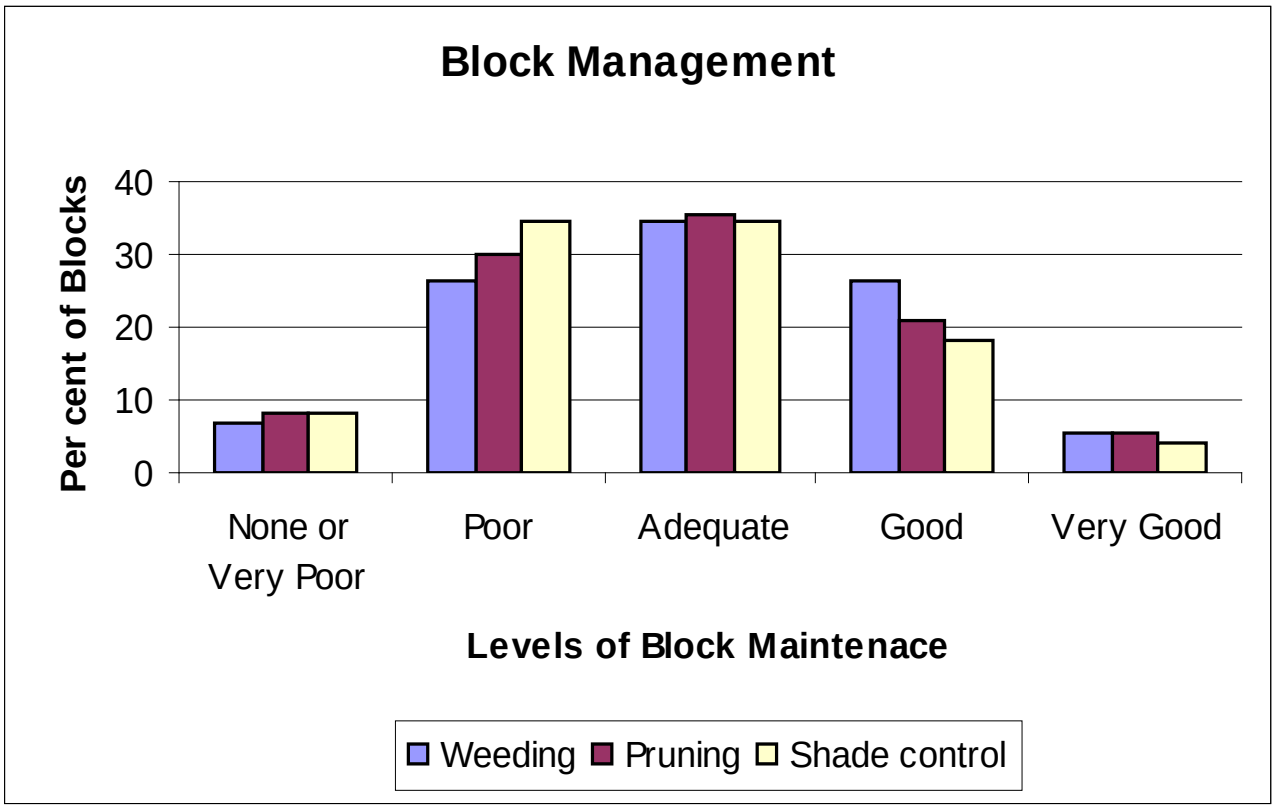

Figure 4.1. Weeding, pruning and shade control levels in November 2008 for the three study sites combined.

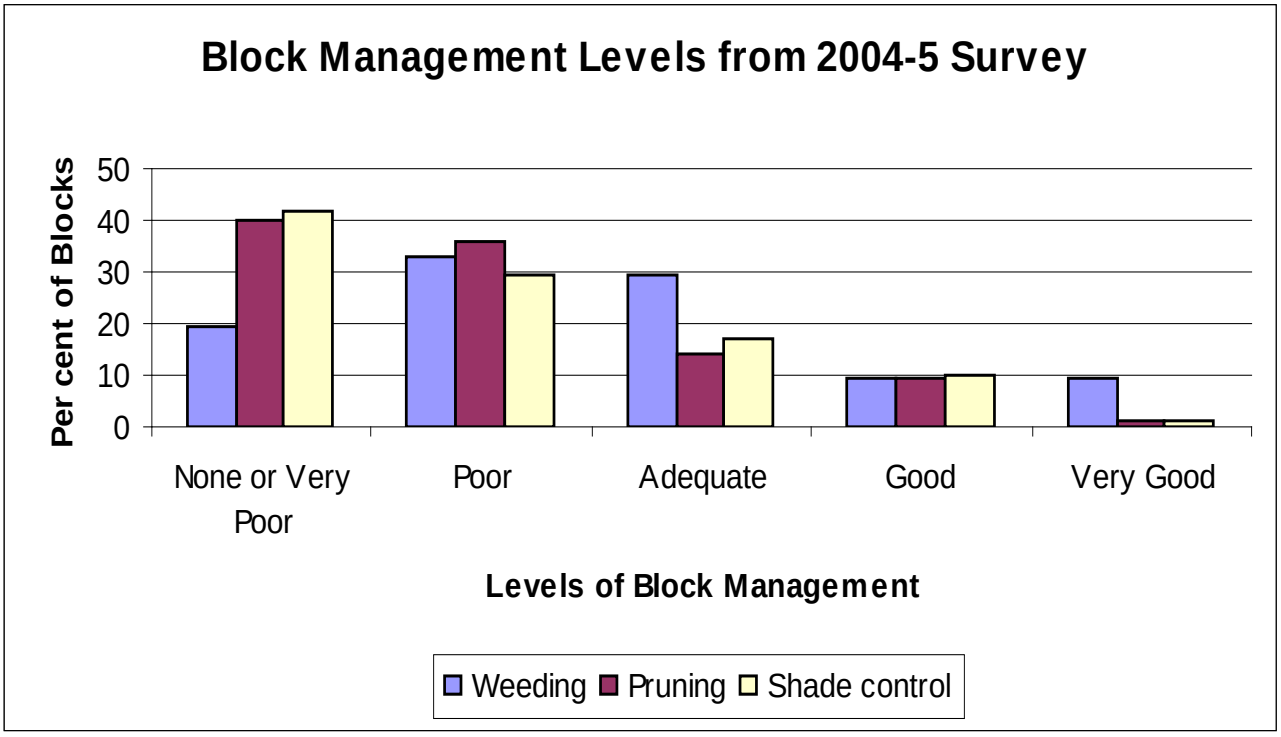

Figure 4.2. Weeding, pruning and shade control levels at Tabaule and Vunalaiting villages in December 2004/January 2005 (n=98)[30]

[30] Source: Curry *et al.* 2007, 73

When block maintenance is examined by ward, the largest improvements were amongst growers who experienced more intense and longer training in IPDM management strategies. CCIL's pathology section has been running IPDM training amongst Tavilo growers (where improvements have been the greatest) for several years now while NGIP-Agmark has been developing close relationships with these growers since 2004 through the delivery of extension training and other farm inputs. This suggests that the improvement in block maintenance from 2004/5 to November 2008 might indeed be a response to the presence of CPB, and the extent of improvement appears to be dependent on the levels and types of extension and other services delivered to growers. Despite a likely improvement in block maintenance from 2004/5, it was not enough to bring about an increase in production to make up for CPB losses. Only a few growers had improved block maintenance to a level where they were experiencing increased production and yields.

Of the three wards surveyed in November 2008, Tavilo growers stand out with the greatest improvements in weed control (Figure 4.3), pruning (Figure 4.4), shade control (Figure 4.5), block sanitation (Figure 4.6) and pest control (Figure 4.7). This is most likely in response to the intense programme of extension introduced by NGIP-Agmark and CCIL, including training in IPDM programmes (Boxes 4.1–4.3 summarise the main CPB management strategies recommended by CCIL Agronomy, CCIL Pathology (IPDM Option 4) and NGIP-Agmark).

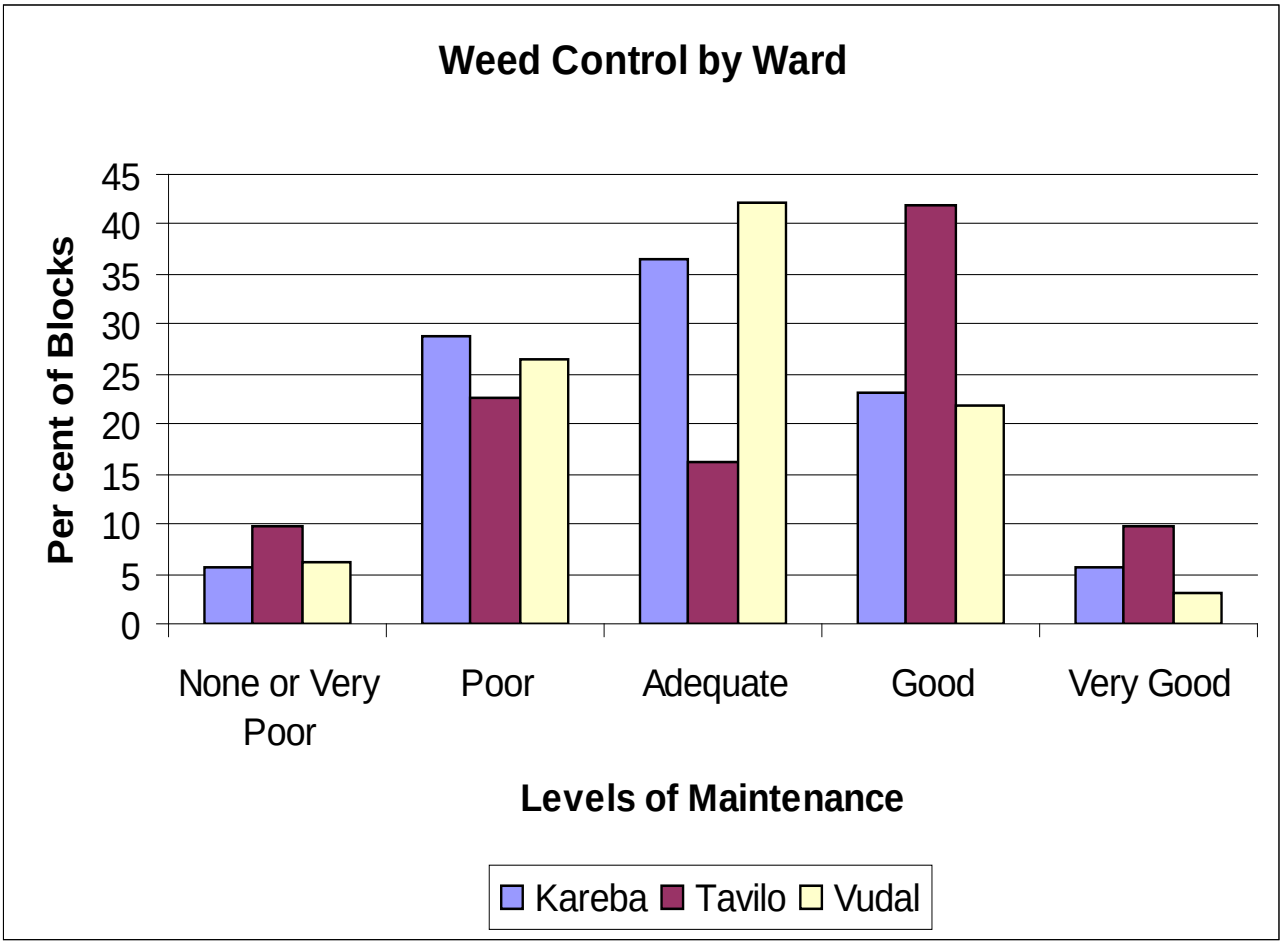

Figure 4.3. Weed control standards for the three study sites.

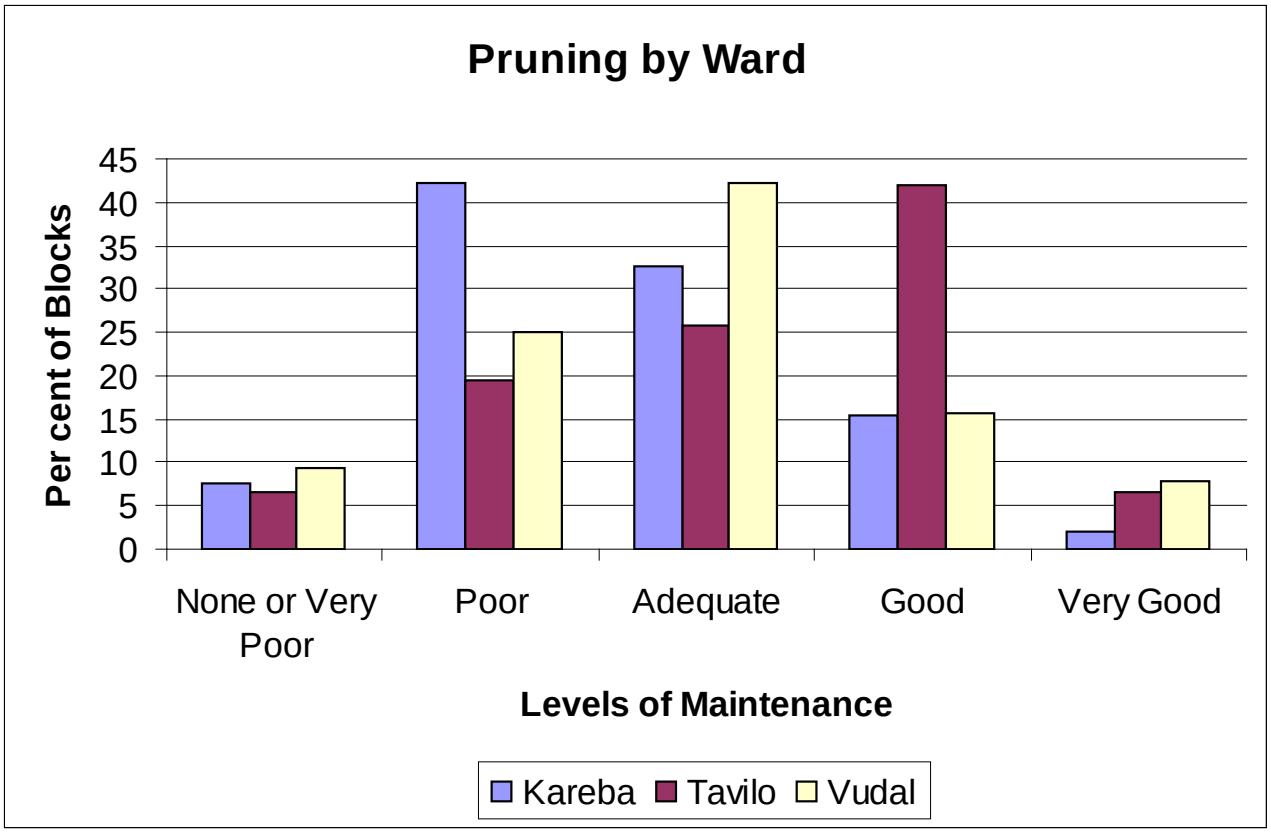

Figure 4.4. Cocoa pruning standards for the three study sites.

