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Final report

project

Improving productivity and the participation of youth and women in the Papua New Guinea cocoa, coconut and oil palm industries

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2 Executive summary

The smallholder cocoa and oil palm sectors in PNG are characterised by low productivity with incomes well below potential levels. Cocoa farmers have a low adoption rate of new technologies and practices developed by the PNG Cocoa Coconut Institute. In contrast, recent interventions in the smallholder oil palm sector (ASEM/1999/084) have led to significant increases in smallholder productivity, including the increased participation of women. A key aim of the project was to replicate these increases in the smallholder cocoa industry. A second aim was to evaluate a trial of a new payment system as developed in ASEM/1999/084 for oil palm smallholders at Hoskins, West New Britain and to modify it for possible introduction to other oil palm regions and for cocoa.

Labour shortages in both crops and poor block maintenance, especially in cocoa, were found to be key constraints on smallholder productivity with the non-payment or under-payment of family and hired labour as a key factor limiting the supply of labour. In oil palm this was addressed through the “Mobile Card” trial at Hoskins (ASEM/1999/084) which involved paying family and hired labour a portion of the harvested fruit thereby circumventing the problem of payment uncertainty associated with cash payments for labour. The trial was evaluated as part of this project (Curry & Koczberski 2004), and a second payment trial amongst Bialla growers ran for 23 months to December 2007.

By guaranteeing payment of labour, disincentives to the mobilisation of family and hired labour were reduced. At Hoskins, monthly production rose from 75% of the smallholder average to 113% during months when Mobile Card labour was deployed. Productivity and incomes rose on 90% of trial blocks with 30% improving by more than 50 percentage points. Similar results were obtained in the Bialla trial (Koczberski & Curry 2008).

It was found that the age of a cocoa stand is a determinant of its condition including vegetation structure, degree of shading and pest and disease levels. With little or no pruning and shade control, and virtually no management of pests and diseases, block condition is largely a function of its age. Until about 7 or 8 years of age there is some grass slashing and harvesting groups tend to be relatively large comprising both men and women following a dry bean production strategy. Beyond this age, pest and disease levels are high and accessibility for harvesting declines. Growers switch from a “farming” to a “foraging” production strategy of very low labour inputs (mainly women) making brief harvesting forays to collect small quantities of crop for sale as wet bean to meet immediate consumption needs. The project began working with the commercial sector to deliver extension and farm inputs funded by deductions from growers’ payments (Curry et al. 2007a). ASEM/2006/127 is extending this

to include a Mobile Card payment mechanism to mobilise smallholder labour for cocoa maintenance tasks and to address the CPB problem.

3 Background

The smallholder cocoa and oil palm sectors in PNG are characterised by productivity and income levels well below potential levels. In the cocoa industry there has been a long-held concern among stakeholders about the relatively low productivity and incomes of cocoa smallholders despite the presence of a long-term research program in cocoa breeding, agronomy, pests and diseases together with a long-term cocoa extension program. These programs have had only minimal impact on improving smallholder yields and incomes, due in part to the low uptake of new technologies and extension advice. The purpose of the cocoa research was to document the main socio-economic factors constraining smallholder production and productivity and to use this information to design research and extension strategies to raise smallholder productivity and incomes. Recent interventions in the smallholder oil palm sector (ASEM/1999/084) have led to significant increases in smallholder productivity, including the increased participation of women in the industry. An aim therefore was to adapt the successful research approach in oil palm to cocoa to develop strategies to replicate the increases in smallholder productivity. A second aim was to evaluate a trial of a new payment system as developed in Project ASEM/1999/084 for oil palm smallholders at Hoskins, West New Britain Province (WNB) and to further adapt it for introduction to other smallholder oil palm regions, and to the smallholder cocoa sector in PNG. The project also aimed to promote the sharing of knowledge and expertise between the key smallholder agencies and research organisations in the three industries. The project was a collaborative research programme involving the Cocoa and Coconut Research Institute (CCRI), Cocoa and Coconut Extension Agency (CCEA), PNG Oil Palm Research Association (OPRA) and Curtin University of Technology (early in the life of the project CCRI and CCEA were amalgamated to form Cocoa Coconut Institute Limited (CCIL)).

The project employed a multi-method approach, which while generating data from a range of sources (e.g., smallholder families, commercial industry stakeholders, CCRI and OPRA research staff, CCEA and OPIC extension officers), also had a capacity building component for CCI and OPRA staff, particularly in the use of qualitative methods in participatory action research. This approach proved successful in the earlier oil palm study ASEM/1999/084. Given that smallholders were the focus of the project, the main method of data collection was at the household level, with face-to-face interviews with farmers and their families. Data gathered at the household level provided detailed information on the socio-economic factors constraining smallholder cocoa productivity and the uptake of new technologies and innovations.

3.1 Under-Harvesting amongst Oil Palm Smallholders

Research among oil palm smallholders as part of Project ASEM/1999/084 revealed that a major determinant of low smallholder productivity was the considerable level of under-harvesting (Koczberski et al. 2001; Koczberski & Curry 2003). Under-harvesting leads to substantial production losses amongst smallholders and is a major cause of low productivity among growers. Analysis of five years of production data from the Hoskins scheme revealed that growers on the land settlement schemes (LSSs) achieved 60% of plantation levels of production (tonnes/ha) while Village Oil Palm (VOP) growers achieved 38% of plantation levels. While some of the smallholder-plantation deficit is explained by lower farm inputs in the smallholder sector (e.g., less fertiliser, delayed replanting and low levels of block maintenance), a substantial proportion of the difference is attributable to high rates of under-harvesting, particularly amongst VOP growers and towards the rear of the 6 ha land settlement scheme block furthest from harvest roads.

Project ASEM/1999/084 revealed that a market for labour in the smallholder oil palm sector had not developed because of uncertainty over payments for labour. The reluctance or inability of blockowners to pay hired (or family) labour and thus fulfil the 'labour contract' was attributable to the numerous demands on the blockowner's monthly oil palm cheque such as loan repayments, credit repayments at tradestores, the financial demands of immediate and extended family, customary obligations and the social pressures on men to gamble and participate in beer drinking parties. Often these cash demands greatly exceed the value of the cheque. Thus blockowners' inability to fulfil the labour contract by adequate and timely remuneration of hired or family labour stymied the development of a market in hired labour and led to some family members not contributing labour to oil palm production. This contributed to the paradoxical situation of high levels of under-employment amongst smallholders while 25% of the crop was unharvested.

The Mobile Card (MC) was designed to overcome the uncertainty of payment for labour through a mechanism whereby the oil palm company paid labour directly. When hired or family labour is employed on a block using a MC, the worker is paid a specified proportion of the harvested fruit with the split between the blockowner and the worker made on the company computer system and the proceeds paid into the blockowner and worker's respective bank accounts. This overcomes the reluctance or inability of blockholders to pay cash for labour, and the worker is guaranteed timely payment. Being a 'cashless' transaction, this labour arrangement is attractive to blockholders because they are not required to outlay any cash in advance, and nor is it necessary for them to retain a portion of their monthly oil palm cheque for the payment of hired or family labour. Thus, the probability of the blockholder not

complying with the labour contract is greatly reduced, and young men and women are more willing to enter into labour contracts with blockholders.

In oil palm a key component of the project was to evaluate the Hoskins MC trial commenced under ASEM/1999/084 and assess its suitability for other oil palm areas including a subsequent trial amongst Bialla smallholder growers.

3.2 Identifying Constraints on Productivity amongst Cocoa Smallholders

Three decades of smallholder cocoa research in PNG point to a set of persistent problems that have been known by the industry for a long time. These constraints include labour shortages, low levels of block maintenance, land shortages and low cocoa prices. Despite awareness of and attempts to overcome these constraints there have been no lasting solutions to low productivity and incomes of growers. The project sought to investigate and explain the social and economic factors underlying these on-going constraints, rather than to simply document their continued presence. The project focused on the following constraints:

- land tenure
- farm management practices (in particular pest and disease management practices)
- household labour and cocoa production strategies.

Earlier research undertaken by CCRI together with ASEM/1999/084 research in oil palm suggested that access to family labour influenced household production strategies and smallholder productivity. Lummani and Nailina (2001), amongst others, found that one of the main constraints on farming activity was labour shortages. Labour shortages do not necessarily reflect a lack of available labour, but rather a low level of cooperation of family members in production, and a reluctance of farmers to use hired labour. Understanding why family members are reluctant to contribute labour and why the use of hired labour is uncommon among farmers were important points for the investigation of smallholder cocoa productivity. It was likely that the constraints to the mobilisation of labour were similar to those identified in the smallholder oil palm industry and would require a modified version on the Mobile Card to address them.

4 Objectives

The overall goal of the project was to improve smallholder productivity and to raise the participation rate of women and youth in the cocoa, copra and oil palm industries. The three main objectives were:

Improve the capacity of research and extension services in the cocoa and coconut industries for meeting the needs of smallholders.

Evaluate OPIC's Mobile Card trial at Hoskins for potential introduction to other smallholder oil palm areas (Bialla and Popondetta).

Introduce and test in the smallholder cocoa sector payment systems that have proven successful in the oil palm industry for mobilising labour by guaranteeing payment of that labour.

5 Methodology

The project employed a multi-method approach which also had a capacity building component for CCI, OPRA and OPIC staff, particularly in the use of qualitative methods in participatory action research. Given that smallholders were the focus of the project, the main method of data collection was at the household level, with face-to-face interviews with farmers and their families. This section is in three parts. First, a description of the methods employed for the cocoa research is presented, followed by an outline of the Mobile Card trial and its methodology. The last section describes the methods employed in addressing the third objective of the project.

5.1 Objective 1: Smallholder Cocoa Research

The research approach relied on quantitative and qualitative methods, particularly qualitative methods associated with participatory action research. By applying participatory approaches to smallholder research, with a focus at the household level, we aimed to make recommendations for improving smallholder productivity and incomes that enhanced existing livelihood strategies, reflected the needs and priorities of smallholders and hence had a higher probability of being successful. Furthermore, the farmer-oriented approach of the research, whereby considerable time was spent with farmers and their families and with agricultural extension officers involved in the research design and data collection, encouraged a more 'bottom-up' approach that facilitated an understanding of the socio-cultural context of smallholder cocoa production.

The research commenced with a review of the smallholder literature in PNG. This was followed by a workshop in July 2003 with cocoa extension officers employed by the Cocoa and Coconut Extension Agency (CCEA). All members of the research team attended the workshop (GC, GK and CCI staff). The workshop sought to identify the main constraints on smallholder production as seen by extension officers. The following broad topics were discussed:

- socio-economic characteristics of high and low cocoa producers and their families
- agronomic and farm management practices of high and low cocoa producers and their families
- factors influencing the supply of family and hired labour for cash crop production
- influence of customary and social/religious factors on cash crop production

- influence of land access and land tenure on cash crop production
- effects of prices on smallholder productivity
- role of market access on production
- growers' access to extension services.

Based on the results of the workshop a list of key factors affecting production was compiled to guide smallholder interviews and quantitative surveys (Table 1).

Table 1. Factors identified by extension officers as affecting smallholder production on the Gazelle Peninsula.

Agronomic and Farm Management Practices	Levels of block maintenance. Harvesting rates. Disease management. Wet or dry bean seller.
Household Labour	Household labour supply (demographic characteristics). Access to household labour (constraining factors). Household labour strategies in cocoa production.
Household Cocoa Holdings	Type of planting material. Type of land tenure. Methods of regulating family members' individual access to cocoa holdings. Size and location of cocoa holdings.
Household Resources	Access to: Adequate and secure land holdings. Labour from the extended family. Hired labour. Fermentary and dryer. Extension advice and services. Credit.
Household Social Relations	Levels of household conflict/stability. Income distribution amongst family members.
Household Livelihood Strategies	Range of livelihood options including off-farm employment and migration. Degree of economic pressure to harvest cocoa (e.g., school fees). Importance of cocoa to the household economy. Social and community obligations.

As evident in Table 1, the household has been emphasised as the unit of analysis, with attention paid to the range of economic and social activities that households pursue in addition to cocoa production. This has been done to place commodity production in the broader context of household livelihood

strategies. Although household-level analysis has been highlighted, consideration has also been given to external factors, such as the role of extension, market access, cocoa prices and marketing as these affect household decision-making.

5.1.1 Study Sites

Data were collected from villages in two LLG areas in the northeast of the Gazelle Peninsula.

- Malakuna No. 4, Ulautava and Tinganavudu villages in the Kokopo-Vunamami LLG area
- Vunalaiting Village in the Livuan-Reimbar LLG area.

Malakuna No. 4, Ulautava and Tinganavudu villages all have good road access, are close to markets at Kokopo, and have been producing cocoa and copra since the early 1970s. Cocoa is cultivated under a mix of land tenure regimes including customary land tenure, 'purchase' and 'reserve' land (for a detailed discussion of land tenure at these study sites see Curry et al. 2007a, Chapter 4).

At Vunalaiting Village, the hamlets of Tabaule and Bulupa were selected because unlike the Kokopo-Vunamami LLG villages, these hamlets do not have coconuts and rely primarily on cocoa for income. Also, land at Tabaule and Bulupa is under freehold title, gained when the land and title which was previously under plantation and registered as State 'reserve' land was transferred to the landholding clan leader and subsequently subdivided amongst clan members. The majority of smallholders allocated blocks at Tabaule and Bulupa were from Vunalaiting and Vunapaka villages. Villagers refer to this subdivided land where they have settled and planted cocoa as 'reserve land'. As 'reserve land', villagers claim the land is not subject to the same matrilineal inheritance rules as customary land and therefore is free from matrilineal claims from the wider clan group. The 'reserve' land tenure regime of Tabaule and Bulupa hamlets enabled comparisons to be made with the Kokopo-Vunamami LLG villages where 37% of cocoa is planted on customary land. Also, because Tabaule and Bulupa are close to the Cocoa Coconut Institute (CCI) (approximately 5 km away) the hamlets provided an opportunity to assess the effectiveness of CCI research and extension, especially since Tabaule and Bulupa have only recently planted cocoa in the last ten to fifteen years.

Data collection in Kokopo-Vunamami LLG and Livuan-Reimbar LLG villages was in three parts:

- Weekly interviews and surveys of fourteen smallholder households.
- Socio-economic survey of 93 cocoa smallholder households.

- Cocoa farm management assessment (including an assessment of pest and disease levels) of 100 smallholder cocoa blocks in the Livuan-Reimbar LLG.

5.1.2 Weekly Household Interviews

Weekly household interviews formed the bulk of the data underpinning this study. A household was defined as all those members of the family and extended family residing together in the same or nearby houses, and sharing household resources. Typically, meals were shared between household members even though members lived in adjacent houses.

