CABI

IMPACT

CASE Study

15

Integrated management of the cocoa pod borer in Papua New Guinea: An impact study

summary

Over 150,000 households in Papua New Guinea (PNG) depend upon cocoa for their livelihoods but yields are threatened by a number of factors including the cocoa pod borer (CPB). A prolific pest that is extremely difficult to eradicate, CPB can devastate cocoa crops, inflicting losses of 80–90%, with subsequent negative impacts on incomes, livelihoods, export earnings and gross domestic product. It is generally accepted that eradication is difficult and therefore not really an option. The best strategy is for farmers to use a combination of techniques under integrated pest and disease management (IPDM) to lower infestation levels.

In 2007, CPB caused great loss and hardship to the people of PNG's East New Britain Province (ENBP) whose livelihoods are sustained by cocoa. Amid fears that the same fate would befall all cocoa growers in the country, a 2008–2011 project – funded by the Australian Centre for International Agricultural Research (ACIAR), led by CABI, and jointly implemented with the PNG Cocoa Coconut Institute Limited (CCIL) and other partners – set out to enable PNG cocoa stakeholders to better manage the pest. Titled '*Managing CPB in PNG through improved risk incursion management capabilities, IPM strategies and stakeholder participatory training*' (CPB1), the project worked to help cocoa growers improve CPB monitoring and surveillance procedures, adapt – for use in PNG – IPDM technology successfully used to manage CPB in other countries, and carry out participatory training and extension for cocoa farmers.

In 2015, project partners, including CCIL and CABI, revisited PNG stakeholders and farmers to assess the project's impact. Through a household survey, review of secondary literature and key informant interviews (KIIs), the adoption and spread of IPDM technologies recommended in CPB1 were evaluated. The aim was to find out: How had farmers involved in the project benefited? Were they still using the technologies and earning income from cocoa? Were those who were trained as trainers still training others? Were the recommended methods in widespread use beyond the

farmers directly involved in the project? Have methods been incorporated into policy? What factors encouraged uptake of recommended IPDM technology and what factors hampered it? What lessons were learned about project design and implementation?

This brief summarizes the activities, findings and recommendations of this follow-up study.

highlights

- IPDM technology used to manage CPB in other countries was evaluated and successful technology was adapted for use in PNG. A total of 21 master facilitators, 131 facilitators and 378 farmers were trained in this technology, leading to the adoption of better farming practices.
- The following IPDM practices were emphasised: basic block sanitation, pruning, canopy reduction and height control, frequent and complete harvesting, regular and systematic monitoring, removal of infested pods, proper sanitation, target pod spraying, pod sleeving and the use of CPB-tolerant planting materials.
- Although it was not possible for all farmers to adopt all recommended practices, those who adopted all or some of the recommended practices experienced economies of scale, and improved yields and incomes, which sustained cocoa growing from 2012 to 2013 when cocoa prices were low.
- CPB1 IPDM training materials were integrated into private sector training and extension programmes.
- CPB1 IPDM package has become part of the national cocoa strategy and is formally recommended by CCIL in its IPDM manual for farmers.
- CPB management strategies have been integrated into the World Bank-funded *Productive Partnerships in Agriculture Project* (PPAP). To date 3,600 farmers have used the new practices and a targeted 20% adoption rate is expected to result in a total of 30,000 farmers adopting the new practices by 2019.
- CPB emergence created great uncertainty and distress among cocoa farmers (leading many to abandon their plots) but the introduction of CPB IPDM strategies has increased confidence in cocoa growing.
- CPB IPDM strategies are dependent on use of inputs and intensive labour. Adoption of these strategies depends, to a large extent, on farm size (economy of scale), world cocoa prices and opportunity cost of alternative crops.

context

Agriculture is the mainstay of PNG's economy, sustaining the livelihoods of 85% of the population and contributing 14% of foreign exchange earnings. PNG only supplies about 2% of the world's cocoa but it provides cocoa of a specific flavour to the United States market and good fermented beans with a high fat content for Asian grinders. Fourteen out of 22 provinces in PNG (the coastal provinces) grow cocoa with East Sepik, Bougainville (the Autonomous region of Bougainville) and ENBP as the main cocoa-producing provinces. Cocoa employs 31% of the national labour force and ranks third in export earnings, after oil-palm and coffee, and is grown in plantations and smallholdings. However, since the mid-1970s, plantation production has been declining and smallholder production increasing – with smallholders now growing 80% of PNG's cocoa. Cocoa is the main source of income for these smallholders, whose livelihoods depend upon it. Production relies largely on family labour, and crop husbandry and inputs are minimal. Few or no plant protection interventions are available to smallholders, and pests and diseases remain a constraint to improved crop production.