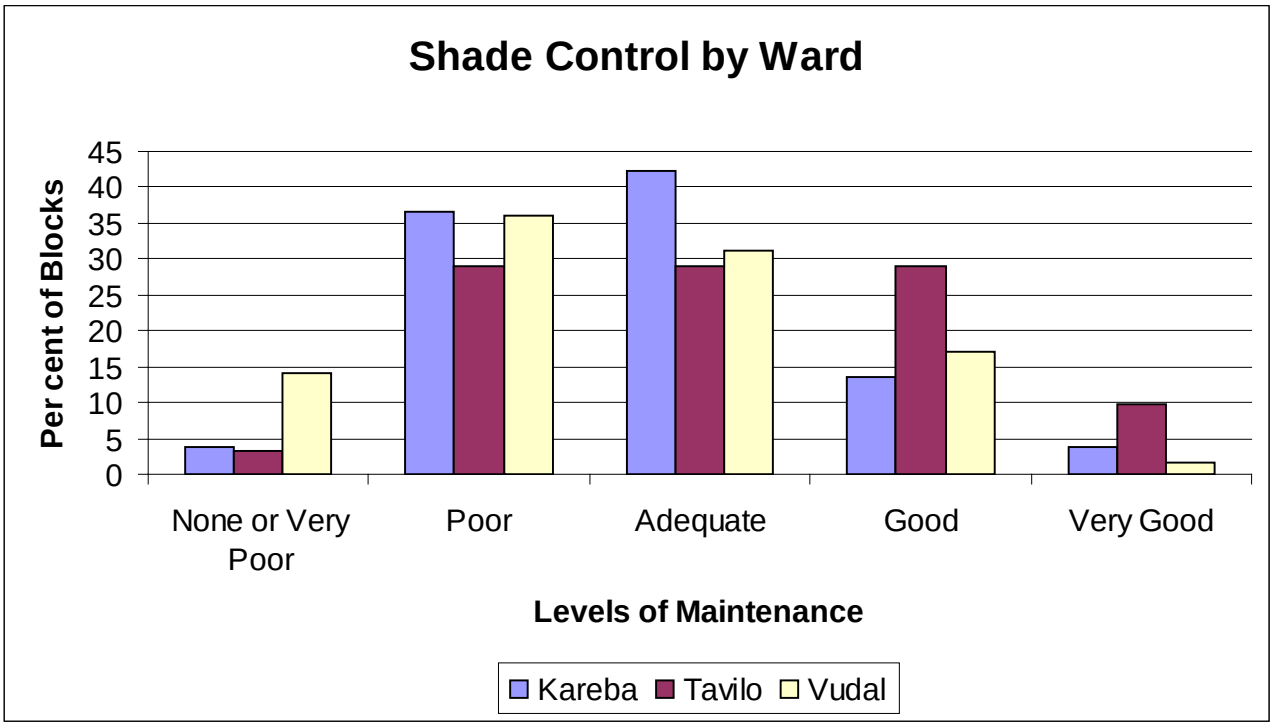

Figure 4.5. Shade control standards for the three study sites.

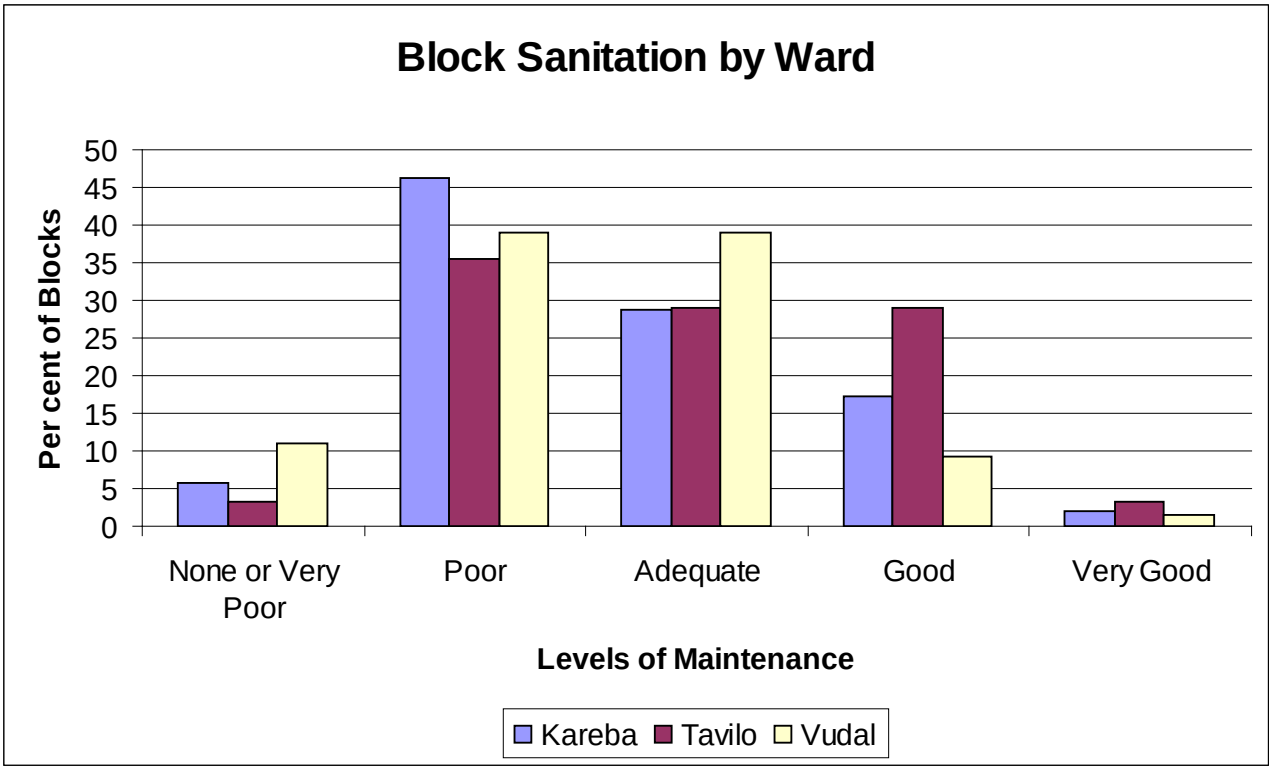

Figure 4.6. Block sanitation standards for the three study sites.

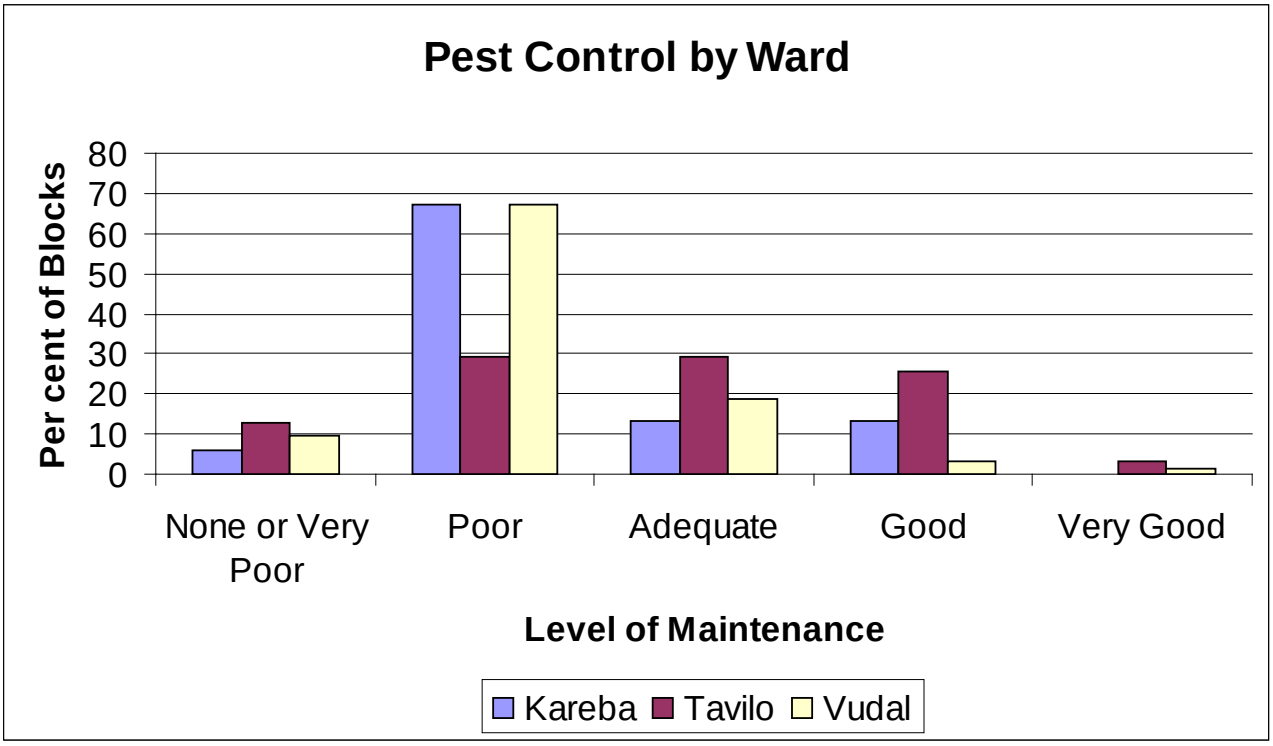

Figure 4.7. Pest control standards for the three study sites.

The proportion of growers claiming to have harvested within the past six weeks was high at 68%, but few of these growers fully harvested their blocks. The vast majority used the forage harvesting strategy involving brief forays into the block to harvest small quantities of beans. Harvesting rates varied by ward with 83% of growers in Tavilo ward claiming to have harvested their blocks within the previous six weeks. The corresponding figures for Vudal and Kareba wards were 68% and 61% respectively (Figure 4.8). A probable explanation for the higher harvesting rate at Tavilo is that CCIL's IPDM programme (Box 4.2) has been operating for a longer period at Tavilo than at the

other sites and NGIP-Agmark has been providing extension services directly to these growers including training in CPB management (Box 4.3). Whilst much of this harvesting could still be categorised as forage harvesting, the results do show that extension can help raise harvesting rates. This is an important consideration in developing strategies to raise the level of block maintenance and management of CPB.

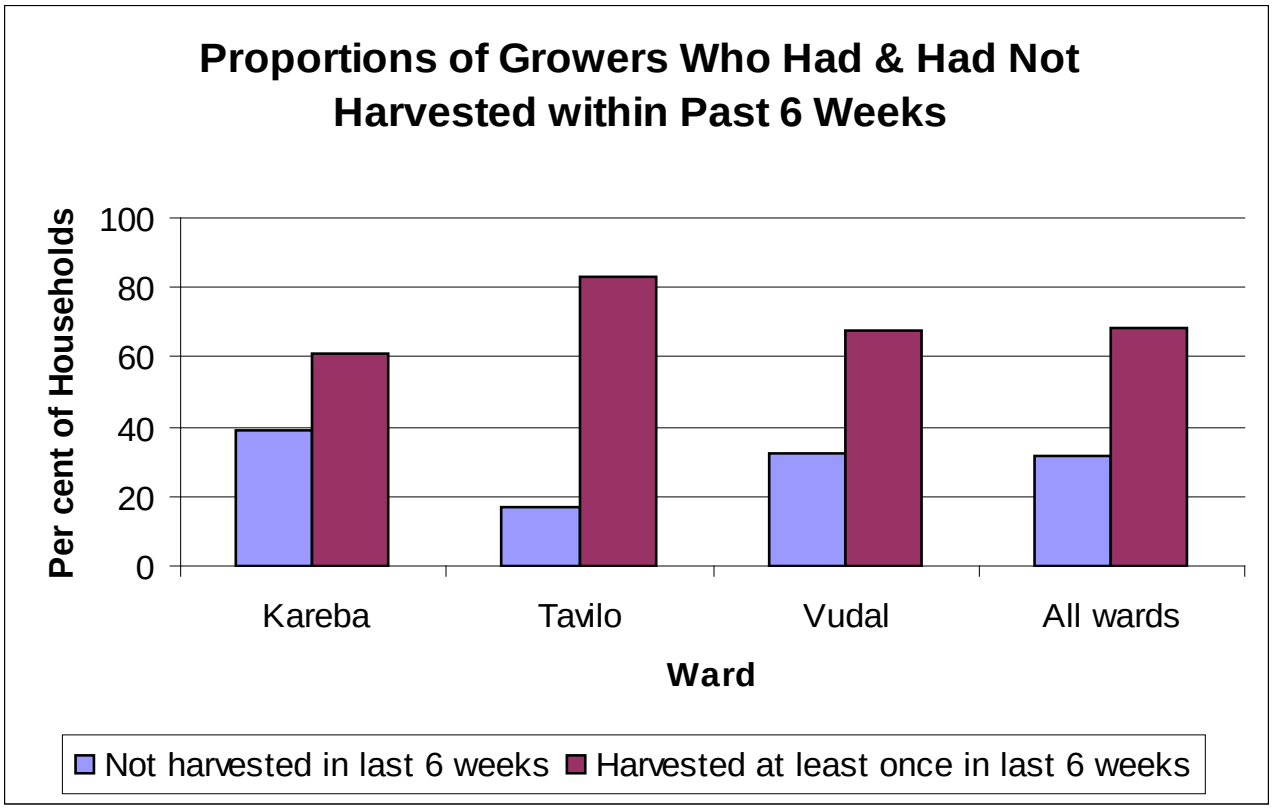

Figure 4.8. Proportions of growers who had and had not harvested their cocoa blocks within the past 6 weeks.

BOX 4.1

CPB management strategies recommended by CCIL Agromomy
(David Yinil, pers. comm., 21 May 2009)

Save your cocoa pods, control and contain the spread of Cocoa Pod Borer!!!

How???

By applying good farming practices in the following order:

1. Good weed and shade management
2. Reduce cocoa canopy and height to 3.5 metres by pruning
3. Do frequent complete harvesting of cocoa pods
4. Bury all cocoa pods at every harvest
5. Apply continuous and consistent good block management (IPDM)
6. Apply target pod spraying

BOX 4.2

CPB management strategies recommended by CCIL Pathology
(IPDM Option 4) (Konam *et al*. 2008, p.10)

1. Sanitation
2. Cocoa and shade tree pruning
3. Weed management (manual and chemical control)
4. Fertiliser/manure application
5. Application of fungicides and insecticides
6. Control of insect vectors
7. Weekly harvesting of all pods

BOX 4.3

CPB management strategies recommended by NGIP-Agmark
(Graham McNally, pers. Comm., 23 May 2009)

1. Weekly harvesting (every pod, every tree, every week)
2. Centralised pod breaking
3. Pod burial
4. Pruning and shade control
5. Target or spot spraying

Are improved block management and CPB control strategies associated with higher harvesting frequencies and increased quantity of crop?

The assessment of block condition described in Appendix 2 was used to calculate a management score for each cocoa block visited. The assessment on each measure of block condition (levels of weed control, pruning, shade control, block sanitation, pest control and nutritional status) ranged from 0 to 4 with the total block management score being the summation of each measure. This gave a maximum possible score of 24. Similarly, a CPB management score was calculated by summing the number of CPB management practices used on the block (centralised pod breaking, pod burial, weekly harvesting and use of insecticides) with minimum and maximum scores of 0 and 4 respectively. These scores were then compared with harvesting frequency, the quantity of wet bean last harvested, numbers of harvest rounds and numbers of bags of dry bean sold.

The block management score was positively associated with harvesting frequency and the quantity of crop harvested from the block (Figure 4.9). The increase in the quantity of wet bean harvested last harvest round was most marked for blocks that scored relatively highly (16+) on block management (Figure 4.9). These blocks harvested a median of 60 kg during the last harvest round compared with a median of 30 kg of wet bean for blocks scoring less than 16. For blocks scoring 10 or less on block management, the median value of wet bean harvested was 30 kg per harvest round compared with 40 kg for blocks scoring higher than 10 points.

There was a clear positive relationship between harvesting frequency and block management scores. Blocks with management score of five or less had a median number of harvests of 3 compared with six harvest rounds for blocks scoring 16 and over (Figure 4.10). Similarly, blocks in the lowest management score category produced a median value of half a bag of dry bean in 2008 compared with two bags of dry bean for blocks in the highest scoring category for block management (Figure 4.10). It must be kept in mind that even the production from the better managed cocoa blocks is well down on pre-CPB levels of production.