Weekly interviews were undertaken during three phases. The first phase was for a four-week period in October-November, 2003. A second phase ran for four weeks in May 2004. In addition a small number of interviews were undertaken between May and November, 2004 by the research assistants during brief monitoring visits to the field sites. A third and final round of interviews was conducted among Vunalaiting Council Ward villages in December 2004 and January 2005 over a five week period.

The second and third phases of the weekly surveys were timed to coincide with the main cocoa flush periods of the two LLG areas. During the 2004 survey period, however, the May to July flush was reduced substantially because of unusually wet conditions in the lead up to the flush period which affected flower and fruit formation. Many respondents complained about the rain affecting production and the high infestation rates of Phytophthora infected pods (Black Pod) in their blocks. It is likely that for some growers, especially dry bean sellers, cocoa incomes for the 2004 flush period were significantly lower than usual for this period. Similarly, in the 2004 October/November to December/January flush in the Livuan-Reimbar LLG area, villagers commented that the flush began well, but pod development declined slightly after a few weeks. Thus, the intention to capture seasonal variations in household cocoa production, economic activities and labour allocation was only partly met.

Households were selected on a range of characteristics including demographic profile of household, size of cocoa holdings and whether the household was predominantly selling wet or dry cocoa beans. The sample size for the weekly repeat interviews was small because of the lengthy time required to collect detailed qualitative data to develop household case studies.

During the weekly surveys, each family was interviewed on the same day each week. Each interview took between one and two hours to complete, allowing for three families to be interviewed per day. By having sample households spatially clustered in two main areas, travel time between interview locations was reduced. This was especially important when household members may be absent on a particular interview day (e.g., visiting relatives, hospital, business

in town). Furthermore, a spatial clustering of sample households allowed the influence of village-level factors affecting cocoa production to be determined, such as village-wide preparations for church, school or ceremonial activities which may reduce or enhance the supply of labour for cocoa production.

Each week a standardised survey instrument was administered which recorded for the previous seven days (the period between interviews):

- Quantity of cocoa/copra sold
- Income earned from cocoa
- Income from other sources (e.g., wage labour, copra, vanilla and sales of items at local markets and remittances from town-based relatives)
- Household and non-household labour contributions to cocoa or copra production
- Cocoa block maintenance activities (labour contributions and type of work)
- Household contributions to communal activities like council or church group work days.

The purpose of these surveys was to develop household case studies that determined the importance of cocoa in terms of labour and income, as well as revealing how households organised and mobilised labour for cocoa production and other livelihood activities.

An informal interview typically followed the standardised survey instrument and expanded on points raised in the formal interview (e.g., labour constraints, theft of cocoa pods or vanilla beans and plants, transport difficulties, and cocoa disease problems). Interviews explored decision-making concerning the allocation of household labour and income, broader factors influencing household and family members' participation in cocoa production, and other household and village activities. Informal interviews were 'free-flowing' and gave smallholders an opportunity to raise points which they saw as important in cocoa production or in other aspects of their lives more generally. On most occasions the survey and interview format involved interviewing husband and wife separately. This was especially important when one partner, usually the wife, had a tendency to take a 'back seat' during interviews. By ensuring women were included in the interviews, the study captured the important role of women in cocoa production and their views on commodity production and broader household and community issues.

In phases one and two, an extension officer was usually present at the weekly interviews. This served two purposes. First, it involved extension officers directly in the research and helped them to develop an appreciation of the broader socio-economic factors influencing smallholder cocoa production. Secondly, when required, they provided advice regarding particular problems

affecting smallholders' blocks (e.g., methods of pest control). Discussions with the extension officers when travelling between interviews also helped the research team develop a fuller understanding of each smallholder family and their circumstances. Often extension officers picked up important details that would have gone unnoticed by other research team members. For instance, the extension officers often made an informal block inspection of the interviewee's cocoa holdings while the rest of the team was engaged in interviews. These inspections enabled a rapid assessment of the condition of the block and the identification of any particular management problems.

5.1.3 Socio-economic Surveys

The smallholder sample (n=93) for the socio-economic survey was drawn from the same villages selected for the weekly surveys. The survey was carried out in November-December, 2003. Data were collected on the following:

- Planting details (cocoa variety, area and year planted, type of shade, land tenure arrangements)
- Cocoa harvested in preceding seven days (amount harvested, income earned, costs of production)
- Household demographic characteristics
- Farm and non-farm income sources
- Farmer training and extension received
- Ownership of farm tools.

Households were randomly selected from the two LLG villages and the surveys were carried out by CCI research staff and four, second-year students from Vudal University. The students participated in a training workshop which outlined the purpose of the survey and explained interviewing techniques. The questionnaire was piloted by the students among eight growers prior to the main survey being administered. The pilot survey resulted in some minor changes to the survey instrument and gave students an opportunity to practice and refine their interviewing techniques. Throughout the survey, students were closely supervised by CCI research staff and/or extension officers.

5.1.4 Cocoa Farm Management Assessments

In November and December, 2004, an assessment of smallholder cocoa farm management was conducted on 100 smallholder cocoa holdings belonging to randomly selected cocoa farmers in the Livuan-Reimbar LLG. The assessment coincided with the flush period in the north-west of the Gazelle Peninsula. For each cocoa holding, the farm management assessment recorded:

- Terrain and size of holding

- Main varieties of cocoa present and year planted
- Shade trees present
- Numbers of un-harvested dry pods
- Numbers of healthy pods
- Numbers and types of diseased pods
- Presence of Canker, Vascular Streak Disease, Pink Disease, Longicorn and Webworm (Panseptor)
- Weed and shade control standards
- Pruning standards and block sanitation levels.

For the count of cocoa trees affected by disease and the number of un-harvested pods, 10 cocoa trees per block were surveyed (in total 1,000 trees). On each tree, counts were made of the number of: Phytophthora infected pods (Black Pod); dry pods (cocoa pods that were not harvested when ripe); and, healthy full size pods. The first tree surveyed on each block was on the road-side edge of the block and then every fifth tree, moving into the centre of the block was surveyed. Pest and disease assessment was supervised by a staff member of CCI's pathology section, with assistance from a senior extension officer. Data collection was undertaken by research staff within CCI's economics section and three Vudal University students on work experience with the project.

5.1.5 Industry Interviews

Industry stakeholder interviews included the following people:

- Members of the Board of Directors of the Bailu Plantation landowner group at Malakuna No. 4, Ulautava and Tinganavudu villages
- CCI extension officers and senior managers
- Commercial sector representatives (including plantation managers and cocoa exporters)
- Rural Development Bank personnel
- Executive Director of the Cocoa Growers Association
- Provincial government representatives from Division of Primary Industry (DPI), Lands Division and Planning Division.

In many of the meetings and interviews with industry stakeholders the research team discussed ideas for the design and implementation of alternative models of extension and marketing for cocoa production. The interviews also provided information about new and proposed industry policies and interventions, the

current state of the industry and the broader national and provincial policy and institutional context of smallholder production.

5.2 Objective 2. Smallholder Oil Palm Research — Mobile Card Trials

Two Mobile Card trials were conducted as part of the project, one for 15 months from July 2002 at the Hoskins scheme (this trial commenced under ASEM/1999/084), and the second at the Bialla scheme from February 2006 to December 2007. The methodological approach for the initial trial at Hoskins was incorporated into and developed further in the subsequent trial at Bialla, so only the methods for the latter trial are summarised here. A detailed discussion of the earlier Hoskins trial is reported in Curry & Koczberski (2004).

5.2.1 Background to the Mobile Card

On the Bialla scheme each smallholder block sells their oil palm fruit to Hargy Oil Palms Ltd (HOPL) and typically receives two payments per month. One payment is made to the registered blockholder (the Papa payment) for fresh fruit bunches (FFB) and the other payment (the Mama payment) is specifically for women for the collection of the oil palm fruitlets (lus frut) that scatter on the ground during the harvesting of FFB. Both payments are linked to a specific block. Unlike the two existing payment mechanisms, the Mobile Card is not tied to work on the block where the worker resides; it can be used as a payment mechanism on any block requiring labour where a 'labour contract' has been signed by the blockholder and Mobile Card worker. This payment initiative is designed to facilitate labour mobility both between and within blocks.

Unlike existing payment arrangements, the Mobile Card labourer is paid a proportion of the oil palm fruit he harvests which is weighed on a separate docket from the Papa and Mama dockets. Thus, rather than being paid in cash by the blockholder, the company pays the labourer directly according to the percentage split agreed to by the blockholder and Mobile Card worker. The payment of labour in fruit (a share of the fruit harvested by the worker) overcomes the reluctance or inability of blockholders to fulfil their part of the labour contract, i.e., the full and timely payment of labour. By guaranteeing payment for work undertaken by hired or family labour there is an incentive for young men to contribute labour to oil palm production whether on their family block or as hired labour on other blocks.

The trial incorporated the key principles underpinning the success of the Lus Frut Mama Scheme, in particular the guaranteed, timely and direct payment of the labourer by the company (See Koczberski et al. 2001; Koczberski 2007). The design principles and concept of the Mobile Card also built on the successful earlier trial of the Mobile Card payment initiative amongst Hoskins

oil palm growers in 2002-2003 which sought to mobilise labour on conflict-ridden and labour-short blocks (Curry & Koczberski 2004). The Bialla trial made some minor operational changes to improve the running of the new payment system, and the final design was based on numerous meetings and discussions with senior OPIC managers and extension officers, and with key personnel from HOPL. The overall aim of the Mobile Card was to enable greater labour and payment flexibility as a way to enhance incentives for increasing smallholder production and incomes.

Before a labourer was employed on a block as a Mobile Card worker a contract agreement was signed by the blockholder and the Mobile Card worker and this was witnessed and approved by an OPIC extension officer. Designed by OPIC, the contract specified:

- the agreed percentage split of FFB weighed on the Mobile Card docket
- The work to be done by the Mobile Card worker (e.g., harvesting, net stacking, pruning, fertiliser application, etc)
- Where the work will be carried out (Phase 1, 2, or 3)
- The period of the contract.

Once the contract has been signed and the details entered into the HOPL smallholder payment computer program, the labourer began work and was paid directly by the company. Contracts were renewable and the terms of the contract (e.g., percentage split of harvested fruit) could be renegotiated at the end of each contract period. Contracts could be cancelled if either party to the contract did not fulfil the terms of the contract.

To assist the research team (GC & GK and OPRA scientist), two OPIC Mobile Card extension officers were employed full-time for the duration of the trial. The Mobile Card officers' main tasks were to promote, supervise and monitor the trial, and explain and organise contracts between blockholders and Mobile Card workers.

Immediately following the signing of a Mobile Card contract the Mobile Card officer conducted an inspection of the trial block. For each trial block, data were collected on levels of pruning, ring weeding, cover crop and general maintenance. This information provided a baseline to monitor changes in block condition. On each trial block the Mobile Card extension officers also maintained monthly production and income records and dealt with any problems as they arose (e.g., late payments, payment inaccuracies or late renewal of contracts). Throughout the trial the officers were also responsible for conducting awareness among smallholders of the Mobile Card which they did in association with the OPIC Divisional managers and extension officers.

Prior to the trial's commencement HOPL modified their computer smallholder payment system to accommodate the trial. This involved reprogramming the

computer to accommodate the agreed percentage split between the blockholder and the Mobile Card labourer of the value of FFB weighed on the Mobile Card docket, and entering the dates of the contract period. During the trial, Mobile Card labourers were paid by cheque directly. The fortnightly production and income data recorded by HOPL for the Mobile Card, Papa and Mama production provided the data to assess the impact of the Mobile Card on block production and incomes.

To assist blockholders and Mobile Card workers with understanding the concept of a percentage split of the production and to arrive at a decision on the proportion of the crop to 'pay' a Mobile Card labourer (and hence their anticipated earnings), a ready reckoner was developed. This was used by the Mobile Card extension officers when explaining to smallholders how the Mobile Card operated and for negotiating contract agreements. Although, the concept of a percentage split was initially difficult to grasp for many blockholders, they gradually developed an understanding of how it worked as the trial progressed.

5.2.2 Selection of trial participants

The selection of blocks for the trial focused on the following types of low producers:

- VOP growers with poorly maintained blocks
- Caretakers receiving poor and/or irregular payment of their labour
- Labour-short blocks of elderly or 'semi-retired' growers in the older LSS subdivisions
- Labour-short blocks among recently married couples with young children on the new LSS subdivisions of Soi and Kabaiya.

While OPIC identified low producing blocks for inclusion in the trial, many blockholders themselves approached OPIC to be involved in the trial because they identified the potential benefits of the Mobile Card for overcoming production constraints on their block and/or solving conflicts between family members over the distribution of oil palm income. Prior to inclusion in the trial the blockholders were interviewed by the Mobile Card officers to assess their suitability for the trial. The assessment was forwarded to the OPIC Field Manager and the HOPL Smallholder Manager for final approval.

Originally, 40 blocks were to be included in the trial. However, because of the high level of interest among smallholders it was decided to progressively expand the number of trial blocks. A total of 71 blocks were included in the trial.

The evaluation of both trials by the research team (GC & GK) collected quantitative and qualitative data for each block which included:

- Production data
- Oil palm income
- Farm management practices during the trial
- Loan repayments
- Improvements in access to labour
- Changes in household social circumstances (e.g., household social stability, income distribution among family members).

Trial results are presented in Section 7.

5.3 Objective 3: Introduce and Test in the Smallholder Cocoa Sector Payment Systems that have Proven Successful in the Oil Palm Industry for Mobilising Labour.

The qualitative and quantitative household surveys described under Objective 1, which identified socio-agronomic and cultural factors explaining variations in smallholder productivity, were used to identify potential intervention points for the adaptation and application of successful smallholder oil palm interventions in the cocoa sector (described in Curry et al. 2007a). This enabled a typology of smallholder production strategies to be identified which were associated with cocoa blocks of different age and vegetation structural characteristics. The interconnections between household cocoa production strategies and livelihood and farm management practices, household labour allocation patterns, tenure security, intra-family relations, and cash needs were also examined.

During the collection of these data the research team (GC, GK, & CCI staff) held numerous discussions with smallholders and with staff of commercial sector organisations to discuss these data and to develop potential strategies involving new payment mechanisms for mobilising labour and funding farm inputs

For several reasons the testing of a new payment mechanism to mobilise labour for cocoa production was not achieved before the conclusion of the project, although deductions from growers' payments for farm inputs like seedlings were achieved. From early 2006, the outbreak of the Cocoa Pod Borer (CPB) in ENB resulted in all of CCI's staff, transport and financial resources being redirected to the CPB eradication programme. All CCI's

research programmes were put on hold during this time. In addition, the CPB outbreak meant that NGIP (a commercial organisation which was to test new payment mechanisms) was also fully engaged in the eradication programme on its own plantations.