Cocoa stakeholders involved in post-harvest activities are categorised into primary, secondary and key stakeholders (PNGCCIL, 2009). Primary stakeholders include smallholders, co-operative groups, large plantation owners, youth groups and NGOs involved in cocoa farming. Smallholders make up the majority of this group. Secondary stakeholders are traders, suppliers/agri-businesses, transport owners and processors. Key stakeholders include local, provincial and national authorities, statutory organizations such as the PNG Cocoa Board, and extension support providers. The domestic cocoa market is divided into the wet bean market, where smallholders sell unprocessed beans to buyers; and the dry bean market, where dried and fermented cocoa beans are sold to exporters or to registered dry bean buyers. Cocoa bean processing is governed by laws and regulations enforced by the Cocoa Board, which is also responsible for issuing licenses to those intending to ferment or export cocoa.

Pieces of land on which cocoa is cultivated, commonly referred to as 'blocks', can be pure stands of cocoa – as in the case of commercial or research plantations – or cocoa intercropped with food crops such as coconut, bananas, cassava, peanuts, or other fruit trees, in smallholder gardens. Block maintenance of cocoa in PNG is

generally characterized by an absence of pest and disease control measures (Curry *et al*., 2007). When cocoa is severely affected by pests and diseases, yields drop especially where management practices are not undertaken adequately so income from cocoa is lowered and growers will look for alternative income sources. As prices rise, more management is undertaken, cocoa yields rise, dependence on other income sources diminishes and cocoa becomes the focus of cash-earning activities. At this point, because farmers anticipate good returns for their labour, they show more interest in their blocks. Pest control costs money, so it is implemented only when farmers expect that income from cocoa will cover this extra cost. Fluctuating world cocoa prices (see Table 1) have a major influence on grower decisions – when they are high, farmers are encouraged to cultivate cocoa; when they fall, farmers dedicate less labour and resources to cocoa, or abandon it altogether.

Smallholders play a key role in the cocoa value chain and are significantly affected by any factor that has a negative impact on the crop. Despite the importance of cocoa to PNG and smallholders, cocoa production in the country is hampered by several factors including inadequate resources, credit facilities, farm management skills and marketing facilities. However, CCIL lists CPB infestation, and the risk of exporting it, as the greatest constraint to cocoa cultivation in PNG (PNGCCIL, 2009).

CPB was first detected in PNG in 2006 and, although the government attempted to eradicate it, it re-emerged in 2007. Post-2008, the pest severely affected cocoa growing in ENBP and gradually spread to all major cocoa-growing regions of the country. CPB – *Conopomorpha cramerella* – a moth of the Gracillariidae family, lays its eggs on the cocoa plant. When the larvae hatch they bore into growing pods, damaging the placenta and arresting development of the cocoa beans. Under the right conditions, the female moth can lay up to 200 eggs and, with a lifecycle lasting just over a month, 11 generations can be produced in one year. Due to this prolific breeding rate, CPB can lead to devastating losses in a short time, which means anyone intending to grow cocoa must be able to manage CPB infestation levels in their blocks.

An ACIAR-sponsored study on CPB impact in ENBP, carried out by Curtin University, stated that CPB was the single largest threat to the economy and society of ENBP (Curry *et al*., 2011). Efforts to eradicate CPB have failed and, despite high global demand for cocoa and the economic importance of the crop to PNG, its cocoa industry is in crisis because of this pest. PNG cocoa yields have been decreasing by 6% a year since 2006, especially in ENBP where cocoa production has declined from over half of total PNG output to less than 15%. This is thought to be a consequence of the emergence of CPB (Pearce, 2016) and data from the PNG Cocoa Board illustrates this trend (Table 1). Much more needs to be done if PNG's 150,000 smallholders reliant on cocoa are to successfully manage CPB infestations.