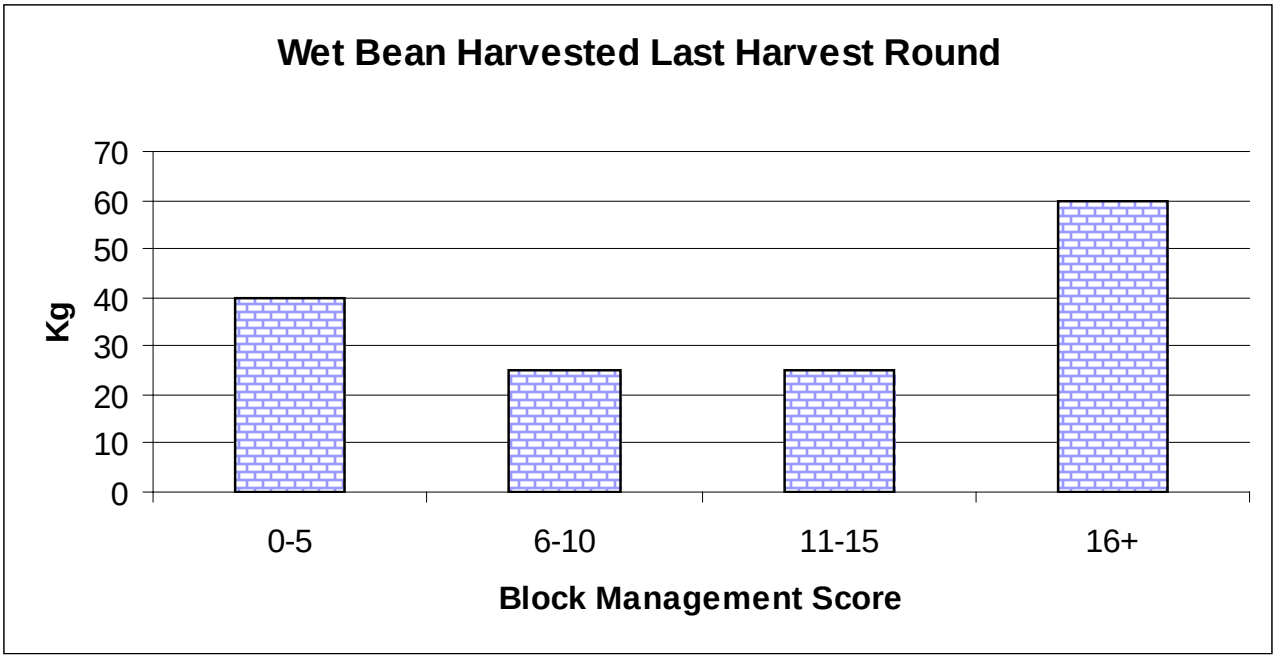

Figure 4.9. Median quantities of wet bean harvest in the last harvest round by block management score (block management score calculated from block assessments carried out by survey team).

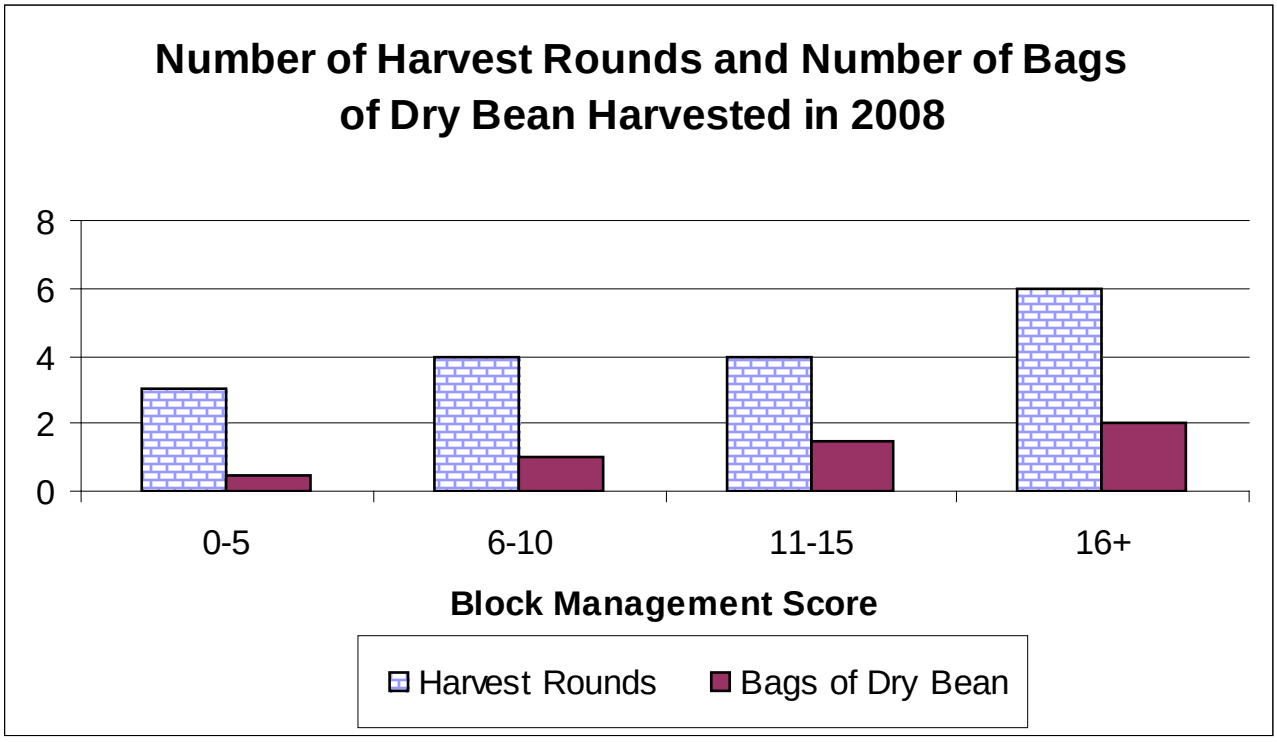

Figure 4.10. Median numbers of harvest rounds and numbers of bags of dry bean processed in 2008 by block management score (block management score calculated from block assessments carried out by survey team).

The CPB management score was positively associated with the quantity of wet bean harvested last harvest round (Figure 4.11). If growers were using all four CPB management techniques (centralised pod breaking, pod burial, weekly harvesting and insecticides) they were able to harvest much larger quantities of wet bean (median of 150 kg for last harvest round) than growers with a CPB management score of 3 or less (26.25 kg for last harvest round).

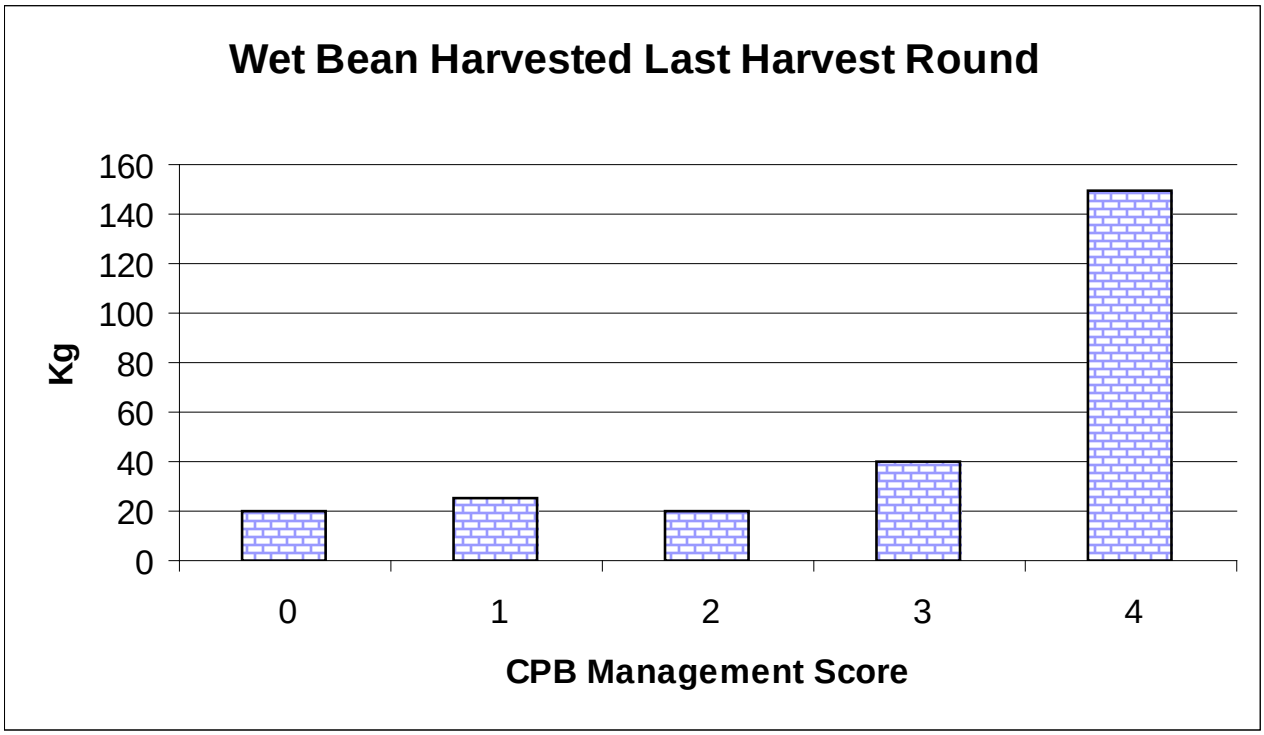

Figure 4.11. Median quantities of wet bean harvested last harvest round by CPB management score.

There was also a strong positive correlation between CPB management score and harvesting frequency and numbers of bags of dry bean processed from January to mid November 2008 (Figure 4.12). If growers were using all four CPB control strategies their production was significantly higher than if they were using only three strategies (Figures 4.11 and 4.12). Insecticide use was very important, and if growers were applying insecticide, most of them (63%) had adopted ALL four CPB control techniques and were applying them at an acceptable level. There was a much higher rate (42% of growers) of insecticide use amongst Tavilo growers than amongst growers from the other two wards (less than 4%) (Figure 4.14). NGIP-Agmark has promoted insecticide use amongst Tavilo growers by providing subsidised insecticide in small quantities suitable for small farmers. This, together with effective promotion of, and training in, insecticide application for CPB control has been relatively successful, and committed growers have adopted this high management input strategy. The use of insecticide was strongly associated with large increases in quantities of cocoa harvested and harvesting frequency (Table 4.2). It appears that those growers investing in insecticide programmes as part of their CPB management regime tend to be the most committed growers and are generally following the other CPB control practices effectively. It is also clear that effective extension training is a critical factor in smallholder uptake of this technology.

Table 4.2. Median values of wet bean harvested last harvest round, numbers of harvest rounds in 2008 and numbers of bags of dry bean processed in 2008 by use of insecticide.

Use of Insecticide	Wet bean harvested (kg)	Nos. of harvest rounds in 2008	Nos. of bags dry bean
Yes	80	6	3
No	22	4	1

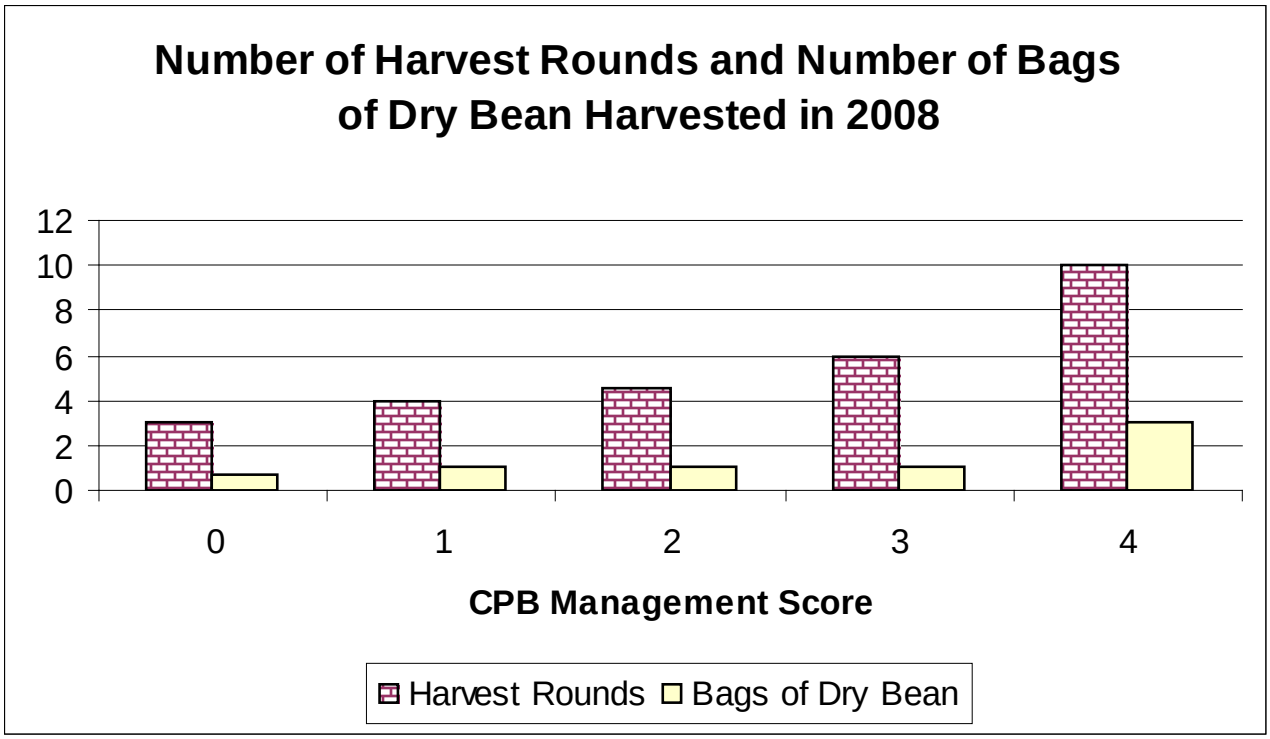

Figure 4.12. Median numbers of harvest rounds and numbers of bags of dry bean processed in 2008 by CPB management score.

Although over 53% of growers claimed they had adopted pod burial procedures as part of a CPB management regime, the research team's observed rate was considerably lower at 32% of blocks visited (Figure 4.13). This disparity in rates was attributable to growers not burying pods properly and therefore receiving a lower assessment from the inspection team (Plate 4.1). The team came across pod burial sites where the partially filled pit was open because the grower was under the impression that he should cover the pit with soil only when it was full (Plate 4.2). At other sites, growers were burying pod skins from harvested pods but not the unopened CPB-infected pods which had been heaped on the ground near the pit. Some growers were devising their own techniques for CPB control such as lighting fires to smoke their blocks and burning chillies to repel CPB. Weekly harvesting was the opposite, with growers reporting a lower rate than recorded during block visits[31]. Overall, the growers appear to be very uncertain about the correct procedure for pod burial.

[31] Growers reported a lower rate of weekly harvesting than was recorded by the block inspection teams (Figure 4.13). This difference probably reflects the difficulty in determining from observations of the trees whether or not weekly harvesting is practised. The block inspection teams had to rely on a person from the family who accompanied them to the block to inform them about harvesting frequency. During a physical inspection of the cocoa block when cocoa maintenance levels were being assessed and discussed openly amongst the research team, growers or their family members perhaps felt embarrassed to report actual rates and so tended to report higher frequency rates of harvesting than was actually the case. In later graphs and tables, the lower figure estimate for weekly harvesting is used.

Plate 4.1. Centralised pod breaking but the pods and husks are not buried.

Plate 4.2. Uncovered pit containing CPB infested pods and the skins of harvested pods.