A further setback with testing new payment mechanisms for mobilising labour was that progress at one of the key sites, Bailu Estate Plantation (about 170 ha) near Kokopo, ENB, became stalled by a protracted dispute between the Rural Development Bank (RDB) and the customary landowners over a large outstanding loan. Bailu Estate Plantation was to be used to establish a Nucleus Enterprise to test the new payment system. The estate had been returned to the customary landowners in the 1980s but was carrying large debts incurred by a former plantation management agency which had responsibility for the plantation after it was returned to the customary landowners. The CPB outbreak also exacerbated the delays on testing a new payment mechanism at Bailu Estate Plantation because CCI and provincial government authorities which had been involved in establishing the Bailu project were fully occupied with the CPB eradication programme. (In 2008 the dispute between the RDB and the customary landowners appears to have been resolved. Bailu Estate Plantation has been subdivided amongst customary landowners and some have paid in full their share of the outstanding loan to the RDB.)

With the delays to the establishment of Bailu Nucleus Enterprise (NE), the project concentrated on four other smallholder Nucleus Enterprise projects that were being developed for cocoa. The first, Stockholm, is in the remote Bainings region of ENB and is managed by NGIP-Newmark (the largest cocoa buyer in Papua New Guinea); the second, Tokiala LSS on the Gazelle Peninsula, also managed by NGIP- Newmark. The establishment of the NE at Tokiala was also delayed by the CPB eradication programme, but work on the NE recommenced this year (2008). The third NE project is a small village-based operation near Kokopo (Bitagalip Holdings), which is being supervised closely by CCI; and the fourth is managed by Sami Jeff in WNB and is supported/facilitated by John Duigu/KBSA.

The NGIP-Newmark version of the NE involves the company buying cocoa from smallholders surrounding the company plantation. NGIP-Newmark provides extension services, planting material (they established nurseries and budwood gardens for smallholders) and other support (e.g., transport, credit for inputs [in the Bainings] and extension for other crops such as vanilla). In November 2004 the team completed an initial baseline survey of the Newmark model at Stockholm in the Bainings, ENB, which included smallholder household interviews, community focus group meetings, interviews with Newmark staff and the collection of smallholder production and income data.

A baseline survey commenced in 2005 at Tokiala amongst smallholders occupying the Tokiala land settlement scheme which adjoins Newmark's

Tokiala Plantation. Data collection was delayed by the CPB eradication program but was completed in 2008. The Tokiala survey was conducted with 70 smallholders residing on the Tokiala LSS and collected data on the following:

- Cocoa block holdings
- Production and processing facilities
- Perceived constraints on cocoa production
- Farm tools
- Sources of household income and food security
- Household cash needs
- Household demographic details
- Training needs and extension services.

The work with NGIP-Newmark NEs involved the CCI research team working closely with key Newmark staff in both data collection and discussing, designing and modifying initiatives to raise productivity.

The village-based version of the NE model at Bitagalip is progressing well but at a smaller scale because the service provider has much less resources than a commercial company. Approximately 60 smallholders sell wet bean to the village service provider and smallholders receive support for block rehabilitation and replanting (many of the cocoa blocks joining this NE had been established many years previously using low-yielding volunteer seedlings). CCI project staff provided training and assisted the service provider to establish a nursery of hybrid cocoa and a budwood garden for hybrid clones. The replanting programme where seedlings are funded by deductions from payments for crop is proving relatively successful. CCI staff (including IPDM staff) visit regularly to monitor progress and provide advice. Since 2004 (apart from the period of the CPB eradication programme), CCI staff working with the service provider at Bitagalip, collected data on smallholder production and income, seedling production and distribution. The attitudes of farmers to the initiative were also monitored by CCI staff through regular focus group meetings with farmers.

The fourth NE in WNB operated by Mr Sammy Jeff with technical and administrative support provided by John Duigu/KBSA began in 2004 with the establishment of a cocoa nursery. At the time of interview in 2006 Sami Jeff had commenced distributing seedlings to several groups of farmers.

Because Bitagalip and Sammy Jeff's NEs are relatively small and under-capitalised relative to a company like NGIP-Newmark, it is unlikely that they will be able to sustain the same level of support for farmers. Nevertheless, the

impact is significant especially in extension training and seedling distribution, and is being monitored in ASEM/2006/127.

While the two NGIP-Newmark models are similar, in that a major company is buying cocoa and supplying services to smallholders, the third model operating at Bitagalip village is very different because the service provider is from the same village as the smallholders. Both models offer promising opportunities for the introduction and testing of new payment mechanisms, though the levels of support provided to farmers will clearly differ between the types of service providers and the resources at their disposal.

While the testing of new payment mechanisms to mobilise labour for cocoa production was unable to be completed in this project, NGIP-Newmark is currently working on these strategies with CCI project staff. These efforts have become much more urgent with the industry shift from CPB eradication to management of the pest. Labour inputs in smallholder cocoa production must rise significantly if a viable cocoa industry is to be maintained in PNG.

6 Achievements against activities and outputs/milestones

Objective 1: To Improve the capacity of research and extension services in the cocoa and coconut industries for meeting the needs of smallholders.

No.	Activity	Outputs/ milestones	Completion date	Comments
1.1	Smallholder survey & qualitative interviews. Data entry & analysis.	Briefing paper written for CCRI	2004	Various briefing papers/seminars were presented to CCI over the life of the project. The data results and discussion were incorporated into Curry et al. 2007a.
1.2 & 1.3	Workshops/meet-ings with CCRI, OPRA, CCEA & OPIC	Briefing paper written for CCRI, OPRA, CCEA & OPIC.	Each year of project.	There were workshops/meetings in each year of the project with CCI (CCRI & CCEA) and OPRA. Representatives of the commercial sector also attended.
			November 2007	Final CCI-PNGOPRA workshop on new extension models involving the commercial sector.
		Realignment of CCI research priorities	2006	CCI adopting the Nucleus Enterprise model for extension delivery. Research programmes now have a stronger socio-economic component.
1.4	a) Case study of uptake of solar dryer. b) Case study of uptake of cocoa hybrid clones by smallholders	Briefing paper for CCEA - strategies to improve extension services.	Solar dryer not studied.	Solar dryer uptake became a PhD research project for CCI staff member on a John Allwright scholarship.
			2003-2005	Various meetings with extensions officers and findings reported in Curry et al. 2007a.

1.5	a) Smallholder surveys; b) focus groups with CCEA extension officers. Data analysis	Final report covering: strategies to improve uptake of CCRI research innovations & CCEA extension services; farmer typology; & impacts of new payment schemes.	Various workshops and meetings throughout project.	Cocoa research monograph produced in 2007.
			2005, 2006 & 2007	Drafts of cocoa report for discussion at meetings/ seminars
1.6	Production of final report/s (in association with Task 1.5)	Final report	2007	Cocoa research monograph produced in 2007.

PC = partner country, A = Australia

Objective 2: To Evaluate OPIC's Mobile Card Trial at Hoskins for Potential Introduction to other Smallholder Oil Palm Areas (Bialla and Popondetta).

No.	activity	Outputs/ milestones	Completion date	Comments
2.1	Evaluate Mobile Card trial in terms of its impact on smallholder productivity, incomes and welfare.	Evaluation Report & recommendations for other oil palm regions.	2004	Report and recommendations produced in 2004: Curry & Koczberski 2004.
2.2	Recommendations for how the payment Card can be modified for other smallholder oil palm areas in PNG.	Oil Palm companies in Bialla & Popondetta support the introduction of the Mobile Card.	2006-2007 trial of Mobile Card at Bialla	Report and recommendations on Bialla trial produced in 2008: Koczberski & Curry 2008.
			2007	Cargills, Popondetta used the Hoskins Mobile Card Report (Curry & Koczberski 2004) to design their own trial which was running prior to Cyclone Guba devastating Oro Province in November 2007.

PC = partner country, A = Australia

Objective 3: To Introduce and test in the smallholder cocoa sector payment systems that have proven successful in the oil palm industry for mobilising labour by guaranteeing payment of that labour.

No.	Activity	Outputs/ milestones	Completion date	Comments
3.1	Qualitative & quantitative surveys with smallholders. Data entry & analysis	Smallholder typology produced	2005	Household typology was found to be less important than age of cocoa block in shaping household production strategies (see Curry et al. 2007a).
3.2	Meetings & interviews with industry stakeholders.	Industry support and participation in new payment system trial.	2004 onwards	Industry support has been strong, particularly from NGIP-Newmark and John Duigu/KBSA.
3.3	Principles underlying Mobile Card and Mama Lus Frut scheme used to design new payment initiatives in the cocoa industry	New payment models devised	2004	The model is described in detail in Curry et al. 2007a.
3.4	Pilot & monitor alternative payment system among smallholders. Data entry & analysis	Improved participation rates of young men & women	2007	The use of deductions from growers' payments to mobilise labour was not possible during the CPB eradication programme. However, Bitagalip and NGIP-Newmark are funding seedling distribution to growers by deductions from growers' payments for cocoa beans.
3.5	Workshops with industry stakeholders	Seminars & workshops for industry stakeholders	2007	Although the alternative payment system amongst smallholders was not completed, the model was presented at an industry workshop in Port Moresby in November 2007.

PC = partner country, A = Australia

7 Key results and discussion

7.1 Objective 1. Smallholder Cocoa Production

Early results from interview survey research among cocoa smallholders identified growers' perceptions of the main constraints on cocoa production. The top ranked four, in declining order of importance were:

- theft of cocoa pods (in some cases, an indication of under-harvesting) (27%)
- poor block condition (overgrown cocoa trees, over-shading and high levels of pests and diseases) (26%)
- labour shortages (19%)
- limited knowledge of proper block management practices (especially regarding the new hybrid cocoa clones) (9%).

Extension officers identified a similar set of constraints on smallholder production (apart from pod theft which only smallholders identified) (Table 1, Section 5). This together with earlier studies on the Gazelle Peninsula (in particular labour shortages and low levels of block maintenance – see, for example, Nicholls 1989; Yarbro & Noble 1989; George 1994; Ghodake et al. 1995; Lummani & Nailina 2001; Omuru et al. 2001), point to a set of problems that have been known for a long time by the industry. Thus, the next stage in the research was to investigate the underlying socio-economic factors that made these on-going problems difficult to resolve using conventional extension strategies.

The research revealed that families experiencing labour shortages tend to have one or more of the characteristics listed in Box 1. For a variety of reasons households experiencing labour shortages are unable or unwilling to overcome labour supply constraints by recruiting family labour, participating in reciprocal labour exchange strategies, or hiring labour. The result is low levels of household cocoa production, which in turn is likely to be reflected in a wet bean production strategy rather than a dry bean production strategy.

Box 1. Characteristics of households with labour supply constraints for cocoa production.

CHARACTERISTICS OF HOUSEHOLDS WITH LABOUR SUPPLY CONSTRAINTS FOR COCOA PRODUCTION

Demographic characteristics (e.g., small family size, young family with dependants, absence of adult family members, elderly household heads without co-resident sons, young family with preschool children).

Short or long-term health problems of adult family members.

Competing economic demands on household labour (e.g., formal employment, alternative cash crops).

Non-economic activities competing with labour for cocoa production (e.g., customary activities, church activities).

Under-utilisation of available family labour (e.g., inadequate remuneration of family members leads them to withdraw their labour from cocoa production).

Perception that household head is not fulfilling his obligations to the family.

Minimal use of traditional strategies of labour mobilisation (e.g., reciprocal labour exchange).

Minimal use of hired labour.

The characteristics of labour-short households listed in Box 1 indicate that labour constraints may be temporary (e.g., illness or the diversion of labour to other activities), or they may be more enduring because of household demographic factors, such as an elderly household head without co-resident sons. Sometimes, as pointed out above, family members are discouraged from providing labour when they feel they are not being adequately remunerated for their labour Women often divert their labour away from export crop production when they, or their family as a whole, are not benefiting from the income earned. Similarly, a son seeking economic independence from his father may resent giving labour which he believes is not being remunerated fairly.

Finally, some household heads lack the status or skills to recruit and manage labour from the extended family or to organise reciprocal labour groups. Without the managerial ability to organise the large cooperative labour groups necessary for dry bean production, some farmers may be limited to selling wet bean. However, the lower returns from wet bean sales than from dry bean sales have implications for the levels of farm investment, farm management practices, harvesting rates and household income and labour strategies.

Whilst labour supply was an important determinant of whether a smallholder pursued a wet bean production strategy (i.e. low income and low labour inputs

in cocoa production) or a dry bean strategy (i.e. higher income and more intensive harvesting rates), there was evidence to suggest that other factors such as, block condition, the age of a stand of cocoa trees and degree of accessibility for harvesting were important influences on household production strategies.

7.1.1 Block condition and maintenance

A typical feature of most smallholder cocoa blocks surveyed was the very low levels of block maintenance, especially blocks more than eight or nine years old. In general, block maintenance was characterised by:

- Virtually no pruning of cocoa trees.
- Little or no shade control.
- Near adequate levels of weed control on relatively high producing younger blocks during cocoa flush periods.
- An absence of pest and disease control measures.
- Relatively high levels of under-harvesting.

The pest and disease survey of 98 cocoa blocks at two villages on the Gazelle Peninsula revealed very low levels of block maintenance and high pest and disease rates. Almost half of the blocks were weeded adequately or better, although a substantial proportion were less than adequately pruned (76%) or managed for shade (72%). As a consequence, mature cocoa blocks are typically characterised by the tall and dense growth of cocoa trees under a heavy shade canopy. Farm visits and smallholder interviews also revealed that most of the slashing of weeds and grasses on cocoa blocks occurs at the beginning of the cocoa flush period. This weeding is to improve access for harvesting during the flush period and not for reasons of block sanitation.

The cocoa block surveys and farm visits also indicated that pest and disease management is minimal, despite the widespread recognition of pest and disease problems amongst growers. The two major known diseases of cocoa in PNG, Vascular Streak Disease and Canker, were common with only 8% and 26% of trees, respectively, being free of these diseases (Pink Disease was absent on 96% of surveyed trees). Considerable evidence of under-harvesting was also found, as indicated by a relatively high incidence of dry pod (29% of full size pods). Observations during the surveys suggest that dry pod is more common in the upper canopy of mature cocoa trees where harvesting is more difficult and time consuming, thus implicating labour supply constraints in its incidence and distribution.

7.1.2 Smallholder productivity

The age of a cocoa block is a key determinant of block condition, household labour inputs and the harvesting strategies of smallholders. Because of very low labour inputs in block maintenance, the age of a cocoa block is associated with the quantity of ripe accessible fruit available for harvesting and the level of accessibility for harvesting which in turn influence the production strategies of smallholders. A plentiful supply of easily accessible ripe crop is more likely to induce smallholders to engage in dry bean production, whereas harvesting cocoa for wet bean sales tends to occur when there are few ripe pods accessible for harvesting. Low crop availability can be associated with non-flush periods or old and overgrown blocks where yields are lower, access is difficult and high pest and disease levels reduce the number of healthy pods for harvesting.