Table 1: Cocoa production in Gazelle district, ENBP

Year	London Prices (GBP/ton)	Kg	% ENBP/PNG total
2005	838	18,241	53
2006	876	20,626	46
2007	984	16,930	38
2008	1,440	21,640	38
2009	1,839	8,279	16
2010	2,128	6,207	15
2011	1,868	7,193	15
2012	1,538	4,061	10
2013	1,566	4,704	12
2014	1,901	5,174	15

Source: PNG Cocoa Board

what did CABI do?

From 2008–2011, CABI partnered with CCIL to help PNG cocoa stakeholders to better manage CPB through the ACIAR-funded project, CPB1. There were three key activities: 1) improving surveillance and monitoring CPB infestations; 2) testing and adapting resource-matched and location-specific IPDM programmes for CPB management; and, 3) developing a farmer participatory training and research (FPTR) programme for the effective dissemination of technologies. The project built on earlier work on black pod disease (Daniel and Guest, 2011), which had introduced IPDM approaches for cocoa production in PNG that, while not specifically targeting CPB, contributed to its management.

CPB was first detected in Kerevat Area of ENBP in 2006, when ENBP was the leading cocoa producer in the country. The economy of ENBP and the livelihoods of its people depended largely upon cocoa and there was an urgent need to establish strategies that would manage its impact on cocoa productivity and minimise its spread to other provinces. For these reasons, ENBP was selected as the main focus area for CPB1 activities.

By the end of the project, a number of scientific, capacity and community impacts had been achieved. A standardized scheme was developed for CPB surveillance and monitoring. CPB management practices from Malaysia and Indonesia were adapted for use in PNG and integrated with existing IPDM packages into an IPDM manual for use by extension workers and farmers. Training materials were prepared and disseminated to extension workers for wider use. Five treatments (ie. target pod spraying and sleeving under five different rates and timings of application) were tested and the findings used to develop the IPDM package, which included the following recommendations: basic block sanitation, pruning, canopy reduction and height control, frequent and complete harvesting, regular and systematic monitoring, removal of infested pods, proper sanitation, target pod spraying, pod sleeving, and the use of CPB-tolerant planting materials. The FPTR programme was implemented through the training of master facilitators (TOMF), training of facilitators (TOF), conducting farmer field schools (FFS) and the production and dissemination – to relevant agencies through CCIL – of several training materials, including a manual, posters (300 copies), a PowerPoint presentation and a DVD (50 copies).

A TOMF course was conducted for 21 participants from CCIL, the Department of Primary Industries (DPI) and the private sector. An important selection criterion was that participants should be committed to training others, and setting up and running FFS. The 21 master facilitators, in turn, trained 131 facilitators on the basics of CPB management, the criteria for identifying suitable FFS field sites, and how to set up and run FFS. Made up of farmers, extension workers, private trainers, DPI staff, ward councillors and various groups/committee members, facilitators were only selected for training if they were able to conduct FFS upon completion of training. Initially, only four FFS were planned but the facilitators managed to conduct 10 FFS at 10 different sites in the Gazelle district, ENBP, where 378 farmers (26% women) were trained. As a result, relevant knowledge and skills were widely disseminated to cocoa growers.

Cocoa farmers in PNG were already aware of the threat posed by CPB prior to CPB1 and were, largely, also aware of recommended management options. However, CPB1 was timely as farmers were yet to fully implement said practices. Reeling from the CPB devastation of 2007 and low global cocoa prices, many farmers were, at the time, preparing to abandon cocoa in favour of other cash crops. When CPB1 started in 2008, the project initiated enhancing existing IPDM strategies to specifically target CPB and to put in place a training programme for farmers. It can be difficult to gauge with certainty CPB1's effect on encouraging farmers to continue in cocoa – when those decisions are also closely tied to fluctuating world cocoa prices – but, in 2015, four years after the project ended, CABI went back to the project sites with just that goal: to evaluate progress and long-term CPB1 outcomes. Attribution of outcomes to a single project such as CPB1 does not make sense when there have been other initiatives before and since. However, the evaluation study sought to track how outcomes from CPB1 are contributing to the overall fight against CPB in PNG.