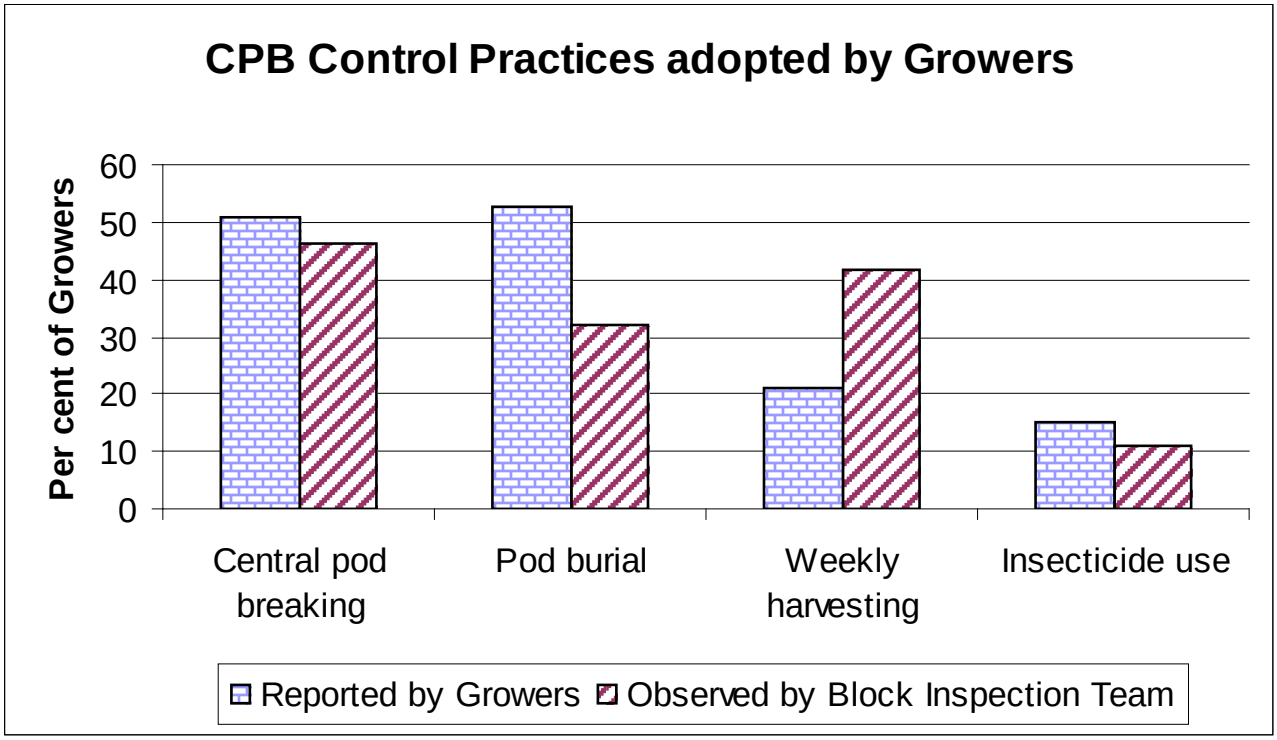

Figure 4.13. CPB control practices report by growers and observed by cocoa block inspection team.

CPB control strategies were observed less often amongst growers in Kareba Ward than in the other two wards. Vudal and Tavilo wards were fairly close in the proportions of growers practising centralised pod breaking, pod burial and weekly harvesting (Figure 4.14). As mentioned above, insecticide use was much higher at Tavilo where NGIP-Agmark had been promoting its use amongst growers (see Chapter 6 for further discussion).

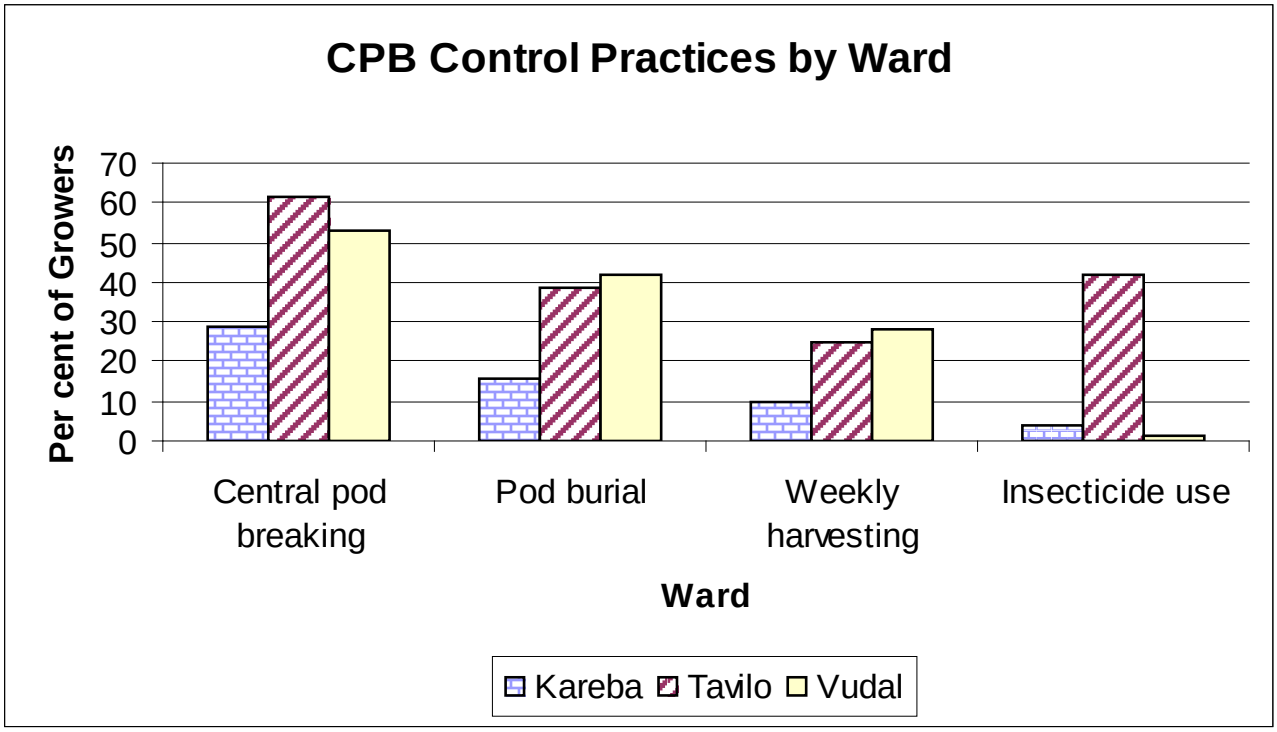

Figure 4.14. CPB control practices by ward.

Can growers control the rate of CPB infestation and the incidence of Black Pod on their blocks through adopting good management practices and CPB control techniques?

While only a small number of growers scored well on block maintenance (score of 21+) and CPB management (score of 4), these growers were able to achieve effective control of CPB (Tables 4.3 and 4.4). As both these scores improved, the CPB infestation rate declined, with the steepest declines towards the highest end of the management scores. As the data discussed above for quantity of cocoa bean harvested last harvest round (Figures 4.9 and 4.11) and numbers of bags of dry bean processed (Figures 4.10 and 4.12) show, there is a threshold near the high end of the scale on block management / CPB management which when crossed places growers in the high production category. On these high-scoring blocks CPB rates were low at an average of 1.5 CPB-infected pods per tree (Tables 4.3 and 4.4).

Table 4.3. Mean numbers of CPB-infected pods and Black/Dry/Soft Rot pods per tree by Block Management Score.

Block Management Score	Mean number of CPB pods per tree	Mean number of Black / Dry / Soft Rot pods per tree
0-5	7.5	8.8
6-10	7.2	8.2
11-15	5.2	7.3
16-20	3.5	4.4
21+	1.5	1.5

Table 4.4. Mean numbers of CPB-infected pods and Black/Dry/Soft Rot pods per tree by CPB Management Score.

CPB Management Score	Mean number of CPB pods per tree	Mean number of Black / Dry / Soft Rot pods per tree
0	7.2	8.5
1	6.2	7.2
2	5.8	8.4
3	4.3	4.6
4	1.5	2.2

Similarly, rates of Black Pod, Dry Pod and Soft Rot Pod declined with improved block maintenance and higher CPB management scores. Again there was a threshold at the high end of the scale on block management / CPB management above which rates of Black Pod fell dramatically (Tables 4.3 and 4.4). In the pre-CPB period growers tolerated these large losses, but with improved block management in response to CPB, these growers are also benefiting from substantial reductions in crop losses due to Black Pod and Soft Rot.

Are growers increasing inputs of labour to tackle CPB?

Farmers and their families were questioned about their perceptions of changes in the amounts of time allocated to different cocoa production activities since the arrival of CPB on their blocks. The majority of growers claimed to be spending significantly less time on cocoa activities, particularly dry bean processing (84%) and pest and disease control (80%), since the arrival of CPB (Figure 4.15)[32]. These data suggest that a large proportion of smallholder growers are not yet responding in any significant way to the CPB epidemic through increased labour or other inputs. From the

[32] Some farmers mentioned that they could no longer afford hired labour and these workers were leaving because of the lack of work. Few farmers employed workers prior to CPB, so this is unlikely to be a significant factor in the decline of labour inputs since CPB incursion.

perception of farmers, only a minority of growers appear to have made the transition to the high input farming system necessary for effective control of CPB.

Growers' perceptions of spending less time on cocoa block maintenance, harvesting and processing since the arrival of CPB is surprising given that they reported receiving extension advice for CPB management from CCIL (at Vudal, Kareba and Tavilo), NGIP-Agmark (Tavilo) and NARI (Vudal) (Figure 4.16). CCIL delivered extension training for CPB control to 72% of the growers at Vudal with NARI delivering extension to 3% of growers (75% of growers in total). At Kareba, 42% of growers reported receiving training for CPB management, all of which was provided by CCIL. Tavilo growers received CPB training from both NGIP-Agmark and CCIL with some growers receiving advice from both organisations.

Most of CCIL's CPB management training was through its IPDM programme supervised by the CCIL Pathology section and delivered by CCIL extension officers working with the pathology section[33]. NGIP-Agmark has its own extension officers and while it sometimes worked with the CCIL IPDM programme, the NGIP-Agmark programme emphasised weekly harvesting and targeted spraying for CPB control. NGIP-Agmark was also encouraging growers to replant their old and overgrown cocoa blocks with a smaller, more manageable number of high yielding clones. The idea behind NGIP-Agmark's strategy is that the replacement of older, overgrown and less accessible cocoa with a smaller number of high yielding cocoa trees will induce farmers to increase their labour inputs in block maintenance and harvesting. This is an appropriate strategy because it is known that farmers will increase their labour inputs in younger, easily accessible blocks where pest and disease rates are lower (the incidence of pests and diseases increases with the age of a cocoa stand), and where there is a good supply of ripe, healthy crop available for harvesting (see Curry *et al*. 2007 for a discussion).

While some growers have made the transition to the high input farming system necessary for living with CPB and are able to make a good income from cocoa, the bulk of growers have not yet made this transition and it is likely that a significant proportion of them will never do so. For effective control of CPB in the province, it may be necessary for those growers who do not adopt CPB management strategies to replace their cocoa holdings with alternative cash crops (see Chapter 7 for further discussion).

[33] See Boxes 4.1–4.3 for summaries of the recommended CPB control strategies.

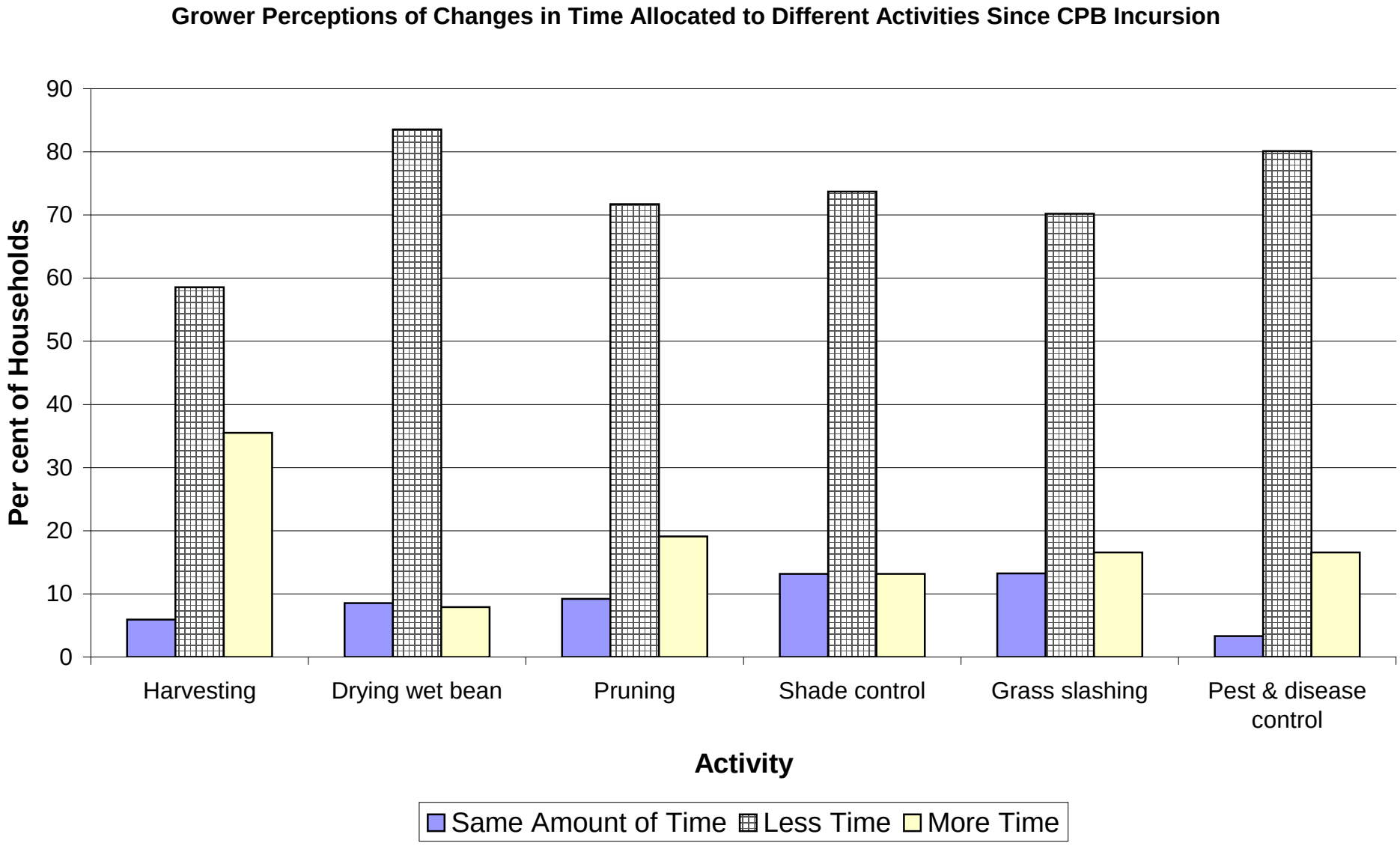

Figure 4.15. Growers' perceptions of changes in the amount of time allocated to different types of cocoa production activities.

