THE GOVERNMENT OF PAPUA NEW GUINEA
ENVIRONMENT IMPACT STATEMENT (VOL 1)

PRODUCTIVE PARTNERSHIPS IN AGRICULTURE PROJECT (PPAP)

ENVIRONMENT ASSESSMENT

February 24th, 2010
Contents

LIST OF ACRONYMS.............................................................................................................. vi

Executive Summary ................................................................................................................. viii

1.0 Introduction ......................................................................................................................... 1
  1.1 Project Description ............................................................................................................. 2

2.0 Legislative Framework ...................................................................................................... 6
  2.1 Legislation, Regulations, International Agreements, Codes of Practice and Policies .......... 6
    2.1.1 Papua New Guinea Environmental Legislative Requirements ..................................... 6
    2.1.2 Policies and Legislation relevant to PPAP ................................................................. 7
    2.1.3 World Bank Environmental Assessment Requirements ............................................. 8
  2.2 Environmental Assessment (OP4.01) .............................................................................. 9
  2.3 Pest Management (OP 4.09) .......................................................................................... 10
  2.4 Indigenous People (OP/BP 4.10) .................................................................................. 11
  2.5 Involuntary Resettlement (OP/BP 4.12) .......................................................................... 11

3.0 State of the Environment ................................................................................................. 12
  3.1 Introduction ....................................................................................................................... 12
    3.1.1 Methodology Used to collect Data ............................................................................. 12
    3.1.2 Reliability of Data ..................................................................................................... 13
  3.2 Physical Environment ...................................................................................................... 13
    3.2.1 Description of the Environment ................................................................................. 13
    3.2.2 Climate ....................................................................................................................... 13
    3.2.3 Geology and Geomorphology ................................................................................... 16
    3.2.4 Soils .......................................................................................................................... 17
  3.3 Biological Environment .................................................................................................. 17
    3.3.1 Overview ................................................................................................................... 17
    3.3.2 Flora ........................................................................................................................ 18
    3.3.3 Fauna ........................................................................................................................ 20
3.4 Protected Areas .................................................................................................................. 20
  3.4.1 Wildlife Management Areas .......................................................................................... 22
  3.4.2 Critical Habitats .......................................................................................................... 22
3.5 Agricultural Chemical Use by Smallholders .................................................................... 22
3.6 Socio-economic Environment ............................................................................................ 23
  3.6.1 Social and Cultural Features ....................................................................................... 23
  3.6.2 Social and Economic Infrastructure ........................................................................... 26
  3.6.3 Cultural Sites and Material Cultural Conservation ....................................................... 26
4.0 Potential Environmental Impacts ....................................................................................... 28
  4.1 Introduction ..................................................................................................................... 28
  4.1.1 Summary of Environmental Issues for the Cocoa and Coffee Sectors (Component 2 PPAP) ... 28
  4.1.2 Rehabilitation of Minor Roads (Component 3 Market Access Infrastructure) ................. 30
  4.2 Market chain for the Cocoa Industry ............................................................................... 31
  4.1.1 Environmental impacts from Cocoa Processing .......................................................... 33
  4.2 Market Chain for the Coffee Industry .............................................................................. 34
    4.2.1 Environmental impacts from Coffee Processing ....................................................... 38
  4.5 Potential Environmental Impacts on Subsistence Resources ........................................... 42
  4.3.1 Water supplies ............................................................................................................ 42
  4.4 Potential Environmental Impacts on Soils ...................................................................... 43
    4.4.1 Erosion .................................................................................................................... 43
    4.4.3 Summary of proposed mitigation measures ............................................................... 44
    Mitigation measures are detailed in tables 5-7 in the ESMF .............................................. 44
  4.5 Surface Waters ............................................................................................................. 44
    4.5.1 Impacts on Surface Water Regimes ....................................................................... 45
    4.5.2 Impacts on Surface Water Quality ....................................................................... 45
  4.6 Flora and Fauna .......................................................................................................... 46
    4.6.1 Critical Habitats and Protected Areas .................................................................... 46
    4.6.2 Potential Impacts from Road Reconstruction and mitigation measures .................... 46
4.7 Air Quality ........................................................................................................... 47
4.8 Noise ..................................................................................................................... 47
  4.8.1 Noise from Road Reconstruction ................................................................ 47
  4.8.2 Noise from Gravel Sorting and Screening ............................................... 47
  4.8.3 Noise from processing and marketing facilities ....................................... 48
  4.8.4 Summary of proposed mitigation measures .............................................. 48
4.9 Cultural & Archaeological Sites ........................................................................ 48
4.10 Public Disruption and Safety .......................................................................... 49
4.11 Construction Activities and Camps ................................................................ 49
5.0 Staffing, Technical Assistance and Training Requirement ............................ 51
  5.1 Requirements within DAL and PPAP ............................................................ 51
  5.2 Cocoa Board ..................................................................................................... 51
6.0 Community Consultations ................................................................................ 52
7. References ............................................................................................................. 55
Appendix 1: Summary TOR for Environmental Assessment ............................... 58
Appendix 2: Notification of Preparatory Work for Level 2 .................................... 59
Appendix 3: Community Consultation undertaken for the EA ............................. 62
Appendix 4: List of persons consulted for the EA ................................................. 93
Appendix 5: Protected Areas in Papua New Guinea with their location ............... 95
Appendix 6: Critical Habitat or Areas in Papua New Guinea ............................... 97

Cover pictures from left to right; feeder road upgraded by the EHDA showing drainage construction, cocoa pod showing CPB infestations and trunk road on ARG.

List of Figures

Figure 1: Location of PPAP provinces ..................................................................... 1

Figure 2: Regulatory Streams under the Environmental Act 2000 (DEC 1996) Error! Bookmark not defined.

List of Tables
Table 1: Policies and Legislation and their relevance to PPAP .......................... 7
Table 2: Temperature and Rainfall of the PPAP provinces ............................ 16
Table 3: Major soil orders in Papua New Guinea ........................................... 19
Table 4: Endemicity of land and freshwater vertebrates of PNG .................. 19
Table 5: Herpetifauna (Native Species of Papua New Guinea) ................. 22
Table 6: Population and cultural data for the districts of EHP and other Provinces 28
Table 7: Environmental Impacts from Cocoa on Small holder blocks ........... 38
Table 8: Environmental Impacts from Coffee on Small Holder Blocks  ......... 45
and Coffee Factories
Table 9: Factors affecting small holder production on the Gazelle Peninsula 58
### LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDs</td>
<td>Acquired Immune Deficiency Syndrome</td>
</tr>
<tr>
<td>ABG</td>
<td>Autonomous Bougainville Government</td>
</tr>
<tr>
<td>ARB</td>
<td>Autonomous Region of Bougainville</td>
</tr>
<tr>
<td>AusAID</td>
<td>Australian Aid Program</td>
</tr>
<tr>
<td>CB</td>
<td>Cocoa Board</td>
</tr>
<tr>
<td>CBB</td>
<td>Coffee Berry Borer</td>
</tr>
<tr>
<td>CCEA</td>
<td>Cocoa and Coconut Extension Agency</td>
</tr>
<tr>
<td>CCIL</td>
<td>Cocoa Coconut Institute Limited</td>
</tr>
<tr>
<td>CCF</td>
<td>Community Consultation Framework</td>
</tr>
<tr>
<td>CP</td>
<td>Chimbu Province</td>
</tr>
<tr>
<td>CPB</td>
<td>Cocoa Pod Borer</td>
</tr>
<tr>
<td>DAL</td>
<td>Department of Agriculture and Livestock</td>
</tr>
<tr>
<td>DEC</td>
<td>Department of Environment and Conservation</td>
</tr>
<tr>
<td>DoWT</td>
<td>Department of Works and Transport</td>
</tr>
<tr>
<td>DPI</td>
<td>Department of Primary Industry</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental Assessment</td>
</tr>
<tr>
<td>EHDA</td>
<td>Eastern Highland Development Authority</td>
</tr>
<tr>
<td>EHP</td>
<td>Eastern Highlands Province</td>
</tr>
<tr>
<td>ENBCPBRRCC</td>
<td>ENB Cocoa Pod Board Response Coordinating Committee</td>
</tr>
<tr>
<td>ENBP</td>
<td>East New Britain Province</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EMMP</td>
<td>Environmental Management and Monitoring Plan</td>
</tr>
<tr>
<td>EMSF</td>
<td>Environmental Management and Social Framework</td>
</tr>
<tr>
<td>ENB</td>
<td>East New Britain</td>
</tr>
<tr>
<td>ENSO</td>
<td>El Nino/Southern Oscillation</td>
</tr>
<tr>
<td>EP</td>
<td>Environment Plan</td>
</tr>
<tr>
<td>ERP</td>
<td>Emergency Response Plan</td>
</tr>
<tr>
<td>GoPNG</td>
<td>Government of Papua New Guinea</td>
</tr>
<tr>
<td>IATP</td>
<td>Integrated Agriculture Training Program</td>
</tr>
<tr>
<td>IFAD</td>
<td>International Fund for Agriculture Development</td>
</tr>
<tr>
<td>ILG</td>
<td>Incorporated Land Group</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>IPM</td>
<td>Integrated Pest Management</td>
</tr>
<tr>
<td>IPMP</td>
<td>Integrated Pest Management Plan</td>
</tr>
<tr>
<td>LLG</td>
<td>Local Level Government</td>
</tr>
<tr>
<td>NADP</td>
<td>National Agriculture Development Plan</td>
</tr>
<tr>
<td>NAQIA</td>
<td>National Agricultural Quarantine Inspection Agency</td>
</tr>
<tr>
<td>NARI</td>
<td>National Agricultural Research Institute</td>
</tr>
<tr>
<td>NDB</td>
<td>National Development Bank</td>
</tr>
<tr>
<td>NZAID</td>
<td>New Zealand Aid for International Development</td>
</tr>
<tr>
<td>PDD</td>
<td>Project Design Document</td>
</tr>
<tr>
<td>PGK</td>
<td>PNG Kina</td>
</tr>
<tr>
<td>PMU</td>
<td>Program Management Unit</td>
</tr>
<tr>
<td>PNG</td>
<td>Papua New Guinea</td>
</tr>
<tr>
<td>PPAP</td>
<td>Productive Partnerships in Agriculture Partnerships</td>
</tr>
<tr>
<td>OD</td>
<td>World Bank Operational Directive</td>
</tr>
<tr>
<td>DOW</td>
<td>Department of Works (Provincial)</td>
</tr>
<tr>
<td>OP</td>
<td>World Bank Operational Policy</td>
</tr>
<tr>
<td>PDD</td>
<td>Project Design Document</td>
</tr>
<tr>
<td>PNG</td>
<td>Papua New Guinea</td>
</tr>
<tr>
<td>PNGRIS</td>
<td>Papua New Guinea Resource Information System</td>
</tr>
<tr>
<td>ROW</td>
<td>Right-of-Way</td>
</tr>
<tr>
<td>SEA</td>
<td>Sectoral Environmental Assessment</td>
</tr>
<tr>
<td>SP</td>
<td>Simbu Province</td>
</tr>
<tr>
<td>STD</td>
<td>Sexually Transmitted Disease</td>
</tr>
<tr>
<td>URS</td>
<td>United Research Services</td>
</tr>
<tr>
<td>WHP</td>
<td>Western Highlands Province</td>
</tr>
<tr>
<td>WMA</td>
<td>Wildlife Management Area</td>
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</tbody>
</table>
Executive Summary

The purpose of the Environment Assessment is to provide the basis for the environmental management of the Productive Partnerships in Agriculture Project (PPAP) to ensure that project activities are implemented in such a manner that there are no deleterious environmental or social effects or if they cannot be avoided that they are managed and mitigated. The EA abides by the legal requirements of the Papua New Guinea Government and adheres to the World Bank Safeguard policies.

This document, The Environment Assessment is part 1 of a four part series; Part 2 is the Environment and Social Management Framework; Part 3 is the Integrated Pest Management Plan and Part 4 is the Compensation Policy Framework, together these four documents constitute the Environment Impact Statement, as required by the PNG Environment Act 2000.

PPAP will be implemented in the highly modified environments of the Highlands Provinces, East New Britain Province and the Autonomous Region of Bougainville, in existing cocoa- and coffee-growing areas, and will include the following components:

- Strengthen key sector agencies to support effective project implementation,
- Develop demand driven public private sector partnerships to improve the delivery of services to and increase the livelihoods of the stakeholder rural sector, and
- Address critical market infrastructure constraints facing the industry

Section 1 describes the objectives of the project and its three components.

Section 2 outlines the Legislative Framework under which PPAP will be administered under the PNG Environment Act 2000 and the various World Bank safeguard policies triggered by the project design. This section details the requirements of relevant legislation and policies and how these have been incorporated into the project design and Environmental and Social Management Framework (ESMF) for the project.

Section 3 describes the State of the Environment of PNG, details the methodology used for data collection and provides an overall description of the climate and geomorphology of PNG, with particular reference to the provinces in which PPAP activities will be implemented. It is noted in this section that PPAP activities will be implemented in densely populated and highly modified environments (existing cocoa - and coffee-growing areas) well away from sensitive environment and protected areas that are generally located in remoter localities with lesser population densities (see appendix 6).

Section 4 describes the current environmental impacts of the coffee and cocoa industries. Most smallholders use no agrichemicals in their coffee groves but do use insecticides in their vegetable gardens which are interspersed with the coffee groves. Coffee processing factories tend to use the coffee husks for the furnaces to dry the beans but vary from those that recycle water and even use worm farms to breakdown the organic waste from processing to those which discharge effluent directly into waterways. Use of fuel wood for fermenting cocoa beans is a cause for concern but the reduction of areas planted to cocoa will free up land for other uses which could include other crops like the Galip nut and small fuel wood groves using native species such as Acacia auriculiformis, a fast growing legume which produces dense wood which can be used in cocoa fermentories and also sold as a cash crop.

The potential environmental impacts of PPAP are described and those for coffee and cocoa growing and processing are summarised in tables 7 and 8. These potential impacts are further outlined and mitigation measures prescribed in Section 6 of the ESMF, with recommendations for mitigation and
monitoring measures to be included in individual sub project Environmental Management Plans (if required) detailed in tables 5-7 of the ESMF.

Section 5 details the Technical assistance and training needs that will be required to implement the project. The Terms of Reference for the Environmental Technical Assistant can be found Appendix 4 of the ESMF.

Section 6 outlines the community consultations that were undertaken during the preparation of the Environmental Assessment and the details of meetings and matters raised can be found in Appendix 3.

The overall impression gained from consultations during preparation of PPAP was that smallholders in particular are extremely enthusiastic for the project to begin. The summary of consultations found in Appendix 3 also highlights some attitudes that the project will have to overcome, such as farmers being trained and not strictly following up (e.g. the coffee growers at Nagamiufa Village admitted to transplanting seedlings collected from beneath their trees despite knowing that this practice was bad and that improved seeds that can be purchased from the CIC Research at Aiyura would result in a better outcome) and farmers blocking culverts to prevent erosion of their coffee trees.

These aspects have been incorporated into the design of PPAP, only partnerships and sub projects that have broad community support and which would result in more productive, environmentally and socially sustainable outcomes will be supported.
1.0 Introduction

The Government of Papua New Guinea (GoPNG) through the Department of Agriculture and Livestock (DAL) is exploring the feasibility of a World Bank and International Fund for Agriculture Development (IFAD) supported agricultural development project – the Productive Partnership in Agriculture (PPAP) with the principal objective to improve the livelihoods of smallholder cocoa and coffee producers through the improvement of the performance and the sustainability of value chains in cocoa- and coffee-growing areas. The PPAP is expected to run from 2010 for a duration of six years ending in 2016. The first year of project implementation will include East New Britain Province, the Autonomous Region of Bougainville, Eastern Highlands Province, Western Highlands Province, Jiwaka Province and Simbu Province, with potential to extend PPAP activities to other provinces in subsequent years.