Specifically, the aim was to find out:

- How did the farmers trained in CPB management benefit from the knowledge disseminated by the project?
- To what extent do those trained as trainers still impart knowledge to others?
- How useful were project materials? Did they continue to be used after the project closed in 2011?
- Which PNG organizations working in cocoa production/trade/extension continue to practise or promote the recommended technologies? Have methods been incorporated into policy?

To feed into future project development, it was also important to tease out any lessons learned about project design and implementation. Had we done everything in the best possible way or, in hindsight, could we have done certain things differently? Were there particular circumstances under which farmers were more or less likely to benefit? To assess all this, we conducted a household survey of farmers who had been trained by CPB1, held KIIs with stakeholders, and reviewed literature. CCIL staff and extension officers assisted with the household survey by administering questionnaires prepared by CABI. A total of 80 farmers (eight from each of the 10 FFS), 12 master trainers and 28 facilitators were interviewed on demographics; their landholdings and cocoa production; how yields and income had changed in recent years; cocoa management practices being used; the training materials used in

CPB1; and whether they had gone on to train others since culmination of project activities.

Organizations interviewed included government institutes (staff of CCIL, DPI, the Cocoa Board and PPAP); staff of the University of Natural Resource and Environment (UNRE) at Vudal; private sector organizations involved in cocoa, including cocoa exporters Agmark and Outspan; and others such as growers' associations.

findings

How did farmers benefit: Interviews with cocoa producers and exporters, such as Agmark, indicate that farmer decisions on whether or not to invest in cocoa production are economic, based on cocoa prices and cost of production. CPB management practices require a significant investment in terms of inputs such as spraying equipment, protective clothing and pesticides; and labour, which could be costly for a smallholder with a small number of trees. The investment may not be offset by the income generated. It was observed that when cocoa prices fell below 400 kina per bag (6.5 kina per kg; ~ US$2), many farmers ceased investing in good management practices. For example, when cocoa prices went down immediately after CPB1 ended in 2011, many farmers stopped investing in cocoa production. Average prices per kg reported in 2012, 2013 and 2014 were 5.4, 5.5 and 5.6 kina/kg, respectively, with 6.1 kina/kg being the median price. Interest in production only returned in 2014–2015 when prices started to rise again. As a result, the household survey data showed a high degree of variation in cocoa production behaviour and it was difficult to derive clear conclusions when analysed as one set of data. In order to tease out lessons learned, the data was regrouped based on the "Technology adoption life cycle model" (Beal *et al*., 1957). Farmers were then categorized into three groups using the above model as a guide, but adapting it to local conditions (Table 2).

Table 2: Categorisation of farmers

Grower category	% farmers	Description of category
A	25	Those who immediately implemented the recommended practices experienced yield improvements from 2011 onwards; they benefitted the most from training. These farmers tend to have larger farms, treat cocoa growing as a business and have more cash flow.
B	40	Those who followed suit when cocoa prices increased above kina 400/bag (started replanting from 2014 onwards); their benefits will be delayed and they will likely request refresher courses or re-training. These farmers are more conservative but open to new ideas and influence their neighbours.
C	35	Those who did not invest in recommended practices and did not experience improved yields; the training had no impact on these farmers and they did not benefit from economies of scale. These farmers are very conservative, have smaller farms and less capital, tend to be subsistence or part-time cocoa farmers, with other employment. They would rather invest in more profitable crops or their jobs.

Table 3 shows that for farmers in category A, yields started off high and increased gradually; while the yields of farmers in category B were low at the start and then increased. Yields of farmers in category C decreased from 2012 to 2014. The majority of farmers in category A were male (82%) and had larger farm sizes and a lot more cocoa trees (Table 3). Farmers in category C were more likely to have secondary, tertiary or vocational education than other categories; they work elsewhere and consider cocoa farming to be a 'side' job or informal subsistence farming engaged in for a little extra income. The data also showed that 75% of these farmers mentioned engagement in occupations other than farming – while only 12.5% with primary or no education had any off-farm activity.