Dry bean producers tend to have younger, more productive blocks, while wet bean sellers tend to have older stands of cocoa with high levels of pests and diseases. In the Kokopo-Vunamami LLG villages, where most wet bean selling households reside, the median year of planting cocoa stands was 1991 compared with 1995 in the Livuan-Reimbar LLG where dry bean sales are more common. The data suggest the two main production strategies are related to the age and condition of cocoa holdings.

The age of a block affects the availability of ripe healthy pods in several ways. First, some cocoa varieties experience sharp yield declines at about seven or eight years of age (see below) which significantly reduces the crop. Second, most mature cocoa blocks over seven years of age are characterised by tall and dense growth of cocoa trees under heavy shade because of the long-term neglect of pruning and shade control. Ghodake et al. (1995) noted that block management was much poorer in mature cocoa stands than in young stands. Minimal pruning and shade control on older blocks exacerbates pest and disease problems by creating a moist micro-climate conducive to pest and disease outbreaks. The combined outcome of these factors is smaller quantities of ripe healthy pods available for harvesting.

The modern varieties of cocoa such as the SG2 hybrids and hybrid clones, while being very high yielding in their early years, experience dramatic yield declines at a relatively young age. CCRI research indicated that the hybrids “show a considerable yield decline after five to six years” (CCRI, 1999 p.44). More recent CCI research also reported significant yield declines in some hybrid clones (CCI, 2004) (Figure 1). This is in marked contrast to the results of some of the Trinitario trials in the 1950s and 1960s at LAES which reported mean annual yields of dry bean of over 927 kg/ha in cocoa trees of 10 to 17 years of age (Powell, 1991). Although the Trinitario were not nearly as high yielding as the modern varieties in their early years, they had much greater longevity and yield consistency over a longer period (Figure 2). In short, they

had several characteristics that might make them suitable to the low input smallholder production strategy.

The marked yield decline of the modern cocoa varieties at five to six years old, combined with minimal pruning and shade control measures, means that cocoa stands become overgrown at around the same time that yield decline sets in, exacerbating the problem of low crop availability. The low density of easily accessible ripe pods is a disincentive to work in the block, and the returns to labour are considered insufficient to warrant the mobilisation of family labour groups for harvesting. At this stage only small wet bean harvests are carried out in short forays into the block by individual harvesters, usually women. Little or no labour is expended on block management. It seems that smallholders adjust harvesting and farm management inputs in response to the amount of crop that is easily accessible for harvesting.

Figure 1. Average dry bean yield distribution of the HC1-B and HC1-S released clone varieties from age two to nine years (CCI Trial 141).

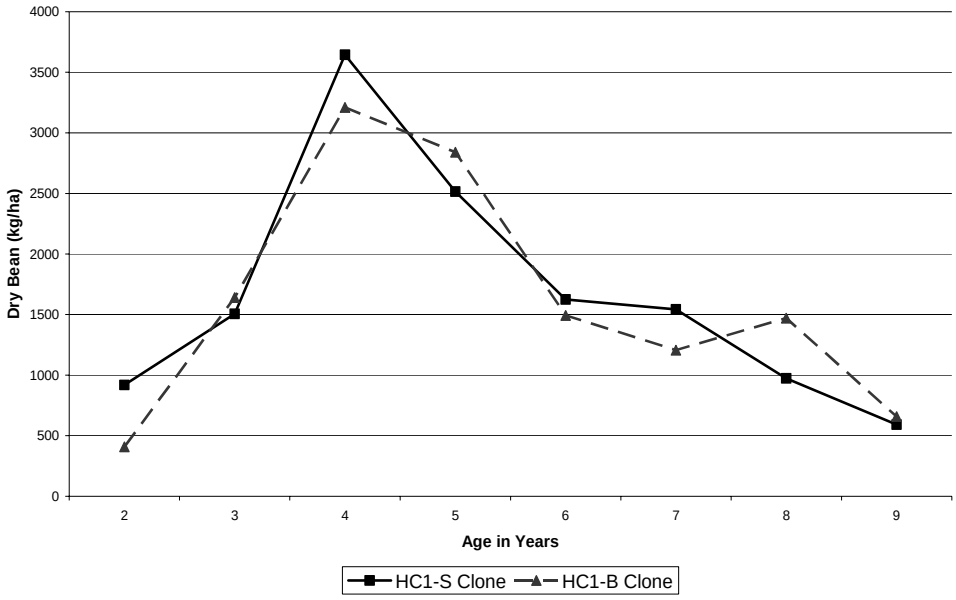
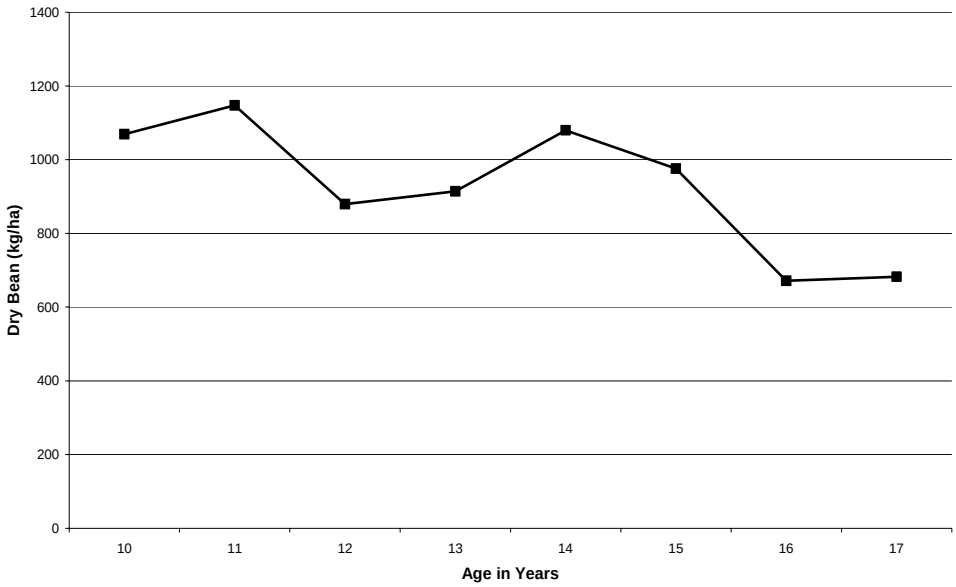


Figure 2. Average dry bean yield of Trinitario trials from 1958/59 to 1965/66 (source: Powell, 1991).



Although other variables, such as labour supply, price and access to a fermentary are important for explaining smallholder harvesting strategies, the quantity of accessible healthy ripe pods is critically important and must be above some minimum threshold quantity for smallholders to invest time and labour in their cocoa blocks. If the quantity of accessible ripe pods falls below this threshold level, smallholders will switch to strategies of lower labour inputs and will not invest labour in grass slashing. On the other hand, when the quantity of healthy ripe crop is above this threshold level (e.g., during flush periods or on high-yielding younger blocks), growers are motivated to spend more time on their blocks, both grass slashing and harvesting for dry bean production. Indeed, farmers with both young and old cocoa blocks invest more harvesting and maintenance labour in their higher producing younger blocks where access is easier and where pest and disease levels are lower.

This crop ‘quantity threshold’ works in a similar way to the more widely recognised ‘commodity price threshold’ for PNG smallholders. Several smallholder studies in PNG have argued that production levels, block maintenance levels and general interest in cocoa are related to price (e.g., Godyn, 1974; George, 1994; Ghodake et al., 1995; Omuru et al., 2001). While price is undoubtedly important, our observations lead us to conclude that the quantity of accessible crop is a more important factor over a wide price range. In other words, the labour response to variations in the quantity of ripe healthy pods available for harvesting is more elastic than the labour supply response to

cocoa prices. The same is true of village oil palm smallholders (see below and Curry et al. 2005). The condition of the block and the availability of ripe pods have more influence on smallholders' harvesting and production strategies than price.

The variations in labour supply associated with the condition of the cocoa block have their parallels in labour strategies in subsistence food production. For instance, on the Gazelle Peninsula, and in many other areas of PNG, subsistence food gardens are cultivated intensively for up to three years with considerable labour inputs for clearing and preparing the site, the planting of food crops, weeding and harvesting, after which the garden enters a low labour input phase until its abandonment to the fallow. Typically, as food gardens in the Gazelle Peninsula move through the cultivation cycle, labour inputs and management techniques change. Crop diversity decreases with the age of the garden, and perennial staples such as bananas (Musa spp), Singapore taro (Xanthosoma sagittifolium), sugar cane (Saccharum spp), and pitpit (Saccharum edule) are planted during the later phases of the garden cycle, after the harvesting of short-term crops such as green leaf vegetables, corn or pumpkin (Bourke, 1976; Ghodake et al., 1995). As the garden enters the fallow phase some perennials such as taro and banana continue to be harvested, but labour inputs are very low. Visits to the garden become less frequent, and are usually made by women.

These examples suggest that the way people assess how much labour (and the type of harvesting strategy employed – wet bean versus dry bean production) to commit to cocoa production has parallels with decision-making regarding the allocation of labour to subsistence production. Declining yields of garden crops relative to labour inputs (due to the exhaustion of soil nutrients after a few years of cropping and the build up of weeds from the growing seed bank in the soil) initiates an incremental withdrawal of labour from garden maintenance and less frequent visits to the garden. The cultivation stage is replaced by a bush-foraging stage in which individual women intermittently visit the old garden to forage for foods in the fallow. In the case of cocoa, when a block reaches low productivity levels and does not meet the threshold quantity of accessible healthy ripe pods, labour inputs decline significantly. While the returns to labour may not be high enough to interest many men at this low productive stage, women still consider it worthwhile to harvest wet bean to earn small amounts of money (kwik moni) for immediate purchases, but they expend little labour in the process.

Whilst access to processing facilities is an important factor explaining why some households are predominantly wet or dry bean sellers, household income strategies, access to labour and the quantity and accessibility of ripe fruit are all important determinants. The low density of ripe and easily accessible fruit of older and poorly maintained blocks reduces incentives to invest labour in the block, thus making a wet bean strategy more attractive

than a dry bean strategy. Given the important influence of block condition on a household's cocoa harvesting and labour strategies (i.e. wet or dry bean), the next section examines block condition in more detail.

7.1.3 A model of Cocoa Smallholder Production

A complex set of interconnected factors encompassing household livelihood strategies, labour supply, pest and disease and block condition influence harvesting and block maintenance levels. How these factors affect smallholder production are better understood by bringing them together in a Model of Smallholder Production. The Model provides a conceptual framework for understanding smallholder productivity that can be used to develop extension interventions in partnership with smallholders to raise productivity and incomes.

The model of smallholder production depicted in Figures 3a to 3f, reveals that the age of a cocoa block is a key determinant of block condition including vegetation structure, degree of shading and levels of infestations with pests and diseases. Because the typical smallholder cocoa block receives little or no pruning and shade control, and there is virtually no management of pests and diseases, the condition of a block is largely a function of its age. Furthermore, the deteriorating condition of the block with age means that under-harvesting can become a significant problem on older cocoa blocks. The age of a cocoa stand influences labour inputs through the particular harvesting/production strategies pursued by households.

The model is based on three development stages of the cocoa block: immature; mature; and, senile (Figure 3a). Each stage has associated with it a distinctive set of structural characteristics of the vegetation:

- Stage 1 Immature: < 3 years (low production and low pest and disease levels)
- Stage 2 Mature: 3-8 years (high production and rising pest and disease levels)
- Stage 3 Senile: 7-8 + years (low production and high pest and disease levels)

Each development stage also has its own distinct characteristics in terms of the following:

- yield profile (Figure 3a)
- levels of pests and diseases (Figure 3b)
- labour inputs (Figure 3c)

- the degree of accessibility for harvesting and production strategy (dry or wet bean) (Figure 3d)
- the quantity of healthy, ripe crop available for harvesting and harvesting strategy (Figure 3e)
- harvesting and production strategies (farming and foraging) employed by smallholders (Figures 3e and Figure 3f).

The three development stages of a cocoa block may vary by cocoa variety and the timing of the transition between stages. They can also be modified by a range of other production factors such as labour shortages (see above), climate variability (poor flush period) or access to or disputes over land. Each stage is discussed below.

Stage 1: Immature

In the young cocoa stand, there is open space between the trees and they are not overshaded by the most commonly planted shade tree, Gliricidia. Most of the crop is harvested because of easy accessibility (open space between trees and short trees) and a high proportion of ripe pods are disease free. The small number of cocoa pods per tree usually means the crop is sold as wet bean. These small wet bean harvests are usually carried out by one or two individual family members working alone or together. Most wet bean harvesting is undertaken by women and children. Although dry bean production is less common on Stage 1 blocks, some growers with large holdings of Stage 1 cocoa or access to an additional cocoa holding with relatively good yields (e.g., a Stage 2 cocoa block), may harvest sufficient quantities of ripe pods to make it worthwhile to process their beans.

Figure 3.a. Yield profile associated with the three stage model of smallholder production.

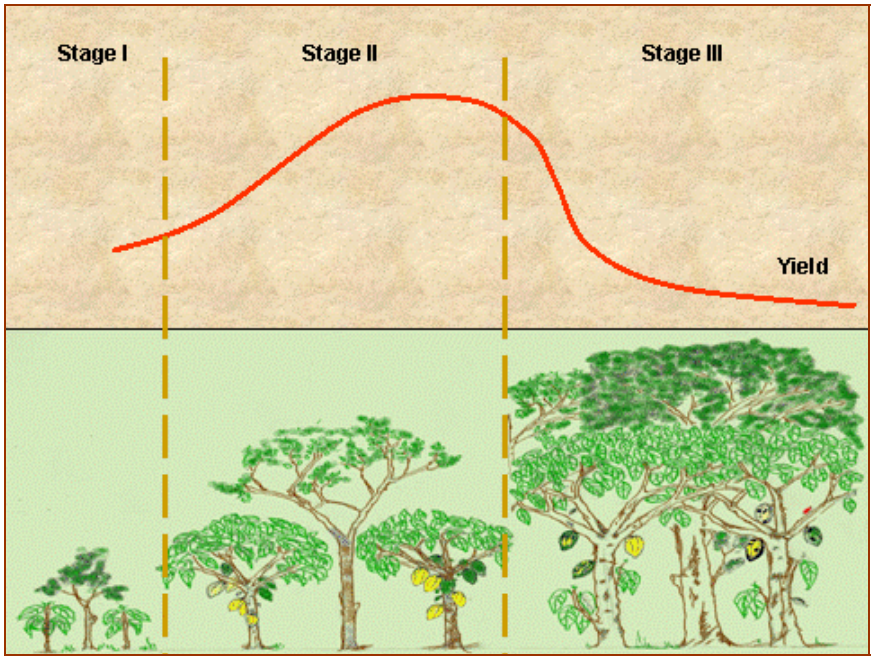


Figure 3b. Pest and disease profile associated with the three stage model of smallholder production.