Figure 1: Location of PPAP provinces

This Environment Assessment responds to the World Bank requirements for more detailed and responsive environmental monitoring and mitigation of the potentially adverse environmental effects of World Bank funded projects and to the Papua New Guinea Government’s requirements under the Environment Act 2000. The Environmental Assessment (EA) is Volume 1 of the overall Environment Impact Statement (EIS) for the Project; Volume 2 is The Environmental and Social Management Framework (ESMF) – this contains the Screening Guidelines and the Environmental Management Plan (EMP) guidelines for project activities; the Integrated Pest Management Plan (IPMP); and the Compensation Policy Framework (CPF). The first three volumes constitute the Environment Impact Statement as required under the PNG Environment Act 2000.
1.1 Project Description

1.1.1 Project development objective and key indicators

The development objective of the proposed project is to improve the livelihoods of smallholder cocoa and coffee producers through the improvement of the performance and the sustainability of value chains in cocoa- and coffee-producing areas. This would be achieved through strengthening industry coordination and institutions, facilitating 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 improvement 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 key indicators at the Project Development Objective (PDO) level would be:

(a) The number of smallholder farmers adopting improved farming practices;
(b) The number and coverage of productive partnerships successfully established and implemented;
(c) The share of the export price including quality premium received by smallholder farmers in the project area; and
(d) The net incomes of smallholder cocoa and coffee growing households in the project areas.

Intermediate outcome indicators would include:

(e) The establishment of effective, representative industry coordination committees, providing policy advice for the sector;
(f) The establishment of operating and sustainable information management systems in CIC and the Cocoa Board;
(g) The number of hectares replanted or rejuvenated with improved planting material;
(h) The share of total coffees exported by PNG that are differentiated;
(i) The increase in average smallholder coffee yields in project areas;
(j) Losses due to CPB infestation substantially reduced in project areas;
(k) The increase in average smallholder cocoa yields in project areas;
(l) The average dried cocoa moisture content is reduced in ARB.
(m) The increase in women’s access to information on improved farming practices, processing and marketing leading to increased income; and
(n) Number of kilometers of rural roads and other access ways rehabilitated and maintained in the project areas.
1.1.2 Project components

The project would include three components: (a) Institutional Strengthening and Industry Coordination; (b) Productive Partnerships; and (c) Market Access Infrastructure. The project would be implemented over a six year period.

**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 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 TA and the operations of the Technical Advisory 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 bud wood 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-farming 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.

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.

1.1.4 Geographical coverage

The project would initially be implemented in East New Britain Province, the Autonomous Region of Bougainville, Eastern Highlands Province, Western Highlands Province, Jiwaka Province and Simbu Province. Most producers and the major stakeholders in the public and the private sectors are all located in those Provinces, and most innovations in the sector originate from those Provinces. Rural household dependency on coffee and cocoa income for their livelihoods is also high. A first review of possible expansion to new Provinces would be conducted at the end of PY2, and a second review at the end of PY4. Component 1 activities would, by nature, provide benefits at the national level.

1.1.5 Targeting

Targeting of disadvantaged groups would be considered in the selection and prioritization of investments under the project. Additional support will be provided under Component 2 to ensure that groups with lower capacity are able to engage in project activities. Specific consideration will be given to partnerships with smallholder farmers in less favored areas (such as more remote areas in the Highlands, or areas hit by CPB and exclusively dependent on cocoa) and partnerships which mobilize vulnerable groups (such as women and young farmers). Gender balance will be considered in all activities, for example the provision of training to both men and women, or employment
opportunities at the ward level through the establishment and management of nurseries and bud wood gardens. The M&E system would monitor targeting of those groups under the project.
2.0 Legislative Framework

2.1 Legislation, Regulations, International Agreements, Codes of Practice and Policies

2.1.1 Papua New Guinea Environmental Legislative Requirements

The Papua New Guinea Department of Environment and Conservation (DEC) is the national agency, tasked with environmental management of projects within Papua New Guinea. The Environmental Act 2000 became effective in 2004 and under this Act environmental assessment requirements for activities and projects in Papua New Guinea incorporated the previous three Acts; Environmental Planning Act (1978), Environmental Contaminants Act 1982 And Water Resources Act 1982. The Environmental Contaminants Act contains procedures and permitting of pesticides and these are now incorporated into the Environmental Act 2000.

Under this legislation, activities are screened into three streams (Figure 2) where Level 1 or Stream 1 activities could be subjected to standards, regulations and codes.

The new Environment Act provides for a regulatory framework for environment management which also covers management of chemicals and hazardous substances. The Act specifies three levels of Activities which is a categorisation of the degree and magnitude of environmental impacts. Levels of impacts are categorized into three groups:

*Figure 2: Regulatory Streams under the Environmental Act 2000 (DEC 1996)*

Level 1 Activities

Refer to those that require a minimum level of environmental protection. Regulation of such activities will be based on standards, codes and regulations that set benchmarks for environmentally acceptable activities. For example, maximum discharge levels, ambient quality standards for receiving environment, codes of practice, guidelines for best/acceptable practice. In cases of non-compliance, environmental protection orders, clean-up orders and emergency directions may be issued.

Level 2 Activities
are those that require a framework of environmental approvals allowing for water discharge permits, or licensing for importation, sale and use of environmental contaminants (hazardous chemicals) and for site-specific environmental conditions to be set for these activities which have more significant potential impacts. Level two activities will be regulated by means of conditions in environmental permits, environmental improvement plans and environmental management programs.

Level 3 activities

cover those with the potential of major environmental impact and are projects of national significance or of large scale. Such activities will be subject to a process of public and detailed considerations of environmental implication through the Environmental Impact Assessment process.

Level 2 and 3 activities require proponents to prepare information in accordance with the Environment (Prescribed Activities) Regulation 2002 to meet their legal obligations under Section 48 of the Environmental Act 2000. Although PPAP has not been officially designated as a level 1 or 2 activity, DAL as the proponent has prepared this notification for assessment to DEC and the letter can be seen in Appendix 2 of this document.

PPAP activities will be largely rehabilitation of existing coffee farms, some reduction in area and diversification of activities on cocoa farms; and all within existing road networks with predominantly minor road reconstruction/rehabilitation to provide better access for farmers to markets for their produce. No level 3 activities will be funded under PPAP.

2.1.2 Policies and Legislation relevant to PPAP

Other policies and legislation requirements within the agriculture, land administration and management and conservation and their relevance to PPAP are in Table 1.

Table 1: Policies and Legislation and their relevance to PPAP

<table>
<thead>
<tr>
<th>Policies/Legislation</th>
<th>Relevance to PPAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Agriculture and Livestock Policies 2001 – 2012</td>
<td>Targets the four activities of commodity policies focused on expanding production on a sustainable basis, inter-sectoral and interacting policies and compliance and monitoring and evaluation policies relating to performance of the sector.</td>
</tr>
<tr>
<td>National Food Security Policy 2000 – 2010</td>
<td>The impacts of the CPB and CBB will affect food security through the removal of cash from commodities; hence it decreases the ability to be able to purchase food.</td>
</tr>
<tr>
<td>National Agriculture Research Institute Act 1999</td>
<td>NARI is a stakeholder in PPAP and hence PPAP is required to abide by this legislation.</td>
</tr>
<tr>
<td>Coffee Industry Corporation Act</td>
<td>Important stakeholder within PPAP. The Act establishes the Coffee Industry Corporation and its function is to administer, regulate, license and carry out research into the coffee industry in PNG.</td>
</tr>
<tr>
<td>Cocoa Board Act</td>
<td>Important stakeholder within PPAP. The Act sets up the Cocoa Board and its function is to administer, regulate and license commercial and small holder cocoa holders in PNG. The research function is with CCIL.</td>
</tr>
<tr>
<td>National Agriculture, Quarantine and Inspection Authority Act</td>
<td>Important stakeholder within PPAP. The Act allows for NAQIA to be established and to administer and regulate on quarantine matters</td>
</tr>
<tr>
<td><strong>Plant Disease and Control Act</strong></td>
<td>Refers to the regulation and controlling diseases of plants within PPAP. The Act allows NAQIA, NARI and DAL to control plant diseases in PNG. NAQIA, DAL &amp; NARI or CIC and CB can implement quarantine measures that restrict the transportation of plants within provinces or into the country when there is an outbreak of a pest or disease of a plant or crop.</td>
</tr>
<tr>
<td><strong>Environmental Act 2000</strong></td>
<td>Environment Act through the Pesticide Regulations 1998 allows DEC to monitor and regulate the import, use and management of chemicals in the country. Under the regulation, DEC is responsible for awarding import permits, transfer of permits, issuing of pesticide guidelines (for sales, importation, manufacture, distribution, promotion, advertisement and use), keep records of pesticide imports, provide packaging guidelines, scrutinize advertising, and impose fines for offences of non-compliance. Currently, there is no effective institutional framework for the control, monitoring and management of chemicals in PNG (NIP 2006).</td>
</tr>
<tr>
<td><strong>Quarantine Act</strong></td>
<td>The Act allows NAQIA to have an overarching role in ensuring pests and diseases through plant and animal products are prevented from entering PNG. The Customs Office works with NAQIA to enforce regulations and penalties for offences. The Act had already been put into place when the CPB arrived in ENB in 2007 and now the Emergency Quarantine measures have been put in place for the CBB and this will be contained in the PPAP.</td>
</tr>
<tr>
<td><strong>Biosafety and Biotechnology Policy</strong></td>
<td>This Policy has application within research institutions, CIC, CCIL and DAL which may be experimenting on new disease resistance varieties of coffee and cocoa within the PPAP context.</td>
</tr>
<tr>
<td><strong>Medium Term Development Strategy 2005 - 2010 (MTDS)</strong></td>
<td>The MTDS calls for a promotion of export driven base for commodities in order to provide economic well being for PNG and strengthening partnership between the GoPNG and people. This is emphasized by PPAP.</td>
</tr>
<tr>
<td><strong>National Agriculture Development Plan (NADP)</strong></td>
<td>The NADP lists its objective of improving research, sustaining agriculture production, improving genetic potential of crops together with the strengthening of research institutions, infrastructure and facilities.</td>
</tr>
<tr>
<td><strong>Organic Law on Provincial and Local Level Governments</strong></td>
<td>All the feeder roads in the PPAP are in provinces and local level government areas; hence the provincial and local level government officials will be an integral part of the decision making process.</td>
</tr>
<tr>
<td><strong>National Strategic Plan (NSP) 2010 – 2050</strong></td>
<td>This is the GoPNG’s forty year plan developed after considerable community consultations for the creation of wealth and prosperity for the people, together with strengthening institutions in service delivery and environment sustainability of PNG.</td>
</tr>
</tbody>
</table>

### 2.1.3 World Bank Environmental Assessment Requirements

The World Bank Safeguard Policies that are triggered by PAPP are:

1. Environmental Assessment (OP4.01)
2. Pest Management (OP 4.09)
3. Indigenous Peoples (OP 4.10)
4. Involuntary Resettlement (OP 4.12)

These policies apply to all activities funded under PPAP irrespective of whether or not they are being funded in whole or part by the World Bank, IFAD, Government of Papua New Guinea or any other donor.


2.2 Environmental Assessment (OP4.01)

This policy requires environmental assessment (EA) of projects/programs proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus improve decision making. The EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the program. The EA process takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and cultural property) and transboundary and global environmental aspects.

The Environment and Social Management Framework (ESMF) establishes a mechanism to determine and assess future potential environmental and social impacts during implementation of the sub project activities and investments under the proposed PPAP, and then to set out mitigation, monitoring and institutional measures to be taken during operations of these activities, to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

OP 4.01 further requires that the ESMF report must be disclosed as a separate and stand alone document by the Government of Papua New Guinea and the World Bank. The disclosure should be both in Papua New Guinea where it can be accessed by the general public and at the Infoshop of the World Bank. The Draft ESMF for PPAP was disclosed in country and in the Infoshop of the World Bank respectively on December 12th and on December 8th 2009. The final ESMF, including any comment received on the draft, will also be disclosed in country and in the Infoshop. The Environmental Assessment policy further calls for the PPAP as a whole to be environmentally screened to determine the extent and type of the EA process. The PPAP has thus been screened and assigned an EA Category B. This category of projects/programs is defined as follows:

“Category B projects are likely to have potential adverse environmental impacts on human populations or environmentally important areas - including wetlands, forests, grasslands, and other natural habitats - and are less adverse than those of category A projects. These impacts are site specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. The EA process for category B projects examines the potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.”

Therefore, the ESMF sets out to establish the process to be undertaken for screening of PPAP activities when they are being identified and implemented. This process requires the implementers/operators/sponsors of the activities in the PPAPs, such as the province, district, ward, village officials, the private sector and/or farmer groups and associations to use processes contained in the ESMF, especially sections 6 and 7, to identify potential adverse impacts of their activities in the PPAPs and determine the corresponding mitigation measures they would need to incorporate into their planned activities.
2.3 Pest Management (OP 4.09)

The Bank uses various means to assess pest management in the country and support integrated pest management (IPM) and the safe use of agricultural pesticides: economic and sector work, sectoral or project-specific environmental assessments, participatory IPM assessments, and adjustment or investment projects and components aimed specifically at supporting the adoption and use of IPM.

In Bank-financed agriculture operations, pest populations are normally controlled through IPM approaches, such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest. An IPMP is a comprehensive plan, developed when there are significant pest management issues such as (a) new land-use development or changed cultivation practices in an area, (b) significant expansion into new areas, (c) diversification into new crops in agriculture (d) intensification of existing low-technology systems, (e) proposed procurement of relatively hazardous pest control products or methods, or (f) specific environmental or health concerns (e.g. proximity of protected areas or important aquatic resources; worker safety).

An IPMP is also developed when proposed financing of pest control products represents a large component of the project. A pest management plan reflects the policies set out in OP 4.09, Pest Management. The plan is designed to minimize potential adverse impacts on human health and the environment and to advance ecologically based integrated pest management.

As the targeted/significant stakeholders in this program are small block holders, together with the cocoa and coffee industry, who during the implementation cycle of the PPAP, will, independently continue to require the use of inputs, the provisions of OP 4.09 are being triggered so that best practice methodologies in this field become part of the farmer training activities of the PPAP.

Papua New Guinea does not have a fully developed policy on IPM although the oil palm industry has its IPM. This will be the second initiative to have an IPMP developed in PNG. Thus the GoPNG has prepared an Integrated Pest Management Plan (IPMP), which will be included as part of the ESMF as a stand alone document to address the needs of OP 4.09.

The IPMP has the following objectives:

- To enhance capacity of the program beneficiaries (individual farmers) to be aware of benefits and possible negative impacts of pesticides and to use pesticides in an economic, efficient and safe way for farmers, their families and environment (ensuring that banned pesticides or agro-chemicals under the Stockholm and Rotterdam Conventions will not be acquired by farmers).

- Introduce them to Integrated Pest Management (IPM) approach or concept as the way to control pests and reduce losses and also as the way to increase their production through good farming practices; and

- Identify the current available IPM practices and improve them in the project, with a view to promote movement towards the development and implementation of a pest management policy.

The first part of the IPMP is the presentation of the current policy regulations together with context of the project. It then identifies the main pest problem pertinent to the cocoa and coffee industry. It then outlines the current IPM practices and includes best practices into the PPAP. At this stage, the Cocoa Pod Borer (CPB) is the only active pest that can cause destructive damage to the cocoa industry and the IPMP therefore has a strong focus on CPB management.