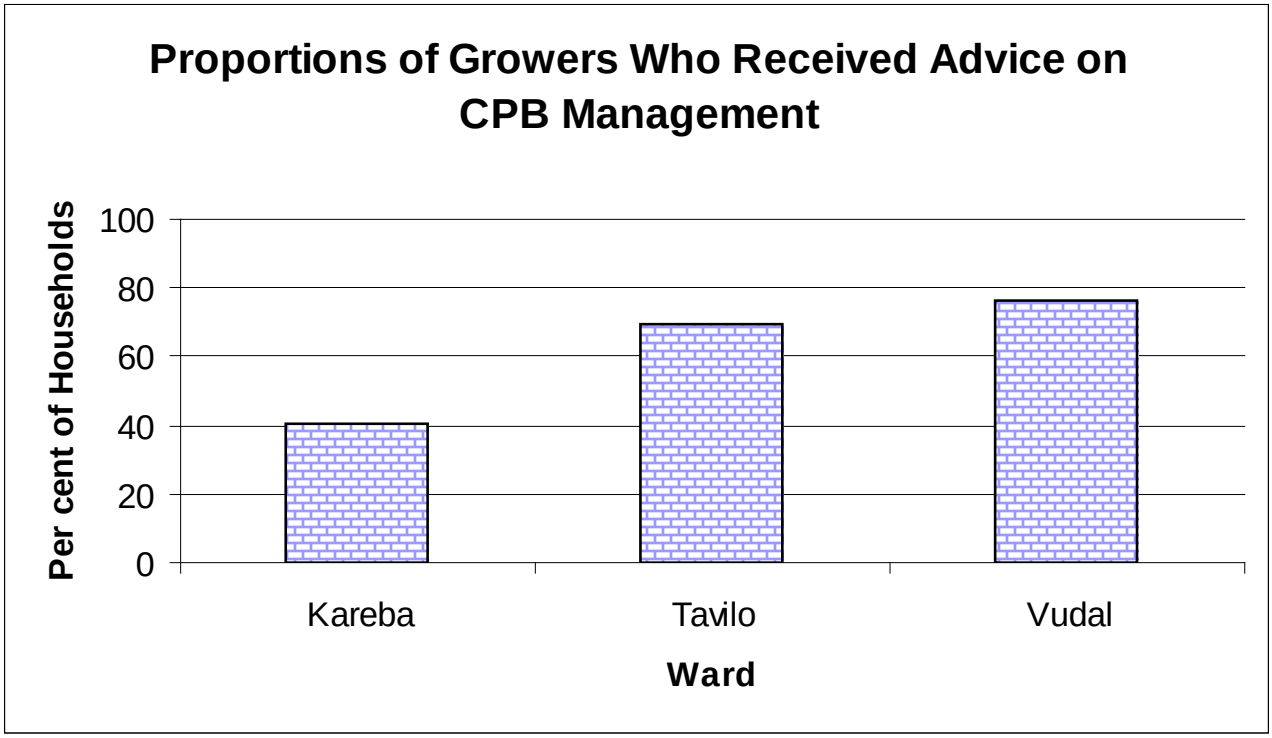

Figure 4.16. Proportions of growers in each ward who received extension advice on CPB management.

7 Smallholder livelihood strategies being modified in response to CPB

Smallholders are diversifying their livelihoods with a major emphasis on garden production for home consumption and for sale at local markets.

Many growers are abandoning cocoa production

Cocoa farmers and their families have responded to the livelihood crisis brought about by CPB in a range of ways. There include:

- Abandoning cocoa production.
- Expanding production of garden crops for home consumption and sale at local markets.
- Establishing new livelihood activities such as the cultivation of new crops or the rearing of livestock such as pigs.
- Increased reliance on remittances from relatives living in non-CPB areas or working in town.
- Harvesting the cocoa of relatives in non-CPB areas (this practice is hastening the dispersal of CPB as the pest is inadvertently being carried into CPB-free areas).

The relative importance of different livelihood options was most noticeable in the decline of cocoa as a source of income for the majority of families and the rise in market income for both men and women (Plate 5.1). Livelihood responses to income losses from CPB also involved reducing expenditures.

Plate 5.1. A food garden in a cocoa block.

The main areas of reduction in household expenditure since the arrival of CPB included:

- Marked decline in the consumption of store foods (48% of families said they rarely purchased store foods; only 3% of families — those with a wage earner — reported not cutting back on store foods). The decline in store food consumption was also reflected in the large drop in turnover of village tradestores and some stores in Keravat town (Chapter 3).
- Less travel to town (100% of growers and their families claimed to have cut back on travel).

- A reduction in the amount of financial support given to the extended family to meet social and cultural obligations (only 17% of growers were still striving to meet these obligations to the extended family while 61% claimed to have stopped supporting their extended families).
- High levels of arrears in children's school fees (Chapter 3).
- Reduced access to and use of medical services in town and a corresponding increase in the use of traditional bush medicines. Eighty-seven per cent of families reported reducing expenditure on medical services. Medical treatment is often postponed until absolutely necessary which means treatment is compromised (e.g., full course of treatment not followed) with higher long-term costs, both financially and socially.
- Reduced expenditure on beer (women reported less crime associated with drunkenness such as domestic violence).
- Increase in certain types of crime, especially the theft of high value and portable crops such as bananas, tobacco, betel nut and mustard.

Although many growers had stopped harvesting and maintaining their cocoa blocks, most wanted to retain their cocoa holdings. Of 149 growers, 117 (79%) claimed they were not intending to make any changes to their existing cocoa holdings. Worryingly, 40 (34%) of these holdings were fully or almost fully abandoned with little or no production of cocoa. These blocks are therefore reservoirs for CPB and sources of reinfestation of neighbouring cocoa blocks where CPB management practices are being implemented. Some growers (14%) felt they could do nothing about their abandoned cocoa because they did not have money or sufficient labour to replace their cocoa. Two growers claimed they would keep their cocoa but would plant coffee on additional land while another two growers said they intended to establish fruit trees or galip nut trees on land separate from their existing cocoa stands. It appeared that many of these growers had adopted a 'wait and see' approach and were hoping for some government intervention to solve their problems.

Thirty-two of 149 (21%) growers were planning to replace their existing cocoa trees. Of those intending to remove their old cocoa, 11 (34%) were planning to replant a portion of the block with hybrid clones thus showing receptiveness to the extension messages of NGIP-Agmark and CCIL to replace their old cocoa with smaller, more manageable holdings of high yielding clones (Figure 5.1). Seven (22%) intended to replace their old cocoa with coffee while smaller proportions of growers said they would plant balsa or a balsa-coffee mix, coffee and galip, food crops or an unspecified cash crop as replacement crops for their old cocoa (Figure 5.1). Of 32 growers who stated an intention to replace their old cocoa, 9 (28%) had fully or partly abandoned their existing cocoa. While the expressed intention of growers to replace their old cocoa with cocoa clones or other cash crops was commendable and was in the right direction for re-establishing a viable smallholder cocoa sector, it must be remembered that these growers represented only 21% of farmers who answered this question — the remaining 79% had no intention of replacing their old cocoa. Furthermore, of the 149 growers answering this question, 49 (33%) had fully or almost fully abandoned their blocks.

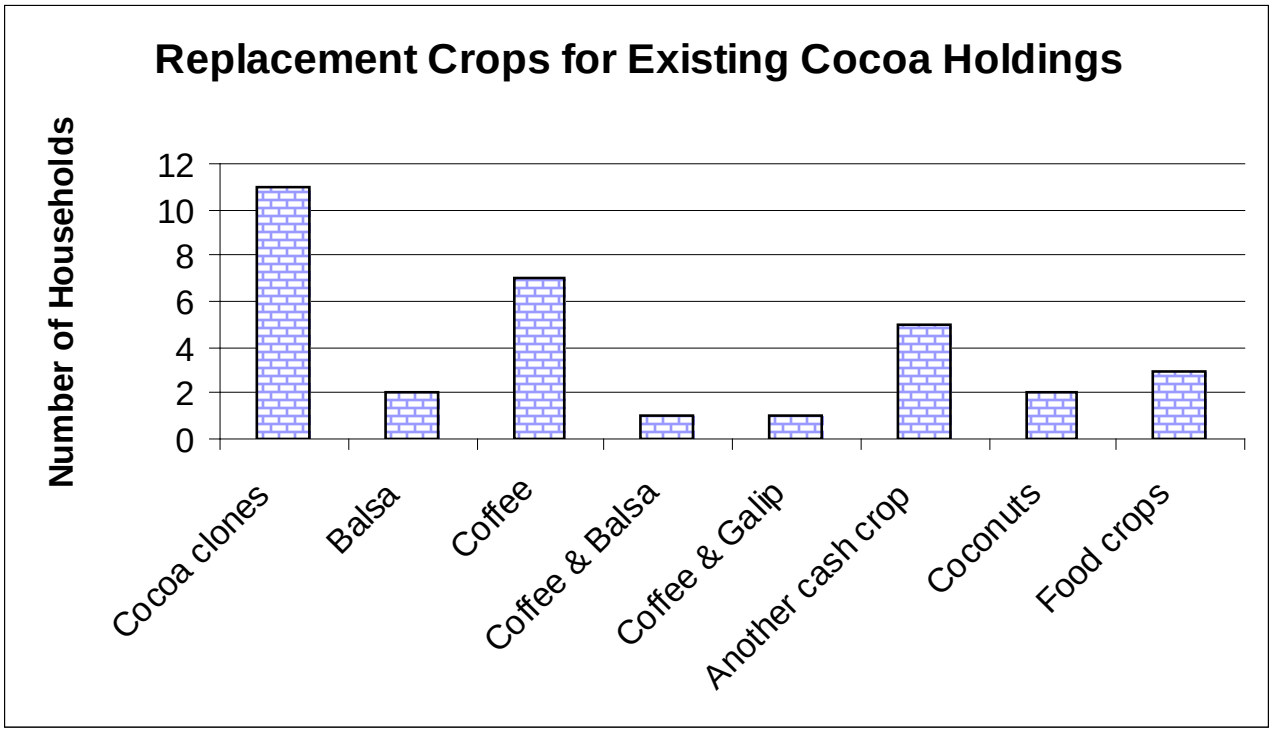

Figure 5.1. The intended replacement crops for old stands of cocoa.

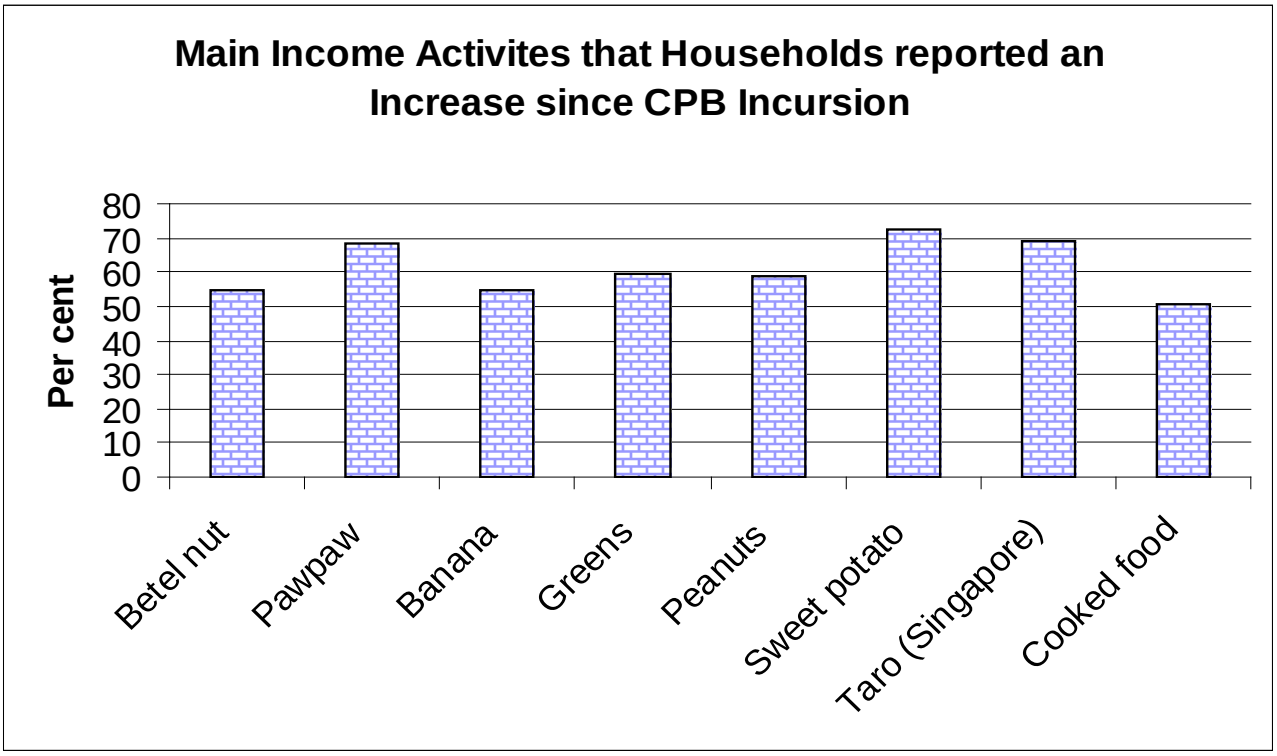

Figure 5.2. Main income activities that households reported an increase in since CPB incursion.

The main livelihood activities in which households reported an increase since CPB incursion were in sales of produce at local markets, livestock production, baking (scones for local markets) and remittances (Figure 5.3). Sales of produce at local markets dominated livelihood activities and had increased greatly since the arrival of CPB. The main items sold at local markets which growers reported had increased since CPB were sweet potato, taro (*singapo*), pawpaw, greens and peanuts (Figure 5.2). The most frequently reported new income sources for growers were greens

and cabbage, and the top ten most frequently mentioned new income activities were all garden produce sold at local markets (Table 5.1).

Table 5.1. The most frequently reported NEW income sources for growers.

Livelihood Activity	Frequency
Greens*	19
Cabbage	18
Capsicum	17
Egg plant	14
Peanuts	13
Tobacco	12
Cooked food	12
Taro	9
Corn	7
Sweet potato	7

**The type of green leaf vegetable was not identified in many of the surveys.*

The new livelihood activities being developed by growers demonstrate a heavy reliance on local markets which reflects the fact that growers and their families are familiar with producing for local markets. The easiest way for growers to respond to the income squeeze from CPB was by intensifying production for local markets. This strategy has worked up to a point, but apart from not fully compensating for the loss of cocoa income as reflected in the drop in store consumption and on other indicators such as school fees (Chapter 3), it may not be viable in the longer-term because it is highly dependent on income earned in the province. As CPB spreads and its impact on provincial incomes worsens then growers will find declining returns from sales at local markets. If a renaissance of the smallholder cocoa sector proves impossible, it is imperative that new livelihood options are developed that bring income into the province. The only realistic strategies would be the development of alternative cash crops for farmers unwilling or unable to make the transition to the high input farming system required for CPB management.

When local markets are removed from Figure 5.3, the relative importance of other livelihood activities is more apparent (Figure 5.4). Livestock production, remittances, baking and wage employment all increased in importance after CPB incursion. Significantly, the largest decline in any livelihood activity was the village tradestore where greatly reduced village income was forcing many of these stores to close (Chapter 3). There was a slight decline in some other activities such as livestock and baking. While these declines were attributable to falling sales within the village, other growers reported increased activity mainly because these products could be sold at roadside and town markets, an option not open to village tradestore proprietors.