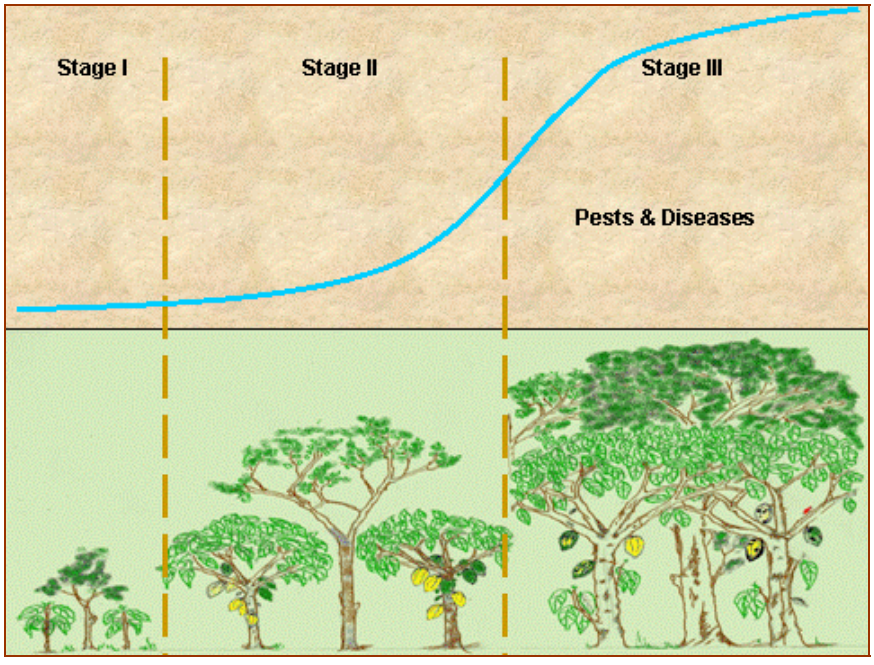


Figure 3c. Labour input profile associated with the three stage model of smallholder production.

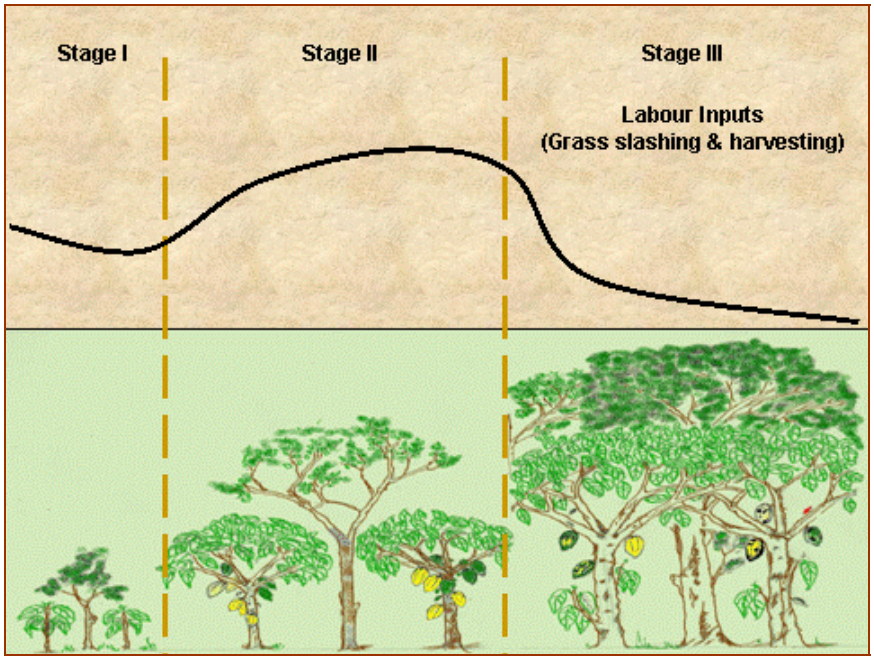


Figure 3d. Production strategy profile associated with the three stage model of smallholder production.

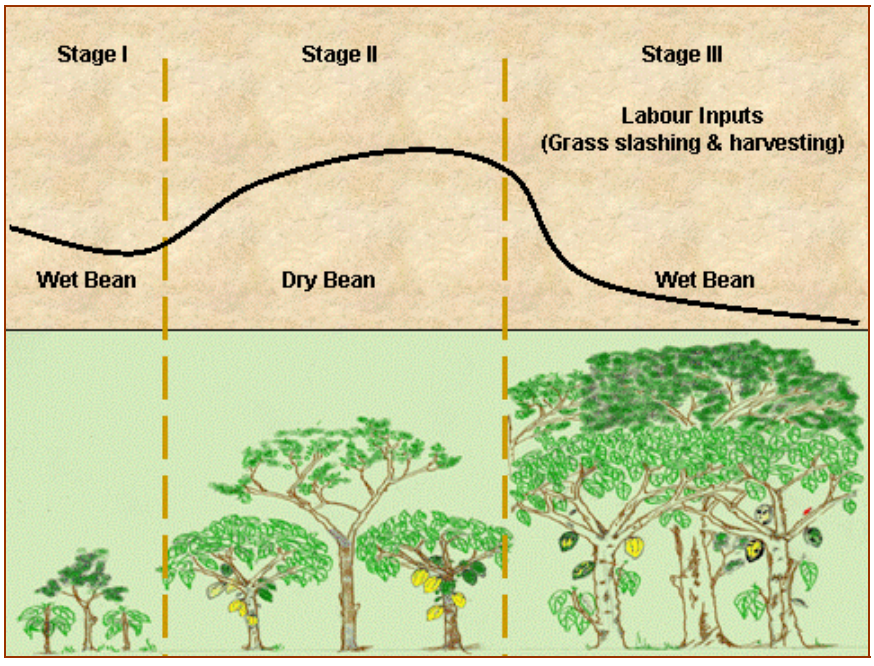


Figure 3e. Labour input and harvesting strategy profile associated with the three stage model of smallholder production.

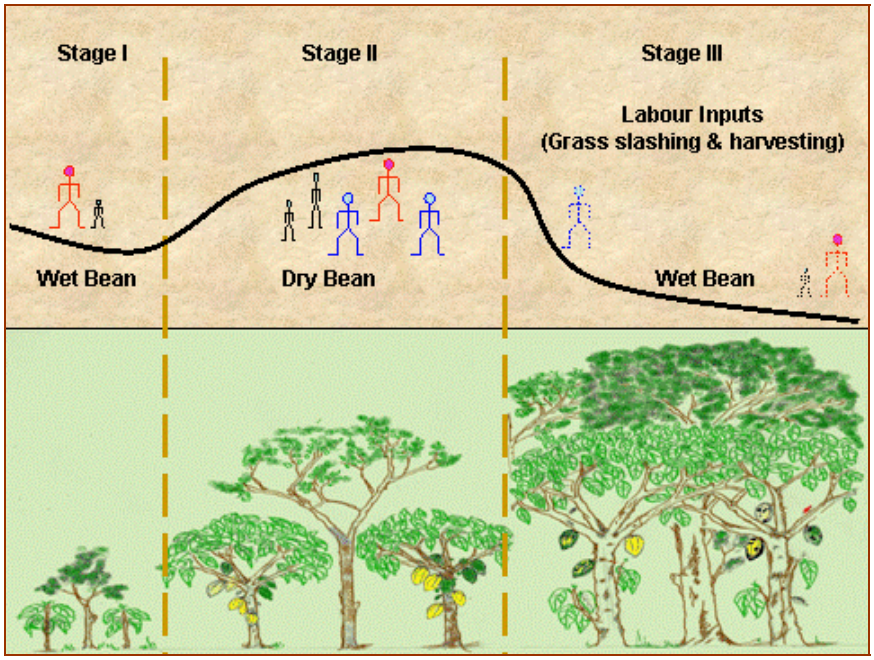
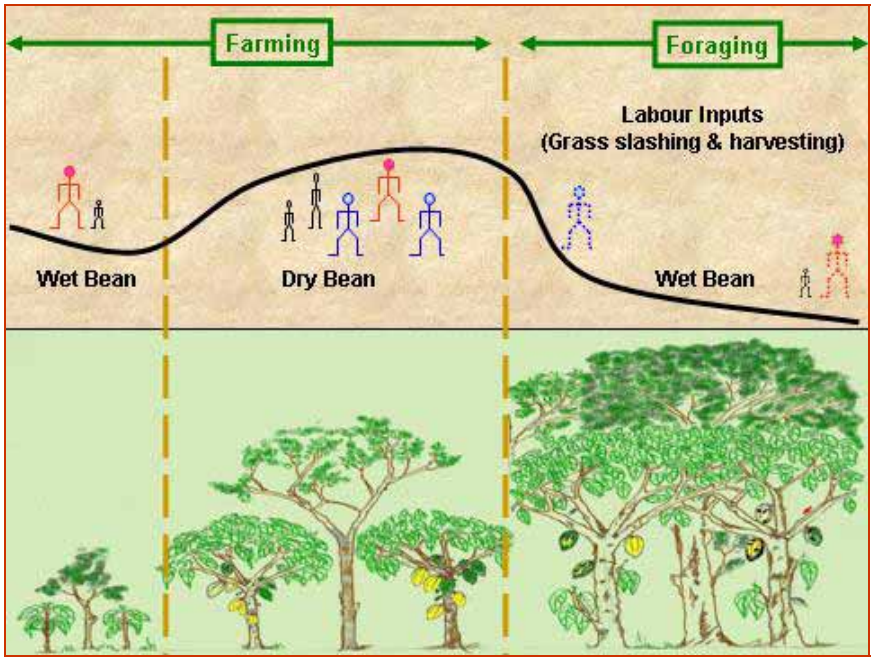


Figure 3f. Farming and foraging phases associated with the three stage model of smallholder production.



Cocoa stands at Stage 1 show promising potential for future production and income levels especially if they are the latest planting material distributed by CCI. During Stage 1, production is rising as the trees mature, and growers show an interest in grass cutting. While many farmers recognise that young cocoa trees are easily choked by weeds and grasses and therefore must be weeded regularly, the onset of pod development and harvesting encourages farmers to invest more time and labour in these blocks. As CCI's on-farm trials have revealed, farmers managing precocious hybrid clones that bear fruit at 18 months commence block maintenance (grass slashing) earlier and visit their blocks more regularly than farmers managing later fruiting hybrids (David Yinil, CCI, pers. comm., November, 2004).

Furthermore, because most growers interplant young cocoa with food crops such as bananas, cassava, peanuts, or fruit trees, the cocoa block is visited more frequently than older blocks where the shade canopy precludes cultivation of food crops. The practice of intercropping cocoa with food crops was observed on the Gazelle Peninsula as early as 1976 by Bourke who noted "[t]he farming systems have been modified so that food crop production can be phased into cash cropping, particularly with cocoa" (p. 96). Ghodake et al. (1995) also found that the majority of recently planted cocoa blocks surveyed in their study on the Gazelle Peninsula were hybrid cocoa interplanted with food crops. They also reported that block management was "fair to very good" on 81% of these blocks (p. 60), although inadequate shade control was a problem on most blocks.

Both the planting of early producing cocoa varieties and the interplanting of young cocoa with food crops encourages growers to visit their Stage 1 blocks more frequently and perform maintenance tasks like weeding. Because the cocoa income from Stage 1 blocks is low (but rising), these growers depend on alternative income sources such as other cash crops or the income earned at local markets by female members of the household. As yields of cocoa rise, the family's dependence on other income sources diminishes and cocoa becomes the focus of cash earning activities. At this stage, farmers show interest in their block and anticipate good future returns from their labour.

Stage 2: Mature

During the mature, productive stage (3-8 years) the trees are larger, but not so tall that harvesting the upper branches is difficult. There is still open space between the trees, making for relatively unimpeded access for harvesting, and some intercropping with food crops continues in the early years of Stage 2. Because the block is not overgrown nor too heavily shaded, pest and disease levels are tolerable and not yet affecting crop yields significantly (Figure 3b). Relatively high crop yields continue to encourage growers to slash weeds and grasses to improve access for harvesting. However, pruning, shade

management, pest and disease control and other tasks necessary for maintaining the block in good condition are generally not undertaken.

he large amount of ripe, healthy crop available for harvesting is associated with a shift in production strategies. Households shift from wet bean selling, typical of Stage 1, to dry bean processing (Figure 3d). At Stage 2 a high proportion of the crop is sold as dry bean, thereby generating better returns for smallholders (families without processing facilities are often able to access those of relatives). The larger quantity of crop available for harvesting also requires larger harvesting groups, and more men are usually involved in harvesting. Harvesting groups tend to be large family groups of men, women and children working together.

If the quantity of ripe cocoa available for harvesting is sufficiently large, family harvesting groups may be augmented with labour recruited from the extended family, and, very occasionally by the employment of hired labour. Co-operative work groups made up of the extended family and/or village groups often form at the beginning of the cocoa flush to slash undergrowth to improve access for harvesting. Sometimes these co-operative work groups operate as reciprocal labour groups (varvarmal), where each nuclear family's cocoa block is cleared of undergrowth in turn by the co-operative group. Hired labour may be employed for grass slashing, but this tends to be limited to those farmers with a more business-focused approach to cocoa production, and this type of grower is in a minority.

While most of the crop is processed and sold as dry bean, small amounts of wet bean may continue to be sold. Many women, although participating in family harvesting for dry bean production in Stage 2, continue to harvest and sell small quantities of wet bean. These small sales of wet bean supplement women's income from local markets, with the income spent immediately on basic household items such as store foods.

The more cooperative household labour strategies associated with Stage 2 cocoa blocks (and dry bean production generally) rely on the skills of the male household head to recruit and manage family labour. A common strategy for facilitating access to labour from the family or extended family is for the male household head (the father) to allocate harvest rounds, usually during flush periods, to co-resident married sons or daughters, or to relatives needing cash. The individual allocated the harvest round will recruit and manage the necessary labour and take responsibility for processing and marketing the cocoa, and distributing the income.