In the case of coffee, the Coffee Cherry Borer (CBB) has not yet arrived into Papua New Guinea, hence the approach is to do surveillance and raise awareness of the coffee farmers and ensure that all
stakeholders are prepared for possible incursion. A contingency plan framework has been prepared. The use of agrochemicals is not properly regulated in PNG and that is also covered in the IPMP.

2.4 Indigenous People (OP/BP 4.10)

This policy has two objectives: A) To ensure that indigenous people benefit from development projects, and B) to avoid or mitigate potential adverse effects on indigenous people caused by Bank-financed activities. Special action is required where Bank investments affect indigenous peoples, tribes, ethnic minorities, or other groups whose social and economic situation restricts their capacity to assert their interests and rights in land and other productive resources.

The PPAP triggers OP/BP 4.10 on Indigenous People. As all beneficiaries of the project, and all people affected by the project are indigenous, no separate Indigenous Policy (IPP) will be required. However, elements of an IPP have been integrated in the project design. A Beneficiaries Participation Framework has also been prepared as part of the Social Assessment, given the need for broad community support for activities to be implemented under the PPAP. It is included as Appendix 5 of the ESMF.

Social surveys carried out under the Social Assessment work together with the community consultations carried out as part of the EA highlight the community’s support for both the cocoa and coffee interventions. The project will however ensure the specific characteristics and vulnerabilities of groups targeted by the sub-projects will be considered.

2.5 Involuntary Resettlement (OP/BP 4.12)

The project will not finance any activity that requires involuntary resettlement or involuntary land acquisition.

Under Component 2 (productive partnerships), any activities requiring land use, such as rehabilitation and expansion of existing nurseries, the establishment of satellite nurseries and budwood gardens, and the improvement of processing and storage facilities will be voluntary in nature and will take place within existing facilities. The Project Implementation Manual details the process for due diligence that will be required as a prerequisite for approval of these sub-projects.

Under Component 3 (Market Access Infrastructure) subprojects may possibly result in temporary land use, minor land acquisition, or damage of crops and economic trees.

A Compensation Policy Framework (CPF) has been prepared which details the key principles for land use and compensation for damaged assets. These principles include:

- Consultations with, and support from, communities as a first step in subproject preparation;
- Minimize land acquisition and damage to assets through appropriate design of infrastructure rehabilitation works; no financing for subprojects that require voluntary or involuntary resettlement or damage to physical assets;
- The provision of minor land acquisition through voluntary donations only.
3.0 State of the Environment

3.1 Introduction

Within the PPAP, the pilot provinces with an initial focus would be the Eastern Highlands Province, Western Highlands Province, Jiwaka Province, Simbu Province, East New Britain Province and the Autonomous Region of Bougainville; project activities will therefore be undertaken in highly modified environments. The cool climate of the highlands region of PNG with adequate rainfall is ideal for growing vegetables (such as the staples sweet potato and bananas) and much more comfortable than the humid lowlands, resulting in the highest population density in PNG, hence the clearing of the forests for gardens. Prior to the agricultural development the grasslands would have been maintained by burning during the dryer months (June-November). Natural environments in the highlands tend to be found above 2500 metres asl where occasional frosts occur which kill off sweet potato, hence the change to the “English” potato at high altitudes. In the 1930s the highlands provinces were already dominated by anthropogenic grasslands particularly between the altitudes of 1000 metres and 2000 metres asl\(^1\). Coffee was first trialed at Asaro in the late 1930s, early forties and in the sixties and seventies there was a concerted effort by the then Department of Forests and the Department of Agriculture to provide extension tree plantings for coffee growing shade, ornamentals, firewood and timber. Many exotic tree species were planted throughout the highlands, particularly *Pinus* and *Eucalyptus species*\(^2\).

The natural environments in the cocoa growing areas of the Gazelle Peninsula and on Bougainville were destroyed in the colonial era mainly for large scale copra plantations.

It is therefore not anticipated that PPAP activities will have any deleterious effect on natural habitats and in fact will provide improved farming practices that are environmentally and socially sound and sustainable.

3.1.1 Methodology Used to collect Data

To collect and collate information for PPAP required a variety of methods:

i) field interviews with stakeholders in the PPAP,

ii) observations and obtaining physical description through photos and documents, and

iii) phone interviews and emails.

At this stage, the exact location of subprojects/investments is not known, due to the demand-driven nature of activities, and so a sample of potential sites were visited, but the exact investments to be

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1 This can be clearly seen in the film “First Contact”, which is a visual record of the early exploration and exploitation of the highlands region, by the pioneering Leahy brothers.

2 Pers com Tom Diawai
covered under PPAP would only be determined during implementation. Section 5 of the ESMF contains detailed screening mechanisms for subproject proposals.

The PNG Resource Inventory System (PNGRIS) which contains maps of soil type, slopes, sensitivity to erosion, location of protected areas such as National Parks, Wildlife Reserves and other sensitive areas and agricultural activity was a key data source for the EA. This, combined with an examination of the project location on topographical sheets, and from Conservation Needs Assessment maps from the Papua New Guinea Biodiversity Country Study provided sufficient information on the general nature of the environment to assess the need for further study. The author's own experiences in the provinces also assisted in assessing the potential impact of feeder roads such as those that may be rehabilitated under the PPAP.

Stakeholders with interest in PPAP were interviewed individually or in small groups in EHP, ENB and ARB, a summary of the discussions held can be found in Appendix 3 of this report.

Field visits in the three provinces provided an overview of the road conditions that will be considered within the PPAP other information was obtained from the documents listed in the Reference section of this report.

3.1.2 Reliability of Data

Papua New Guinea’s environmental parameters have been broadly mapped and are available through the Papua New Guinea Resource Information System (PNGRIS). This database was initially created in 1995 and subsequently updated in 2001 and 2007 giving a broad overview of the biophysical and meteorological attributes which would only change through geological timescale.

In addition to this data set, other information such as the Mapping Agriculture System Project (MASP) and Forest Inventory Mapping Systems (FIMS) are available through the government departments/agencies in charge, the Department of Agriculture and Livestock (DAL) and the Papua New Guinea Forest Authority (PNGFA). Apart from those, other information or rural development published in 2001 provides basic rural development data in Papua New Guinea (Hanson et al 2001).

For primary data, field observations of feeder roads and visiting potential partners provided an avenue to record the environmental conditions and discussions with stakeholders (Appendix 3) provided valuable and concurrent information.

3.2 Physical Environment

3.2.1 Description of the Environment

Papua New Guinea is situated in the tropics and has a diverse rainfall pattern which together with its geomorphology and geology gives rise to road building challenges taking into consideration erosion, landslides and drainage controls. Descriptions in this section relate to these physical conditions which greatly influence and create special maintenance problems for roads. This section provides the meteorological, geological and biological overview of PNG with an emphasis on the PPAP provinces.

3.2.2 Climate

The PPAP covers Eastern Highlands, Western Highlands, and Simbu, Jiwaka and East New Britain provinces and the Autonomous Region of Bougainville. These are the pilot project areas but as other
provinces may be included as PPAP is implemented descriptions are given for PNG generally and then more specifically for the pilot provinces.

Papua New Guinea is located in the humid tropics. The climate is influenced by oceanic and altitudinal factors. The mean temperature ranges from a minimum of 22°C in the low lands to a maximum of 31°C. The region receives heavy rainfalls of up to 10,000 millimeters per annum. Port Moresby, the capital city is however exceptional, being located in a rain shadow and has an average annual rainfall of less than 1,000 millimeters. Close to Port Moresby, the driest region in Papua New Guinea, average rainfall is 2,000 millimeters.

The country consists of a central mountain range with elevations up to 3900 masl with hills and plains in both north and south direction. The island chain also has pockets of upper mountain forest. The climatic variations within the PPAP provinces are presented in Table 5.

Provinces in the Highlands naturally display cooler climate with more westerly provinces of SHP and WHP having the lower range of temperatures than the Eastern Highlands Province. The soils are very fertile having been largely derived from volcanics and combined with the cooler temperature and adequate rainfall is ideal for the growing of many vegetables and coffee (cafe arabica). On the summit of Mt Wilhelm and other mountain peaks, temperatures can get below freezing during the night particularly during the drier times of the year when night time skies are clear of cloud cover.

In contrast, coastal provinces display the typical tropical weather temperature of $23^\circ - 30^\circ$ C, and it gets cooler in the evenings and is affected by changing weather patterns from Australia.

The Eastern Highlands Province is in the Central Highlands of PNG and covers 11,000km$^2$. It is bounded in the north by the rugged Bismarck Range and reaches elevation of 3500m on Mt Otto, while other peaks in the south of the Province such as Mt Michael exceed 3500m. Elevation is from 300 – 2400m ASL. and most people live from within the narrow range of 1500-2000m. The flood plains and fans of the Asaro, Benabena, Kamnuntina, Enfutina and upper Ramu valleys have productive soils supporting intense agriculture with high population densities.

In general, the northern valleys are economically vibrant with intensive small holder coffee production and good road access to markets in Goroka and Lae. However, the south of the province is mountainous and remote and the absence of roads is an impediment for development. The Western Highland Province occupies 900km$^2$, also in the central highlands of PNG consisting of valleys in the north, centre, northwest and southwest; these contain very fertile soils derived from the ash falls from dormant and extinct volcanoes of Mt Hagen and others in close proximity such as Mt Giluwe. There is also the Kubor Range and the Sepik Waghi divide mountain ranges.

Most people live within the 1400-2200 metres above sea level altitudinal range; the Waghi Valley is densely populated and has a high coffee production with smallholders and plantations. Elevation varies from 600m to over 4000m on Mt Wilhelm, Mt Kabangama and Mt Kegeraga. Rainfall ranges from 2200 to 4000 mm per annum.

Table 2: Temperature and Rainfall of the PPAP provinces
<table>
<thead>
<tr>
<th>Province</th>
<th>Temperature $^3$</th>
<th>Rainfall (mm) $^4$</th>
<th>Elevation Range (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHP</td>
<td>13 - 25</td>
<td>2200 - 4400</td>
<td>300 - 2400</td>
</tr>
<tr>
<td>WHP</td>
<td>13 - 25</td>
<td>2200 - 4400</td>
<td>600 - 4000</td>
</tr>
<tr>
<td>SP</td>
<td>13 - 25</td>
<td>2200 - 4000</td>
<td>300 - 4500</td>
</tr>
<tr>
<td>ENB</td>
<td>23 - 30</td>
<td>2000 - 5000</td>
<td>0 - 2000</td>
</tr>
<tr>
<td>ARB</td>
<td>23 - 30</td>
<td>2500 - &gt; 4000</td>
<td>0 - 2700</td>
</tr>
<tr>
<td>Morobe</td>
<td>23 - 30</td>
<td>1600 - &gt; 4000</td>
<td>0 - &gt; 4000</td>
</tr>
<tr>
<td>Madang</td>
<td>23 - 30</td>
<td>2000 - &gt; 4000</td>
<td>0 - 4000</td>
</tr>
<tr>
<td>East Sepik</td>
<td>23 - 30</td>
<td>1800 - &gt; 4000</td>
<td>0 - &gt; 3000</td>
</tr>
</tbody>
</table>

Sharing borders with Western Highlands and Eastern Highlands is the Simbu province which covers 6000km$^2$. It is bounded by Mt Wilhelm, (PNG’s highest mountain) in the north to the lower altitudes south of Karamu Mountain. The population lives along the rivers and valleys, including the Waghi valley which starts in the Western Highlands Province. This is also a dominant smallholder coffee growing region in the country. Altitude ranges from 300 m on the southern border with the Gulf province to over 4500m on the summit of Mt Wilhelm. Most people reside within the 1400 – 2000m altitude range. Average annual rainfall ranges from 2200 – 4000 mm and it increases from the north to south.

East New Britain province includes roughly 15,100km$^2$ of the island of New Britain. Altitude ranges from sea level to over 2000m at Mt Ulawun, Mt Bamus and Mt Berurumea. The Gazelle Peninsula is in the north of the province and encompasses the Baining Mountain, valleys of Kerevat and Warongoi, and numerous smaller rivers and nature coastal plains. In the north east of the Gazelle Peninsula are fertile hills and plains that surround the Rabaul volcanoes.

The islands of Wartom and Duke of York make up the larger of the islands to the northwest and east of Rabaul respectively. In the south, the Nakanai Mountains of extensive limestone plateau dominate, with narrow coastal plains and the active volcanic peaks of Mt Ulawun and Mt. Bamus. With the province built upon successive layers of ash, commercial agriculture is widespread and small holder cocoa farmers thrive. Agriculture is practiced up to 1200m on the Mamusi Plateau in the Baining Mountains. The average annual rainfall varies from 2000mm near Kokopo to over 5000mm on the south coast.

The Autonomous Region of Bougainville is dominated by the volcanic peaks of the Crown Prince Range, including the active volcano of Mt Bagana. Altitude varies from sea land to over 2700m on Mt Balbi. The coastal areas include raised coral limestone plains, volcanic plains and fans, valleys, flood plains and swamps. Most of the coastal areas have fertile volcanic soils that have been used intensively for plantation and small holder cocoa and coconut production. Buka Island is a raised coral limestone plain having the hills for the Parkinson Range in the south west. Average annual rainfall varies from 2500mm around Tinputz, to over 4000mm around Buin (Henson et al 2001).

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3 Temperature taken from McAlpine, Keig and Fall, 1983. ARB’s temperature is inferred from Rabaul as is for East Sepik.

4 Taken from Hanson et al 2001. Rainfall in the Autonomous Region of Bougainville range from 2500 to 5000mm annually and this is included within the range for East New Britain, although not explicitly stated.
Madang province occupies 28,000 km$^2$ in the central north of the PNG mainland. It has a diverse range of environments from having its border with Mt Wilhelm, the highest peak in PNG, to the coast. Mountain ranges of Adelbert, Finisterre and Bismarck, the extensive Ramu River floodplains, coastal limestone plains and volcanic islands offshore.

Three of these volcanoes are active and are a serious hazard to the people of Madang. Bismarck Fall, with a vertical drop of 4300m from the summit of Mt Wilhelm to the Ramu valley, over a distance of 45kms. Altitude ranges from the sea level to over 4000m on the slopes of Mt Wilhelm. Annual rainfall varies from 2000mm around Bogia to more than 4000 mm in the Ramu valley and Bismarck Fall. Madang contains both cocoa and coffee with cocoa and copra being the dominant cash crops.

The province of Morobe occupies 33,525 km$^2$ in the northeast of the mainland of PNG and shares boundaries with the Madang, Eastern Highlands, Oro, Central and Gulf provinces. Major features of the Morobe Province are the Finnesterre and Sarawaged Ranges and the extensive Markham valley which extends westwards towards the Ramu Valley. Altitude varies from sea level to over 4000 m on the Sarawaged Range. Average rainfall varies from 1600mm in the Snake Valley, to over 4000mm around Lae. In Morobe, more emphasis is on coffee planted in the Wau, Bulolo and Menyamya areas. The latter area roads are in a very bad state and often coffee bags are not able to be transported to Lae.

East Sepik province occupies 43,700 km$^2$ in the northwest of PNG. The northern part contains the Wewak coastline plains and islands, the Torricelli Range and the Prince Alexander Range. To the south contains a large area of hills. The swamps and lakes of the Sepik River occupy the middle, and plains and flood plains cover the edges. The Sepik River is inundated annually where water level can rise and fall by five metres. The province borders with Madang, West Sepik and Enga provinces. Altitude ranges from sea level to over 3000 m on the Central Range. Average annual rainfall varies from 1800mm near Maprik to over 4000 mm near April River. Coffee and cocoa is grown in three of the four districts and cocoa is more dominant in Maprik.

