PART II – INTEGRATED PEST MANAGEMENT PLAN

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1.0 Introduction

This Integrated Pest Management Plan (IPMP) provides a framework for ensuring that the Productive Partnerships in Agriculture Project (PPAP) supports environmentally sound pest management procedures. It directly addresses World Bank Policy OD/OP 4.09: Pest Management, and constitutes Part III of the Environmental Management and Social Framework (EMSF) for the project.

The Productive Partnerships in Agriculture Project is executed by the Papua New Guinea Cocoa Board and the Coffee Industry Corporation (CIC) Limited, with funding from the International Development Association (IDA) and the International Fund for Agricultural Development (IFAD). The National Department of Agriculture and Livestock (NDAL) will have a monitoring and coordinating function at the national level.

1.1 Project Overview

PPAP is one of the Government's programs contributing towards the goals of PNG's National Agriculture Development Plan (NADP) and complements other government initiatives, under the Medium Term Development Strategy (MTDS), together with activities supported by other development partners in the sector. The focus of the PPAP is on the coffee and the cocoa industries, given their strategic importance for the rural economy and rural households, and in view of the challenges that those industries are facing. Within those two major industries, the proposed PPAP would provide, over several years, the predictable and continued support required to implement some of the structural changes necessary to improve their performance and sustainability – and maintain their competitiveness in global markets- by strengthening core institutions and improving the delivery of support services and infrastructure for smallholders.

The **development objective** of the proposed project would be to improve the livelihoods of smallholder cocoa and coffee producers supported by the Project. This would be achieved through strengthening industry coordination and institutions, expanding and strengthening linkages between smallholder farmers and agribusiness for the provision of technologies and services, and through the provision of critical market access infrastructure.

Key outcomes would be that: (i) smallholder farmers adopt efficient, market responsive and sustainable production practices leading to an increase in their income; (ii) demand-driven productive partnerships are scaled up and sustained; and (iii) key infrastructure bottlenecks in the targeted value chains are addressed.

The proposed project would include the following components:

Component 1: Institutional strengthening and industry coordination

Component 2: Productive partnerships

Component 3: Market access infrastructure

Component 1: Institutional Strengthening and Industry Coordination. The specific objective of this component would be to improve the performance of sector institutions and to enhance industry coordination in the coffee and cocoa sectors. Existing stakeholder platforms for industry coordination would be consolidated to

address short- and long-term issues such as sector governance, skills development in the industry, improvement in extension services, industry strategy on threats to quality and quality promotion, information within the industry, market development and crop diversification. This component would have four sub-components as follows:

Sub-component A: Industry coordination & policy development: This sub-component would build the capacity of industry coordination committees (ICC) to support sector dialogue and policy development in the cocoa and coffee subsectors.

Sub-component B: Communication and information management systems. The project would strengthen the information management systems necessary to inform policy development and stakeholders' decisions in the coffee and cocoa industries.

Sub-component C: Quality and sustainability management: This sub-component would strengthen quality promotion in the coffee and the cocoa industries and promote, where appropriate, the adoption of certified sustainability practices (such as Organic, Fair Trade, Rainforest Alliance, Utz, and quality certification schemes);

Sub-component D: Project management and monitoring and evaluation (M&E). This sub-component would support all project management and M&E functions in the Project Management Units (PMUs) respectively located in the Cocoa Board and the CIC, as well as a small Project Coordinating Unit (PCU) in DAL. It would also finance the related Technical Assistance (TA) and the operations of the Technical Appraisal Committee (TAC) under Component 2.

Component 2: Productive Partnerships. The specific objective of this component would be to increase the integration of smallholder producers in performing and remunerative value chains, by developing and implementing productive alliances between smallholders and the private sector in the project areas.

Those partnerships would be demand-driven and consistent with the specific priorities identified in each subsector. During project preparation, these strategic priorities have been identified as follows:

(a) In the cocoa sector, activities which support CPB management such as training on good farming practices; the production of improved planting material (nurseries and budwood gardens) to increase their availability for replanting; the promotion of and support for rotational replanting and cocoa garden rejuvenation; market-driven diversification of cocoa-farming system; and management of quality through the adoption of more efficient and environmentally-friendly post-harvest and processing technology;

(b) In the coffee sector, activities which support the adoption of sustainability practices and the expansion of the production of differentiated coffees; training on good farming practices; the production of improved planting material to increase their availability for replanting; replanting and coffee garden rejuvenation programs; market-driven diversification of coffee-farming systems; and management of quality

through the adoption of more efficient and environmentally-friendly post-harvest and processing technology.

Project funding would be channeled through partnerships with legal entities in the private and associative sectors, which have already been successfully working with smallholders on productivity, quality and sustainability enhancement and are interested in scaling up those activities. Those partnerships would be result-oriented, and expected results and cost-sharing arrangements would be specified in the partnership agreements. The project would provide assistance for the development of those partnership proposals, as needed, through contracted local service providers.

This component would have two subcomponents:

Sub-component A: Productive partnerships in the cocoa growing areas. This component would finance result-oriented partnerships in cocoa-growing areas to increase smallholder cocoa productivity, quality and sustainability and improve cocoa-faming systems. Its implementation would be under the responsibility of the PMU within the Cocoa Board with support from a Technical Appraisal Committee (TAC).

Sub-component B: Productive partnerships in coffee growing areas. This sub-component would finance result-oriented partnerships in coffee-growing areas to increase smallholder coffee productivity, quality and sustainability and improve coffee-farming systems. Its implementation would be under the responsibility of the PMU within the CIC with support from the TAC

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Component 3: Market Access Infrastructure. The specific objective of this component would be to improve smallholder market access in targeted areas under the project. This component would have two sub-components as follows:

Sub-component A: Preparation of market access infrastructure investments. This sub-component would finance the identification and selection of priority investments in support of Component 2 partnerships.