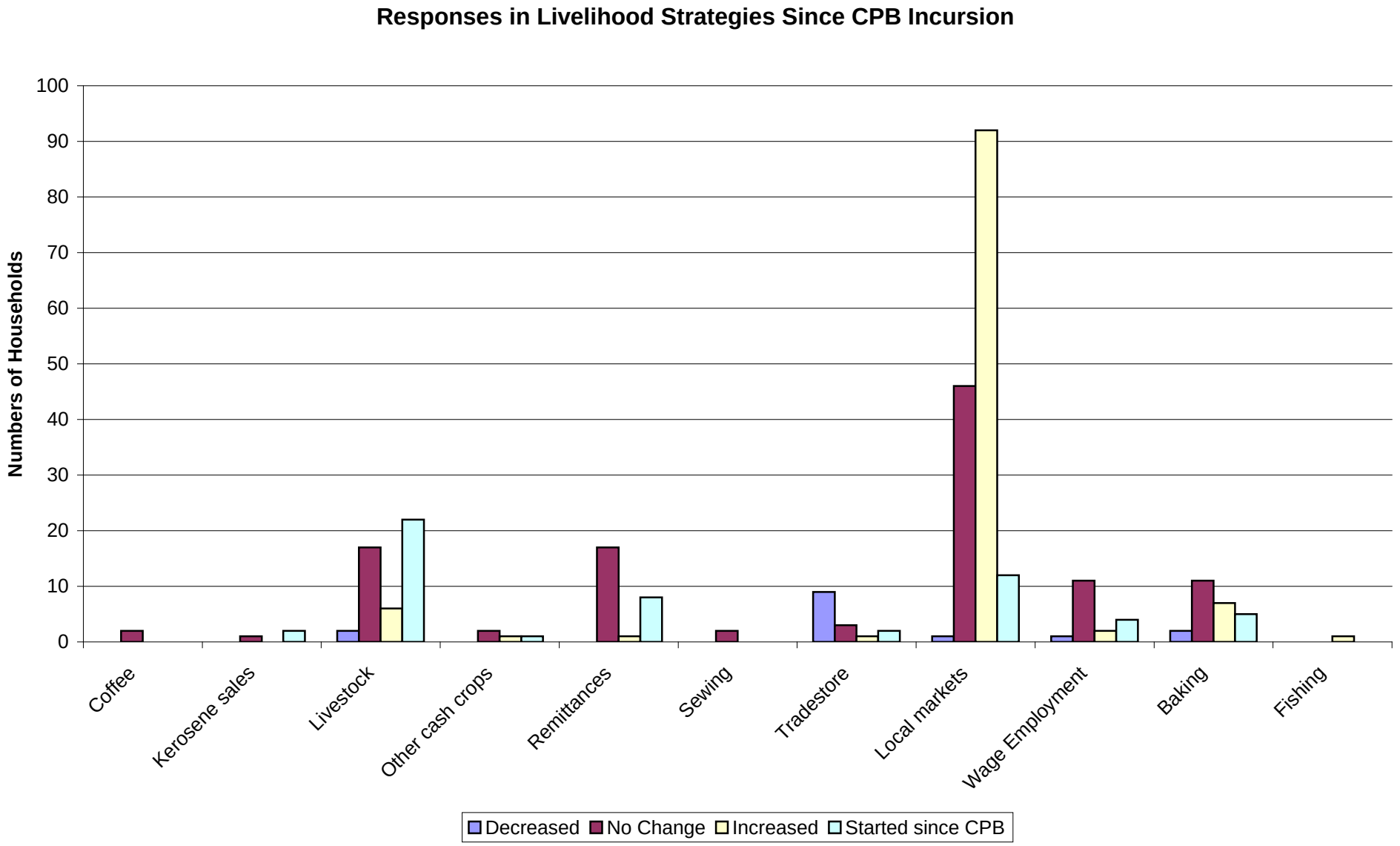

Figure 5.3. Changes in the relative importance of different livelihood activities following CPB incursion.

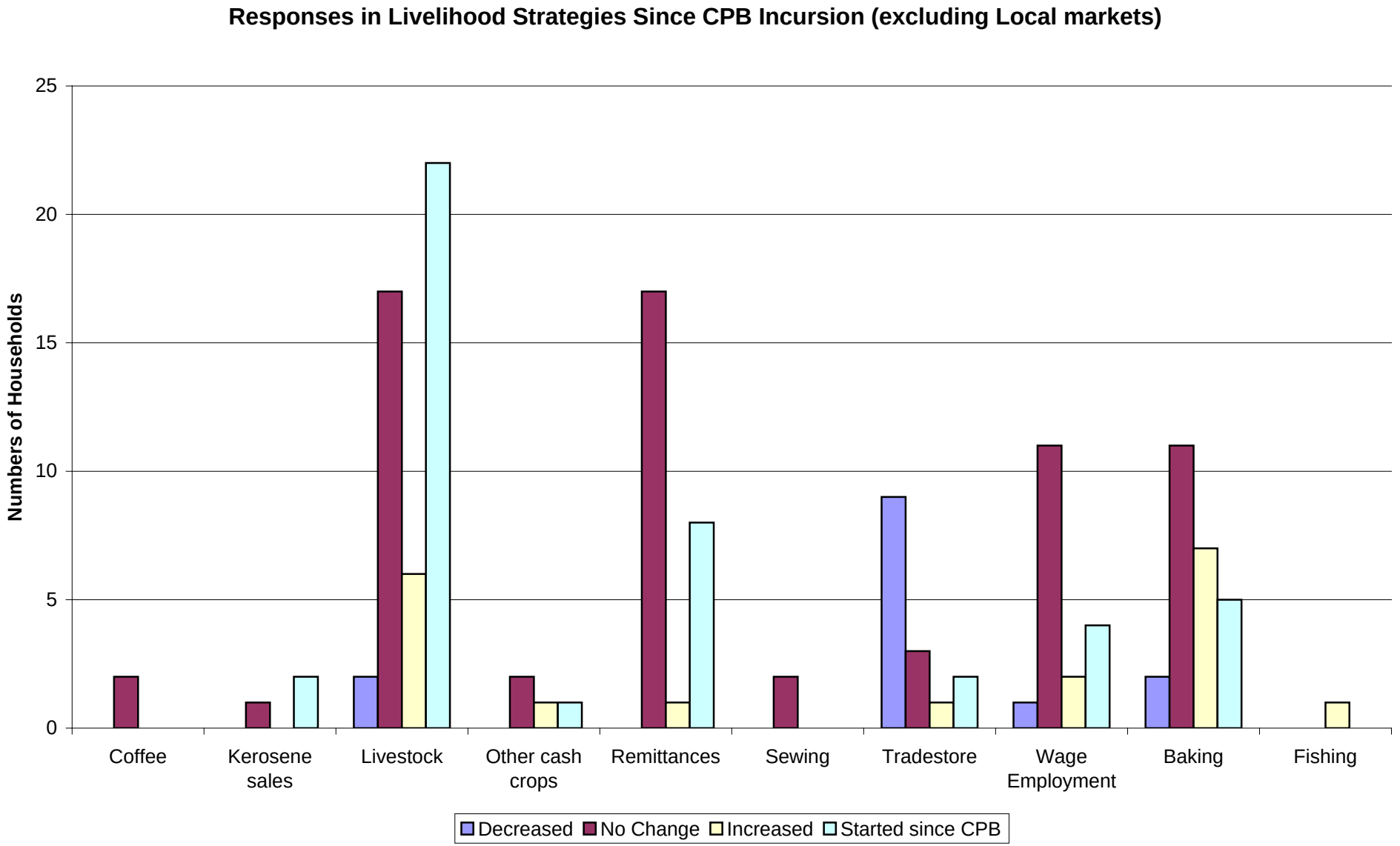

Figure 5.4. Changes in the relative importance of different livelihood activities following CPB incursion (excluding local markets).

8 The main obstacles for the industry and other stakeholders in tackling the CPB threat

- Growers will adopt the foraging production strategy of very low labour inputs thereby exacerbating CPB problems and impacts and making solutions more elusive.
- Abandoned blocks will increase and become a reservoir for CPB, thus reducing the effectiveness of CPB control programmes.
- The limited capacity of extension agencies and ineffective coordination among them.
- Complacency amongst some people in government, the private sector and amongst the general public which may make it difficult to implement an effective and coordinated response to CPB.

Throughout this report we have referred to the risk of farmers adopting a low input *foraging* production system in response to crop losses from CPB. Because this is the central issue for the industry to address, we explore this in more detail here. The fact is that since the CPB incursion increasing numbers of growers are adopting a forage production strategy of very low labour inputs. This will make it very difficult to implement CPB-management strategies requiring high labour inputs.

Most smallholder cocoa growers follow a system of production with labour inputs being very low. When cocoa blocks are young (<8 years of age) accessibility is high and pest and disease rates are relatively low. At this stage there is a high density of easily accessible ripe healthy pods which induces a *farming* strategy of relatively high labour inputs (grass slashing to improve accessibility and larger harvesting groups made up of both men and women). With relatively large quantities of crop being harvested, growers are more likely to engage in dry bean processing rather than wet bean sales. However, because labour inputs for pruning, shade control and block sanitation are low, cocoa blocks at around 7-8 years of age pass into a low production stage — the *foraging* phase (Curry *et al.* 2007). On these older cocoa blocks there is no open space between the cocoa trees because the branches interlock those of neighbouring trees and the shade cover is dense. Block maintenance is virtually abandoned, and the amount of healthy ripe crop that is easily accessible for harvesting falls significantly because of the high proportion of diseased pods (over-shaded and moist micro-climate) and the difficulty of harvesting pods in the dense vegetation or high in the canopy. Incentives to invest labour in block maintenance and harvesting decline to very low levels.

On these old and overgrown cocoa blocks the large cooperative work groups typical of younger, high producing blocks are disbanded and replaced with a strategy of harvesting very small quantities of cocoa usually by women, often working alone, with the cocoa sold as wet bean at local buying points. Production becomes driven by short-term consumption needs. Visits to the cocoa block rarely involve more than an hour or two of harvesting during which time one or two baskets of cocoa are collected and sold as wet bean (Curry *et al*. 2007). Very little or no time is allocated to block maintenance.

With the switch to the *foraging* strategy, family labour is diverted to other livelihood activities, such as to the family's younger and healthier cocoa holdings, to other cash crops, or to increased production of food crops, tobacco or betel nut for sale at local markets to compensate for the declining income from old cocoa holdings. If the household has sufficient land, they are much more likely to establish new cocoa blocks rather than replant/rehabilitate their old cocoa block. Whilst

these old blocks are not generating much income (much less than could be achieved by replanting), growers are reluctant to replant them because they are still generating some income.

The risk with CPB is that more growers will switch to the *foraging* production strategy of very low labour inputs. This was confirmed by the data presented in Chapters 3 and 4 which showed that many growers responded to high CPB infestation rates by either abandoning their blocks or adopting the foraging strategy. Only a small proportion of growers had effectively implemented the CPB management practices recommended by NGIP-Agmark and CCIL (IPDM).

While the foraging strategy may work for old cocoa blocks carrying high levels of Black Pod, it is not a viable strategy for managing CPB-affected blocks because the amount of ripe, healthy crop available for harvesting is so low that the labour returns to foraging for small amounts of cocoa to sell as wet bean are likely to be so small that the block will ultimately be abandoned.

For the survival of the smallholder cocoa sector in ENBP, it is critical that farmers move to the high labour system of production. While this is easy to recommend, it is much more difficult to design and implement effective strategies to achieve this. The success or otherwise in bringing in a new high labour input system of cocoa production in ENBP will ultimately determine the future of cocoa production in the province.

The evidence from the small number of farmers who have successfully made the transition to high input production is that the increase in yields can more than compensate for labour and other input costs associated with implementing a CPB management regime. Basic block maintenance tasks such as pruning and shade control on their own are known to stimulate large yield responses (Ghodake *et al.* 1995; Drenth and Sendall 2004), and combined with a CPB management regime of weekly harvesting, centralised pod breaking, pod burial and an insecticide programme, yields would be much higher than those obtained in the pre-CPB situation when growers invested little labour in their blocks. Therefore, it is conceivable that with the right guidance and support and adequate levels of extension, the arrival of CPB may be the trigger that shifts smallholder cocoa production to a high input farming system with returns to labour better than they were in pre-CPB times.

Even if the industry were successful in facilitating the transition of the majority of growers to the high input production system, a proportion of farmers will not adopt this system, and their cocoa stands will become abandoned blocks acting as reservoirs for CPB. The existence of abandoned cocoa blocks would add significantly to the labour and other costs of CPB management in the province, and the high rate of re-infestation of smallholder blocks following CPB control strategies from abandoned or semi-abandoned blocks would undoubtedly undermine the motivation of growers to keep investing in farm inputs.

Another major problem confronting the industry is simply the limited capacity of CCIL to mount the necessary levels of extension programmes to ensure that sufficient numbers of farmers receive the training and other resources to make the transition to the high input production system required to control CPB. As one CCIL officer involved in IPDM extension commented:

> *I am only one extension officer and I cannot be in more than one place at a time. I give farmer demonstrations on how to manage CPB, but if they don't come I can't help them. We have limited resources so we can't be everywhere. (CCIL officer involved in IPDM extension)*

At present CCIL has six extension officers in ENBP which gives an extension officer to grower ratio of 1:3,833. If we include the province's Department of Primary Industry (DPI) extension officers (52), the ratio rises to 1:396. Given the scale of the CPB problem, it is evident the present extension strategy relying on CCIL resources will not be enough to tackle the CPB problem effectively. As the quote above highlights, CCIL extension officers cannot be everywhere. In the next chapter we consider ways that the extension capacity of ENBP could be bolstered by new approaches involving increased coordination across the various organisations involved in extension, including greater involvement of the commercial sector and farmers themselves.

Finally, it should be noted that there is a worrying sense of complacency regarding the extent of the threat of CPB to ENBP which must be overcome. This complacency was recognised amongst some members of the provincial government, people in the private sector and members of the

general public not living in CPB-affected areas. People need to be reminded that CPB is not just a problem confined to cocoa growers and exporters/processors. Nor is it solely up to the government to act. Rather it is everyone's problem in ENBP because of its capacity to undermine the quality of life of most residents in the province. It is imperative that this point is understood by all ENBP residents because it is only by all sections of the ENBP community working together cooperatively (*wok bung wantaim*) that the threat can be mitigated.

9 What Should the Industry do in Response to the CPB Threat

> The theme of the industry response should be '*Restoring Livelihoods*' to stress the breadth of the response required, and acknowledge that cocoa is only one part of the solution.

- Develop an integrated approach to extension involving government, commercial and community organisations.
- Establish a Project Implementation Unit to coordinate extension efforts and to source funding from donors (or from levies) to sustain these programmes.
- Ensure farmer/community involvement in extension delivery and CPB monitoring.
- The Cocoa Board should immediately:
    - relax regulations prohibiting the sharing of village processing facilities to encourage farmers to pool their wet bean for dry bean processing;
    - fast-track the approval of small fermenting boxes for use by growers in CPB areas.
- Distribute small hybrid clones free to farmers in return for removing their old cocoa stands.
- Promote income and livelihood diversification such as coffee as an alternative crop to cocoa for growers not willing to make the transition to high input cocoa growing.
- Amend quarantine regulations to allow the removal of CPB hotspots.
- CCIL Breeding section should immediately:
    - initiate a crossing programme to develop CBP-resistant/tolerant material (long-term strategy);
    - assess released and new clones planned for release for their reactions to CPB (short-term strategy);
    - with the assistance of CCIL extension, establish a farmer network to report CPB tolerant cocoa in their farms for evaluation with genotypes possessing the desired traits recommended to farmers for cloning (short-term strategy);
    - assess the ten SG2 hybrid crosses and new SG3 hybrids planned for release and distribute only those crosses showing tolerance to CPB (short-term strategy).
- Develop a Strategic Plan for agriculture in response to CPB.

Where we are now and where do we want to go?

If the fall in production observed in CPB areas in November 2008 were to apply to all the cocoa growing areas of the province, the cocoa industry in ENBP would collapse and the infrastructure to sustain a cocoa industry would deteriorate rapidly as investment is withdrawn. The industry and the government cannot afford to wait for the 'silver bullet' solution of CPB-resistant material becoming available through CCIL's breeding programme. The ten years or more required for CCIL to breed and distribute CPB-resistant cocoa is too long and the industry would be lost before then. Action is needed NOW before CPB destroys the entire productive capacity of the cocoa industry in ENBP.

The fate of ENBP's cocoa industry ultimately depends on convincing a large proportion of smallholder farmers to adopt the high labour and management input system of cocoa production. The low input farming system which has served Papua New Guinea farmers in the past is no longer sufficient for managing cocoa when CPB is present.