### 3.2.3 Geology and Geomorphology

Papua New Guinea and adjacent area geology is characterized by three main geological provinces (Williamson and Hancock 2005);

i Continental craton in the south west,

ii A complex collision zone in the centre, and

iii Volcanic islands in the north east.

The collision zone corresponds to the cordillera whilst the craton provides a stable platform for the lowland forest, swamps and wetlands. Papua New Guinea is highly mineralized and highly prospective. The zones that are in collision are still moving slowly in a north westerly direction at a rate of 3cm/yr. The dynamic geology of Papua New Guinea is part of the Pacific Ring of Fire which has active volcanoes along its path. Associated with this geology are earthquakes, floods and tsunamis.

Papua New Guinea has very young rocks (up to 260 million years) and combined with the heavy annual rainfalls up to 10,000 mms and the central cordillera has resulted in a variety of landforms ranging from deeply incised valleys and rugged mountains to limestone karst terrains.
The heavy annual rainfalls increase weathering and erosion rates and lead to very high rates of aggradations in the river systems and flood plains. These climatic and geological characteristics greatly increase the costs of road building and maintenance in Papua New Guinea.

3.2.4 Soils

Soils within PNG fall into eight classes or orders ranging from Entisols (mangrove, alluvial soils), Histosols (peat soils), Inceptisols (humic, ash and clay soils), Vertisols (earth soils), Mollisols (limestone soils), Alfisols (meadow, podzolic, brown clay soils), Ultisols (lateritic, humic clayey soils), and Oxisols (strongly weathered red and brown clay soils. Within these eight orders are 73 individual soil types. Of these, over half are much localized while others are common soil types (Bryne & Sherman 2008). Their distribution is determined by the geological and geomorphologic processes at work (section 4.1.1) and influenced by extensive rainfall patterns. Soil distribution with the main classes is presented in Table 6.

About three million of PNG’s population live on Inceptisols, mainly derived from volcanic ash or mixed with volcanic ash from explosive eruptions which are now extinct in the Highlands and also a few from volcanic islands off Madang (Long Island) (Hope & Hartemink 2007).

The dominant soil type of the PPAP provinces is Inceptisols and hence provides fertile soils for the planting of cash crops such as coffee and cocoa and food crops.

Table 3: Major soil orders in Papua New Guinea

<table>
<thead>
<tr>
<th>Major Soil Classes</th>
<th>Area of coverage ($10^4$ km$^2$)</th>
<th>Percentage of coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entisols</td>
<td>120</td>
<td>26</td>
</tr>
<tr>
<td>Histosols</td>
<td>8.6</td>
<td>2</td>
</tr>
<tr>
<td>Inceptisols</td>
<td>219</td>
<td>48</td>
</tr>
<tr>
<td>Vertisols</td>
<td>0.2</td>
<td>&lt; 0.1</td>
</tr>
<tr>
<td>Mollisols</td>
<td>34</td>
<td>7</td>
</tr>
<tr>
<td>Alfisols</td>
<td>13.3</td>
<td>3</td>
</tr>
<tr>
<td>Ultisols</td>
<td>63</td>
<td>14</td>
</tr>
<tr>
<td>Oxisols</td>
<td>0.007</td>
<td>&lt; 0.1</td>
</tr>
</tbody>
</table>

3.3 Biological Environment

3.3.1 Overview

PNG is a mega biodiversity country having tremendous and endemic flora and fauna and the PNG Country Study on Biological Diversity (Sekran and Miller 1995), estimates about 400,000 species of fungi, plants and animals. This is because of the complex geological history, relative isolation from continental areas within similar climates, its great topographic diversity and the evolutionary diversification of species (Allison 2007). Additionally, inadequate studies of fungi, nematodes and insects makes detailed tabulations impossible. However, some cataloging has been done (ibid).

5 Table adapted from Hope & Hartemink, 2007, p.174.
PNG shares a land boundary with the Papuan province of Indonesia; hence some of the species have an extensive or similar range across the total land mass which is often referred to as the island of New Guinea. Within mammals, six orders exist; monotremes, three orders of marsupials [Dasyuromorphia, Peramelemorphia & Diprotodontia], rodents and bats. Of these 284 species and 69% (195) are endemic (Table 7). Mammal bats and rodents are incompletely known and ten new species have been described and still more unknown left to be discovered. Frog numbers still to be discovered and the number stated may double or triple if more research is being undertaken.

**Table 4: Endemicity of land and freshwater vertebrates of PNG**

<table>
<thead>
<tr>
<th>Taxon</th>
<th>No of endemic species</th>
<th>Total no of species</th>
<th>% Endemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater fishes</td>
<td>179</td>
<td>213</td>
<td>84.0</td>
</tr>
<tr>
<td>Frogs</td>
<td>260</td>
<td>282</td>
<td>92.2</td>
</tr>
<tr>
<td>Turtle</td>
<td>8</td>
<td>11</td>
<td>72.7</td>
</tr>
<tr>
<td>Crocodile</td>
<td>1</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Lizard</td>
<td>124</td>
<td>193</td>
<td>64.2</td>
</tr>
<tr>
<td>Snakes</td>
<td>41</td>
<td>84</td>
<td>48.8</td>
</tr>
<tr>
<td>Birds</td>
<td>324</td>
<td>578</td>
<td>56.1</td>
</tr>
<tr>
<td>Mammals</td>
<td>195</td>
<td>284</td>
<td>68.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,132</strong></td>
<td><strong>1,647</strong></td>
<td><strong>68.7</strong></td>
</tr>
</tbody>
</table>

As for birds, New Guinea has 578 species of breeding birds with 324 species endemic. Some interesting data for freshwater fish relates to their evolution. Most, around 84% lack a marine larval stage and are thought to have evolved from their marine ancestors. For marine fishes, it is thought that around 2600 – 3000 species exist in New Guinea and about 30% of the total world reef fishes exist here (Allison 2007). These marine species are wide spread in the Indo Pacific region, and species richness of the marine biota is higher here that in other parts of the world. A large number of other data do exist for some organisms (e.g.; flowering plants and most vertebrates) but these data are scattered and not synthesized into a suitable information management system.

Endemism within the island of New Guinea ranges from high (many plants, insects and vertebrates) to low (many marine animals). Besides the native species there are exotic species that have arrived in PNG, such as the fresh water weed (*Sylvania molesta*) and the climbing perch. These created havoc in lakes and waterways in the Sepik and Fly River systems during the late 1990s and since then *Salvinia molesta* has been brought under control by a biological agent.

For descriptions of flora and fauna within each province in PNG, there is no cataloguing and it would be impossible to describe terrestrial flora and fauna, invertebrates, vertebrates for each province. However, a general description of the flora and fauna is given below for the Highland provinces covering EHP, Simbu and Western Highlands. Some information exists for the island of New Britain and the Autonomous Region of Bougainville.

### 3.3.2 Flora

*Table taken from Allison 2007, p482 without data from the Papuan province of Indonesia.*
In lowland environments (below 1000 m), the most important vegetation groups are the Anacardiaceae, Anonaceae, Burseraceae, Combretaceae, Euphorbiaceae, Elaecarpaceae, Flacortiaceae, Malvaceae and Sapindaceae (Takeucki 2007). In the montane habitats, at high altitudes the most important groups are the cryptogams, gymnosperms (seed plants) and angiosperms (flowering plants) such as Araliaceae, Cunoniaceae, Ericaceae, Fagaceae and Orchidaceae among others (ibid). Often, biodiversity falls sharply at elevation above 2500 m. Endemism is highest in the montane zone as a result of environmental change, caused by rapid rates of geological uplifts (section 3.2.3).

Vegetation within the three highland provinces ranges from the common grassland with kunai (Imperata cylindrica), and other grass species such as Themeda spp and Saccharum spp and minor shrubs.

Tree species are dependent on the soil conditions and there is a gradation range from the grasslands up to the montane forests. The montane forest is divided into the lower montane, mid montane and upper montane. The lower montane is dominated by Castanopsis and Lithocarpus, together with Araucaria (pine trees) Agathis and Eucalpytopsis and Nothofagus. This corresponds to the agriculture zone where traditional gardening has been practiced.

Nothofagus (broad leaf trees) dominates the mid montane zone and is often covered with epiphytes, particularly orchids and ferns. Above this is the upper montane forest dominated by Podocarpaceae and Cupressacae. This is often mixed with other tree species. At the higher level, species diversity decreases and epiphytes increase (Johns et al 2007).

Within the EHP, WHP and SP, this vegetation are likely to be found and most common trees planted as they are used for firewood, house building and other purposes are the Casuarinas C. oligodon and C. papuana and various Eucalyptus spp including E. grandis, E. robusta and E. deglupta. Pandanus spp occur throughout the natural forest and are cultivated as a source of food.

3.3.2.1 East New Britain

Very few studies have been done on the flora and fauna on New Britain although there may be individual studies but the data has not been collated. The province of East New Britain is featured resting onto a volcanic caldera setting where the Gazelle Peninsula consists of layers of ash that have been settled over periods of volcanism and this is still continuing today from the active Mt Tavurvur. Flora and flora within the cocoa blocks are not endemic but are common throughout the province. Only through the inner mountain ranges where extensive logging or development has not expanded will there be an abundance of endemic flora and fauna.

Vegetation is mostly lowland rainforest with numerous coastal plains having coconut palms with island cedar (Calophyllum papuanum). Fifty three forest birds have been recorded where half are within the New Britain and Bismarck Archipelago. Of these, six are endangered with also several bat species are facing a similar fate (Duguman 2008). The marine life provides an abundance of organisms; however, information on this is scarce.

3.3.2.2 Autonomous Region of Bougainville

Fauna of Bougainville consists of 55 species of reptiles and amphibians of which 20 are endemic frogs, 9 species of snake, 8 species of geckos and 27 species of skinks. Most of them are endemic to the ARB and a few have affinities to the Solomon Islands, a skink and the Bougainville Honeyeater is
rare on Bougainville (ARB 2007). Within ARB, there are also rare butterflies such as Graphium meeki, Graphium mendana (Graphium spp) and Papilio toboroi (Swallowtail butterfly).

The flora of ARB consists of lowland and montane forest types which includes lowland Calophyllum kajexkki forest and Neonauclea/Sloanea forest at 450 – 750 m, swamp forest in the south, beach forest, mangroves, scrub and grasslands, rivers, coastal lagoons and fringing reefs. Occurring along the coast and adjacent inland areas is mostly lowland forest together with swamp grassland and forest with the presence of Terminalia brassii occurring along the west coast. Along the ranges are numerous limestone/karst areas where stunted growth of montane forest is common (ibid).

### 3.3.3 Fauna

The native herpetifauna of PNG includes 33 families, 117 genera and 553 species of frogs, crocodiles, turtles, lizards and snakes (Table 6). Within the Indonesian province of Papua, it is stated that the majority of species (~340) are found primarily on land or in freshwater although a small portion (24) are primarily marine (sea snakes and turtles) (Allison, 2007b, p.564). Hence, this can be extracted for PNG where the landmass is shared. Likewise, frogs within PNG can be found within the lowlands to alpine grassland above 3,200m. Species richness varies geographically in relation to climate and geological history but is generally highest in hill forest and upland forests. These frogs fall into classes of climber (scansorial) forest floor dwellers (terrestrial) or live in burrows or cavities within the soil (fossorial).

The number of invertebrates known from New Guinea is not known with any accuracy and there are no comprehensive checklists of most groups. Miller (2007) estimates a figure of slightly more than 300,000 species, although this is very conservative and the actual number could be near to a half a million. Butterflies seem to be well known and but it is likely to be only about 50% of species have been described in most insect order. For fauna, besides the listing in Table 8, a lot of material are in museums worldwide and may add to the inventory of New Guinea if they are catalogued or returned to PNG.

#### Table 5: Herpetifauna (native species) of Papua New Guinea

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Families</th>
<th>Genera</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frogs</td>
<td>4</td>
<td>33</td>
<td>248</td>
</tr>
<tr>
<td>Turtles</td>
<td>5</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Crocodiles</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Lizards</td>
<td>5</td>
<td>32</td>
<td>183</td>
</tr>
<tr>
<td>Snakes</td>
<td>6</td>
<td>40</td>
<td>103</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>117</td>
<td>553</td>
</tr>
</tbody>
</table>

### 3.4 Protected Areas

Papua New Guinea has fifty-two declared areas as protected; having a total area of 1,643,900 hectares. According to Papua New Guinea’s Convention of Biological Diversity commitments, PNG

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7 Extracted from Table 4.6.1, Allison 2007b, p565)
is required to set aside 10% of the landmass for biodiversity conservation. However, the total area protected is only 4% of the country's total landmass.

The constitution of Papua New Guinea allows for the creation of twelve types of protected areas. These, twelve protected area types can either be government owned (the most common ones being; Parks; that is, National/Provincial/District/Memorial, Sanctuaries, Nature Reserves, National Walking Tracks; others include Protected Areas, Historical Sites or community owned (Wildlife Management Areas, Conservation Areas) and others such as; world heritage area, Ramsar sites, or the newly introduced Local Level Government Project Protected Areas. So far all 52 protected areas have been gazetted only under seven of the types of protected areas and their sizes differ from less than 12 hectares to 590,000 hectares.

Protected area and critical habitats within PNG vary from province to province and where ninety-seven per cent of the land in Papua New Guinea is owned by the local inhabitants (customary land) most protected areas are community based. The system's greatest strength is that ultimate power over the land lies with the landowners and no development can take place without their consent. Such ownership should also engender in the management at least the benefits of commitment and continuity.

Protected areas occur in all the PPAP provinces; however these are not in close proximity to any of the PPAP's activities. The Crater Mountain WMA occurs about 70kms to the North West of the Okapa feeder roads. This extensive area of 270,000 ha is remote and only accessible by light aircraft or is a couple of days walk to the nearest road. Its remoteness provides the barrier against human infringement in search of forest resources. Although in recent years, minerals and petroleum exploration licenses covering extensive portions of the WMA provides threats to the protected area.

Mt Gahavisuka Provincial Park (Appendix 5) is situated in the foothills of Mt Otto at 145° 20'E 60's between elevations of 2000-2600m a.s.l. Its primary focus is to maintain scenic and recreational values and over 1000 orchids and a couple of rhododendron shrubs have been noted. Also 6 species of Bird of Paradise have been recorded. In addition, it is an important lower montane area rich in fauna, 3 undescribed rhododendron and orchid collection, also valuable for tourism and local community education. The park is accessibly by road into the main Highlands Highway to Goroka. It is located 70-80km directly north of the Okapa feeder roads.

Within East New Britain are the Kavakuna Cave, Klampun WMA, Nanuk Island Reserve, Talele Island National Part Reserve and Tavalo WMA. Tavalo WMA, Kavakuna Cave and Klampun are situated in the Pomio district at 230, 130 or 120 Kms to the South of the Gazelle Peninsula where the majority of small holder cocoa farmers reside. Each of these protected area have their own significance where Tavalo contains extensive black sandy beaches together with creeks with a diverse range of aquatic endemic marine species. Kavakuna Cave is a karst feature where rivers disappear into sinkholes; Klampun WMA contains the last remaining tract of Agathis spp (Kauri pine) on the island of New Britain, as the island of New Britain has been extensively logged. Talele and Nanuk Island are two islands to the North West and east of the Gazelle Peninsula. Both are small islands which contain nesting and sprang area for turtles and other marine species. Talele Island is threatened by local harvesting of marine species and as the population increases, this threat will increase. Nanuk Island Resource is supposed to become a Provincial Park where the responsibilities for management would wrest with the ENB Provincial Administration. Both these Island protected areas are not in close proximity to the cocoa blocks or plantations in ENB.