By allocating harvest rounds to immediate family and other relatives, the father ensures the supply of labour for harvesting (and often grass slashing) is adequate for maintaining high harvesting rates during Stage 2 production. The allocation of harvest rounds creates an obligation amongst those granted harvest rounds to reciprocate by providing labour for cocoa and subsistence

tasks. Also, because of the high density and easy accessibility of healthy, ripe pods during cocoa flushes in Stage 2 blocks, labour recruitment is easier than for older, Stage 3 blocks. Some household heads lack the status or skills to manage reciprocal labour arrangements, and therefore find it difficult to shift from wet bean sales (associated with Stage 1) to the Stage 2 dry bean production strategy that requires larger work groups.

Stage 2 cocoa blocks can return relatively good incomes to smallholders. During flush periods, cocoa is likely to be the dominant household economic activity and source of income. But while income levels are relatively high, very little of that income is reinvested in block maintenance. Furthermore, because of the absence of pruning and shade control, the increased flowering rate in response to effective pruning and shade control does not occur. Towards the later years of Stage 2, pest and disease levels begin to rise sharply, leading to falling yields. As the blocks become overgrown, accessibility declines, and it becomes progressively more difficult to harvest. Farmers begin to lose interest in their cocoa block

Stage 3: Senile

Stage 3 (>7-8 years) is the least productive stage in the life cycle of the cocoa block. At this stage, the vegetation is dense and the block is overgrown (Figure 3a). 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. The amount of healthy ripe crop that is easily accessible for harvesting falls to very low levels because of the high proportion of diseased pods 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.

When a cocoa stand enters Stage 3, income from the block declines rapidly to low levels, and dry bean production ceases (Figure 3d). Cooperative household work groups are disbanded and production strategies revert to those similar to Stage 1 development, that is, very small quantities of cocoa harvested by women working alone or with young children. During Stage 3, the small quantities of cocoa harvested are sold as wet bean and production is driven by short-term needs. Typically, families use their Stage 3 cocoa blocks like bank ATMs: the cocoa block is visited only when cash is required for immediate consumption (e.g., church donations or small store purchases such as soap, kerosene, or food for the evening meal). Growers call this type of income ‘kwik moni’ because the income is earned quickly and with little effort. Block visits rarely involve more than a few hours of harvesting during which time one or two baskets of wet beans are collected and sold (average harvest 17.7 kg). Very little or no time is allocated to block maintenance (Figure 3e). This type of production practice is known as ‘forage harvesting’. Male farmers

have lost almost all interest in their cocoa block as it enters the Stage 3 senile phase.

Associated with the transition to a Stage 3 cocoa block is the diversion of family labour to more lucrative income sources, such as to the family's younger and healthier cocoa holdings, to other cash crops, or to increased production of food, tobacco or betel nut for sale at local markets to compensate for the declining income from their Stage 3 cocoa holdings. If the household has sufficient land, they are much more likely to establish new cocoa blocks rather than replant their old Stage 3 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. Also, it is easier to establish a new block on an existing garden site than rehabilitate or replant an old block. This observation is supported by Ghodake et al. (1995, p.58) who reported that several farmers in their study had large tracts of land (at least several hectares) planted to cocoa. The level of farm management among these farmers was very low, and the area planted was too large for individual households to manage effectively. Rather than investing their labour in managing their existing mature cocoa blocks and increasing the cash returns, these same farmers were clearing additional land to plant new hybrid cocoa.

7.1.4 Farming or Foraging

The three stages of block development described above in the model of smallholder production are associated with two very different harvesting and block management practices. In Stages 1 and 2 regular harvesting and some block maintenance, essentially grass slashing, is carried out and we label these two stages, the 'farming phase' of the cocoa block (Figure 3f). In Stage 3, block maintenance is abandoned and harvesting is intermittent. At this stage the block has entered a 'foraging phase' (Figure 3f) where the block is visited intermittently in order to 'forage' for small quantities of ripe pods. The key differences in cocoa production strategies associated with the farming and foraging phases are summarised in Table 2.

During the 'farming phase' of Stages 1 and 2, the vegetation structure is such that the open space between the cocoa trees allows easy access for harvesting. Furthermore, because the shade canopy has not yet closed, and the cocoa trees are still receiving adequate light, there is good pod development without significant losses from pests and diseases (e.g., less Black Pod because of the drier micro-climate). Together these factors help sustain growers' interest in their cocoa holdings so that they are motivated to pursue a farming strategy of production.

Without pruning and shade control, the block passes prematurely into Stage 3, the old, unproductive foraging phase. The premature 'ageing' of the block

further reduces the motivation of smallholders to commit labour to block maintenance and harvesting, and the cocoa block becomes like any other 'bush' resource or old abandoned food garden. A downward spiral starts in which pest and disease levels rise even further as labour is withdrawn, creating more disincentives to invest in block maintenance and harvesting. The interrelationships amongst labour supply, block management, tree productivity and harvesting strategies are illustrated in Figure 4.

Table 2. Cocoa production strategies for farming (Stages 1-2) and foraging (Stage 3).*

Cocoa Production and Labour Characteristics	**Farming Phase (Stages 1-2)**	**Foraging Phase (Stage 3)**
Labour inputs in block maintenance	Relatively high labour inputs in grass slashing at beginning of flush periods.	Very little or no labour inputs in block maintenance.
Harvesting strategy	'Farming harvesting strategy' used through the year. Farmer may revert to 'foraging' during low crop non-flush periods.	'Foraging harvesting strategy' used throughout the year in flush and non-flush periods.
Harvested beans	Processed and sold as dry bean. Some wet bean sales during low crop non-flush periods.	Unprocessed and sold as wet bean.
Harvest duration	Long (>4 hours/day on multiple days).	Short (<4 hours/day).
Harvest frequency and rates	Fortnightly, especially during flush periods. Full harvesting.	Intermittent and partial/under-harvesting.
Size of family work group engaged in harvesting during flush period	Large (3+ labourers).	Small (<3 labourers).
Family labourers	Men, women and children.	Women and children.
Labour recruitment in flush period	Extended family. Varvarmal work groups. Some hired labour on a small proportion of blocks.	Nuclear family.
Purpose of income	Deferred consumption. Large purchases (e.g., school fees, house building materials). Investment in other business such as tradestores or poultry coops.	Immediate consumption. Small purchases (e.g., soap, kerosene, store foods).
Control of income	Controlled by household head, usually the husband/father.	Controlled by harvester, usually individual women.
Importance of alternative income sources	Low (cocoa is the primary income source).	High (labour often diverted to other economic activities).

**Data derived from wet bean and dry bean sales, harvest labour data and family interviews.*

Whilst a combination of socio-economic factors influences levels of labour inputs in cocoa production (Figure 4), the main factor appearing to influence whether cocoa producers are ‘farmers’ or ‘foragers’ is the quantity of ripe healthy crop easily accessible for harvesting. As argued above, the quantity of accessible healthy ripe pods must be above some minimum threshold level before smallholders will adopt a ‘farming strategy’. If the quantity of ripe pods falls below this threshold, smallholders switch to a ‘forage harvesting strategy’ of very low labour inputs (minimal grass slashing and harvesting), and they will begin to invest their labour elsewhere (Figure 4). At this stage, a smallholder might consider replanting the block, but this tends to be deferred indefinitely if there are more productive blocks to harvest or if land is available to plant new cocoa stands. On the Gazelle Peninsula most new cocoa stands are established in new garden sites. In this case, little additional labour is required to establish a cocoa block on a newly cleared garden site compared with the amount of labour required to rehabilitate an old cocoa block.

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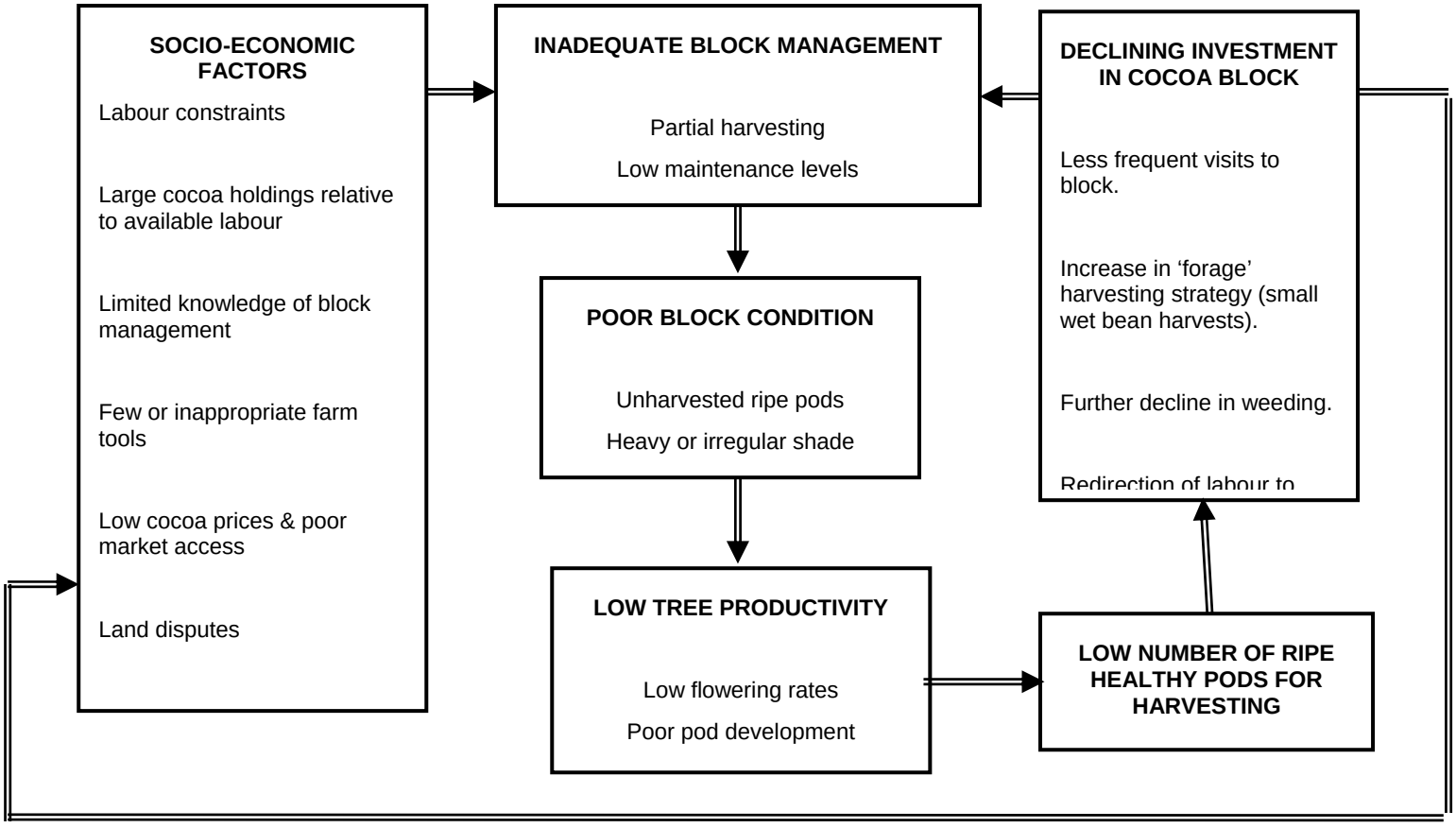
Figure 4. The relationship between labour supply, block management, tree productivity and harvesting strategy.



With the transition to the foraging strategy of Stage 3, the returns to labour are lower, although not as low as they would be if smallholders continued to apply Stage 2 production strategies to their old, Stage 3 cocoa holdings. While the returns to labour on Stage 3 blocks might not be high enough to interest many men, women still consider it worth their while to harvest wet bean for kwik moni, but they expend minimal labour in the process. In other words, given the lack of pruning and shade control, Stage 3 foraging strategies are a rational production strategy for old and overgrown cocoa blocks.

The reluctance to replant and the long-term acceptance of very low productivity associated with Stage 3 cocoa blocks means that many smallholder cocoa holdings are in the old unproductive Stage 3 phase for a much longer period than the more productive Stage 1 and 2 phases. Indeed, the evidence presented in this study, together with other studies on the Gazelle Peninsula (e.g., Ghodake et al., 1995; Kakul, 2006) indicate that old and/or overgrown cocoa blocks are the most common type of smallholder cocoa block. Kakul (2006) estimates that 69% of cocoa blocks in Kokopo and Gazelle Districts are aged 11 years and over, 25% of which are more than 21 years old.

7.1.5 Modifications of the Model

The three stage model of smallholder production should be considered the standard pattern of smallholder production. The basic model can be modified to accommodate a range of other socio-economic factors that influence smallholder productivity. These socio-economic factors are listed in the left-hand box of Figure 4 and can modify the model in two main ways:

- by expanding or contracting the duration of Stage 2 production by shifting the boundary to the left or to the right between Stages 2 and 3
- by shifting upwards or downwards sections of the curves for yields, labour inputs and pests and diseases shown in Figures 3b and 3c.

For example, one or more of the socio-economic factors listed in the left-hand box in Figure 4 may lead to a reduction in labour inputs thereby causing pest and disease levels to rise, which in turn may create further disincentives to invest labour in block maintenance and harvesting. This would lead to a contraction of the productive Stage 2 period and a dampening down of the curves for yields and labour inputs and a steeper and upward shift in the pest and disease curve (Figures 3b and 3c).

One of the most important factors modifying the basic three-stage model of smallholder production is labour shortages, both absolute (e.g., small family size) and functional. For example, in less co-operative households where social conflicts over work and income distribution are common, functional shortages of labour may emerge despite the abundance of ripe, healthy crop available for harvesting during Stages 1 and 2. Family members, particularly the female household head or a married, co-resident son, may be unwilling to provide harvesting labour because they feel underpaid for their labour. In these situations, the dry bean production associated with Stage 2 will be below potential levels. Under-harvesting may emerge as a serious problem, which may hasten the build up of pest and disease levels as unharvested pods become reservoirs for diseases such as Phytophthora. Thus, the effect of this functional labour shortage on the model is to shift the boundary between Stage 2 and Stage 3 to the left, whereby the block would enter Stage 3 at a younger age. There would also be a dampening down of the curves for yields and labour inputs. In extreme cases where the mobilisation of family labour remains a problem for prolonged periods, the block may not enter the dry bean production phase usually associated with Stage 2, and the household may continue to rely on a wet bean production strategy with relatively small quantities of beans harvested by individual family members working alone.

The Model of Smallholder Production provides a conceptual framework for understanding smallholder production strategies than can be used for developing policy initiatives to address some of the long-standing constraints on smallholder production. These policy initiatives are discussed further in Section 9.

7.2 Objective 2. Oil Palm Research and Mobile Card results

The primary objective of the Mobile Card initiative was to overcome labour supply constraints by eliminating payment uncertainty and reducing disputes over labour remuneration through guaranteeing timely and full payment of labour. The trial results at Hoskins (Curry & Koczberski 2004) and Bialla (Koczberski & Curry 2008) demonstrated that the payment of labour in fruit (a share of the fruit harvested by the worker) overcomes the reluctance or inability of blockholders to pay cash for family or hired labour, thereby improving the supply of labour for oil palm production and increasing smallholder income.