Table 3: Characteristics of farmers in category A, B and C; figures in brackets are standard deviation

Characteristics	A (n=17)	B (n =32)	C (n=31)
% male	82.4	56.3	38.7
Age	47.4 (9.93) n=16	46.3 (12.96) n=30	48.0 (10.68) n=25
Farm size (ha)	1.93 (0.934) n=17	1.09 (0.773) n=31	1.52 (0.967) n=28
No. of cocoa trees	744 (458) n=17	302 (192) n=31	353 (249) n=28
% with off-farm activity	88	79	77
Education level (%)			
Primary only or none	76	81	61
Secondary, tertiary or vocational	24	19	39
Yield (kg/ha)			
2012	222 (230.8) n=16	34 (39.8) n=17	105 (96.1) n=21
2013	288 (273.8) n=16	63 (91.3) n=17	68 (62.1) n=21
2014	370 (298.4) n=17	110 (125.2) n=17	31 (49.3) n=21
Yield (kg/tree)			
2012	0.7 (0.97) n=15	0.3 (0.41) n=15	0.64 (0.70) n=19
2013	0.9 (0.97) n=15	0.6 (1.18) n=15	0.39 (0.36) n=19
2014	1.0 (0.74) n= 16	0.8 (1.49) n=14	0.16 (0.19) n=19

Farmers in category A were more likely to have been following the CBP management practices provided in training (Table 4). It was found that the pod sleeving method, which avoids use of chemicals – although effective and environmentally-friendly – was not sustainable. The plastic bags required for this method are quite costly and not readily available, so farmers who practised pod sleeving during the project period, when bags were provided, did not continue once the project concluded. Pesticide application equipment is also expensive as it has to be purchased, along with personal protective equipment and pesticides, and this deters growers who do not enjoy the economies of scale that would justify the capital outlay.

Table 4: Percentage (%) of farmers who followed recommended CPB management practices

	A	B	C	Men	Women
Havest weekly*	41.2	15.6	3.2	8.8	7.5
Havest fortnightly	23.5	21.9	9.7	11.3	6.3
Havest monthly	35.3	28.1	54.8	22.5	17.5
Centralized pod breaking*	64.7	40.6	19.4	27.5	10
Bury pod husks*	82.4	50.0	38.7	31.3	21.3
Dry and burn pod husks	11.8	3.1	12.9	5	3.8
Pod sleeving	0.0	0.0	0.0	0.0	0
Spraying insecticides: karate or Binatox*	82.4	46.9	25.8	54.5	36.1
Pruning BEFORE spraying*	76.5	31.3	16.1	23.8	11.3
Pruning AFTER spraying	17.6	6.3	6.5	6.3	2.5
Pruning AFTER havesting*	70.6	37.5	19.4	26.3	11.3

** indicates key CPB management practices that lead to increased cocoa yield*

Traditionally, cocoa in PNG has been a low-input crop. It is treated as a subsistence crop, with some farmers referring to it as an 'ATM' crop as cocoa pods are a ready source of cash, often harvested and sold when households need money. With the arrival of CPB in PNG, any pods that were not harvested on time were attacked and damaged by the pest, which meant the traditional low-input systems yielded low or no returns. Cocoa production was therefore only viable under a more high-input system with increased pesticide and labour costs. Consequently, many farmers switched to alternative enterprises rather than invest in high-input strategies; and only 25% appeared to adopt improved strategies and maintain or increase yields.

Smallholder cocoa growers often have diverse income sources including copra (coconut), garden produce, betel nut, vanilla, livestock and trade-stores (Curry *et al*., 2007) and livelihood strategies are likely to vary. The importance of cocoa production as an income source is different for men and women – with women ranking the income from markets higher than the income from cocoa and the reverse being true for men (Curry *ibid*.). This may be the reason why women were less likely to invest time and money in more intensive management practices compared to men (as shown in Table 3, most women fell into category C). Hence, for future training, it would be more effective to target growers in category A first so that they, in turn can influence, teach and encourage other farmers.