On the Autonomous Region of Bougainville, only a large protected area of Pirong WMA exists and covers 43,200 ha on customary land about one kilometre from Kieta. The WMA contains coastal and marine areas with pristine reefs and eight islands which have a broad range of marine biodiversity. Elsewhere on ARB are the upper mountain lakes of Mt. Balbi and the active Mt Bagana volcanoes.
Within Morobe, Madang and East Sepik provinces there are 17 protected areas having a range of biodiversity from terrestrial, marine and natural sanctuary. Their sizes range from 220,000 ha to a small as 1.9 ha, the latter is a National Peace Park commemorating the Second World War in the Pacific.

3.4.1 Wildlife Management Areas

Wildlife Management Areas were devised in the 1970s so that PAs could be generated through community initiative and could retain and even strengthen existing local traditions. The community selects the WMA committee and devises the boundary and the rules. This allows for local practices, such as restricted access as traditionally enforced by Masalai spirits, to be incorporated. Although respect for traditional lines of authority has diminished, traditional forms of resource management have in some cases been the only safety-net following a collapse of formal management.

A major drawback of the WMA concept is that only the fauna and not the flora is legally protected. Thus, large developers such as logging, mining and oil companies can circumvent the system.

At the local scale WMA committees are commonly under pressure from rapidly increasing human populations placing ever-higher demands on the natural resources. With no formalised system of patrols the PAs are open to abuse without fear of recrimination. Maintaining local respect for the ideals of the WMA appears to be essential and can only be achieved with strong local leadership and effective enforcement of rules.

3.4.2 Critical Habitats

A listing and maps of critical habitats can be found in Appendix 6 with maps from Henson et al 2001. Within EHP – Crater Mountain is designated as very high priority because of the intact mountain forest vegetation containing endemic flora and fauna. As mentioned earlier, it is an area under threat from mining and petroleum development.

Mt Wilhelm National Reserve and Jimi Valley National Park are critical habitats in the Simbu and Western Highlands provinces. Both are allocated high priority areas and as Mt. Wilhelm is the highest mountain in PNG, it is of national significance and steps to conserve this habitat are imperative. The Jimi Valley National Park represents rich valley flora and fauna and again is highlighted in the Conservation Needs Assessment of Papua New Guinea.

All protected areas described in this section can be considered critical habitats and the ESMF contains strict guidelines to ensure no PPAP activities encroach into or near them. In fact PPAP activities will be undertaken in the most modified environments well away from any protected areas.

The Jimi Valley National Park is 10 – 15 kms away from the main coffee growing areas in the WHP. It is location is also isolated and DEC has not been visiting this park for a long time and its status is unclear. There are no facilities there as a normal park situation and does not contain park rangers to administer its boundary.

3.5 Agricultural Chemical Use by Smallholders

Twenty known suppliers of agrochemical companies including the National Agriculture Quarantine & Inspection Authority (NAQIA) and the Department of Health have stockpiles of agrochemicals in PNG (DEC nd). These range from pesticide such as miticide, insecticide, rodenticide, bacteriacide,
fungicide, acaricide and molluscide. There may be other supplies of agrochemicals that could contain banned substances and in some cases, these are imported in with writing in foreign languages although the chemical setup is that of a banned agrochemical as it is in the Persistent Organic Pesticides (POPs) list. These agrochemical products are obtained by plantations, subsistence farmers and the novice gardener.

The National Implementation Plan for the Removal of POPs (DEC 2006) was endorsed by the GoPNG but to date there has been no implementation of the plan. The use of agrochemicals has not been practiced by a large number of coffee or cocoa farmers. This is attributed largely to the prohibitive cost of agrichemicals. Small holders seen in the field used Roundup/ Glyphosate to control weeds in their coffee and cocoa plots.

The environmental impacts of these herbicides are restricted within areas of application and quickly decompose into harmless compounds that are absorbed by the soil by naturally occurring bacteria.

There is the potential of herbicides and pesticides getting into the streams and waterways if the coffee or cocoa plots are in close proximity and this will need to be assessed if there is a need for greater application. Within the large plantations, it is possible for them to use large quantities of the agrochemicals to improve their productive yields and this could be an area of concern, although the PPAP is targeted primarily to the small holder coffee and cocoa farmers.

### 3.6 Socio-economic Environment

#### 3.6.1 Social and Cultural Features

Papua New Guinea is the largest country in the South Pacific except Australia in terms of natural wealth, landmass and population base. Located on the eastern half of the sub-continental island of New Guinea, plus the great islands of the Bismarck Archipelago and the northernmost Solomon group, as well as some 600 additional smaller islands, its population of some 5.7 million is largely subsistence based.

PNG’s landmass encompasses in excess of 464,000 km² with a marine jurisdictional zone in excess of 3 million km² (Nita 2006).

The biological and geological diversity is equally matched by PNG’s cultural wealth, subsumed in over 800 distinct language groups and spoken by over ten thousand autonomous tribes. The country has abundant natural resources. Besides petroleum, gold, nickel and copper, much of the land supports tree crops and other cash crops.

Agriculture is still the main stay of the economy with about 85 percent of the population at least partially or fully reliant on subsistence agriculture. About three quarters of the country’s land area is forested and much of this is inaccessible for both commercial and subsistence purposes at present. Of

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8 Information obtained from Dr. Samson Laup at CCIL 15 Sept 2009.
this ninety seven percent of the total land is owned by traditional landowners. In the PPAP provinces, a range of agricultural products are cultivated and the main ones are listed in Table 9.

People

The people of PNG are extremely diverse ethnically and are attached to well over 250 distinct cultures. The population of 5.7 million people with a current annual average growth rate of nearly 3 percent in contrast to a 2.3 percent a decade ago is the fastest in the region. PNG is a lower middle income country with a per capita GNP of US$860 (Tameo 2004). Social indicators show a low quality of life for many in the rural areas and the unemployed of the towns. UNDP's 2002 Human Development Index (HDI) of 173 countries places PNG at 129. The HDI of 2004 places PNG at 133 out of 177 countries implying no significant changes to PNG’s human development record since 2002 (UNDP 2004). The provinces initially covered under the PPAP have a total population of 2 million rural people (Table 6).

Life expectancy is 54 years, infant mortality is 64 deaths per 1000 live births, and maternal mortality is high at 300 deaths per 100,000 births. The adult literacy rate is 52 percent and despite relatively high public expenditure on education, the completion rate of primary school is only 59 percent (DFP 2004; UNDP 2002). The PPAP provinces show a range from 55 to 72 % in ENB (Table 9), reflecting the availability of services in different areas. PNG professes Christianity and up to 200 different denominations are here, and people are free to worship. Within the PPAP provinces, nearly all are occurring in some numbers and the traditional and majority of religions are represented (Table 6). Law and order continues to be a serious socio-economic problem, particularly in urban areas and some rural communities. Only 10 percent of the population is employed in the formal wage sector. This is further complicated with the potential work force which is expanding with about 60,000 school-leavers annually, with only a small proportion of who can expect to find employment.

The imbalance in economic opportunities in provinces and population growth is likely to be a major impediment to achieving the social targets set by the Millennium Development Goals.

Economy

Significant economic events over the last ten years have placed heavy demands on economic management. The steady but moderate growth in GNP of the mid 80's was followed in 1989 and 1990 by negative growth rates of -1.4 percent and -3.7 percent respectively. This downturn was due to a sharp fall in the terms of trade, exacerbated by the closure of the Bougainville copper mine, which alone contributed about 35 percent of export revenue. The economy bounced back with growth rates of 9.5 percent in 1991 and 9 percent in 1992 as new petroleum and mining ventures came under production (Nita 2006).

The Progress Report for the PNG MDG discussed the economic realities under its economic profile for the nation. There is general consensus that the 1990s were characterized by mixed economic performance even with the booming nonrenewable resource sectors in energy and mineral commodities which witnessed significant gains in the early 1990s (Tameo 2004; UNDP 2004).

There are however, positive indications in the economy despite the negative performances in the first few years of the Millennium. Consolidating the performance of the previous two years, the economy grew by 3 percent in 2005, given favorable external conditions, political stability and supportive fiscal, monetary, and trade policies. Agriculture performed particularly well, especially coffee, copra, oil palm, and rubber. Construction recorded strong growth, as a result of low interest rates and solid demand for residential and commercial buildings. Mineral, natural gas and oil contracted by 4.5 percent, primarily on a 6 percent reduction in gold production due to a landslide at the Lihir Gold Mine in 2005. In total, the mining sector earned over 50 percent of total export earnings since Panguna Mine closed in 1989 (Post Courier July 13 2006).
GDP growth is currently at 3.5 percent from -0.1 percent in 2002. Growth is expected to increase dramatically with impact of the LNG project coming on-stream and as industries including construction, manufacturing, and wholesale and retail trades are expected to grow at stronger rates than previous years.

Interest rates have fallen from 13.3 percent in 2002 to 6.5 percent in 2006. Public debt was dangerously high — rising from K1.950 billion in 1992 to K8.80 billion in 2002 but has fallen significantly since. However, law and order problems, governance issues, land tenure arrangements, limited infrastructure, and basic service delivery are long standing issues, which continue to impinge upon growth and higher living standards (Asian Development Bank 2006).

These figures do not match with the current annual national population growth rate of nearly 3 percent which implies that the ‘economic growth rate needs to be significantly higher and maintained over many years to achieve real growth per capita. Further research is required to establish whether or not structural transformation in the economy has led to the registered growth rates or that it was reacting to external developments.

Table 6: Population and cultural data for the districts of EHP and other Provinces

<table>
<thead>
<tr>
<th>District/Province</th>
<th>Population 9</th>
<th>Religion</th>
<th>Out Migration 10 (%)</th>
<th>Retention Rates at Primary School (%) 11</th>
<th>Literacy rate (%) 11</th>
<th>Economic activity 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okapa</td>
<td>54,000</td>
<td>SDA, NT, OB, FS, SA</td>
<td>7.4</td>
<td>43.2</td>
<td>0.554</td>
<td>Coffee and fresh food</td>
</tr>
<tr>
<td>Lufa</td>
<td>39,000</td>
<td>SDA, NT, OB, FS, SA</td>
<td>7.4</td>
<td>43.2</td>
<td>0.554</td>
<td>Coffee, fresh food, firewood and tobacco</td>
</tr>
<tr>
<td>Kainantu</td>
<td>35,000</td>
<td>SDA, NT, OB, FS, SA</td>
<td>7.4</td>
<td>43.2</td>
<td>0.554</td>
<td>Coffee, fresh food, firewood and tobacco</td>
</tr>
<tr>
<td>WHP</td>
<td>358,000</td>
<td>RC,L, SDA, O</td>
<td>4.0</td>
<td>47.8</td>
<td>0.587</td>
<td>Coffee and fresh food</td>
</tr>
<tr>
<td>Simbu</td>
<td>182,000</td>
<td>RC,L, SDA, O</td>
<td>10.2</td>
<td>45.4</td>
<td>0.574</td>
<td>Coffee, fresh food and firewood</td>
</tr>
<tr>
<td>ENB</td>
<td>247,000</td>
<td>RC,L, SDA, O</td>
<td>6.6</td>
<td>73.4</td>
<td>0.723</td>
<td>Cocoa, betel nut, fresh food, copra &amp; fish.</td>
</tr>
<tr>
<td>ARB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9 Population here is taken from Hanson et al 2001 and is specifically stated as rural population.


11 The retention and literacy rates are provincial averages and literacy covers the youth (15 – 24 yrs) (GoPNG 2004).

12 Taken from Hanson et al 2001.
<table>
<thead>
<tr>
<th>Province</th>
<th>Population</th>
<th>Religion</th>
<th>Literacy</th>
<th>GDP per Capita</th>
<th>Primary Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morobe</td>
<td>157,000</td>
<td>RC, L, SDA, O</td>
<td>2.7</td>
<td>69.5</td>
<td>Cocoa, copra, fish, betel nut</td>
</tr>
<tr>
<td>Madang</td>
<td>309,000</td>
<td>L, RC, SDA, O</td>
<td>7.8</td>
<td>56.1</td>
<td>Cocoa, coffee, fresh food, coconut</td>
</tr>
<tr>
<td>East Sepik</td>
<td>251,000</td>
<td>RC, L, SDA, O</td>
<td>5.1</td>
<td>57</td>
<td>Cocoa, betel nut, coconut, fresh food</td>
</tr>
<tr>
<td></td>
<td>270,000</td>
<td>RC, L, SDA, O</td>
<td>9.9</td>
<td>71.5</td>
<td>Cocoa, betel nut, fresh food, coffee, rubber</td>
</tr>
</tbody>
</table>

SDA = Seventh Day Adventist; NT = New Tribes; OB = Open Bible; FS = Four Square; SA = Salvation Army; RC = Roman Catholic, L = Lutheran, O = Other denominations such as Pentecostal and Reformed churches.

### 3.6.2 Social and Economic Infrastructure

(a) Communication infrastructure

Supporting this background of information, is the development of rapidly increasing communication into rural areas brought about by the introduction into PNG of Digicel, a rival telecommunication company that has prompt PNG's B Mobile network to thoroughly amend the communication system. In 2009, Digicel and B Mobile continue to provide mobile services into the rural areas with Digicel. Fixed line in towns and major centres are fully operational with STD and IDD direct dial up to the world. Within rural areas, these are limited, but with the introduction of Digicel, Telikom PNG is now expanding its line into the rural areas with more remote areas having access to the Virtual Small Aperture Telecommunication (VSAT) network. Within the PPAP provinces, communications through both networks are fully functional with Digicel and B Mobile providing a range of special rates and offers.

(b) Service infrastructure

Similarly, services such as municipal and household sanitation is more regulated within the major towns and cities with dedicated dump sites and disposal areas. However, the situation is very different in the provinces where most of the sewage and household garbage do not have a sewage treatment plant or dedicated dumps, although some provinces are seeking avenues to change these. Transportation within the urban and rural areas is more focused within existing roads and there are still other roads that are impassable.

(c) Commercial infrastructure

Earlier paragraphs described the mineral and petroleum boom that is occurring in PNG. In 2009, the Liquid Natural Gas (LNG) project proposes to add more finance into PNG and for that matter, there is an intense commercialization of infrastructure in Port Moresby. This is expected to move to Lae and other centres as they keep up with the demands of the project. The mineral infrastructure is seeing the expansion of mine life and development of new ore bodies such as the Hidden Valley Mine and others such as the Ramu Nickel Mine stand ready to operate soon.

### 3.6.3 Cultural Sites and Material Cultural Conservation

Within PNG, cultural sites are numerous and most are associated with Protected Areas, Wildlife Management Areas and Critical Habitats (section 3.4). Each of these sites are either open to the
public or secluded and the 800 different language groups would have varying ways of conserving and protecting them. Those that have approached the GoPNG through DEC and Conservation Non-Government Organisations such as World Wild Fund for Nature (WWF) and Conservation International (CI) have got their areas conserved, while others have yet to formalize conservation. Although, conservation is not new to PNG where all cultural sites have been traditionally conserved throughout the history of societies.
4.0 Potential Environmental Impacts

4.1 Introduction

Activities from Component 1 do not have physical impacts on the environment as this component comprises institutional strengthening and project management. It is however imperative for environmental assessment awareness to be included in the deliverables so that stakeholders are more environmentally conscious with the sustainability of the cash crops.

Within the cocoa sub sector in ENB (section 1.2.2), no major environmental impact is envisaged from the project. The CB considers the use of pesticides as the last option as it wants to maintain its 70% fine flavouring cocoa rating\textsuperscript{13}.