Sub-component B: Market access infrastructure development. This sub-component would finance the related investments in infrastructure rehabilitation and maintenance.

Under the MTDS, a key strategy is the promotion of economic growth by empowering smallholders to mobilize their resources to generate higher income. The PPAP is fully aligned with this strategy.

1.2 Sector Background

Coffee and cocoa are produced in PNG by approximately 400,000 and 151,000 households respectively, which accounts for about 60 percent of the total population.

Smallholder production accounts for about 85 percent of total coffee production and 80 percent of cocoa production[1].

Smallholder coffee and cocoa farmers typically have low input – low output farming systems, involving relatively minimal levels of agrochemical use. However, this may begin to change with the recent outbreak of cocoa pod borer (CPB) and the expected infestation of coffee berry borer (CBB). Conversely, agrochemical use on plantations is fairly high and reflects their more intensive management systems.

1.3 IPMP Focus

The IPMP[2] has been prepared to address the requirements of the World Bank OP's 4.09 Integrated Pest Management and, consistent with the PPAP design, focuses on the smallholder sector. However, other direct and indirect issues are also addressed, such as implications of partnerships with plantations, agrochemical runoff effects, etc.

2.0 Policy Regulation and Institutional Capacity

2.1 Conventions regarding Agrochemicals

Papua New Guinea is a member of the Governing Council of the United Nations Environment Program, and it has membership to a number of international and regional treaties and conventions relating to the environment, including a number that relate specifically to the control of hazardous substances:

(a) Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal;

(b) Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade[3];

(c) Stockholm Convention on Persistent Organic Pollutants;

(d) Vienna Convention on Protection of the Ozone Layer;

(e) Montreal Protocol on Ozone Depleting Substances; and

(f) London Dumping of Wastes at Sea.

Other regional agreements to which PNG is a party to include:

(a) Waigani Convention; and

(b) South Pacific Regional Environmental Programme.[4]

PNG is a member of the Intergovernmental Forum on Chemical Safety but has yet to become a Party to the Rotterdam Convention on Prior Informed Consent (PIC). To date, PNG has been participating in the PIC process on a voluntary basis under an interim arrangement. However, now that the Convention has entered into force, PNG needs to ratify and become a member.

[1] CIC & NAQIA 2006 and URS 2009

[2] It should be noted that although the term integrated pest and disease management (IPDM) has been adopted by most PNG research institutions, the term IPM, adopted by the World Bank, is interpreted as all encompassing and of the same meaning for the purposes of this document.

[3] Annex 1 lists the chemicals under the Stockholm and Rotterdam Conventions.

[4] DEC, 2006 Final Draft of National Implementation Plan.

The large majority of pesticides that are available in PNG are on the list of permitted pesticides by the Rotterdam and Stockholm Conventions, however there are three pesticides that are on the prohibited list (methamidophos and certain formulations of Benomyl and carbofuran). These pesticides are generally not used in cocoa and coffee.

2.2 PNG Pesticides Legislation and Control

The Importation and Distribution of Agrochemicals into Papua New Guinea is under the jurisdiction of the Department of Environment and Conservation (DEC). DEC is empowered to monitor and regulate the import, use and management of chemicals in the country under the Environmental Act 2000 (Pesticide Regulation 1998).

DEC is also responsible for the awarding of import permits, transfer of permits, issuing of pesticide guidelines (for sales, importation, manufacture, distribution, promotion, advertisement and use). In addition, DEC is responsible for maintaining an inventory of pesticide impacts, for providing packaging guidelines for agrochemicals, and for enforcing compliance with the regulations.

However, there is no proper institutional framework or network established for controlling the monitoring and controlling chemicals in Papua New Guinea. While a permitting system was previously in place under the repealed Environmental Contaminants Act[5], it was never properly implemented due to a lack of institutional capacity.

DEC's lack of capacity is a major issue. For instance, the Act requires pesticide users to submit annual pesticide returns and to provide management plans for hazardous chemicals (industrial chemicals). However, these are often not provided and there is a general lack of control over both the import and use of hazardous chemicals.

DEC has developed action plans and a draft National Implementation Plan (NIP) to address at least some of these shortcomings but there appears to be a major problem in finalizing and operationalizing them, and then implementing them[6].

Other departments with responsibility and legislation relating to agrochemicals and pesticides include the Departments of Health, Transport, National Agriculture Quarantine Inspection Agency (NAQIA) and Customs - the latter two both focus on the quarantine chemical usage and the implementation of imports respectively. Again, the effectiveness of these institutions is constrained due to a lack of capacity.

The Department of Agriculture and Livestock (DAL) has no relevant legislation that deals with agrochemicals, although there is a mention of IPM within the NADP[7]. While some awareness is undertaken by DEC, DAL and the National Agriculture Research Institute (NARI) on the use and management of the organophosphate and carbamate groups of pesticides and fertilizers, including their potential risks to humans and the environment, not much else has been provided to farmers and the public (NIP 2006).

The chemicals in pesticides and petroleum products have regulatory controls while no regulations exist for industrial and consumer chemicals, except in specific instances

[5]The Environmental Contaminants Act is now absorbed into the Environmental Act 2000.
[6] Conversation with DEC Officer 31/8/09)
[7] The NADP is outlined in the EA: Part I of the EMSF - one of its objectives includes the utilisation of IPM.

where particular chemicals are named. For example, specific regulations under the Health Act deal with the herbicide Paraquat, the industrial safety regulations for timber treatment chemicals, and also the now banned insecticides *monocrotophos* and *methamidophos or chlorpyrifos*. With exception of *monocrotophos*, the stated pesticides are still being used in the PNG agriculture sector, however only *chlorpyriphos* is occasionally used in cocoa cultivation

Moreover, the processes for regulation and control under the Environment Act (2000) are vague and are yet to be tested in the field. Nevertheless, there are other regulations which have specific provisions and mandates to meet PNG's obligations under various International Treaties and Conventions that PNG is a signatory to. The full report of the National Implementation Plan highlighted the missing linkages between agencies of government to coordinate, regulate and manage chemicals in the country.