Training: The survey revealed that seven out of 12 master trainers, and nine out of 28 farmer trainers, continued to train others after the project concluded. Of the master trainers, two became full-time trainers: one became lead trainer/ project manager at the Didiples Integrated Training and Extension Centre (DITEC); and the other became the training coordinator at the Agmark Tokiala training centre. Most of the master trainers were professionals involved in extension work for private sector companies or researchers. More than half of the farmer trainers were farmers or cooperative representatives, with the rest mainly self-employed; two were researchers. During project training, master trainers and farmer trainers used project materials, but master trainers were more likely than farmer trainers to use formal training aides, including a training manual (75% and 46%, of master and farmer trainers, respectively) and PowerPoint presentations (42% and 18%, of master and farmer trainers, respectively). The project management strategies have been incorporated into the IPDM package of CCIL's cocoa strategy, produced as a manual and are disseminated through various extension activities. The practices are also being integrated into training delivered by private sector companies such as Agmark.

Materials: The CPB1 FFS training manual was used for TOMFs and TOFs during the project. It was then adapted into various training documents for use by private sector actors like Agmark Tokiala training centre, DITEC and Outspan. A cocoa management practices training manual was published by ACIAR in 2008, and revised in 2011 to include additional CPB management strategies from the project (Konam *et al*., 2011). The pocket sized manual continues to be used and has proved very useful for farmers and trainers. The project posters and video have not been used due to insufficient funds for mass production and dissemination. Similarly, the PowerPoint presentation was largely unused as farmers generally do not have access to computers and power.

Continuity of IPDM practices: Some stakeholders (such as the Cocoa Board, CCIL, DPI, provincial technical teams and private sector players) continued working in cocoa and sustained the momentum of CPB1. Agmark, one of the beneficiaries of CPB1 training, has adapted the CPB1 method, rebranded it as 'five steps' and is, to date, heavily involved in training and awareness of CPB management. Some new players, affiliated to those who follow the CPB1 methods, are also perpetuating the methodology; for example, OLAM, a big cocoa buyer, purchases cocoa beans from Outspan who use the FFS approach. The Training by Association scheme is a hugely active training programme supported by the PNG Sustainable Development Program: trainees are brought in from various parts of PNG and manage cocoa farms using the Agmark method. IPDM practices developed by CPB1 and an earlier ACIAR project (Daniel and Guest, 2011) are being used in the World Bank-funded PPAP, which is targeting 30,000 coffee and cocoa farmers by the end of 2019 and anticipates adoption rates of 20% (Pearce, 2016), similar to adoption rates observed for CPB1 farmers.

Achievements and way forward

The overall conclusion of the CPB1 impact study is that, although the impact of CPB1 alone was not significant, it has made a substantial contribution to the fight against CPB. The key CPB1 output was a modified IPDM CPB package, produced as a training manual for extension workers and farmers – which led to better farming practices and improved yields – directly and indirectly by feeding into the World Bank PPAP (Pearce, 2016). This package was disseminated widely, incorporated into a training manual, and reproduced as a variety of training materials that were used to run FFS. A total of 530 trainers and farmers received training on this technology. IPDM has been integrated into national cocoa policy and is disseminated through extension activities. CPB1 increased the potential for higher yields.

Field visits strongly indicate that, whereas CPB emergence created great uncertainty and distress among cocoa farmers (leading many of them to abandon their plots), the development and dissemination of IPDM techniques dramatically increased confidence in cocoa growing. Farmers have achieved substantial yield increases, and adoption of IPDM techniques has extended beyond the original project areas. It should be noted that benefits of the project are ongoing and will continue to be reaped into the future. Follow-up projects such as PPAP and CPB2 are testing and distributing new CPB-tolerant germplasm. An ACIAR impact evaluation noted:

"The three projects in PNG [Daniel and Guest, 2011; Curry, 2011; and CPB1] combined in a unique way with each other and with the World Bank Productive Partnerships in Agriculture Project (PPAP) (funded through a loan facility to the PNG Government) to provide a comprehensive set of farming options and a well-defined extension and adoption approach. The ACIAR projects contributed to the development of the PPAP and substantially to the understanding of integrated pest and disease management (IPDM) practices in PNG, with a particular focus on CPB. The interaction with the private sector purchasers of cocoa (in this case, NGIP Agmark) provides a unique approach to disseminating research outcomes. (Pearce, 2016)"

We have learned some valuable lessons:

- The need for increased inputs creates a particular challenge to adoption of IPDM practices, especially in parts of PNG where most cocoa farming is typically very low input. Complex economic and social calculation within farming households and communities is involved when considering adoption of these practices. The opportunity cost of labour is key here.
- Furthermore, are the materials for the technologies readily available? Is it cost effective? What are the implications of economies of scale? Bigger producers can produce more cocoa, reduce the cost per kg of cocoa beans and thus handle low prices. Smallholders are unable to absorb this cost.
- The above economies of scale suggest a need for more strategic recruitment of farmers for training, targeting the growers who are most like those in category A. However, the study team also noted that some PNG communities are close-knit and attempts to single out particular farmers could be counter-productive. Participation of the whole village should be considered, but also the selection of individuals by local leaders/chieftains/head-men – with requests from project staff for selection of those most likely to benefit from training.