For the ARB, the notice of the outbreak of CPB in September 2009 triggered a response from the Autonomous Government of Bougainville, the Cocoa Board and the Regional Member of Bougainville. An Action Plan was initiated consisting of an initial funding of PNGK400,000 as seed finance to start preliminary activities while approaching the GoPNG for K10 million for a three year CPB Management Plan\textsuperscript{14}.

4.1.1 Summary of Environmental Issues for the Cocoa and Coffee Sectors (Component 2 PPAP)

Cocoa Production and Processing

- **Nursery.** Cocoa seedlings are regularly watered and fertiliser added (NPK and Urea) to enhance growth up to about 60cm in height before they are ready to be planted. Potential impact could result from excess fertiliser use causing run off into water ways and creeks and resulting in pollution.

- **Planting and Growing.** During the juvenile and during the production phase of cocoa trees, fertilisers and herbicides are often applied to stimulate trees to develop well, start flowering and pod-setting. Potential environmental impact could be excess use of fertilisers of herbicides leaching into water ways and creeks affecting aquatic organisms. However, in PNG the majority of small farmers are not using fertilizers due to very good soil.

- **Harvesting and Fermenting.** Ripe cocoa pods are harvested, broken and cocoa beans are placed into a wet box tray where beans ‘sweat’ releasing the thick pulp. Partly drained cocoa beans are then placed into the fermentation boxes where they release the rest of pulp during

\textsuperscript{13}Discussion with Cocoa Board staff, 14/9/09.

\textsuperscript{14}Discussion with CCIL staff, Buka 16/9/09.
fermentation. The thick 'sludge' from the collection of the pulp may pose an impact if it enters into water ways. This could only occur if the fermentories is close to a creek. The sludge itself is not toxic but in large quantities could be toxic to aquatic organisms.

- **Drying of cocoa beans.** After the fermentation process, the beans are dried to reduce the moisture level in the beans to 7%. Sun drying is preferred for good quality and low cost, however due to excessive rainfall majority of cocoa in PNG is being dried by kiln driers with the heat generated with firewood and in some fermentories by fuel. Excessive fire-wood collection could be a problem in the future. More economic and environmental friendly methods of cocoa drying would be supported under PPAP. Badly maintained driers are the reason for very serious negative impacts to the quality of the bean as escaping smoke will tint the flavour of cocoa. No impacts are foreseen from the processed cocoa beans as they ready for sale.

**Coffee Production and Processing**

- **Seedling and Nursery** Coffee seedlings are placed in nurseries where adequate water and fertilizer is provided to them. The only possible impact would be if nurseries are close to rivers or drinking sources and fertilizer residues may contaminate these water sources.

- **Planting and Growing**
  Young coffee plants are planted into prepared coffee plant plots. Similar to the seedlings and nursery, fertilizers, herbicides and fungicides are used in reducing pest and diseases and ensuring fully development coffee trees. Potential environmental impacts would be from fertilizer and herbicide residue run-off into water ways or drinking water sources.

- **Picking, Fermenting and Processing**
  No impact arises when people hand pick coffee cherries and as long as the cherries are processed at once, they will not ferment.

  Processing of coffee through the dry, semidry and wet processing methods involve varying amounts of water where the dry method uses minimal water and hence waste water when discharged. Impact on the receiving water will be also for coffee pulp that is not disposed under coffee trees. No impact on the coffee pulp on soil as it will decompose into organic matter. PNG gardeners have traditionally incorporated organic matter into the soil to enhance fertility.

- **Ferment and Wash Method.** Remains of coffee pulp are broken down by microbes and washed down with water. Impact here is the waste water containing high Biological Oxygen Demand (BOD). In addition, waste water gives off a pungent smell that is unpleasant.

- **Dry Milling.** This involves the removal of the last layer of dry skin and remaining fruit residue from the dry coffee bean. Potential impacts is the waste of dry skins, however coffee factories visited use this as a fuel for the hot air drying of the coffee beans.

- **Polishing and Sorting.** Polishing involves the removal of remaining silver skin on the coffee beans and the chaff produced when roasted. Sorting involves sorting by colour through machines or by hand. No adverse impacts are anticipated here except for the fruit skins of the coffee beans that are removed. It is mainly used as a fuel for the drying of coffee beans.
4.1.2 Rehabilitation of Minor Roads (Component 3 Market Access Infrastructure)

- **Acquisition of land for Widening or Realignments**
  This involves the acquisition of land for widening or realignment requirements. In PNG, land acquisition and issues of compensation are often problematic and therefore it is important to deal with any potential land acquisition questions in an effective and efficient manner. This project will not require any involuntary acquisition of land or resettlement. Part IV of the Environmental Management and Social Framework contains the Compensation Policy Framework (CPF) which defines the approach taken by the PPAP.

- **Clearing of Right of Way (ROW)**
  During rehabilitation activities, there will be clearing of the existing ROW. In some cases, this ROW will not have been cleared for many years and there will be a significant loss of vegetation along the roadside as a result of the clearing exercise. In the case where there are large trees or other desirable vegetation, it will be important to ensure that these are not removed by the contractors if at all possible. However, there may be incidences where some peripheral damage to ROW vegetation is unavoidable and the processes detailed in the CPF will be followed.

- **Equipment Mobilisation**
  Includes the delivery of materials, plant and equipment to the site and may involve large transport vehicles which cause air and noise pollution. May also result in traffic and safety problems and damage to vegetation.

- **Mobilisation of the Labour Force**
  Refers to the arrival of an outside labour force for construction activities. These newcomers may be culturally or ethnically different from people in the area and in PNG this can have significant impacts. Potential health impacts are also possible. To avoid social conflict, local labor must be used as much as possible.

- **Establishment and Operation of Labour Camps**
  This refers to the camp established to house the non-resident workforce. However, it is not anticipated that large scale roadworks requiring labour camps will be required under PPAP. The major problems with the labour camps are the pollution caused by waste and sewage disposal and the potential use of local resources in an unsustainable manner (for instance, fuel wood for cooking, hunting and fishing activities).

- **Operation of Existing Quarry Sites (Terrestrial)**
  This refers to the on-going operation of quarry sites which have been established prior to the commencement of project construction activities. The activities associated with this include blasting and the resultant noise and dust pollution. Abandonment of the quarry after material extraction can have impacts if not properly managed. These will be overseen by the Environmental Specialist and Sr. Engineer at the project level.

- **Establishment and Operation of Stone Crushing Plants:**
  This involves the crushing of stones using large and very noisy equipment. The activity generates substantial amounts of dust and can be very disturbing to nearby settlements.

- **Earth Movements Relating to Cutting and Filling Activities in Steep, Hilly or Unstable Areas:**
  This involves cutting and filling in areas that are steep and as such could result in significant increased erosion and increasing slope instability unless carefully controlled.
• **Earth Movements in the Vicinity of Settlements along the Roadside:**
This could disturb local market activities and affect pedestrian walkways. Even though the earthworks would be undertaken within the ROW, there is the possibility that illegal structures have been constructed which could be affected. Compensation for these assets may need to be provided as per the Compensation Policy Framework.

• **Drainage Works:**
This includes all drainage works such as culverts and drainage ditches. The main anticipated impacts are the possible effects of increased sedimentation in surrounding water bodies as a result of inappropriate deposition of excavated materials and associated disturbances.

• **Material Transport:**
This includes the transport of all construction materials such as rock, gravel, bitumen, concrete or other material as well as the transport of equipment or machinery. Again, minor environmental impacts would include noise and dust pollution.

• **Increased Access:**
This is actually an indirect impact of the road rehabilitation and the potential impacts that could result include increased and unsustainable exploitation of the natural resources in the area.

• **Increased Traffic and Operating Speeds:**
This can result in increased traffic accidents, especially involving children. Increased traffic can also result in some pollution in surrounding water bodies as a result of runoff.

### 4.2 Market chain for the Cocoa Industry

Cocoa (*Theobroma cacao* L) production is a major industry involving 150,000 families in the coastal and island regions of Papua New Guinea. Small holder predominantly family or clan groups produce up to 75% of the total annual production while plantations produce the remainder (Curry et al. 2007).

The process in the industry can be described in various stages;

i) seedlings/nurseries

ii) planting, growing

iii) harvesting and, fermenting process

iv) handling – transportation, storage to markets

#### Stage 1 Seedlings

Seedlings are propagated from cocoa seeds which are taken out from mature cocoa pods. These are often done in industry sponsored establishments such as the Cocoa Coconut Institute Limited or AgMark Plantations or even on a smaller scale in villages. These are placed in a black nursery bag with soil for individual sprouting of the new cocoa plant. The soil needs to be fertile to allow quick plant growth.

During this period, it is placed into nursery area, mostly in shade and adequate water and fertilizer to enhance their growth. When these are grown to a height of 60 cms, they are transferred to the prepared areas for them to be planted.

#### Stage 2 Planting and Growing
Young mature seedlings are then planted by removing the bottom of the polythene bag to allow roots to grow into the surrounding soil. Depending on whether the seedlings are hybrid or normal cocoa trees, pruning will take place in order to let the cocoa develop its branch and tree structure so as to support the growth of new cocoa budding and then into pods. Family members ensure that the cocoa plant is free from competing weeds or shrubs. The removal of weeds also eliminates potential habitats for insects and pests (Kumar 2001).

With adequate shade, often from the Glyricidia sepium, a leguminous tree, the cocoa trees will grow and in three months, start to develop budding and the development of pods. These will develop until they reach full length and width around 20 - 22 cms and 15 - 18 cms respectively and also ripen as shown by the yellow colouring, although some may show beige or light brown colour. These are then harvested. Harvesting needs to be carried out carefully so that there is no damage to the branch as this would allow the insects or pathogens to be introduced into the cocoa tree. Potential insects and pests are the grey weevil, longhorn and rhyparid beetles, cocoa webworm (Pansepta), mealy bugs, caterpillars and the Cocoa Pod Borer (Conopormorpha cramella) CPB.

Stage 3 Harvesting and Fermenting Process

The cocoa pods are taken from the tree and then cut open across the middle to expose the cocoa beans that are held together in a network of lygenious sap (MCB 2009). The wet beans can either be sold to fermentories who will continue the process of separating the sap through a wet box process that allows the sap to drip off.

The pulp and seeds are then piled in heaps, placed in bins, or laid out on grates for several days. During this time, the seeds and pulp undergo "sweating", where the thick pulp liquefies as it ferments. The fermented pulp trickles away, leaving cocoa seeds behind to be collected. Sweating is important for the quality of the beans, which originally have a strong bitter taste.

If sweating is interrupted, the resulting cocoa may be ruined; if underdone the cocoa seed maintains a flavor similar to raw potato and becomes susceptible to mildew. This process takes two to three days and the beans are then sun dried to reduce the stickiness of the beans. If rainy periods prolong, then the sticky beans are placed into the fermentories, and this will take about two days to get the achieved dryness of the beans.

The fermented beans are dried by spreading them out over a large surface and constantly raking them. In large plantations, this is done on huge trays under the sun or by using artificial heat. Small plantations may dry their harvest on little trays or. Drying in the sun is preferable to drying by artificial means, as no extraneous flavors such as smoke or oil are introduced which might otherwise taint the flavour.

The sap and the remains of the tendons holding the cocoa pods together are usually placed back underneath the cocoa tree to allow natural decomposition. At this stage, cocoa farmers do not consider the sludge from this process as being of any use although in Malaysia, studies have shown potential uses as livestock feed and as a use for gums (MCB 2009). Contents of the lygenious sap are hexisugar and contain galactose, glucose and glucose acid among other substances (ibid). The wet

15 Lygenious refers to materials that have cavities and secrete enriched higher forms of sugars, as is the case for entrails of the cocoa pod.
cocoa beans are then placed onto a wire tray over a centralised dryer where often coconut husks and shells or firewood is burned as the heat source for the dryer.

**Stage 4 Handling, Transportation, and Storage to Markets**

After the drying period, often a day or two, the cocoa beans are taken out and then packed into jute bags where a fully packed cocoa bag would weight around 63.5 Kgs. This is then sewn up at the top and is ready for sale to the cocoa buyer. Cocoa buyers and merchant enterprises then store cocoa bags on pallets in warehouses waiting for shipping buyers in US, Singapore, Europe and Australia. These are then processed further into chocolate and assorted products.

**4.1.1 Environmental impacts from Cocoa Processing**

The cocoa market chain from the seedling to planting, harvesting and processing have some environmental impacts although these are not as extensive and polluting as in the coffee industry. The reduced use of agrochemicals by small holders in Nigeria (Okuneye et al 2003) is very similar to the situation in Papua New Guinea where the cost of these agrochemicals are a hindrance to the small holder farmers. The identified environmental impacts on the cocoa from the planting to the processing are stated in Table 13. The findings are taken from an ESCAP publication and modified with additional references.

The production activities overlap with four stages as stated earlier. Overall, the environmental impacts on the soil and creeks would be the use of agrochemical such as the case for Ghana (Ntiamoah and Afrane 2008). In Ghana, 40 litres of pulp through the ‘sweating’ is produced from 800 kg of wet beans and if allowed into waterways can cause eutrophication. In addition, phosphate emissions can evolve from phosphate fertilizers. (ibid).

Within cocoa blocks in PNG, no additional rainforest has been cleared, although there may be areas cleared for gardening and then conversion to cocoa plots. Overall, the application of agrochemicals by small holder farmers is minimal as the costs are a barrier for farmers. However, within the plantations, the application would be intense as the plantation owners’ focus on getting a better yield and there is potential for pesticide run off. However, this most creeks within the Gazelle Peninsula are dry for most of the time and only have water in them during the wet season. In addition, the soil is also predominantly ash layers hence, pesticide residues would immediately dissipate into the soil. Similar situation occurs in the ARB.

<table>
<thead>
<tr>
<th>Table 7: Environmental Impacts from Cocoa on Small holder blocksootnote{16 Taken from ESCAP 2009 and modified in key areas.}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production activities</strong></td>
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<tr>
<td>--------------------------</td>
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<tr>
<td>1. Nursery establishment</td>
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16 Taken from ESCAP 2009 and modified in key areas.
2. Transplanting

<table>
<thead>
<tr>
<th>Method</th>
<th>Impact on Ecosystem</th>
<th>Aquatic Organisms</th>
<th>Pesticide Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Weed control</td>
<td>Disturbance to habitats</td>
<td>Toxic chemicals</td>
<td>As above, possible</td>
</tr>
<tr>
<td>through use of herbicides</td>
<td>(a) Weed control</td>
<td></td>
<td>eutrophication</td>
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<td></td>
<td>(b) Established shade trees:</td>
<td>Man</td>
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<tr>
<td></td>
<td>coconut and fruit trees</td>
<td></td>
<td>Improves cooling in</td>
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<td></td>
<td>Micro-climatic changes</td>
<td></td>
<td>the overall ecosystem</td>
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<td></td>
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<td>having to provide</td>
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<td>oxygen in the</td>
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<td></td>
<td></td>
<td></td>
<td>immediate area.</td>
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<tr>
<td>(c) Use of insecticides</td>
<td>Habitat destruction; changes in species diversity; reduced insect resistance.</td>
<td>Toxic chemicals</td>
<td>Potential runoff into</td>
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<tr>
<td></td>
<td></td>
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<td>creeks if close by.</td>
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<td>Low to medium</td>
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<td>depending on the</td>
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<td>application and</td>
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<td>concentration of</td>
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<td>insecticides</td>
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<td>Cost is a limiting</td>
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<td>factor.</td>
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3. Field maintenance

<table>
<thead>
<tr>
<th>Method</th>
<th>Impact on Ecosystem</th>
<th>Aquatic Organisms</th>
<th>Pesticide Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Weeding and use of herbicides</td>
<td>Physical disruption of habitat</td>
<td>Toxic chemicals</td>
<td>Possible impact on</td>
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<td>fisheries, source of</td>
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<td>drinking water etc.;</td>
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<td>death of local</td>
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<td></td>
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<td>population of</td>
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<td></td>
<td></td>
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<td>organisms.</td>
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<td>Low to High</td>
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<td></td>
<td></td>
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<td>depending on</td>
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<td></td>
<td></td>
<td></td>
<td>concentration.</td>
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<tr>
<td>(b) Fertilizer application</td>
<td>Chemical alteration of habitat</td>
<td>Chemical nutrients</td>
<td>As above, eutrophication.</td>
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<td>Low to High</td>
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<td>depending on</td>
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<td>concentration.</td>
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<tr>
<td>(c) Pesticide use</td>
<td>Changes in the ecosystem and population of organisms</td>
<td>Toxic materials</td>
<td>As above</td>
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<td>Low to medium</td>
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<td>frequency and</td>
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<td>coverage (see footnote 2 &amp; 3).</td>
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</table>

The use of firewood as a fuel for heat generation in the fermentories in ENB is an issue for small cocoa block holders with less than a hectare. In that instance, transportation was needed to get firewood from other areas which incurs a cost (Curry et al 2007). For those cocoa farmers who have a lot of land, firewood was not an issue (see community consultation; section 8). Under PPAP, the area of cocoa production is going to decrease due to the CPB infestation. This being said, the project would promote more efficient driers to address this issue.