At Hoskins there was a significant increase in oil palm production amonst smallholders in the trial. Monthly production for trial blocks increased from 75% of the LSS/VOP average without contract labour to 113% during months when contract labour was employed. Productivity increased on 90% of blocks in the trial with 30% improving by more than 50 percentage points.

In addition to productivity gains, those participating in the trial experienced considerable socio-economic benefits. These included:

- Utilisation of under-employed labour
- Improved access to labour for elderly and disabled growers
- Greater financial security for married sons and caretakers
- More equal distribution of income within households
- Less social conflict on blocks

The discussion below focuses on the results of the more recent Bialla Mobile Card trial, as the Bialla trial was modelled on the successful Hoskins Mobile Card trial. For further details on the results of the Hoskins Mobile Card trial see Curry & Koczberski (2004).

At Bialla, productivity improved significantly on Mobile Card blocks as measured against average monthly LSS and VOP production. Monthly production increased from 6% above the LSS/VOP average without the Mobile Card to 40% above the LSS/VOP average during months when Mobile Card labour was deployed. This gave a productivity improvement of 34.4 percentage points, just less than the 38 percentage point gain recorded for the Mobile Card trial at Hoskins (Curry & Koczberski 2004). The success of the Mobile Card trial can also be gauged by the fact that 68% of contracts were renewed once or more, with the average number of contracts per block being 2.28 (Table 3).

Table 3. Mobile Card contract details by relationship of Mobile Card worker to blockholder.

Relationship	Average number of contracts	Most common percentage split Papa: Mobile Card worker
Son	2.17	40:60
Other co-resident relative		
Caretaker	2.35	50:50
Hired labourer	2.56	40:60
Not identified	2.23	50:50
Total	2.28	50:50

7.2.1 Factors affecting the trial results

Productivity improvements were documented for 72% of trial blocks with 28% improving by more than 50 percentage points (Table 4). At the earlier Hoskins trial, productivity improvements were recorded on 90% of trial blocks. The difference between Bialla and Hoskins in the proportions of trial blocks showing an improvement in productivity related to the relatively large proportion of blocks in the Bialla trial that were already high producers (Table 5). Some of these high producing blocks were self-identified blocks which sought to enrol in the trial because they saw the Mobile Card as providing some additional benefit for themselves, not because they were low producers,

per se. These high producers viewed the Mobile Card as potentially assisting with financial and labour management on their blocks through providing an additional mechanism for allocating labour and income.

Table 4 Improvement in production on trial blocks using the Mobile Card.

	Improvement in Percentage Points* No gain	**>0-10**	**>10-50**	**>50**	**Total**
No. of blocks	20	7	24	20	71
Per cent of trial blocks	28	10	34	28	100

**0 represents mean productivity.*

Table 5 Productivity of trial blocks in relation to the smallholder average before the introduction of the Mobile Card.

	Starting Point in Relation to Average LSS/VOP Productivity* <-50	**>-50 to <0**	**0 to <+50**	**50+**	**Total**
No. of blocks	10	22	18	21	71
Per cent of trial blocks	14	31	25	30	100

**0 represents mean productivity.*

The largest improvements in productivity were associated with the most poorly performing blocks prior to the trial (Table 6). For example, blocks that started at worse than 50% below average productivity improved their position to above average productivity with the Mobile Card. Blocks that were in the range of average to 50% above average productivity managed to improve by 20 percentage points. However, as pointed out above, blocks that were high performing to begin with (more than 50% above average productivity), improved their productivity only minimally (Table 6).

Furthermore, all trial blocks below average productivity on entering the trial showed some improvement in productivity with the Mobile Card (Table 6). In the range of average to 50% above average productivity, the proportion of blocks that improved was still high at 67%. Even in the most productive group entering the trial, one-third of blocks showed an improvement in productivity (Table 6).

Table 6 Mean productivity improvements by initial starting position in relation to the smallholder average.

Starting Position in Relation to Smallholder Average					
Position before Mobile Card	<-50	>-50 to <0	0 to <+50	50+	Total
No. of blocks	10	22	18	21	71
Improvement in percentage points	84	54	20	3	
Per cent of blocks showing improvement	100	100	67	33	72

7.2.2 Productivity gains by relationship between blockholder and Mobile Card labourer

Improvements in productivity by type of relationship between blockholder and Mobile Card worker were similar to those observed at Hoskins (Table 7). ‘Hired labourer’ and ‘other co-resident relative’ showed greatest improvement at Bialla followed by ‘caretaker’ and then ‘son’.

Table 7. Average productivity improvement in percentage points by relationship between blockholder and Mobile Card labourer for Bialla and Hoskins.

Improvement in Percentage Point Bialla Hoskins		
Hired labourer-blockholder	45	58
Caretaker- blockholder	40	37
Son-father	17	18
Other co-resident relative- blockholder	44	n.a.

**Hoskins data reported in Curry & Koczberski (2004, 21).*

Hired labour

As stated above, blockholders employing 'hired labourer' showed the largest improvement in productivity following adoption of the Mobile Card (Table 7). Eighty-five per cent of blocks employing hired labour experienced an improvement in productivity, which was the highest proportion of blocks to show an improvement amongst the different relationship categories (Table 8). These findings are not surprising given that those blocks recruiting off-block labour are usually faced with long-term labour shortages. That is, they tended to have low numbers of able-bodied workers (e.g., elderly blockholders with few co-resident adult sons or blocks occupied by young families with dependant children).

Table 8. Per cent of blocks showing an improvement in productivity by relationship between blockholder and Mobile Card labourer.

Relationship	**Per cent of Blocks**
Hired labourer	85
Caretaker	81
Son	52
Other co-resident relative	76

Also, the use of Mobile Card contracts for hired labour addressed one of the key disincentives to employing hired labour in the smallholder sector — the risk that labourers recruited from off the block will accumulate tenure rights through expending their labour in oil palm production. Some blockholders are reluctant to address labour shortages by employing hired labour because they are fearful that the labour 'investments' of hired labour might lead to compensation demands being made on them by the worker, especially when the work is for an extended period. As discussed further below in relation to caretaker blocks where these issues are more pronounced, the existence of a Mobile Card contract for hired labour formalises the relationship between blockholder and worker and makes such claims less likely. Thus the Mobile Card overcomes not only payment uncertainty for workers, but also eases the concerns of blockholders that the recruitment of outside labour might ultimately be a threat to their tenure rights. The easing of such fears and the effectiveness of the Mobile Card in overcoming long-term labour shortages are reflected in the high proportion of contracts that were renewed during the trial (68%). Some blockholders were into their seventh Mobile Card contract by the end of the trial.

Other reasons for the success of Mobile Card contracts for hired labour included:

- Improved access to labour for elderly and widowed growers with long-term labour shortages. By offering hired workers guaranteed 'employment' of at least three months with regular fortnightly pay, it was much easier for elderly and widowed growers to recruit young men.
- It offered a solution to short-term labour shortages when blockholders were ill or had temporary off-block commitments such as visits to the home village or short-term work commitments elsewhere. It is therefore very useful for addressing temporary labour shortages of up to two or three months.

- Improved working environment for hired labourers. Mobile Card labourers and blockholders had much praise for the Mobile Card. For Mobile Card labourers there were increased opportunities for work with much lower risks of delayed payment or under-payment. As one Mobile Card worker pointed out, he no longer had to hound the blockholder for payment. For blockholders the payment of labour in fruit with the transaction handled by the company circumvented the difficulty of trying to retain cash for the payment of labour.

Caretakers

The impact of the Mobile Card was significant on caretaker blocks where 81% of blocks showed an improvement in productivity (Tables 7 and 8). The payment initiative was very acceptable to caretakers and absentee blockholders, as demonstrated by the high proportion (75%) of contracts renewed during the trial and the large number of requests to the Mobile Card officers for 'permanent' Mobile Card contracts. The production data show that the Mobile Card is very effective for overcoming the problems of uncertain and unfair payments that create disincentives for caretakers to harvest regularly and invest labour in block maintenance. Also, it is likely that the practice of some caretakers to weigh their fruit using a neighbouring block's number on the weigh docket (to ensure adequate and timely payment) may cease with the adoption of Mobile Cards on caretaker blocks.

It is also probable that in the long-term the use of Mobile Cards on caretaker blocks will reduce the incidence of tenure disputes and compensation claims that commonly arise on these blocks, a problem that also deters the recruitment of hired labour as highlighted above. Tenure disputes often arise after a caretaker has resided and worked on a block for several years or more while the blockholder has resided elsewhere and has taken scant interest in the day-to-day management of the block.

Mobile Card contracts on caretaker blocks can reduce the likelihood of these disputes in four interrelated ways. First, Mobile Card contracts signed by the blockholder, the Mobile Card labourer and witnessed by an OPIC extension officer specify the contract period, the percentage split of the income, the work tasks to be completed, and the phases to be harvested and maintained. The Mobile Card is in effect a contract between an employer (the blockholder) and an employee (the caretaker), thereby reinforcing their respective positions and roles.

Thus, the Mobile Card has the potential to overcome some of the long-standing production problems on caretaker blocks and turn these blocks into stable high producing blocks that benefit both caretakers and blockholders.

Family labour

Soon after the commencement of the trial there were numerous requests for Mobile Cards from blockholders with married, co-resident sons. These growers saw the Mobile Card as a way to better manage the distribution of work and income on their blocks and to reduce the competing demands on the Papa payments. Despite the marked interest in the Mobile Card, productivity gains were lower for this relationship category than other categories (Table 7). This was also observed in the earlier Hoskins trial. Further, almost half those blocks where a son was using a Mobile Card showed no improvement in productivity (Table 8).

The lower productivity gain for sons with Mobile Cards was not surprising because typically these blocks were not confronted with absolute labour shortages. Rather, as indicated above, the blockholder used the Mobile Card as a way to improve financial and labour management on the block. Therefore, the Card may be valued more as a social innovation because of its capacity to reduce conflict amongst family members, especially between fathers and sons on the more heavily populated LSS blocks. As previous research among Bialla and Hoskins smallholders demonstrated, social conflict among co-resident households is a major factor explaining long-term low production and poor block management (Koczberski et al. 2001; Koczberski & Curry 2003).

The enhanced social stability, especially on densely populated LSS blocks following the Card's introduction, is likely to lead to more stable production over the longer term, and may facilitate a smoother inter-generational transfer of block management from father to son. For leaseholders

whose authority and leadership are increasingly being challenged by a younger generation of males, the Mobile Card provides the father with a means to maintain his control over production and income. If the Mobile Card is effective in assisting the father's control and management of the block, then it would be worthwhile promoting its use on densely populated LSS blocks where conflicts occur between father and sons. Whilst the production gains were lower on father-son blocks than other relationship categories (e.g., hired labour) the improvements in social relations among family members and the more equitable distribution of the oil palm income were of considerable benefit to block residents.

Block management

Alongside the increases in productivity and incomes resulting from the reorganisation and increased deployment of labour, improvements in block management were also noted (Table 9). On average, general block condition improved by 20% (Table 9).

Table 9 Impact of Mobile Card on block management.

Activity	Before Mobile Card (June 2006)		After Mobile Card (June 2007)		% Improvement
	Score	Average	Score	Average	
Paths	162/310	5.22	199/310	6.42	23
Pruning	157/310	5.06	187/310	6.03	19
Ring Weeding	136/310	4.39	187/310	5.68	29
Maintenance	163/310	5.26	198/310	6.39	21
Loose fruit	161/310	5.19	179/310	5.77	11
Cover Crop	146/310	4.71	177/310	5.71	21
Management	163/310	5.26	193/310	6.23	18
Fertiliser	115/310	3.71	135/310	4.35	17
Total	1203/2480	4.85	1444/2480	5.82	20

Table adapted from Henry Turuo's October, 2007 report to OPIC Field Manager. Data based on 31 trial blocks.

In summary, the range of socio-economic benefits for smallholders from adoption of the Mobile Card included the following:

- Utilisation of under-employed labour on LSS blocks.
- Greater capacity of growers to overcome long and short-term labour shortages and thus generate higher incomes for themselves.
- Improved access to labour for elderly and disabled growers.
- Greater financial security for long-term caretakers and increased tenure security for absentee leaseholders.
- Greater opportunities for work as hired labourers with full and timely payment assured.
- More equitable distribution of oil palm income amongst household members.
- Less social conflict on highly populated blocks.

8 Impacts

8.1 Scientific impacts – now and in 5 years

In both cocoa and oil palm, the results of the research are having a scientific impact by changing how scientists think about productivity issues in the smallholder sector. This is enabling better targeted research into issues affecting productivity. For example, in cocoa, growers can tolerate high levels of pests and diseases because they change their production strategies by reducing labour inputs when cocoa trees are over seven years of age when pests and diseases rise sharply. In this case men reduce their labour inputs, dry bean processing ceases, and women take over harvesting using a low input “forage” harvesting strategy whereby small amounts of cocoa beans are collected and sold as wet bean. Cocoa research at CCI is now beginning to examine the critical 5-7 year age of cocoa to identify ways to delay blocks transiting into the “forage harvesting stage” in order to maintain men’s involvement in production, especially dry bean processing. Some of this research is now being undertaken in association with the commercial sector because the forage harvesting stage provides ideal conditions for CPB to flourish.

Furthermore, as a result of many discussions and meetings with CCI staff and a seminar on the research findings in June 2005, there has been a growing appreciation amongst senior management and researchers at CCI of the complex range of interacting factors influencing cocoa smallholder production. There is a growing recognition that effective solutions are unlikely to be single disciplinary fixes. CCI is now moving towards collaborative research among its scientists in pathology, entomology, agronomy, breeding and economics, and is encouraging the involvement of extension staff. This is a major achievement of the project. An example is the growing research collaboration between the economics and pathology sections of CCI through an interdisciplinary investigation of pests and diseases.

In oil palm, the research is leading to a better understanding of the factors affecting variability in production of village smallholders and settlers on the land settlement schemes. The two groups follow different production strategies which greatly influence their levels of productivity. When settlers’ productivity is rising villagers’ productivity is falling and this is related to the amount of crop for harvesting. During high crop periods, settlers, because of their truncated kinship networks, are not able to harvest all available crop, so their productivity falls. Villagers, on the other hand, increase their harvesting rate during high crop periods because they are able to mobilise labour through their extended kinship networks in the village. When there is little crop to harvest, their productivity falls. These differences between settler and village oil palm growers were not understood by the oil palm scientific community and are generating much interest, because of their potential to lead to improved extension strategies by, for example, using versions of the Mobile Card to mobilise labour.