The deficiencies in regulatory procedures and institutional capacity, outlined above, present both challenges and opportunities for the implementation of PPAP. Although in general smallholder farmers do not use chemicals for insect pests for their tree crops, a small percentage[8] use herbicides to control weeds. Farmers at Nagamiufa Village in the Eastern Highlands (11th December 2009) reported using Grammoxone and Glyphosate for weed control, with no safety gear such as overalls, gloves and facemasks. The reason given for herbicide use was shortage of or cost of labour inputs. This presents an opportunity for PPAP to encourage partnerships that promote improved and rationale use of agrochemicals.

2.3 Policy and Organizational Issues

The main public sector institutions relevant to PPAP are the Coffee Industry Corporation (CIC) and Cocoa Board (CB), as well as the Cocoa Coconut Institute Limited (CCIL), DAL, NARI and NAQIA.

Whilst CIC's legal statutes are considered adequate for the purposes of IPM, there is a need for a review of the legislation related to the cocoa industry. This should include the development of environmental sustainability criteria for the cocoa industry, with a medium term goal of ensuring internationally recognized certification of sustainability. Support for this review to the relevant legislation will be provided under the PPAP, as part of work on the Cocoa Act and related regulations under Component 1 of the project.

2.4 Institutional Arrangements and Collaboration

As the IPMP is focused on the coffee and cocoa industry, it is essential to note the institutional arrangements and collaboration within each industry. Capacity building activities would be carried out under Component 1 of the PPAP.

2.4.1 Coffee

There is currently no proper IPMP in place for the coffee industry, although recommended procedures for clearing or application of herbicides for weed control around coffee trees provide examples of IPM already in practice. However, with the

[8] Approximately 5% according to CIC.

possible infestation by CBB, there is a real need to establish an effective IPMP as soon as possible.

The CIC Research Division at Aiyura is well staffed with a plant pathologist, three entomologists and a post-harvest engineer. The division undertakes a number of IPM related activities, including:

- Trials on disease resistant/tolerant varieties of coffee seedlings and hybrids;
- Field trials aiming at minimal, efficient and safe utilization of pesticides and fertilizer and
- Optimizing the efficiency and environmental aspects of "wet processing".

In 2006, an Emergency Response Framework for the Pre- Entry Quarantine and Possible Incursion of Coffee Berry Borer was compiled by CIC and NAQIA (CIC & NAQIA, 2006). This plan encompasses six strategic steps to restrict the pest from entering PNG: 1) Pre-entry quarantine, 2) Preparedness, 3) Detection, 4) Alert, 5) Containment and 6) Eradication.

The Coffee Sub Sector report[9] highlights that since the use of agrochemicals by smallholders is very minimal, any IPM or biological control methods proposed would need to be compatible with smallholder farming systems.

There is particular concern for smallholder farmers if CBB enters PNG. On the one hand these farmers could become reservoirs for the pest, on the other hand they may be able to be persuaded to treat their coffee gardens more seriously or in a similar way to the handling of the CPB in the cocoa industry (Adoption of improved tree husbandry practices, which would also result in higher yields). The strengthening of service delivery, support for the adoption of improved coffee farming practices, and information to smallholders under PPAP will therefore contribute to preparedness efforts.

2.4.2 Cocoa

The arrival of CPB in 2006 in East New Britain Province initially led to a concerted eradication strategy. However, when in 2008 it was realized that the program had been unsuccessful and that the CPB infestation was "chronic", strategy shifted to one of management of the pest.

The Cocoa Pod Borer Response Coordinating Committee (CPBCC) is tasked with oversight of the CPB management strategy. This Committee comprises representatives from CCIL, NARI, NAQIA, the East New Britain Agriculture Division (DPI), DAL, the Cocoa Board, the University of Natural Resources and the Environment (formerly University of Vudal) and the Papua New Guinea Growers Association (PNGGA). The committee meets fortnightly to address progress with the implementation of a CPB Action Plan launched in 2007. The main areas of intervention undertaken by the CPBCC include:[10]

i) INTENSIVE public awareness,

ii) INTENSIVE farmer training,

[9] URS 2009 Coffee Sub Sector (PPAP background paper) [full reference]
[10] Strategy outlined in the Post Courier, one of the two major daily newspapers of PNG on the 9/7/09.

iii) FARMER support,

iv) STRENGTHEN stakeholder partnership,

v) SUPPORT to stakeholders,

vi) FARMER mobilisation,

vii) RESOURCE mobilization, and

viii) LEGISLATION.

The response plan involves a pest management approach consisting of six steps - strip weeding, pruning height and canopy control, shade management, pod removal and burial, regular harvesting and target spraying. The slogan used is: "harvest every pod, every tree, every week". These strategies present opportunities for support under PPAP.

Early implementation indicates that CPB infestation can be reduced to viable levels by implementing the first 5 steps. Targeted spraying is necessary in heavily affected areas.

3.0 Pests and Diseases

Pests and diseases for coffee and cocoa are diverse and the weather pattern can lead to increases in their populations.

Coffee

For coffee, a total of 175 pest and disease species have been found on trees and these can be classified into green scales, coffee ring borer and coffee center borer. In addition, there are the defoliators such as the coffee reef roller, army worms and semi loppers. Furthermore, there are the cicadas, leaf hoppers and also 160 species of insects that have been noticed on coffee trees (Table 1).

Within the Eastern Highlands Province, most coffee trees suffer from the Pink disease and Coffee Rust. The advice from CIC Research Division to the farmers is to cut out the Pink diseased tree and replace it with a new tree. This advice is reasonable however, the small farmers may have to remove their trees and replant, which would be devastating to them in terms of initial loss of income. For the Coffee Rust, the chemical brand *White* is used by farmers who can afford it.