4.2 Market Chain for the Coffee Industry

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17 Ntiamoah & Afrane 2008.

18 Kumar 2001.

Coffee production is the backbone of the rural economy in the Highlands (with more than 80 percent of national production from Eastern and Western Highlands Provinces alone). Over 370,000 households (approximately 2 to 2.5 million people) depend on coffee production. Almost all coffee produced in PNG is Arabica, and 50 percent falls into the Y1 Grade, which is considered by many exporters as the least expensive and best Washed Arabica on the market. The specific flavor of Y Grade coffee from PNG has helped it capture a market niche in the world market. Certified coffees represent a growing but still small share of production (3 percent), and Y Grade coffees are considered the key market driver. Nevertheless, exporters have developed a range of strategies based on their comparative advantages and business networks, some targeting niche markets (Fair Trade, Organic, Utz, etc) while others target specialty or traditional markets. In terms of the market chain and delivery of coffee to the markets, process in the industry can be described in various stages;

i) Seedlings/nurseries

ii) Planting and growing

iii) Picking and fermenting process

iv) Handling – transportation, Storage to markets

Stage 1 Nursery

Seedlings are propagated from ripe coffee cherries and placed in a black nursery bag with soil for individual sprouting of the new coffee plant. The Coffee Industry Corporation and large coffee plantations have their own nurseries and seedlings can be obtained from local nurseries in the villages.

During this period, it is placed into nursery area, mostly in shade and adequate water and fertiliser to enhance their growth. When these are grown to a height of 60 cms, they are transferred to prepared areas to be planted. There are a variety of coffee types, and the time period for their maturity varies, although a figure of five years has been stated for maturity (Wikipedia 2009).

Stage 2 Planting and Growing

Young mature seedlings are then planted by removing the bottom of the polythene bag to allow roots to grow into the surrounding soil. The coffee tree is spaced at least 1.5 metres apart, and under shade trees, often these are the Casuarina trees. Coffee trees will grow and reach maturity in about five years, with ripen cherries as the flowers are developed from the fourth year (ibid).

Family members or plantation workers ensure that the coffee plant is free from competing weeds or shrubs. The removal of weeds also eliminates potential habitats for insects and pests (Kumar 2001). Herbicides and other pesticides are used and the use is greater in the plantations than for individual farmers. In the highlands of PNG, pesticide use is very low as observed during field visits. This is despite the 173 insect species observed on the coffee plant (ibid). These may all be beneficial.

Stage 3 Picking and Fermenting and Processing

A couple of stages can be identified in this phase and it is also the most vital stage in this industry.

This is the Picking, Processing and Milling with minor steps within those three stages. Picking can be done either in strip picking or selective picking. The second option is the most applicable option here in PNG where only the ripe cherries are harvested and they are picked individually by hand. Pickers rotate among the trees every 8 - 10 days, choosing only the cherries which are at the peak of ripeness. Once picked the beans will need to be processed as if these are left in storage, the cherries will start
to ferment. Only ripe cherries will make the required quality of coffee and green cherries should not be harvested.

**Processing**

The processing of coffee is the conversion of the raw fruit (cherry) of the coffee plant into the commodity green coffee. The cherry has the fruit or pulp removed leaving the seed or bean which is then dried. While all green coffee is processed, the method that is used varies and can have a significant effect on the flavor of roasted and brewed coffee.

Once picked, there are then processed through dry, semi dry and wet processing. Dry process, also known as unwashed or natural coffee, is the oldest method of processing coffee. The entire cherry after harvest is first cleaned by sorting out the ripe from the unripe and overripe berries. These can also be separated by flotation in water and then placed in the sun to dry on tables or in thin layers on patios.

This is the practice for 95% of coffee from Brazil, although in PNG, a variety of rudimentary methods such as bashing with rocks or using their fingers to separate the cherry skins from the beans (URS 2009a). Only half of the coffee farmers surveyed had access to mechanical pulper and this was the most preferred method where after pulping; the coffee beans are dried in the sun for up to a few days depending on the availability of sunlight.

**Semi dry** is a hybrid process used in Indonesia and Brazil. In Indonesia, the process is also called "wet hulled", "semi-washed" or "Giling Basah". Literally translated from Indonesian, Giling Basah means "wet grinding". In this process, farmers remove the outer skin from the cherries mechanically, using locally built pulping machines, called "liuwak". The coffee beans, still coated with mucilage, are then stored for up to a day. Following this waiting period, the mucilage is washed off and the parchment coffee is partially dried in the sun before sale at 30% to 35% moisture content. This is what coffee road side buyers' purchase from the local community.

In the **Wet Process**, the fruit covering the seeds/beans is removed before they are dried. Coffee processed by the wet method is called wet processed or washed coffee. The wet method requires the use of specific equipment and substantial quantities of water.

After the cherries are picked, the coffee is sorted by immersion in water. Bad or unripe fruit will float and the good ripe fruit will sink. The skin of the cherry and some of the pulp is removed by pressing the fruit by machine in water through a screen. The bean will still have a significant amount of the pulp clinging to it that needs to be removed. This is done either by the classic ferment-and-wash method or a newer procedure variously called machine-assisted wet processing, aqua pulping or mechanical demucilaging:

**Sorting coffee in water**

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20 Mucilage is the soft flesh of the coffee cherries that has a layer of gelatine like substance and occurs after the top skin of the coffee bean is removed. It is a polymer produced by most plants and some microorganisms.

21 A mechanical demucilaging machine is on trial up at CIC – Aiyura and has an advantage of using very little water and processes using the cherries own liquid.
Ferment-and-Wash Method: In the ferment and wash method of wet processing the remainder of the pulp is removed by breaking down the cellulose by fermenting the beans with microbes and then washing them with large amounts of water. Fermentation can be done with extra water or, in "Dry Fermentation", in the fruit's own juices only. The fermenting varies in factories is PNG and some ferment with water while one coffee factory is using its own juices and is recycling a lot of water as this is where the bulk of the environmental impacts in the coffee industry originate from.

The fermentation process has to be carefully monitored to ensure that the coffee doesn't acquire undesirable, sour flavours. For most coffees, mucilage removal through fermentation takes between 24 and 36 hours, depending on the temperature, thickness of the mucilage layer and concentration of the enzymes. The end of the fermentation is assessed by feel, as the parchment surrounding the beans loses its slimy texture and acquires a rougher "pebbly" feel. When the fermentation is complete, the coffee is thoroughly washed with clean water in tanks or in special washing machines.

In machine-assisted wet processing, fermentation is not used to separate the bean from the remainder of the pulp; rather, this is done through mechanical scrubbing. This process can cut down on water use and pollution since ferment and wash water has a foul odour. In addition, removing mucilage by machine is easier and more predictable than removing it by fermenting and washing. However, by eliminating the fermentation step and prematurely separating fruit and bean, mechanical demucilaging can remove an important tool that mill operators have of influencing coffee flavor.

Furthermore, the ecological criticism of the ferment-and-wash method has become popular. Any wet processing of coffee produces coffee wastewater which can be a pollutant. Around 130 liters of fresh water is required to process one kilogram of quality coffee. Solutions exist such as a combination of low-water equipment plus settling tanks allowing conscientious mill operators to carry out fermentation with limited pollution.

After the pulp has been removed what is left is the bean surrounded by two additional layers, the silver skin and the parchment. The beans must be dried to a water content of about 10% before they are stable. Coffee beans can be dried in the sun or by machine but in most cases it is dried in the sun to 12-13% moisture and brought down to 10% by machine.

Drying entirely by machine is normally only done where space is at a premium or the humidity is too high for the beans to dry before mildew sets in. Again drying varies from factory to factory but for small holders, the bulk is sun dried before being sold.

The final steps in coffee processing involve removing the last layers of dry skin and remaining fruit residue from the now dry coffee, and cleaning and sorting it. These steps are often called dry milling to distinguish them from the steps that take place before drying, which collectively are called wet milling.

Drying: The coffee cherries are spread out in the sun, either on large concrete or brick patios or on matting raised to waist height on trestles. As the cherries dry, they are raked or turned by hand to ensure even drying and prevent mildew. It may take up to 4 weeks before the cherries are dried to the optimum moisture content, depending on the weather conditions. On larger plantations, machine-

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22 Lahemanegu Coffee Factory recycles its water and also has ponds for anaerobic digestion and has plans to use the tannin back into its nursery.
drying is sometimes used to speed up the process after the coffee has been pre-dried in the sun for a few days.

The drying operation is the most important stage of the process, since it affects the final quality of the green coffee. A coffee that has been over dried will become brittle and produce too many broken beans during hulling (broken beans are considered defective beans). Coffee that has not been dried sufficiently will be too moist and prone to rapid deterioration caused by the attack of fungi and bacteria. The dried cherries are stored in bulk in special silos until they are sent to the mill where hulling, sorting, grading and bagging take place. All the outer layers of the dried cherry are removed in one step by the hulling machine.

The first step in dry milling is the removal of what is left of the fruit from the bean, whether it is the crumbly parchment skin of wet-processed coffee, the parchment skin and dried mucilage of semi-dry-processed coffee, or the entire dry, leathery fruit covering of the dry-processed coffee. Semi-dry hulling at 30% to 35% moisture (Giling Basah), as occurs in Indonesia, is thought to reduce acidity and increase body. Hulling is done with the help of machines, which can range from simple millstones to sophisticated machines that gently whack at the coffee.

Polishing is an optional process in which any silver skin that remains on the beans after hulling is removed in a polishing machine. This is done to improve the appearance of green coffee beans and eliminate a byproduct of roasting called chaff. It is described by some to be detrimental to the taste by raising the temperature of the bean through friction which changes the chemical makeup of the bean.

Cleaning and Sorting is essential as coffee beans are sorted by Size and Density: Most fine coffee goes through a battery of machines that sort the coffee by density of bean and by bean size, all the while removing sticks, rocks, nails, and miscellaneous debris that may have become mixed with the coffee during drying. Some machines blow the beans into the air; those that fall into bins closest to the air source are heaviest and biggest; the lightest (and likely defective) beans plus chaff are blown in the farthest bin.

Other machines shake the beans through a series of sieves, sorting them by size. Finally, a machine called a gravity separator shakes the sized beans on a tilted table, so that the heaviest, densest and best vibrate to one side of the pulsating table, and the lightest to the other. Finally, Sorting by Color completes this process. Defective beans are separated from sound beans on the basis of color rather than density or size. Color sorting is the trickiest and perhaps most important of all the steps in sorting and cleaning. With most high-quality coffees color sorting is done in the simplest possible way: by hand. Teams of workers (mostly women) pick discolored and other defective beans from the sound beans. The very best coffees may be hand-cleaned twice (double picked) or even three times (triple picked). Coffee that has been cleaned by hand is usually called European preparation; most specialty coffees have been cleaned and sorted in this way.

4.2.1 Environmental impacts from Coffee Processing

The environmental impacts from coffee may include the clearing of land for potential nurseries and in doing so convert primary forests (WWF 2009). Should new land be cleared then the natural ecosystems would be affected (ibid). The PPAP will not allow for new areas to be cleared but only the rehabilitation of existing blocks.

There is also the potential for some pesticide, fungicide and fertilizer runoff into creeks during the stages from nurseries to transplanting on to coffee plots, although very few smallholder coffee farmers apply them as compared to plantations in PNG. However, in Africa, these were encouraged (Hillock 2000). There is also the potential of soil impacts particularly on soil microbial community (Lancaster et al 2009).
The bulk of the environmental impacts from coffee processing is in the processing of the cherry beans where waste water having a high Biological Oxygen Demand (BOD) and also a high Chemical Oxygen Demand can pollute water ways and rivers (WWF 2009). These will remove the dissolved oxygen level available to aquatic organisms hence leading to their demise. Fungicide residues from the use of copper oxychloride are possible and this would be in the waste water, although more studies are needed to fully determine this (Hillocks 2001).

As for the coffee pulp, with its high organic content is very useful as organic matter under coffee trees and the Organic Coffee Fair Trade Scheme encourages this practice (Henry Ame, pers comm. 7/9/09).

Within coffee, most large commercial factories have a primary treatment system while only a few factories have secondary treatment but even fewer may be effectively working (Nicholls 2004).

It is estimated the majority of coffee grown by small holders neither have resources or skill to install and operate effluent treatment systems so there is a propensity for pollution of streams and rivers, depending on the location and scale of the processing facility. At the CIC, no efficient discharge treatment system has been designed for coffee factories, together with the documentary of water usage and process technology, although an area of research has been the designing of appropriate technology and the wet ‘mills’ as proposed by CIC for the PPAP is designed to recycle water use and then have it go through three treatment ponds before discharge. At this stage, the CIC has not been firm on where the ‘wet factories’ will be placed hence the appropriate rivers have not been sampled (ibid).

DEC also does not have guidelines dealing with the discharge of wastewater effluents into the river. However, it has a Water Quality Standard by which all developments are supposed to be screened. In 1997, recommended water quality criteria for physical and microbiological parameters and nuisance organisms were drafted but this has not been accepted. In the meantime, the BOD as stated in the water quality guidelines is represented by Dissolved Oxygen as Oxygen of 6.0 mg/l and that would be the level that waste waters should meet before effluents are being discharged.

DEC also has a permitting scheme where waste water is allowed into rivers and is based on the polluter pays principle.

The amount of water used in the coffee processing varies from country to country and in PNG, about 4 – 8m³/tonne cherry has been stated and this is for the full wash and recycling of water (Wikipedia 2009). Water used in processing coffee leaves the coffee processing unit with high levels of pollution. The main component is organic matter, stemming from de-pulping and mucilage removal.

These are very high values hence the need for the ponding system where anaerobic and aerobic process assist in the reduction of this large BOD before disposal into the rivers. Hence the wet processing factories proposed by CIC will have a series of ponds for primary and secondary treatment before discharge at BOD levels of 6 mg/l.