At the start of CPB1, the pest was present mainly in ENBP but has, since, spread to all cocoa-growing provinces. A new project (referred to as CPB2), led by Sydney University and involving CABI, is working in ENBP, New Ireland, Bougainville and Madang provinces to build on the work started by CPB1. Titled '*Improved management strategies for cocoa in Papua New Guinea*', CPB2 is expected to produce versatile and region-specific extension guidelines for intensified cocoa management involving CPB-tolerant germplasm, improved pest and disease management practices, improved soil fertility, and improved cocoa quality and market access. The use of organic fertilizer (cocoa pods and manure) and application of bio-pesticides have been added to CPB1's IPDM package to form an improved IPDM package used in CPB2 trainings. The extension method that was tested during CPB1 (the FFS approach) is being widely applied in PPAP and CPB2 sites.

CPB2 has a wider scope than CPB1, focusing not just on CPB management but on all aspects of cocoa growing, extension work, testing of planting material, business/marketing and training. CABI will be leading the training component of CPB2, and is responsible for developing training materials and region-specific extension strategies, specifically TOMF.

References

- Beal, G.M., Everett, M.R. and Bohlen, J.M. 1957. 'Validity of the concept of stages in the adoption process'. *Rural Sociology*, 22 (2): 166–168.
- Curry, G., Koczberski, G., Omuru, E. and Nailina, R.S. 2007. *Farming or Foraging? Household Labour and Livelihood Strategies Amongst Smallholder Cocoa Growers in Papua New Guinea*. Black Swan Press. Curtin University of Technology, Perth, Australia. **http://espace.library.curtin.edu.au/R/?func=dbin-jump-full&object_id=129444&local_base=GEN01-ERA02**
- Curry, G., Lummani, J. and Omuru, E. 2011. *Socioeconomic Impact Assessment of Cocoa Pod Borer in East New Britain Province, Papua New Guinea*. Project no. ASEM/2008/034, Final report no. FR2010-25. Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia.
- Daniel, R. and Guest, D. 2011. *Enhancing Papua New Guinea Smallholder Cocoa Production Through Greater Adoption of Disease Control Practices*. Project no. ASEM/2003/015 Final report no. FR2011-29. Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia.
- Ho, C.T., Lim, G.S., Loke, W.H. and Sastrautomo, S.S. 2011. *Managing CPB in PNG through Improved Risk Incursion Management Capabilities, IPM Strategies and Stakeholder Participatory Training*. Project no. PC/2006/114. Final report submitted to Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia. Unpublished to date.
- Konam, J., Namaliu, Y., Daniel, R. and Guest, D.I. 2011. *Integrated Pest and Disease Management for Sustainable Cocoa Production: A Training Manual for Farmers and Extension Workers*. 2nd Edition. ACIAR Monograph No. 131. Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia. **http://aciar.gov.au/files/node/9136/mn131_2nd_edition_2011_integrated_pest_and_di_17838.pdf**
- Pearce, D. 2016. *Sustaining Cocoa Production: Impact Evaluation of Cocoa Projects in Indonesia and PNG*. ACIAR Impact Assessment Series Report No. 89. Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia. **http://aciar.gov.au/publication/ias89**
- PNGCCIL. 2009. *Papua New Guinea Cocoa Coconut Institute Limited's Strategic Plan 2010–2020*. PNGCCIL, Papua New Guinea. **https://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwiy2rvxt5zNAhVIsJQKHb_pDIQQFggeMAA&url=http%3A%2F%2Fwww.biblioz.com.au%2Flp25764949078.html&usg=AFQjCNHX1ZXwGQQr27diMDbF16QkwyrEcw**

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