The expected incursion of CBB into PNG is likely to be far more serious than coffee rust and whilst some measures have already been put in place through the "Emergency Response Framework for the Pre- Entry Quarantine and Possible Incursion of the CBB", much more rigorous and urgent actions will be required.

Cocoa

Cocoa insect pests can be classified as being wood boring larvae, pod damaging mirids and leaf feeding caterpillars (Table 1). Other problems include; grey weevils, moths and wood eating termites together with beetles, pod boring moths, roof chafers and mealy bugs. Notable diseases of cocoa in ENB, in order of dominance are: Vascular Streak Disease, Pink disease (present in 4% of cocoa trees surveyed[11]), Canker and Black pod, both caused by *Phytophthora palmivora*. The main pests are

[11] Curry et al 2007 (p.78)

the *Conopomorpha cramerella* (Cocoa Pod Borer, CPB), *Pantorhytes* weevil and Longicorn beetles. CPB infestation now affects about 90 percent of East New Britain (ENB) Province production areas and has also spread to Bougainville, New Ireland, Morobe, Madang, East Sepik, West Sepik and West New Britain Provinces.

Table 1: Pests, Type of Damage and Diseases of Coffee and Cocoa (Kumar 2001)

Insect Pest	**Type of Damage/Disease**
Coffee	
Green scales, *Coccus celatus* and C. *viridis* (Horn., Coccoidea: Cocidae)	Cause growth reduction in young co and up to 50% loss in cherry yield of mature coffee.
Coffee ring borer, *Meroleptus cinctor* (Col., Curculionidae)	May kill young trees and severely weaken older trees by ring-barking stems
Coffee center borer, *Zeuzera cofJeae* (Le ., T ortricidae)	Defoliate coffee plants resulting in losses.
Coffee leaf roller, *Homona cofJearia* (Lep., Tortricidae)	Larvae tunnel in branches which are usually killed.
Army worms, *Spodoptera exempta* (Lep., N octuidae)	A seasonal pest, its larvae defoliate plants and feed on the expanding cherries which can be a serious problem.
Semi-looper "army worms", *Tiracola plagiata* (Lep., Noctuidae)	Defoliate whole trees and seriously damage or kill them.
Shothole weevils or leaf-eating weevils, *Apirocalus* sp., *Aulacophrys fascialis, Oribius* s . (Col., Curculionidae)	Adults chew holes in soft flush and defoliate plants in secure attacks.
Leafhoppers, *Batrachomorphus szentivanyi* & *B. blotei* (Horn., Cicadellidae)	Dense populations cause plant to show loss of vigour, retard growth & yellowing of leaves.
Cicadas (Horn., Cicadidae)	Larvae/nymphs suck sap from coffee rootlets thereby affecting nutrient uptake and tree vigour.
Coffee Berry Borer (CBB) *Hypothenemus hampei Ferrari (Coleoptera; Scoltytidae)*	Adult and larvae feed inside the cherries eating out the flesh. Cherries will have an exit hoe made by the beetle [not into PNG yet]
Cocoa	
Pest	**Type of Damage/ Disease**
Pantorhytes (Coleoptera: Curculionidae) weevil	Larvae bore into wood of trunk and main branches causing debilitating of trees and Phytophthora canker
Longicorns (Coleoptera: Cerambycidae).	Larvae bore into wood of trunk and main branches. (Canker)
Cocoa Pod Borer (CPB) *(Conopomorpha cramerella)*	Larvae bore into the pod and feeds on pulp and placenta causing clumping of beans and small and flat beans if placenta is damaged
Mirids (Heteroptera: Miridae).	Adults and nymphs suck sap from pods and shoots.
Flush and Foliage Catepillars (Lepioptera: Geometridae Limacodidae, Noctuidae).	Larvae feed on both young and mature leaves.
Grey Weevils (Coleoptera Curculionidae)	Adults chew bark of young cocoa shoots Larvae bore in branches of larger trees.
Pansepta (Lepidoptera: Xylonctidae).	
Termites (Isoptera: Kalotermitidae)	Adults and nymphs chew wood inside the tree.
Rhyparida (Coleoptera: Chrysomelidae)	Adults feed on leaves.
Pod Borers (Lepidoptera: *Cryptophlebia*	Larvae bore into husk of pods.
Tortricldae, *Olethreutus:*(Olethreutidae).	Larvae chew roots of young trees.

Chafers (Coleoptera; Scarabaeidae: Melolonthinae)	Larvae bore into terminal branches.
Oxymagis (Coleoptera: Cerambycidae) *Zeu.zera*	Larvae bore into wood of trunk and main branches. Adults and nymphs suck sap from shoots, pods and flowers.
(Lepidoptera: Cossidae). Mealy bugs (Homoptera)	Adults and nymphs suck sap from pods.
Pseu ococcidae). *Amblypelta* (Heteroptera: Coreldae).	More than 400 species which patronize leaves, pods and wood of the cocoa tree.

4.0 Current IPM Practice

4.0.1. General IPM principles

IPM consists of a set of interventions that all together result in reduction of pest incidence to low and acceptable levels with minimal possible negative impact on natural ecosystems, non-targeted pests and the environment. Generally, components of IPM are the following:

1- Cultural practices – good farm management:
   a. Frequent, complete harvesting
   b. Sanitation
   c. Pruning of cocoa/coffee trees and shade trees
   d. Weed management;
2- Planting materials resistant/tolerant to major pests and diseases;
3- Biological control of pests and diseases if available;
4- Rational pesticide utilization (minimal, efficient and safe use of permitted pesticides).

4.0.2 Current IPM methods used in PNG

There is no explicit IPM policy in PNG, with the main control being focused on cultural practices - although the oil palm industry provides an exception with an IPM practice. Cultural practices are often the first level of defense, with pest management strategies generally built upon them subsequently.