The immensity of the task to convince small farmers to switch to a high input cocoa production system should not be under-estimated. Because it involves growers making a radical shift in the way they manage their cocoa blocks, it will require new approaches to scale-up the intensity and quality of extension delivery so that growers everywhere in the province will have ready access to quality extension for effective CPB management. It also means broadening what is meant by extension because the high input production system requires additional skills to those required for a low input farming system. These new skills include farm management planning, budgeting and savings. Intensifying and broadening the range of skills taught through extension will require a coordinated response that draws on the human and other resources of a wide range of

organisations in the government, commercial and community sectors working together towards a common goal.

Living with CPB: where does the industry want to be in the future?

In 2008 when CPB was still limited in its distribution in the province and almost all farmers were following the low input production strategy, 20,000 tonnes of dried cocoa were produced on 55,000 ha of land (0.364 tonnes dried bean/ha). For a viable cocoa industry co-existing with CPB into the future, a successful high input production system should be introduced to produce much higher yields on a much smaller area of land. Some current low producers will drop out of the industry and switch to other crops while remaining growers adopt smaller and more manageable stands of high yielding cocoa clones. Under this scenario of high input production it should be possible to produce between 20,000 and 30,000 tonnes of dried bean on 15,000 ha of land (between 1.3 tonnes and 2 tonnes dry bean/ha). The rest of this chapter considers how this might be achieved. The chapter concludes with a recommendation that these initiatives in cocoa production form the basis of a "Strategic Plan for Agriculture in Response to CPB"

9.1 Solutions

9.1.1 Extension / Training

Despite CPB training, many growers had not shifted to the high input production system necessary for managing CPB, and a large proportion of growers had abandoned their cocoa stands (Chapter 3). The largest improvements in block maintenance were amongst growers who had more intense and longer experience with IPDM management training. For instance, at Tavilo, CCIL's pathology section has been running IPDM training for several years, while NGIP-Agmark has been developing close relationships with these growers for five years through the delivery of extension training and other farm inputs. Some of these growers have been able to control CPB and increase production to reasonable levels. But the sheer size of the problem makes it impossible to extend this kind of extension throughout the province. CCIL simply does not have the human and financial resources to deliver to all CPB areas the depth and intensity of extension services necessary for effective control of CPB. A different kind of extension delivery is required.

Existing extension must be scaled-up significantly to ensure extension services are available on demand. The success of such a scaling-up of extension requires four inter-related conditions to be met. These are:

- An integrated approach to extension involving government (particularly CCIL working with DPI), commercial and community organisations with a stake in the cocoa industry.
- The farming community to be fully involved in extension delivery and CPB monitoring.
- The establishment of a full-time body to coordinate these efforts and to find funding from donors (or from levies) to sustain these programmes.
- Amendment of the quarantine regulations to allow the elimination of CPB hotspots as sources of re-infestation.

Each condition is discussed below.

An integrated approach to extension

Although CCIL is the lead organisation in cocoa extension in ENBP, it simply does not have the capacity to single-handedly meet the CPB challenge. Therefore, it will be necessary for government, community and private sector organisations to combine their resources and work together. Even these combined resources would not be enough to meet the extension challenge, and it will be necessary for farmers themselves to be a large part of the solution in terms of extension delivery. A preliminary list of organisations/agencies that could be involved in the extension effort to address CPB include:

- CCIL (extension delivery, research and seedling supply).
- DPI (extension delivery).
- Cocoa Board (information source).

- DAL (extension delivery and legal frameworks).
- NAQIA (quarantine issues and regulations)
- NARI (extension delivery, particularly in intercropping of cocoa and development of alternative cash crops such as galip nut, balsa and fruit trees).
- Vudal University (extension delivery and IATP courses on "Farming as a Business").
- Savings and loans societies such as the ENB Savings and Loans Society (financial management/and savings schemes to finance farm inputs — delayed harvesting to accumulate pods on the tree as a form of savings is not possible in a CPB environment).
- Schools (training and awareness including extension delivery).
- Churches (training and awareness including extension delivery).
- Exporters/processors and other private service providers (extension delivery and supply of tools, insecticides and other farm inputs/equipment).
- Plantation companies (extension delivery and supply of tools, insecticides and other farm inputs/equipment).
- LLGs, wards and community/farmer groups (extension delivery, village work groups for labour intensive skilled maintenance tasks, and monitoring of CPB levels, especially of CBP hotspots).

The extension capacity of ENBP to deal with CPB could be given a massive boost by harnessing the synergy created by integrating the extension capacities of CCIL and the Department of Primary Industry (DPI). Further synergy would be created by integrating this combined capacity with the commercial sector to enhance their individual and collective capability through 'inter-agency' or joint stakeholder training and collaboration. Only when farmers are also brought in as extension agents in their own right does the model begin to approach what is needed to manage CPB. To achieve this requires a high level of coordination and planning, the topic to which we now turn.

Establish a Project Implementation Unit to coordinate extension efforts.

The planning and coordination across all these different agencies and groups requires the establishment of an organisation charged with administering and implementing an integrated programme of activities for high input farming and CPB control. One might suggest the East New Britain Cocoa Pod Borer Response Coordinating Committee (ENBCPBRCC) as filling this role. The ENBCPBRCC is under the authority of the provincial government and is a committee made up of industry and government people serving largely an advisory role to the industry and CCIL, and acting as an information broker amongst the different stakeholders in the industry. However, at present it does not have the capacity to administer and implement the types of programmes necessary to shift the smallholder sector from the low input foraging system of cocoa production to the high input farming system necessary for living with CPB.

A potential model is the Gazelle Restoration Authority (GRA) which was established under a special act of parliament in 1995 to rebuild infrastructure after the September 1994 volcanic eruption near Rabaul[34]. Now in its second phase (the "Second Gazelle Restoration Project"), the GRA oversees several Project Implementation Units (PIUs) working across different areas such as roads, bridges and schools. A PIU for livelihood restoration in CPB areas may provide the appropriate model of an agency that has the capacity to work across different organisations to develop and implement extension programmes that draw on the resources of a wide variety of stakeholders. The simplest, quickest and probably the cheapest way to create a unit for livelihood restoration in CPB areas, would be for a new PIU funded by an external donor to be established under the GRA.

[34] Given that the GRA is a well-established organisation in ENB with several PIUs under its structure, the GRA might offer one way to quickly establish the necessary organisation charged with coordinating the different government and commercial sector organisations and implementing the programmes of extension and other services. A CPB unit could be established as a PIU within the GRA, for example.

We recommend that the ENBCPBRCC, CCIL, GRA and other stakeholders explore with the GoPNG, World Bank and other donors, the feasibility of setting up a PIU (perhaps under the GRA) for restoring livelihoods in ENBP's CPB areas. An adequately funded PIU which has the capacity to coordinate (and where necessary fund) the resources and activities of the agencies/departments and community/farmer groups would be more likely to be successful in facilitating the transition to the high input farming system. Arguably, what is ultimately achieved in ENBP will set the pattern and direction for later interventions in other provinces where CPB already has a foothold, and where the World Bank is considering funding programmes for cocoa rehabilitation. What is learned in ENBP will be of great relevance elsewhere.

In developing these strategies, there is much to be gained from drawing on the experiences of the commercial sector. They are a key component of any strategy to expand extension and training and some such as NGIP-Agmark are already rolling out quality extension programmes that are achieving remarkable successes in reducing the CPB rate and improving cocoa productivity amongst some growers (Box 4.3). The commercial sector should therefore be considered a major ally in efforts to reinvigorate cocoa production in ENBP.

It is worth drawing attention to one example of commercial sector involvement in extension which is proving successful and offers a model that could be scaled up at little cost. This is the NGIP-Agmark 'Training by Association' programme. Since 2004 the Tokiala Plantation near Tavilo (and surrounding farmers — see below) has been providing a range of extension services (which they prefer to call 'Advisory Services') to farmers living near the plantation. Since the arrival of CPB, the plantation has also been training farmers in CPB control techniques including weekly harvesting, centralised pod breaking, pod burial and target or spot spraying of insecticide. Together with IPDM training from CCIL, some of these farmers have successfully made the transition to high input farming and are achieving high levels of production (see Chapter 4).

Farmers from surrounding and more distant communities have requested similar training and services from NGIP-Agmark, and to meet this demand the company recently commenced bringing in farmers from these other areas to live (they are housed in a nearby plantation labourers' compound) and work with the Tavilo farming community to participate in the Training by Association programme. By living and working alongside Tavilo farmers, NGIP-Agmark's original investment in extension is being leveraged to the benefit of many other farmers and communities at little additional cost. Importantly, under this model a large part of the delivery of extension training is diffused amongst the host farming community thereby making for a very efficient model of extension delivery. Farmer involvement is critical to the extension effort, as the next point makes clear.

Farmer involvement in extension

To attain sufficient critical mass for the extension effort, farmers themselves, with support from their LLGs and wards, must play a central role in the delivery of extension services and as monitors of CPB within their own areas. Farmer involvement would include:

- CPB monitoring;
- the establishment of budwood gardens of CPB-tolerant varieties of cocoa identified by farmers themselves and following evaluation and approval by CCIL;
- distributing CCIL-approved hybrid clones to other farmers in their communities;
- extension training for other farmers in general block maintenance, CPB management, and in maintenance techniques of hybrid clones;
- identification, recruitment and training of local work groups to undertake skilled cocoa maintenance tasks for CPB control such as pruning, shade control and insecticide spraying.

Farmers who are recognised as knowledgeable and proficient cocoa growers and leaders in their communities would become the contact points for the various extension agencies working through and coordinated by the PIU (The Livelihoods Restoration Project Implementation Unit?). Such farmers could be trained in budding and be assisted to establish budwood gardens with material identified and collected from the network of contact farmers from all parts of the province (as a short-term measure while CCIL's breeding programme is stepped up — such budwood material, as highlighted above, would need to be screened and approved by CCIL before distribution to

farmers). Nominated farmer leaders could also be the distribution points for hybrid clones issued to farmers in return for removing their old cocoa. These farmers would play a critical role in CPB monitoring within their own areas and would be largely responsible for the identification of CPB hotspots. For this farmer-level approach to be effective these services must be embedded in the communities, and farmer extension networks (with LLG and ward support) is one way of ensuring local involvement.

Another potential benefit of strong farmer involvement in, and responsibility for, extension is the potential to tap the resources of the community for the heavier and more skilled block maintenance tasks. The large numbers of under-employed young men are an under-utilised resource who could be mobilised for CPB control. For example, it was apparent during the November field visits that while many farmers were interested in maintaining their cocoa, they were, for a range of reasons, unable to implement CPB control techniques correctly (Chapter 4). Some key block maintenance tasks (e.g., pruning and shade control) and CPB control techniques (e.g., insecticide spraying) might be more effectively and efficiently undertaken by work groups trained in these tasks[35]. While these tasks would be performed more cheaply and more effectively by well-trained work groups, the added benefit of a coordinated spraying programme in which all the blocks in an area are treated at the same time raises the returns through a greatly reduced overall CPB infestation rate and a longer period for CPB numbers to rebuild[36]. The programme for insecticide application in each area should be informed by the results of the CPB monitoring programme managed by farmers.

The question arises as to how to pay for these work groups. A levy on production may be the most appropriate way to fund these services. Ideally, a portion of the current levy collected by the Cocoa Board should be used to meet these costs. If this were not possible and a donor cannot be found to cover the cost, then consideration should be given to introducing a small levy on all production across the province (the CPB levy?). It must be remembered that pruning and spaying are critical components for shifting to a high input system of production. It must also be remembered that the yield response from the switch to the high input system will more than compensate for any pod losses from CPB and the additional cost of a levy on growers (Black Pod losses would also be reduced significantly with the adoption of CPB management strategies — Chapter 4). At the end of the day, despite the presence of CPB and the imposition of a new CPB levy, a high input system of cocoa production would put more money in the pockets of growers and their families than was possible in pre-CPB times under the old low input system of production.

Cocoa Board regulations prohibiting the sharing of village fermentaries and dryers should be relaxed in CPB areas.

As part of a strategy to sustain cocoa infrastructure through this lean time in the transition to high input farming and to encourage growers to keep producing, the Cocoa Board should relax its regulations regarding the sharing of village processing facilities[37]. At present, few growers are harvesting enough wet bean for dry bean processing. Relaxing restrictions on the sharing of processing facilities would facilitate production in two ways. First, it would encourage growers to coordinate harvesting so that there is sufficient wet bean harvested to enable processing (this in itself would encourage farmers to harvest who would not have otherwise bothered). Second, it would promote synchronised production (harvesting and processing) which would provide a platform for greater coordination across cocoa blocks in CPB control techniques. For example, insecticide spraying is more effective if the cocoa stands in an area are all treated at the same time (discussed above). While seemingly a small change to make in the regulatory environment, such

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[35] Ideally, these work groups should be in competition with each other to reduce the CPB rate in their own areas. Those groups achieving the greatest reduction and maintaining the lowest rates of CPB infestation should be rewarded with recognition such as prizes and cash bonuses for their groups.

[36] Because insecticides are expensive some farmers undertaking insecticide spraying may cut corners and not apply insecticide correctly.

[37] Licenses for processing facilities are issued to identified growers to help maintain quality in processing.

small steps will contribute towards the attainment of a high input farming system by helping to sustain an interest in cocoa production.

The Cocoa Board should also immediately fast-track the approval of small fermenting boxes for use by growers in CPB areas. These fermenting boxes were developed under an ACIAR project and have been awaiting Cocoa Board approval for use by smallholders for nine years (discussed at ENBCPBRCC, 21 may 2009). The adoption of this technology in CPB areas would encourage growers to maintain production.

Distribute 300-500 hybrid cocoa clones at no cost to growers who have removed their old cocoa stands.

Growers who are interested in continuing as cocoa producers and who are willing to make the commitment to high input farming and sign up to IPDM and CPB management training should be provided with small[38] varieties of hybrid clones free in exchange for removing their old trees[39]. Seedlings should be distributed to growers at no cost because income levels are now so low that few would have sufficient savings to fund replanting themselves[40]. Growers should not receive the clones until an extension officer has verified that their old cocoa has been removed.

The number of hybrid clones distributed to each grower should depend on the availability of household labour to ensure there is sufficient labour to maintain a high input farming system relatively easily. From discussions with industry people and CCIL researchers who have worked on these issues, it is anticipated that most seedling batches distributed to individual families would be in the range of 300-500 trees[41] (David Yinil, pers. comm., November 2008; Otto Kuaimba, pers. comm., November 2008)[42]. By establishing small and manageable plots of high yielding small variety cocoa clones, the high density of easily accessible ripe healthy pods will induce farmers to increase their labour inputs in block maintenance and harvesting.

Industry and government to support the diversification of livelihoods

As part of an overall strategy of livelihood restoration in ENBP, growers and their families must be supported in their efforts to diversify into other income sources including other crops. ENBP cocoa farmers have demonstrated remarkable adaptability and willingness to respond to the CPB crisis by diversifying their income sources. Opportunities for intercropping cocoa should also be explored as part of the overall strategy for restoring livelihoods through income diversification[43].

Coffee, which is expanding rapidly in the province, may be a suitable crop for income diversification and an alternative crop for those growers leaving the cocoa industry. The ENB Coffee Growers Cooperative Association has been active in the promotion of Robusta coffee (Omuru variety) and has been establishing nurseries and distributing seedlings to farmer groups (Plate 7.2). In November 2008, they had 190 farmer groups with a total of 4,420 members, many of whom were located in CPB areas. By September 2008, 1.6 million coffee trees had been planted

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[38] The small varieties of cocoa are easier to harvest. Their small stature also means that pruning and spraying are much easier tasks. Spraying, in particular, can be thorough as the entire tree is within reach.

[39] NGIP-Agmark was also encouraging growers to replant their old and overgrown cocoa blocks with a smaller, more manageable number of high yielding clones.