Finally, a major finding of the oil palm research is that underharvesting is one of the main factors explaining low smallholder production. While some of the smallholder-plantation production deficit is explained by lower farm inputs in the smallholder sector (e.g., less fertiliser inputs, delayed replanting and low levels of block maintenance), a substantial proportion of the difference is attributable to high rates of under-harvesting, particularly amongst VOP producers and towards the rear of the 6 ha LSS block furthest from harvest roads. These findings are leading to a reappraisal of current extension and research approaches used by OPIC and OPRA which prioritise the promotion of fertiliser amongst growers as a means of improving smallholder production. It has now been show that given a significant proportion of smallholders regularly under-harvest, strategies to promote fertiliser application rates must be undertaken in conjunction with strategies to raise harvesting rates. Hence industry attention has shifted more towards finding ways to improve harvesting rates among smallholders through interventions such as the Mobile Card.

Another major impact is that PNGOPRA is now moving to develop a smallholder section within the organisation. This permanent unit will become one of the core programmes of OPRA's research. They have recently advertised a position for a Social Science Research Officer to be based at their Popondetta office.

8.2 Capacity impacts – now and in 5 years

In early 2005, Dr E. Omuru was awarded a Visiting Crawford Fellowship and amongst his visits to other institutions, he visited Curtin University for three weeks. At Curtin Dr Omuru presented a seminar on price stabilisation policies in cocoa, gave a lecture to undergraduate students and worked on a report on smallholder cocoa production in PNG. His two presentations were very well received by staff and students, and Dr Omuru established links with several staff from Curtin's Muresk Institute of Agriculture.

CCI research staff including Mr Joachim Lummani and Mr Robert Nailina (an RA with CCI) accompanied the Australian research team to Bialla to assess the Mobile Card trial amongst oil palm growers. The visit helped them develop a better understanding of how the Mobile Card trial and the research that led to the trial, as well as how extension is organised in oil palm. This knowledge has helped their understanding of how such an initiative might be modified to mobilise labour amongst cocoa smallholders.

Robert Nailina has since successfully applied for a NZ Development Scholarship to undertake a degree in "Business and Society" at Lincoln University. He will commence his studies in September 2008.

Joachim Lummani, a CCI staff member on a John Allwright Scholarship at Curtin, completed his Masters thesis on time. His thesis examined the social factors influencing cost structures in cocoa production.

Training of CCI research assistants in the project has been carried out in each year of the project with an emphasis on survey design, interviewing and data coding and data entry.

This project has been instrumental in developing links between CCI and the private sector and other industry organisations. The evaluation and monitoring of new smallholder models of production being developed by NGIP-Newmark and with Bitagalip Holdings have resulted in a considerable exchange of information and ideas that are providing CCI with creative and alternative ways to improve smallholder extension and marketing. Also, Bitagalip Holdings, which is a village-based venture, has received ongoing support and training from CCI research staff involved in the monitoring and evaluation of the venture.

8.3 Community impacts – now and in 5 years

8.3.1 Economic impacts

The research has resulted in a greater understanding of why a market in labour has not developed in the oil palm smallholder sector (see Curry and Koczberski 2004; Curry 2007; Koczberski 2007), and why some smallholder farmers find it difficult to draw on family labour. This has implications for other cash crops and business development more generally in PNG and Melanesia.

The Mobile Card is currently being rolled out at Bialla. This initiative is likely to have a dramatic impact on smallholder productivity and incomes and in generating increased employment opportunities for young men and women either as family labour or as hired labour. As the mobile card is rolled out in 2008 and 2009, the economic (and social impacts) will be monitored in ASEM/2006/127.

Cargills at Popondetta are planning a slightly different version of the Mobile Card amongst their smallholders.

In 2006/7 Curry, Koczberski, Omuru and Duigu (together with Imbun and Yala) undertook a World Bank-funded social and institutional assessment for a five-year Smallholder Agriculture Development Project (SADP) in oil palm commencing in 2008. Their main report (Curry et al. 2007b) was greatly informed by their previous ACIAR research, and the report's recommendations are now being incorporated into the design of a large Smallholder Agriculture Development Project in the oil palm provinces of West New Britain and Oro. It is anticipated that this project will have major social and economic impacts through new financing and payment arrangements for growers that were initially developed as part of this ACIAR project.

In cocoa the Nucleus Enterprise model of agricultural extension involving the commercial sector working in partnership with smallholders has been adopted as an extension strategy by CCI and the ENB Provincial government. In addition NGIP-Newmark, and John Duigu in association with KBSA are introducing the model amongst several groups of smallholders. This will be studied further under ASEM/2006/127.

8.3.2 Social Impacts

In oil palm the key issues are related to rapid population growth, especially on the land settlement schemes, while in cocoa the primary threat is now from CPB which could devastate the industry. By increasing productivity through improved extension delivered through the NE model, labour inputs are rising with consequent improvements in block condition (at the Stockholm site in the Bainings). While still too early to assess the impacts at the other sites, (e.g., Tokiala and sites in WNB), the early prognosis is good and the social impacts will be monitored as part of ASEM/2006/127.

In oil palm, the Mobile Card is one way for the industry to address some of major socio-demographic and economic pressures now affecting the smallholder sector. Productivity increases, the reduction in intra- and inter-household conflicts over work and income together with a more equitable distribution of income among household members are generating substantial social benefits for families using this initiative. As the Mobile Card becomes available more widely, the social benefits are likely to be large. ASEM/2006/127 will monitor the broader uptake of this initiative.

8.3.3 Environmental impacts

Through more efficient use of existing oil palm and cocoa holdings, the pressure on land for cash cropping may be lessened. For example, in areas where land is available, cocoa growers tend to plant new cocoa blocks when their existing stands of cocoa are old and producing little. Through commercial sector partnerships and the delivery of extension and other inputs, productivity will rise thus reducing the need to cultivate new land. Furthermore, the CPB threat makes it critical that growers abandon their 'foraging' strategy in old cocoa blocks as these low labour input blocks will become reservoirs for CPB.

Finally the research findings clearly show that with an appropriate extension program tailored and integrated with the livelihood strategies of smallholders, there are opportunities for considerable increases in smallholder productivity without the need to expand the area of land under cultivation. The latter option of increasing the area of cocoa cultivation (a strategy promoted by the PNG Cocoa Board) is no longer viable for PNG given high population growth rates and limited availability of land for further expansion of cocoa.

8.4 Communication and Dissemination Activities

A cornerstone of the project approach was the continual line of communication between the community of smallholders and the research team, with smallholders involved directly in most aspects of the research in both cocoa and oil palm. Smallholders had considerable input into the design and monitoring of various project activities. Research findings were also regularly reported back and discussed with smallholders to assist smallholders to understand how different socio-agronomic practices affected their productivity and incomes. These discussions with smallholders

(e.g. individual or group interviews and informal community meetings) also enabled the research team to further refine their own research methodologies and understanding of the socio-agronomic factors constraining smallholder productivity.

An evaluation of the Mobile Card trial amongst oil palm smallholders at Hoskins was completed in early 2004, and a report written. The report has been widely circulated amongst industry stakeholders, and the Bialla OPIC extension staff communicated the results of the Hoskins trial to Bialla smallholders as part of their awareness program of the Bialla Mobile Card trial. The oil palm companies at Bialla and Popondetta are looking at ways of implementing the payment system for their smallholders.

All reports are published online on Curtin's internet archive site. In the past 12 months there were over 12,000 downloads of these reports and other PNG-related research produced by the team.

The World Bank has been using the team's oil palm research extensively in the design of a five-year Smallholder Agriculture Development Project (SADP). In addition, the World Bank is drawing on one of the key reports from the cocoa research (Curry et al., 2007b) for a potential new project in that industry.

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Omuru, E., Duigo, J., Koczberski, G. and Curry, G.N. 2004. Presentation for the Bailu Landowner Group. CCI, May.

Omuru, E., Curry, G.N. and Koczberski, G. 2005 Socio-Economic Factors Constraining Smallholder Productivity in Cocoa. Invited paper presented to the PNG Growers Association, Kokopo, East New Britain, PNG, 30 June.

8.4.2 Workshops

2007 Building Alliances for Agricultural Extension in PNG. 27th November, Holiday Inn, Port Moresby. Publicly advertised workshop.

2006 Mobile Card Workshop held with OPIC and OPRA extension and research staff, two representatives from Hargy Oil Palm Ltd and two representatives from the Bialla Oil Palm Growers Association. OPIC Baubauta, 17th February.

2003 Constraints on smallholder cocoa production. Workshop held with CCEA & DPI Extension Staff, Warangoi, ENB. 13 October.

The 2007 Port Moresby workshop brought together representatives and smallholders from the main tree crop export sectors of PNG to ‘showcase’ successful initiatives involving partnerships between smallholders and the private sector. See Appendix xx for list of invited speakers. The workshop contributed significantly to the exchange of skills and information between different industry organisations.

9 Conclusions and Recommendations

9.1 Conclusions

9.1.1 Smallholder cocoa production: towards a synthesis

The model of smallholder production in Section 7, reveals that there are two broad production strategies followed by smallholders: the low labour input foraging strategy in which cocoa is harvested and sold as wet bean; and the higher labour input farming strategy usually associated with dry bean processing. Because labour inputs in block maintenance are generally low, especially for pruning and shade control, cocoa blocks typically enter the very low productivity foraging phase prematurely at around 7 or 8 years of age during which recurrent income is insufficient to finance replanting.

Developing strategies to overcome the complex and long-standing constraints on smallholder productivity, particularly the premature transition of cocoa blocks into the unproductive foraging stage, require innovative approaches that create new incentives for smallholders to devote more time and labour to cocoa production. Potential strategies for raising smallholder productivity using the commercial sector to provide extension services and support for farmers are summarised in the recommendations section below (for more detailed discussion see Curry et al. 2007).

9.1.2 Smallholder oil palm production and the mobilisation of labour

Labour supply constraints among oil palm smallholders are the primary cause of under-harvesting and low smallholder productivity. Constraints on the supply of labour lead to the under-utilisation of family or caretaker labour and the minimal supply of hired labour. The results of the Hoskins and Bialla Mobile Card Trials demonstrated that an effective payment mechanism that guarantees full and timely payment of youth and women's labour is effective for mobilising labour and raising productivity and incomes. The payment of labour in fruit (a share of the fruit harvested by the worker) overcomes the reluctance or inability of blockholders to pay cash for family or hired labour. Such a payment mechanism has potential to raise productivity in other smallholder cash crops where similar constraints limit the supply of family and hired labour.

The Mobile Card is effective for three reasons: 1) it gives confidence to workers that they will be paid in full and in a timely manner for work completed; 2) it provides a mechanism for overcoming the difficult problem that blockholders have of retaining cash for the payment of labour; and 3) by formalising in a contract the roles and status of both blockholder and worker, the Mobile Card helps ameliorate blockholders' fears that the recruitment of labour is a threat to their tenure rights.

9.1.3 Extension and service provision for smallholders

It is clear from research findings that traditional models of cocoa extension have not been effective in raising smallholder productivity. Given the threat of CPB there is an urgent need for the commercial sector to become involved in the delivery of extension and services to growers in. Commercial sector partnerships with smallholders modelled on elements of the successful nucleus estate-smallholder (NES) model of oil palm development in PNG offer a way forward. In oil palm, commercial sector involvement in the smallholder sector has been through direct investment in infrastructure, market access including transport, extension, seedling production and distribution and credit for tools, fertiliser and replanting.

The research has shown that the commercial sector is keen to engage further with smallholders to deliver extension and other inputs to cocoa farmers. At several sites in East New Britain Province, NGIP-Newmark is now providing smallholders with extension services, planting material and other support such as transport and credit (similar partnership models are being established in West New Britain Province). These initiatives offer potential solutions for addressing low cocoa productivity and the CPB threat.

9.2 Recommendations

9.2.1 Cocoa Smallholder Production

Based on the Smallholder Model of Production in Section 7, the following recommendations are made to reverse the falling production, income and labour investments which characterise cocoa stands of more than 7 or 8 years of age (the foraging stage) of:

- Shift from an extension model of 'teaching' farmers about block management, to a system where the extension agents work in 'partnership' with smallholders.
- Enhance smallholder motivation to produce cocoa by focusing on strategies to improve the quantity of easily accessible crop available for harvesting.

There is a need to extend the Stage 2 farming phase through improved block management to prevent blocks entering prematurely into Stage 3, so that there is a longer period when the block is producing sufficient crop for dry bean production. An extended Stage 2 will motivate smallholders to invest labour in harvesting and dry bean processing. Second, it is necessary to promote replanting (where rehabilitation is not a viable option) to eliminate the unproductive Stage 3. Timely replanting would initiate a reversal of the downward spiral of declining labour inputs associated with rising pest and disease levels and falling yields, to an upward cycle of rising yields. This would act as an inducement for smallholders to commit more labour to block maintenance and harvesting for dry bean production.

Most growers do not think about replanting until the block is well into Stage 3 and cocoa income is so low that they cannot afford to replant from recurrent income. The current extension recommendation of whole-block replanting should be replaced with a rotational/staged replanting strategy to make replanting affordable. Under a rotational replanting program a significant proportion of the block remains in the productive Stage 2 phase (70% of the cocoa stand based on a staged 10% replant each year), which would be more than sufficient to finance replanting while providing the family with a relatively high level of income.

However, as highlighted elsewhere in this report, conventional extension strategies appear unable to reverse or even arrest this decline. Therefore, it is recommended that ACIAR investigate and facilitate promising new extension models involving the commercial sector working in partnership with smallholders to raise productivity and incomes. The Nucleus Enterprise (NE) model involving 'partnerships' between the commercial sector and smallholder producers offers advantages over existing extension models including a centralised payment system that offers opportunities for providing extension and other inputs funded by deductions from growers' payments. This can also be extended to new payment mechanisms for mobilising labour (similar to the Mobile Card) (for further detail see Curry et al. 2007a).

9.2.2 Oil Palm Smallholder Production

To build on the success of the Mobile Card trials at Hoskins and Bialla the following recommendations are made:

- Promote and extend the Mobile Card initiative to all oil palm regions.
- Ensure that the initiative remains highly flexible and responsive to smallholders' production needs. Ideally, it should be possible for Mobile Card contracts to be drawn up at short notice for a single harvest round, specifying the phase or phases to be harvested.
- Sporting clubs, church groups and schools should have access to Mobile Cards for fund raising. This would build social capital, while creating awareness amongst smallholders that the oil palm industry is an integral part of their community life.
- The Mobile Card could be used as part of a replanting package for heavily populated blocks. For multiple household blocks undertaking replanting, it may the Mobile Card can provide supplementary income while waiting for new palms to come into production.

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