Regarding cocoa, the large majority of small cocoa farmers do not use any chemical inputs. The most used chemical input by small farmers is herbicide, mostly Round-Up (glyphosate), however, Gramoxone is also available. Lately due to cocoa pod borer infestation some cocoa farmers started to use insecticides, usually lambda Cyhalothrin (Karate). Large plantations are also using lambda cyhalothrin (Binatang) as the principal insecticide and are alternating it with Acelic (primiphos-methyl) and with cypermethrin or other synthetic pyrethroid to mitigate any possibility for the buildup of resistance.

With regards to cocoa, currently small cocoa farmers in PNG in majority do not manage their cocoa blocks with needed attention, therefore losses due to pests and diseases are high and productivity of cocoa trees is low in spite of good planting materials with high production potential. To address this problem, an ACIAR project started in 2005 to test in the field Integrated Pest and Disease Management (IPDM)

options with different levels of management inputs, starting with the option that only included labor inputs (good farming practices), with the next option adding also fertilizer and finally a full package including also insecticide, fungicide and herbicide. These management trials showed very good results in significantly increased cocoa production and decreased losses due to pests and diseases. These field trials received strong attention from farmers and some farmers are starting to adopt these better management systems. IPDM methods are elaborated in more details later in this document.

Good cocoa planting materials that have been bred for 20 years to be resistant to black pod disease caused by *Phytopthora palmivora* and Vascular Streak Dieback (VSD) caused by *Oncobasidium thoebromae* are used in PNG. Very low incidence of these two diseases is observed in the field with very low losses of cocoa production. However, breeding and selection of clones that are resistant to CPB have only started with CPB introduction in 2006. CCIL has selected some clones that are high yielding and also showing very low infestation with CPB. These selected clones are already being tested on smallholder cocoa gardens and, as soon as possible, at least partly resistant clones could be released to farmers together with training on management of clones for attaining higher yields. More clones with higher resistance to cocoa pod borer are being bred and selected by CCIL.

4.1 Coffee

The Coffee Industry Corporation promotes the production of coffee in PNG and has set targets to increase the tonnage of coffee beans to reach new higher levels from year to year. As earlier stated, most coffee is grown by smallholders who apply minimal agrochemicals to their plots – where they are applied, they are normally limited to NPK fertilizers and herbicides such as *Glyphosate* (Round Up).

CBB Control

There have been suggestions that CBB could be controlled by endosulfan. However, this is a banned chemical under both FAO/UNEP and the Stockholm Convention. Biological control of the CBB is possible through a guild of natural enemies, such as *Cephalonomia stephanoderis*, *Proropsnasutu*, *Phymastichus coffea* and *Bouveria bassiana* - these are parasitoids that feed on the CBB.

In addition, the white muscardine fungus kills the CBB under favourable environmental conditions of high humidity (>80%) and optimum temperature of 25 – 30^{o}C. Hence, a number of factors would need to be considered to minimize or eradicate the population of CBB (NAQIA – CIC 2009). Currently, the Emergency Framework has placed its emphasis on Pre Quarantine measures right through to Eradication. The steps are:

1. Pre Entry Quarantine
2. Preparedness
3. Detection
4. Alert
5. Containment and
6. Eradication.

The Contingency Plan Framework defines the functions or steps to be taken by NAQIA and CIC to restrict the CBB from entering the country through the implementation of three strategic steps;

- ❖ Pre- entry quarantine
- ❖ Preparedness, and
- ❖ Detection.

Table 2 outlines the roles that NAQIA and CCI will need to facilitate.

Table 2: CBB Contingency Plan Framework

Pre-entry quarantine	Awareness leaflets/posters	Technical information
	Surveillance	Surveillance
	Implementation of quarantine restrictions in 20 km buffer zone	Implementation of quarantine restrictions in 20 km buffer zone
Detection	Detect exotic CBB Notify Chief Quarantine	Advise Industry
Emergency Response	Invoke Emergency Response Plan	Implement ERP
Recovery	Disbandment of ERP	Advice Industry

Upon the detection of CBB, the Emergency Response Plan will be activated and resources placed into agencies to address the outbreak. As it stands, this framework would need to be given to the farmers and CIC would be required to circulate leaflets informing the community of the threat.

When the CBB does arrive in the Highlands of PNG, NAQIA and CIC will need to decide on the effective steps to take. The CIC should start identifying possible responses, including options such as biological control and a pyrethrium-based pesticide to be fully developed and ready for the outbreak of the CBB.

4.2 Cocoa

As mentioned previously, the CCIL has field tested the five options of increasing intensity levels of cocoa farm management based on IPM principles (IPDM/IPM of cocoa) (Table 3). The level of IPM increases from cultural practices demanding only labor inputs (pruning, sanitation, weekly complete harvesting and weeding) through to the maximum inputs involving the rationalized addition of fungicides, herbicides and insecticides where CPB infestation is high. Table 4 provides a summary of those options.

Table 3: IPDM Measures suggested by CCIL[12]

Option	**IPM**	**Activity**
1	Low	Current practice
2	Medium	Weekly complete harvest, sanitation, weeds management, cocoa & shade prune related to crop cycle. Cocoa height @ 3.5m-4m

[12] Information in this section including all tables were provided to the author by CCIL staff on 21/10/09.

		maximum
3	High	Option 2 + Chemical inputs include: 100ml/ha Glyphosate & Gramoxone (Herbicide) 100g/tree Urea/240g/tree NPK (Fertilizer)
4	Very High	Option 3 + Fungicide & insecticide: 2g/tree Ridomil+2ml/tree, 6g/tree Copper oxide, Dichlorvos (Fungicides & insecticide)
*5	Maximum input including controlling CPB	Option 4 + CPB control, Chlorpyrifos 1.6%ai @ 10ml/15Ltr of water (to be used wherever CPB is reported

Some of the chemicals mentioned in Table 3, i.e. Grammoxone (Negative List), Dichlorvos (Class 1b) and Chlorpyrifos (Class 2) are prohibited from World Bank supported activities under OP 4.09, Pest Management.