[40] The offer of free cocoa clones might overcome some of the frustration of growers who believed they were inadequately compensated for the rampasing of their cocoa trees.

[41] Of course, other factors influence labour supply such as the grower's capacity to recruit labour (family and hired), the extent to which the cocoa block is managed as a business (farming versus foraging), cocoa prices and the cash needs of families which vary through time. For example, during school fee time, or when cocoa prices are relatively high, the motivation of growers and their families to invest labour in their cocoa block rises.

[42] In the oil palm industry village growers are strongly advised to limit their holdings to 2 ha. This makes pest and disease outbreaks less likely to occur because the labour demands on a family for managing a 2ha block are not too onerous and time consuming.

[43] Young cocoa blocks interplanted with food crops are the best managed blocks (Ghodake et al. 1995). The agronomic benefits of intercropping cocoa (more thorough weeding and reduced levels of pests and diseases) have been documented in other cocoa growing countries (Johns 1999; Rice and Greenberg 2000; Rosenberg and Marcotte 2005).

by 4,400 people (John Rarau, ENB Coffee Growers Cooperative Association, pers. comm., 20 November 2008). Coffee and other cash crops such as balsa, spices and galip nut should be part of any suite of strategies for the restoration of livelihoods in the province[44].

Plate 7.1. The nursery of the ENB Coffee Growers Cooperative Association.

When identifying suitable cash crops for diversifying livelihoods, consideration must be given to seasonal variations in the labour demands of potential new crops so that they do not coincide with the peak labour demands for cocoa.

For growers who have abandoned their cocoa stands or are unable or unwilling to shift to high input cocoa production, it is very important that it is made relatively easy and painless for them to move out of the cocoa industry. For these farmers — and there is likely to be a lot of them — suitable incentives are required to encourage them to remove their old cocoa and shift into other livelihoods. One incentive may be the offer of an alternative cash crop such as coffee seedlings with training on condition that their old cocoa is removed. However, for some growers it may be necessary to have a legal requirement that stands of abandoned or semi-abandoned cocoa are removed. This issue is discussed next.

Amend the quarantine regulations (or introduce LLG by-laws) to allow the removal of abandoned or semi-abandoned cocoa stands that are at risk of becoming "hotspots" for CPB.

Abandoned or semi-abandoned cocoa blocks including cocoa stands where growers continue to follow a foraging strategy pose a major challenge to creating a sustainable future for the ENBP cocoa industry. Such blocks are reservoirs for CPB and allow re-infestation of areas where growers are following CPB control strategies[45]. While these CPB hotspots will add significantly to the costs of CPB control (financial and family labour) for smallholder farmers pursuing high input

[44] Some villagers in CPB areas have started planting coffee, e.g., villagers from the Naparar Villages 1-5, Burit, Vunapalading, Sinivit, Gaulim, Vudal, Vunadawai, Totovel, Ramalmal, Rakotop, Rakunai, Tinganagalip, Navunaram, Vunadidir, Rapitok, Tanak, Rabagi.

[45] With an appropriate CPB control regime it should be possible to reduce the CPB infestation rate to below 5% of mature pods. NGIP-Agmark has exceeded this rate on their plantations with an infestation rate below 3% of mature pods.

farming, continual re-infestation with CPB from nearby abandoned blocks will frustrate growers and undermine their motivation to persevere with CPB control and high input farming.

Strategies to address CPB must consider ways to eliminate CPB hotspots. The incentive to remove old or abandoned cocoa holdings may be to plant another cash crop such as coffee, but this will not induce all farmers with abandoned cocoa blocks to remove their cocoa and it is likely that a legal requirement will be necessary to enforce removal of such cocoa stands. It may be necessary for the quarantine regulations to be amended so that abandoned or semi-abandoned cocoa blocks harbouring high levels of CPB can be removed if they pose a threat to neighbouring cocoa blocks.

CCIL Breeding should immediately initiate a crossing programme to develop CPB-resistant/tolerant material as a long-term strategy. In the sort-term they should begin screening CCIL hybrid and cloned varieties for CPB tolerance.

Although a CCIL breeding programme may take ten years or more to produce, test and distribute CPB-resistant/tolerant cocoa, such a programme and related CPB research should be a priority and stepped up immediately. In the meantime, and as a matter of urgency, CCIL should assess released and new clones planned for release for their reactions to CPB. They should also assess the ten SG2 hybrid crosses and new SG3 hybrids planned for release and distribute only those crosses showing tolerance to CPB.

Farmers themselves are a considerable resource in these endeavours to identify CPB tolerant material (see Point 3 above). To maintain some level of production while the high input farming system is adopted, and to ensure cocoa infrastructure is maintained (village and commercial sector processors and transport), villagers should be encouraged to identify from amongst their own cocoa stands trees displaying some level of CPB tolerance. There is considerable genetic diversity in PNG cocoa, and it is possible, indeed likely, that CPB tolerant cocoa is already present in village cocoa stands.

During fieldwork for this assignment, the team heard reports of CPB-tolerant cocoa in areas heavily infested with CPB. The team visited one of these sites near Vudal and in a CPB-infested SG2 cocoa stand they were shown two trees the grower claimed had never carried CPB. All of the trees in the stand were from the same batch of seedlings, but unlike the rest of the trees in the stand that carried yellow-green pods, these two trees carried purple pods with smooth surfaces (Plate 7.1). They also had a hard and brittle sclerotic layer compared with the softer sclerotic layer of pods from the other trees[46]. On Sang Plantation (owned by NGIP-Agmark), several cocoa varieties (K4, K6 and K9) were showing some tolerance of CPB and these too had smooth pod surfaces and a hard sclerotic layer[47] (Graham McNally, pers. comm., November 2008).

[46] Cuttings were taken back to CCIL for budding and testing.

[47] These varieties have not been released officially and are currently being assessed by CCIL Breeding.

Plate 7.2. A pod from a tree which the grower claims is CPB tolerant. Note the smooth surface and shallow furrows on the surface.

Given the urgency of the situation, farmers should be encouraged to locate CPB-tolerant cocoa in their villages (using the farmer network described above) and to report their presence to CCIL for further evaluation and possible development as part of CCIL's cocoa breeding programme. Cocoa trees identified in the field by farmer and assessed by CCIL as being CPB-tolerant and possessing other desirable traits, should be budded and distributed through farmer networks. With some coordination of the programme (see below) budwood gardens made up of a range of CPB-tolerant material developed from village plantings could be established in each main cocoa growing area as a short-term strategy to maintain production.

Strategic Plan for Agriculture in Response to CPB

The recommendations sketched out above are a starting point for developing a strategy for a sustainable cocoa industry in ENBP. An overriding requirement for ENBP will be for the development of a 'Strategic Plan for Agriculture in Response to CPB'. This strategic plan should have two overarching concerns.

First is the need to develop strategies for the reduction in the total area of cocoa cultivation to match the availability of family labour to sustain a high input cocoa farming system. As part of this strategy, land will be removed from cocoa production by several means including natural attrition, incentives, and legislative change. All of these changes need careful planning.

Second, a key part of this planning strategy would be the development of a framework for implementing the massive boost in advisory, extension and training services required to enable the farming community to make the quantum change in their farming methods and cropping systems. This can only be met through the development of a fully integrated approach involving all industry stakeholders. Much of the material required for developing such a strategic plan is already available and dispersed amongst various agencies such as CCIL, ENBCPBRCC and DPI. A first step in developing this Strategic Plan would be to collate this existing material. This could become the project document used to procure donor funding to establish a Project Implementation Unit.

The transition from low input foraging to high input farming will take several years, and there will be a continuing need to refine the market-led, cocoa based farming systems that emerge during the transition period. This will involve monitoring programmes and adjustments to strategies along the path to high input cocoa farming in ENBP. There is no choice in the matter, and no room for complacency. Failure to adopt a high input farming system will mean the end of the cocoa industry in ENBP.

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10.2 Tables

10.3 Figures

10.4 Boxes

10.5 Plates

11 Appendixes

11.1 Appendix 1 - Record of CPB Detections and Occurrences/Spread in PNG

Detections within East New Britain

	Date of detection	Location	Reported, Detected and Confirmed by
1	23`d March 2006 detected; 29th March confirmed.	LAES- near Keravat	NARI PNGCCIL staff; confirmed by NARI/CCIL entomologists
Delimiting survey carried out-extent of spread determined (2400 ha). Buffer zone and boundary for eradication established with installation of quarantine checkpoints. Eradication exercise commenced from 15th May, 2006 (completed in 10 weeks time).			
2	30th November 2007	Ramandu Plantation	Reported by Ramandu Plantation Management and confirmed by PNGCCIL entomologists
3	24th January 2008	Mandrass	
4	2nd February 2008	Kalas	
5	4th February 2008	Vunapalading DPI Station, towards beachfront.	
6	25th February 2008	Nagalut, Balupa and Totovel Blocks (all NCR)	Reported by smallholder and confirmed by CCIL staff (Rodney Minana)
7	11th February 2008	Small Vudal	S&M: Rodney Minana
8	14th Aug 2008 reported. Confirmed 15th Aug 2008	Londip Pit	S&M Team
9	28th August 2008	Ganai	S&M Team confirmed report by Bitapaka LLG DPI Staff-Albert
10	Reported on 25th September 2008. Confirmed on 29th September 2008	Vunapalading (Inland Bain.)	Reported by smallholder Confirmed by S&M
11	Confirmed 23`d Sept 2008	Warena (Tavana Ward)	Reported by DPI Confirmed by S&M
12	Confirmed 23`d Sept 2008	Rapitok (Tomadir)	Reported by DPI Confirmed by S&M
13	Confirmed 8th Oct 2008	Tobarip UC (Tomadir)	Reported by DPI Confirmed by S&M
14	Confirmed 2nd Oct 2008	Rabagi 2 (Tomadir) Bogolua Vincent	Reported by DPI Confirmed by S&M
15	6th November 2008	Tauli)	Confirmed by S&M
16	1st November 2008	Burit	
17	26th October 2008	Napapar 5 (Koniel FFS farm)	Confirmed by S&M
18	8th November 2008	Napapar 5 (Simitab's farm)	Confirmed by S&M (P. Gende)

CPB Occurrences outside of East New Britain

8th April 2008 (symptoms on pods) 18th April, 2008 (adult on pheromone traps)	Boroi Village, Bogia District, Madang	Confirmed by CCIL Staff-Titus, Yak, Rodney	Adult caught on pheromone traps
June 2006	Poro Agr. Resettlement Scheme, Aitape,WSP.		

August 2008 confirmed	Sakap, Drekikir, ESP	Titus Kakul and V. Sale	
2"d October 2008	Pinatgin, New Ireland	Suspect	Morphotype 1 on trap
23`d September 2008	Siarra Pltn, Bougainville	Suspect	Morphortype 1 on trap

CPB re-occurrence within eradication zone

Date of Detection	Location	Reported, Detected & Confirmed by
August 2007	Vudal Uni/Kairak Centre	Surveillance team – Rodney Minana
October 2007	Tavilo Plantation (Blocks 4,5,6 & 7); Spread to Blcoks 10 & 11; Pollination Block 4	S & M Team
December 2007	Kervera Plantation (Blk 9)	
February 2008	Navuvu Plantation	S & M Team
March 2008 (suspected that it has been there since 2007)	Kareeba Plantation	S & M Team

11.2 Appendix 2 - Methods

Cocoa Farm Management Assessments

The socio-economic impact assessment was carried out in November 2008 over a 10-day period which coincided with the flush period in the north-west of the Gazelle Peninsula. In total, 152 interviews in three wards (Kareba, Tavilo and Vudal) were conducted with smallholder growers and their families as well as an inspection of their cocoa blocks. Fourteen village tradestore proprietors in CPB affected areas were interviewed about their experiences of CPB impacts on turnover and other aspects of their businesses. The managers of four large town stores (two each in Keravat and Kokopo) were also interviewed about CPB impacts on turnover. NGIP-Agmark kindly provided sales data on the turnover at their Keravat store. Five schools (two pre-school/elementary, two primary and one secondary) were visited and their principals or senior teachers interviewed about the impacts of CPB on school enrolments and payment of school fees. The police station commander at Keravat was also interviewed about changing patterns of crime in CPB areas compared with CPB-free areas.

Smallholder Interviews and Block Inspections

The interview schedule for household surveys was trialled and modified prior to the commencement of the formal survey and interviewers were trained in its use. Two teams of researchers carried out the smallholder interviews and an assessment of the condition of the cocoa block and CPB management practices. Each team consisted of five people: two to interview household members and three to carry out a physical inspection of the cocoa block.

Before administering the questionnaire the purpose of the survey was explained to interviewees and their consent to participate was sought. Most growers were aware of the interviews because they had been informed by their ward councillors who had received notification of the work in the week prior to the interviews. All growers and family members present consented to being interviewed.

Each interview took between 30 and 45 minutes to complete. Interviews with household members, where possible, included the views of husbands and wives and close family members present at the interview (e.g., adult sons and daughters). The questionnaire covered the following topics:

- recent harvesting (quantity and frequency);
- quantity of dry bean processing;
- whether or not (and from what organisation) they had received training for CPB management;
- what CPB management practices they had adopted;

- estimates of changes in the amount of time (less time, same amount of time, more time) allocated to different cocoa production activities following the arrival of CPB;
- growers' intentions of what to do with their CPB-infected blocks;
- top ranked sources of cash income before and after CPB for men and women; and
- detailed questioning about individual livelihood activities and how these have changed since the arrival of CPB.

At the end of the formal question section an opportunity was provided for respondents to comment generally on the impacts of CPB on their lives. A great deal of useful information was collected in this way, much of which was not captured in the more formal section of the survey.

At the end of the formal question section, growers and their families were encouraged to discuss areas of their lives where they thought CPB was having a significant impact. After responding to this open question, they were then asked if CPB was having an impact on any of the following areas of their lives which they had not already mentioned: food, travel, education, heath care, fund raising (church and *kastom*), family relationships and law and order. This was to let interviewees know that we were interested in the impacts of CPB on *all* areas of their lives and not just how CPB affected cocoa production and incomes. A page of the survey form was allocated for noting these responses, but frequently the responses ran to more than one page, with notes made on the back of the survey form.

The research assistants carrying out the farm management assessment were accompanied by the grower or a close family member with an active interest in the block. The farm management assessment involved a physical inspection of the cocoa block including a pod count on a sample of 10 trees. The physical inspection assessed the following:

- an assessment of block condition (weed control, pruning, shade control, block sanitation levels, pest control and nutritional status);
- evidence of CPB management (centralised pod breaking, pod burial, weekly harvesting and use of insecticides); and
- observations of the general level of harvesting and block maintenance.

For the pod count, the first tree sampled on each block was on the road-side edge of the block or next to the house. Every third tree moving towards the least accessible area of the block was sampled (in total 1,520 trees). If the block boundary was encountered before the 10th three, this was noted on the form and the sampling continued back into the block at three rows parallel to the first transect. Each block inspection team had at least one experienced extension officer from CCIL or NGIP-Agmark. The two teams were assisted by a very experienced research assistant from CCIL's pathology section. He helped standardised the assessment procedures for the pod count across both teams (Plate 1). The pod count of 10 cocoa trees obtained data on the following variables from each sampled tree:

- Height of cocoa tree;
- Number of ripe unharvested pods;
- Number of unripe healthy pods (healthy pods that will ripen within the next three months);
- Number of Black Pods/Dry pods/Soft Rot pods;
- Number of pods with CPB;
- Number of healthy cherelles
- Number of dry or black cherelles.

Plate 1. Standardising the procedures for pod counts.

All members of the research team contributed to data entry. The research assistants checked each other's data recording forms and any inconsistencies, errors or omissions were clarified while the survey was fresh in everyone's memory (Plate 2).

Plate 2. Research team members cross-checking survey forms.