There are alternative options as per the table below:

Option	**IPM**	**Activity**
1	Low	Current practice
2	Medium	Weekly complete harvest, sanitation, weeds management, cocoa & shade prune related to crop cycle. Cocoa height @ 3.5m-4m maximum
3	High	Option 2 + Chemical inputs include: 100ml/ha Glyphosate (Herbicide) 100g/tree Urea/240g/tree NPK (Fertilizer)
4	Very High	Option 3 + Fungicide & insecticide: 2g/tree Ridomil+2ml/tree, 6g/tree Copper oxide, lambda cyhalotrin (Fungicides & insecticide)
*5	Maximum input including controlling CPB	Option 4 + CPB control, lambda cyhalotrin (Karate) 1.6%ai @ 10ml/15Ltr of water (to be used wherever CPB is reported

The CPB Response Coordinating Committee has adopted and promoted five golden rules for the management of CPB:

1. Clean Weed and Reduce Shade
2. Prune Cocoa (control height to 3 -4 m and reduce canopy)
3. Do Frequent Complete Harvest (Every Pod, Every Tree, Every Week)
4. Infested Pods and Pod husks buried after every harvest
5. Target Pod Spray (on pod surface and underside of branches).

However, some of these rules have met resistance from smallholder farmers, especially regarding the burying of infested pods due to the high labor inputs required.[13] To them, it is not practical nor desirable to dig holes every week - this requires far more time and effort than their previous low management systems. The

[13] Community consultation with small holder farmers on 22/10/09.

option of covering cocoa pod husks with a plastic sheet for a fortnight is also efficient, however there are problems with the cost of this option as well as plastic sheets being stolen. Sanitation of cocoa husks is a very important part of IPM and farmers who want to control CPB will have to adopt one of the proposed sanitation measures.

Target pod and branch spraying with insecticides to control CPB is important in the areas with high CPB infestation but the critical prerequisite to assure efficiency of applied insecticide are good farming practices that are keeping cocoa block well maintained and cocoa trees well accessible. Insecticide spraying is not a substitute to good farming practices. Where farmers are observing lower levels of CPB infestation, good cultural practices – good farm management, will be sufficient to keep CPB in low levels and reduce losses to very acceptable levels. Generally, approximately 70% of CPB control is achieved by strict application of good cultural practices (weekly complete harvesting, sanitation, pruning), so for the small cocoa farmers the use of these practices with no routine insecticide applications would be the best option. Occasional, limited rounds of insecticide spraying might be needed if infestation builds up to high.

Another important factor is timing in relation to the cocoa crop cycle (Table 4). Pruning and fertilizer applications should be done after the large harvest while insecticide applications, if needed, should be done during the raising crop to protect developing pods.

The application of spot sprays on cherelles in areas with high CPB infestation is essential and should be done when the majority of cherelles are approximately 8cm long and continued with fortnightly spraying for 4 –5 consecutive applications. If the pod is sprayed after the cherelle grows into a full sized pod, then insecticide spraying will be ineffective as the CPB will have already infected the pod. It may be necessary to increase application frequency during the wet season. Recommendations on timing and frequency of pesticide applications need to be further defined by CCIL and the need to spray or not should be related to the level of infestation that is observed in farmers' cocoa block.

Table 4: Cocoa Crop Cycle

Input Periods	Flower and cherelle formation period	Harvest periods	Crop Type
January February March	April May June July	October November December January	Main crop
August, September October	November December January February	April May June July	Mid crop

Linking IPM strategies to the crop cycles and to pest cycles is crucial. For example, the CPB has a life cycle of 30-35 days and it is essential to target disruption of its reproductive cycle in order to reduce number of adult insects in cocoa blocks. Table 5 shows the typical results from the various IPDM inputs where all these contribute to the health of the cocoa tree.

PPAP activities will include support for training of farmers and other stakeholders on IPM strategies for the control of the CPB, as well as resources for the implementation of the response plan. This is in line with the needs expressed by communities during

consultations carried out for the preparation of the EA[14]. Specific training should also be performed related to the safe, efficient and minimal utilization of pesticides (Rational pesticide utilization- RPU)

Table 5: Results of various IPM Inputs

Results of inputs	Outputs or the results of the inputs
Sanitation	1. Reduce pests and diseases(+CPB) 2. Improves general tree health
Canker & Longhorn paint	1. Reduce infestation with Longhorn larvae on the trunk and incidence of canker caused 2. Improves tree health 3. Tree survives longer
Vector control	1. Reduces black pod incidence 2. Localized black pod incidences
Fertilizer Urea	1. Increase tree vegetative growth 2. Improves tree health
NPK	1. Induce flowering 2. Promote growth 3. Maintain fruit shedding
Weed control	1. Reserve plant nutrients 2. Discourage pests and diseases 3. Improve tree and block sanitation
Shade control	1. Allow light penetration to dry moisture 2. Discourage Pests and disease development
Cocoa pruning	1. Allow light penetration 2. Provide uniform canopy 3. Promote flowering 4. Improves tree health, reduce pests and diseases 5. Allows good cocoa husbandry and management as trees are small and accessible

5.0 Pesticide Management under PPAP

It is essential that PPAP supports the development of knowledge and builds upon lessons already learned on IPM in PNG. Little work has been conducted concerning biological control methods for either CPB or CBB – this is something that could be supported by the likes of ACIAR.

5.1 Occupational and Health Risks and Mitigation Measures

Table 1 clearly demonstrates the myriad of pests and diseases that beset coffee and cocoa farmers. PPAP has an opportunity to support farmers, who are mostly (90%) smallholders to improve their productivity by emphasizing horticultural practices as the key strategy to managing the impact of these pests and diseases.

There is a need for much more emphasis by the CIC and CB on awareness and training of "best practice" methodologies so that the use of agrichemicals is minimised. Even where training has been given, some farmers have indicated that they do not always follow up, for example the coffee farmers at Nagamiufa admitted transplanting seedlings from under their existing trees rather than purchasing improved seeds or seedlings from Aiyura and using grammoxone without protective clothing.

[14] Discussion with cocoa farmers during community consultation 22/10/09.

IPM methods based on good cultural practices only do not entail chemicals and thus, there is no risk to farmers. However, when agrochemicals are adopted, such as will be required for CPB (and CBB if it enters PNG), it is essential that farmers are made adequately aware and are taught proper procedures for the safe use, handling, application, storage and disposal of chemicals. This would include the use of face, nose, eyes, and body protection with appropriate gears, and personal hygiene to thoroughly wash hand and clothing after the application of the agrochemicals. Only permitted pesticides should be used in recommended quantity and frequency with appropriate application techniques and nozzles that assure the most efficient control of targeted insect with minimal quantity of insecticide used.

By adhering to this, the incidence of pesticide poisoning could be minimized. The PPAP Social Survey in ENB noted a higher uptake of training and use of pesticides by women because, besides applying to the cocoa pods, they also used that on their vegetable[15]. They seem to be more adept to applying pesticides (URS 2009). Training activities on the minimal, efficient and safe utilization of pesticides should therefore be designed the way to also maximize participation by women farmers.

Again this presents both challenges and opportunities for PPAP to support CIC and CB in their awareness and training programmes with follow up extension activities and monitoring.

5.2 Overview of Training and Human Resource Development

Training of small farmers on IPM is an integral part of PPAP activities. Small farmers need to know and understand how they can produce quality coffee and cocoa while minimizing any negative impact on the environment.

5.3 Training of Farmers

Within ENB province, farmer training on IPM started in 2008 with a focus on three districts within the province. Under PPAP, farmers will be trained in other districts and in ARB. This will also be promoted for the coffee growing provinces. In addition, modules emphasizing IPDM/IPM are part of the Integrated Agriculture Technical Project (IATP) that is jointly implemented by the University of Environment and Natural Resources[16] and the University of Queensland, and will complement the training conducted under PPAP. Other training modules under the IATP are:

- Sustainable Livelihood
- Basic Management
- Book Keeping
- Setup of Cooperative Society

All these will be delivered through the various productive partnerships within Component 2 of the PPAP. During community consultation, a number of sentiments were expressed about different modalities for the delivery of this training. Training on IPM would be conducted through a number of modalities, including on plantation

[15] Confirmed during community consultation 22/10/09.
[16] Formally University of Vudal.

training ("training by association"), "farmer to farmer" approaches as promoted by the Cocoa Board in the Madang and Morobe provinces, and other proven approaches. Excellent results were shown from the update of this training in only a short period of time where cocoa production was greatly increased[17].

In addition, farmers could be trained in a community setting at community halls. This would have the advantage of greater community spinoff and involvement. Training in dormitories is a more formal avenue of training which is often not popular with smallholder farmers who have various family and community obligations. It may be more appropriate for training of trainers.

A large number of cooperative societies have been formed in the project provinces and they could be also sources to draw farmers from to attend the training.

6.0 Monitoring And Evaluation under PPAP

The Department of Agriculture and Livestock indicated its preference for an Environmental Specialist (ES) to be engaged during the PPAP to build capacity of the Implementing Agencies. It would be the responsibility of this TA to train the relevant staff in the PMUs (Component 2 coordinators, and any other staff involved in monitoring activities) and to routinely visit all the establishments of PPAP target provinces, and to report to the Project Management Unit (PMU) on any issues arising with the implementation of pest management practices under PPAP.

6.1 Activities Requiring Monitoring

The application of IPM measures are often done by the farmer as he or she is in control of his coffee or cocoa garden, based on the training that has been given. The uptake of IPM by farmers would be confirmed through the project M&E activities, by observing a sample of farmers, who have attended the training and monitoring results from their cocoa or coffee blocks.

The Environmental Specialist (and Component 2 Coordinators and M&E Officers respectively in the Cocoa Board and CIC) would need to visit selected blocks to observe the application of IPM measures. These sites and areas would need to be discussed with the CIC, CCI, CB, CPBCC, and NAQIA.

[17] Post Courier 23/10/09.

7.0 References

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4. Kumar, R, 2001, Insect Pests of Agriculture in Papua New Guinea: Part I: Principles and Practice- Pests of Tree Crops and Stored Products. Science in New Guinea, University of Papua New Guinea.
5. URS, 2009, Productive Partnerships in Agriculture Project (PPAP) Draft Project Design Document for PNGDAL Rpt 42444072
6. Pesrticide use on cocoa. Manual issued by ICCO (International Cocoa Organisation), prepared by Dr. Roy Batemen, IPARC, Imperial College London.
7. _____Working Paper No. 1 Institutional Assessment
8. _____Working Paper No. 2 Cocoa Sub Sector
9. _____Working Paper No. 3 Coffee Sub Sector
10. _____Working Paper No. 6 Social Assessment

Annex 1: List of chemicals under Stockholm & Rotterdam Conventions

Stockholm Convention	Rotterdam Convention
Annex A • aldrin • chlordane • dieldrin • endrin • heptachlor • hexachlorobenzene • mirex • toxaphene • polychlorinated biphenyls (PCB)	**Pesticides** • 2,4,5-T • aldrin • captafol • chlordane • chlordimeform • chlorobenzilate • DDT • dieldrin • dinoseb and dinoseb salts • 1,2-dibromoethane (EDB) • fluroacetamide • HCH (mixed isomers) • heptachlor • hexachlorobenzene • lindane • certain mercury compounds • pentachlorophenol **certain hazardous pesticide formulations of** • methamidophos • methyl-parathion • monocrotophos • phosphamidon • parathion **Industrial chemicals** • asbestos (crocidolite) • polybrominated biphenyls (PBBs) • polychlorinated byphenyls (PCBs) • polychlorinated terphenyls (PCTs) • tris (2,3-dibromopropyl) phosphate **recently added include pesticides** • binapacryl • toxaphene • ethylene dichloride • ethylene oxide • DNOC and its salts • All formulations of monocrotophos and parathion • Certain formulations of benomyl, carbofuran and thiram **industrial chemicals** • asbestos (actinolite,anthophyllite, amosite, tremolite) • Tetraethyl and tetramethyl lead

Annex 2: Pesticides used in the PNG Agriculture & Livestock sector

No	Chemical Trade Name	Active Ingredients	No	Chemical Trade Name	Active Ingredients
1	"Dibbs" Bromo-O-Gas	methyl bromide	55	Calixin	tridemorph
2	2, 4-D Amine	2, 4-D	56	Carbofuran	carbofuran
3	Abate	temephos	57	Chemoxone	paraquat
4	Acephate (Pilarthene)	acephate	58	Chemoxone	paraquat
5	Acephate 75 SP	acephate	59	Chloropyrifos	chloropyrifos
6	Actellic	pirimiphos-methyl	60	Cislin	deltamethrin
7	Actellic 50 EC	pirimiphos-methyl	61	Confidor	acephate
8	Aimit insecticide	permethrin	62	Coopex dust	permethrin
9	Ally 20 DF	metsulfuron methyl	63	Copper Nordox	copper oxide
10	Amatrex 50 SC	ametryn	64	Copper Oxychloride	copper oxychloride
11	Ametrex	ametryn	65	Cypermetrin	permethrin
12	Anisban	chloropyrifos	66	DDVP 50 Ec	dichlorvos
13	Atrazine 5- % FW	atrazine	67	Decis 200 EC	deltamethrin
14	Atrazine 50 % ww	atrazine	68	Delfin	bacillus thuringiensis
15	Banvel	dicamba	69	Diuron 800	diuron *
16	Barrack 720	chlorothalonil	70	Diuron 900	diuron *
17	Basta	glufosinate ammonium	71	Diuron 900 Df	diuron *
18	Bayfidan	triadimenol *	72	Dow-Agroscience-Chloropyrifos Dursban 5	chloropyrifos
19	Bayfidan	triadimenol *	73	Ebor baits	warfarin
20	Baythiod	cyfluthrin	74	Ebor rat bait	warfarin
21	Befenthrin	bifenthrin	75	Elanco garlon 600	triclopyr
22	Benlate	benomyl **R**	76	Ezy kill	permethrin
23	Benlate	benomyl **R**	77	Feritrothion 1000	fenitrothion 1000
24	Bifenthrin	bifenthrin	78	Ficam dust	bendiocarb
25	Blitzem	metaldehyde	79	Fumtoxin	aluminum phosphide
26	Blitzem granules	metaldehyde	80	Fumtoxin	aluminum phosphide
27	Blizem	mataldehyde	81	Fusilade 212	fluazipop-butyl *
28	Blue copper	copper hydroxide	82	Fusiland post emergency selective herbicide	fluazipop-butyl *
29	Bravo	chlorothalonil	83	Garlon	triclopyr
30	Bravo	chlorothalonil	84	**Garlow**	triclopyr
31	Bromakil bait	bromadiolone	85	Glyphosate	glyphosate
32	Calixin	tridemorph	86	Gramoxone	paraquat
33	Icon 10 WP	lambda cyhalothrin	87		
34	Iconet satchhets	lambda cyhalothrin	88	Racumin 8 Tracking powder	coumatetralyl
35	Imada 70 WSB	phosmet	89	Racumin	coumatetralyl
36	Invader	triclopyr	90	Round up	glyphosate
37	Invader 600	triclopyr	91	Shoot weedicide	glyphosate
38	Kamba	dicamba	92	Spread stick	Aclcohole alkoxylate ??
37	Karate	lambda cyhalothrin	93	Starane	fluroxypyr *
38	Mavrik insect Spray	tau- fluvalinate	94	Starane	fluroxypyr *
39	Mesurol	methiocarb	95	Starane 200	fluroxypyr *
40	Methamidophos	methamidophos **R**	96	Stedfast	alpha cypermethrin
41	Mimic	tebufenozide *	97	Stomp	Pendimethalin
42	Mimic	tebufenozide *	98	Storm rat bait	flocoumafen
43	MSMA	monosodium methyl arsenate (MSMA)	99	Storm rodenticides	flocoumaten
44	Mustang	imidacloprid	100	Striker 50 EC	hexaconazole
45	Mustang 200	imidacloprid	101	Tallon pellets	brodifacoum

46	Nutrazene	atrazine	102	Tamaron special	methamidiphos
47	Orthene	acephate	103	Tecto Flowable SC	thiabendazole
48	Ortin	acephate	104	Terbutryn FW	terbutryne *
49	Perkil 25 EC	permethrin	105	Terbutryne	terbutryne *
50	Permatrin powder	permethrin	106	Thiram WDG	thiram **R**
51	Permethrine dust	permethrin	107	Tomcat Blox	bromadiolone
52	Pilafuran	carbofuran **R**	108	Toxaphos	aluminium phosphide
53	Pilarfuran	carbofuran 10 % w/w, 2,3-dimethyl 1-7 benzofuran **R**	109	Trisodium Phosphate	triadimefon
54	Punch 330	flusilazole	110	Weedmaster	glyphosate

*Not on list of registered pesticides **R** = Rotterdam / PIC