Water use will be increased when the number of wet processors increases, however, with reduced intake and recycling, the impacts on the water ways will be reduced. Coffee cherries pulp after processing is rich in organic matter and must be returned back under coffee trees which can act as a weed suppressant and fertiliser. The Lahemanegu Coffee factory is trialing out Californian red worms which feed on the coffee pulp and provide manure which is applied back under the coffee trees and a growth medium for coffee nurseries. It is an innovative idea and could be tried out around the central
wet processing factories. Table 8 shows a matrix arising from the various stages of the coffee processing.
### Table 8: Environmental Impacts from Coffee on Small Holder Blocks and Coffee Factories

<table>
<thead>
<tr>
<th>Production activities</th>
<th>Primary environmental impact</th>
<th>Agents of pollution</th>
<th>Secondary impact on ecosystem</th>
<th>Degree of seriousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nursery establishment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Nursery shade</td>
<td>Bush clearing; disturbance to habitats.</td>
<td>Man</td>
<td>Potential soil runoff into creeks.</td>
<td>Low</td>
</tr>
<tr>
<td>(b) Application of pesticides</td>
<td>Chemical alteration of the ecosystems</td>
<td>Toxic chemicals</td>
<td>Water pollution, depletion of fish and aquatic organisms</td>
<td>Low to high depending on the concentration of pesticides</td>
</tr>
<tr>
<td>2. Transplanting and growing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Weed control through use of herbicides</td>
<td>Disturbance to habitats.</td>
<td>Toxic chemicals</td>
<td>As above, possible eutrophication if greater concentration into water ways.</td>
<td>Low to high depending on concentration of herbicides.</td>
</tr>
<tr>
<td>(b) Established shade trees: casuarinas and eucalyptus trees</td>
<td>Micro-climatic changes.</td>
<td>Man</td>
<td>Improves cooling in the overall ecosystem by additional trees having to provide oxygen in the immediate area.</td>
<td>None and beneficial to the coffee trees. Although could be hosts to insects and pests.</td>
</tr>
<tr>
<td>(c) Use of insecticides</td>
<td>Habitat destruction; changes in species diversity; reduced insect resistance.</td>
<td>Toxic chemicals</td>
<td>Potential runoff into creeks if close by.</td>
<td>Low to high depending on the application and concentration of insecticides. Cost is a limiting factor.</td>
</tr>
<tr>
<td>3. Field maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Weeding and use of herbicides</td>
<td>Physical disruption of habitat</td>
<td>Toxic chemicals</td>
<td>Possible impact on fisheries, source of drinking water etc.; death of local population of organisms.</td>
<td>Low to high and potential for soil microbial activity.</td>
</tr>
<tr>
<td>(b) Fertilizer application</td>
<td>Chemical alteration of habitat</td>
<td>Chemical nutrients</td>
<td>As above</td>
<td>Similar comments as above.</td>
</tr>
<tr>
<td>(c) Pesticide use</td>
<td>Changes in the ecosystem and population of organisms</td>
<td>Toxic materials</td>
<td>As above</td>
<td>Low to High depending on concentration and application.</td>
</tr>
</tbody>
</table>

---


3. Field maintenance

(d) Fungicide use | Changes in natural habitat; reduced insect resistance. | Toxic materials | Possible impact on fisheries, source of drinking water etc.; death of local population of organisms. | Low to medium depending on frequency and coverage.

4. Post Harvest and on-farm processing

(a) Hand picking coffee cherries wastes | Garbage, nuisance | Solid waste | Coffee pulp, rich in organic matter. If discarded into water ways will increase BOD. | Low; although will decompose.

(b) Processing of coffee

i) Dry processing | Garbage, nuisance | Solid waste | Beneficial as compost material for soils, however will impact on BOD if discharged in water. | Similar comments as in 4 (a)

ii) Semi-dry processing | Garbage, nuisance | Liquid and solid waste | If discarded in water ways, will impact on BOD and water quality. | High and can impact seriously on creeks

iii) Wet Processing | Can impact on land if spilled onto assets. | Liquid Waste | If discarded in water ways, will impact on water quality. | Similar comments as above.

4.3. Potential Environmental Impacts on Subsistence Resources

4.3.1 Water supplies

Potential Impacts from agricultural and processing activities under the Project

Large coffee plantations and coffee processors have the potential to impact on the creeks and rivers if their water from the coffee processing is not channeled into a settling pond, to allow decay and a reduction of Biological Oxygen Demand (BOD), before being discharged into the water ways. The Lahemanegu factory, outside Goroka is an example of the correct processing of waste water before being discharged into the creek. The factory has now diverted the waste water back into the coffee nursery after removing the coffee beans and allowing worms to consume then providing excellent manure and growth medium (when mixed with sand) for the coffee nursery.

For cocoa processing, it is done within the cocoa block and is very remote from the creeks or water ways. Once cocoa pods are broken by a knife, the cocoa beans are placed into a wet processing box where the ‘mucus’ of the cocoa is allowed to slowly drain out leaving the cocoa beans having less residue of the mucus. The cocoa beans are then placed on a wire tray into fermentories where heat is applied to them and dried cocoa are ready to be packed to a buyer. For those that do not have fermentories, wet cocoa beans are sold to a fermentory owner who will roast the cocoa beans to get a better price.

Potential Impacts from infrastructure rehabilitation and development under the Project
No large infrastructure rehabilitation is envisaged to be constructed for the project. Any setting up of processing facilities for the small holders would involve the construction of buildings; however it is not anticipated that a large area would be required for this. It is possible for grants to be given to large coffee factories to adopt low environmental impact technology (coffee sub sector) and this would involve adaptation of existing facilities. Hence there may be a possibility of additions to the factory, although this would need to be assessed during the project.

In ENB and ARB, there is a possibility of the expansion of wharves and jetties to ensure the delivery of cocoa to a central processing area. When these infrastructures are necessary, appropriate assessment will be done through the environmental and social management plans and this is explained further in the ESMF section 5.

4.4 Potential Environmental Impacts on Soils

4.4.1 Erosion

(a) Land clearance

Minor land clearing may be required to realign road lengths to ensure ROW is maintained. In addition, earth works consisting of spoil will be relocated to a low area or to a place where the community requires backfill. This creates another opportunity to landscape individual communities who may not have had that opportunity and create a communal place for gathering. The road rehabilitation works within all provinces will be similar, and it is imperative to discuss with communities prior to the commencement of the earthworks.

The clearance of cocoa trees to replant other food crops may create an opportunity for erosion if the cocoa plot is on a slope and within the rainy season. However, this will be much localized. For coffee trees, no assessment on the replanting of coffee trees if CBB infect trees has been done and time is the essence in determining if there is a possibility of losing large plots of coffee, although this is very unlikely, given the importance of the coffee tree as the main cash crop in the Highlands.

(b) Areas particularly susceptible to erosion

The commencement of road works along short passages of steep area within the Porosa valley or the Tarabo – Gimi – Ivingoi are areas that could be susceptible to erosion, however with contractors abiding within the clause of their contract, all steps will be taken to minimize erosion. This is further stated in the EMP guidelines in the EMSF.

(c) Gravel Extraction Sites

Gravel extraction sites where material is being excavated for road works contain loose gravel when stock piled to be used as road base material could be a potential hazard during the wet season and these sites such as quarries would need to have procedures to allow water to be drained out of the sites. Otherwise, the potential of water logged areas remain. A number of potential sites were mentioned along the Tarabo - Gimi – Ivingoi loop road, although these will need to be investigated further through during design work and the prioritisation process for feeder roads.

(d) Gravel Sorting and Screening

Similarly, gravel extraction sites will need to be maintained in a stable condition where hazards such as water impounding are reduced. Within the screening set up, fine dust from gravel being sorted out is a great hazard and this will be addressed in the EMP for each road reconstruction sub-project. At this time, no gravel sites have been confirmed.
(e) **Contamination of soils**

PPAP project activities will not involve the addition of substances besides the reworking of soil to realign the ROW. Hence, there is no anticipation of contamination within the soil. Earthworks for rehabilitation involve the placement of road base and sub base materials which involve mostly gravel rather than soil.

(f) **Contamination by inert materials**

Inert materials refers to uncontaminated rock, trees, stumps and other land clear debris, excavated soil, masonry or even chipped tyres in land fill construction (Schaefer 2007\(^26\)). Rehabilitation work along the existing feeder road will involve minor clearing of dirt where drainage work will be undertaken. However, all these will be addressed through the EMPs with appropriate mitigation measures. As it stands, no extensive road clearing is anticipated including the removal of trees. Hence the impact of inert material will be minimal.

(g) **Contamination by biodegradable / organic materials**

Within road works, no organic material is envisaged to be cleared except for a few grass species which will be cleared as the feeder roads are rehabilitated. Hence this is a non issue with road works.

(h) **Contamination by toxic materials**

No materials deemed to be toxic will be used in the rehabilitation of the feeder road in the three PPAP provinces. Hence only those materials mentioned in (e) - (g) will be available and these are not toxic to any organism within the drainage or water ways.

4.4.3 **Summary of proposed mitigation measures**

Mitigation measures are detailed in tables 5-7 in the ESMF.

4.5 **Surface Waters**

PPAP activities will be implemented in landscapes that have been subject to considerable modification and multiple uses. The coffee and cocoa farmers interplant their commercial crops with vegetables when the crops are young and the landscapes consist of a mosaic of commercial tree crops, commercial vegetable patches and gardens for home consumption. Interspersed amongst this mosaic are villages and hamlets with pit latrines the most common method for disposing of human waste. Although agrichemicals are rarely used in tree crop production, they are more commonly used in commercial vegetable production. Commercial vegetable production is an important source of income, particularly for women and particularly when the tree crops are not in full production.

People tend not to use surface waters for drinking due to potential upstream contamination and rely on springs or where available communal taps which provide potable water for drinking and cooking.

Rivers are regularly used for personal hygiene and washing of clothes, so rivers are contaminated by detergents and soaps on a daily basis. For these reasons, and the fact that the PPAP project locations are not known until well into project implementation, a baseline survey of surface water quality was not carried out. However, during PPAP implementation there will be regular assessments of water quality in the sub project areas particularly regarding the environmental impacts detailed in Tables 7 and 8. Papua New Guinea receives abundant rainfall and these recharges the hydrological cycle delivering water to the entire biosphere and the atmosphere. On the surface, streams, creeks and rivers are distributed being dependent on the geology and geomorphology of the surrounding environment. The impact on surface waters will vary and in most cases is dependent on the discharge and the ability for water to dilute any potential input into the water ways.

4.5.1 Impacts on Surface Water Regimes

All surface waters if connected to rivers and lakes are continually discharged and recharged, provided the discharge is sufficient to allow the continuous interchange of the water body. The water levels must be adequate for aquatic organisms to maintain their ecological functions in the water body.

Activities such as gravel extraction or water intake must ensure about 10% of the normal water flow in the river is maintained at all times. When a water body has an addition of any material, the creek, streams and river will adjust as it maintains its ecological functions.

4.5.2 Impacts on Surface Water Quality

(a) Sedimentation

Sedimentation occurs when enormous sand or silt is placed into the water body. Depending on the discharge and the ability of the water body to flush out this sediment would mean the aquatic organism’s ability to adjust to newer habitats if their habitats are destroyed.

(b) Eutrophication

The process of eutrophication occurs when there is over abundance of nutrients (usually by nitrates and phosphates) in aquatic ecosystems. If this occurs, then the productivity of the system ceases and is limited in other nutrients (Allaby27 1996). A term often mentioned is algal bloom. Upon death, bacterial decomposition of the excess algae deplete oxygen levels hence aquatic flora or fauna can be severely affected. Within coffee, the potential impact on the surface water is the coffee pulp if disposed of into the creek or streams in excess amount and there is no active discharge to dilute the water pollution. Another potential impact from coffee would be the waste water after the washing of coffee beans, which will contain high levels of Biological Oxygen Demand (BOD) which must be diluted to ensure the contamination of the waterways is limited.

(c) Toxic Contamination

Within the scope of activities of PPAP, it is highly unlikely for any toxic contaminant that might be discharged into the surface water quality. No substance deemed toxic will be discharged into the surface water.

Cocoa production produces a sludge-like substance which contains a lot of sugar compounds (section 4.1). This may be toxic if available in large amounts and dispersed into the surface water hence affecting its quality. Should this occur, then mitigation steps would be put into place to divert this onto land where it would be left to decompose.

(d) Current strategy for pest management in the project area

Within the project areas in the six initial provinces (EHP, WHP, Simbu, Jiwaka, ENB & ARB), coffee and cocoa farmers are not keen in the use of synthetic pesticides. Purely, because it is expensive and to them, it is not worthwhile to purchase something costly that they cannot see a quick return of the money spent. Although for those who are more entrepreneurial, the purchase of this would be accepted. During the field visits, only a handful of coffee or cocoa farmers with knapsack sprayers were seen. In some cases, smallholders used herbicides to reduce weeds around their coffee or cocoa trees, particularly if there was a shortage of labour or the cost of labour was higher than using agrichemicals. The PPAP Integrated Pest Management Plan is a stand alone document that should be read in conjunction with this EA and the ESMF.

4.6 Flora and Fauna

Flora and fauna in PNG are biologically diverse (section 3.3) and each PPAP province has its own ranges of species. The provinces that have recorded flora and fauna are noted, and elsewhere these are generally listed as occurring in Papua New Guinea. While some flora and fauna groups have been studied in detail, there are still a lot of unknown taxa in the flora and fauna (section 3.3 & 3.3.2).

4.6.1 Critical Habitats and Protected Areas

Each of the PPAP provinces contains some of these areas and none of them will be affected by the scope of work and activities to be undertaken (section 3.4 & 3.4.2). Most of the protected areas are contained in Wildlife Management Areas which is voluntarily governed by the community. It is not envisaged that PPAP activities will encroach anywhere near a protected area as all PPAP activities will be concentrated in areas of high population density and highly modified environments.

4.6.2 Potential Impacts from Road Reconstruction and mitigation measures

Impacts on Fauna and mitigation measures

The activities in the PPAP will not involve the conversion of primary forest areas and therefore the potential for impacting on the fauna will be negligible. Within the small holder coffee or cocoa plots, fauna would be limited to common rats, maybe snakes and lizards, which harbor amongst the leaf litter or undergrowth. Should a species that is endemic and threatened to be on the Convention of the International Trading of Endangered Species (CITES) be found then, liaison will be with the DEC to establish the need for its protection and mitigation of the species habitat.
Impacts of Flora and mitigation measures

Similar comments can be made for flora as for the fauna. All flora and vegetation within the coffee, cocoa and feeder roads are all common species (section 3.3.1 -3.3.2) and no new species of flora is anticipated to be identified during the implementation of the PPAP activities. However, should there be a discovery or a claim from the community that these is such a flora that is on the CITES listing then, liaison should be with DEC to determine the mitigation measures to be undertaken to safeguard this species.

4.7 Air Quality

The activities that have the potential to impact of the air quality would be the outlets from chimneys from the coffee mills and the cocoa fermentories. With coffee, chards are used as fuel for the furnace and the chimney stack produces mostly fine smoke and this is not considered toxic although there may be a concern for flue gases (Johannsen 1992).

For the cocoa fermentories, the situation is very similar where coconut husks and shells together with firewood provide the fuel for the drying of cocoa beans. Concerns were noted where flue gas was escaping from the furnace and onto the cocoa. This provided a reduction in the quality of the cocoa beans produced (URS 2009c). Hence, this is an issue that needs to be addressed as PPAP is focused on the delivery of high quality cocoa and coffee that would find markets around the world.

4.8 Noise

4.8.1 Noise from Road Reconstruction

Noise arising from the PPAP activities is confined to the rehabilitation of feeder roads and the machinery involved with the earthworks. In any given day, the earthworks begin around 8.00am and continue to 12.00 noon with a lunch break for the operators before starting after lunch and finishes at 4.30 or 5.00pm. The noise from the machinery can reach up to 50 decibels (dB) (A) on these feeder roads with occasional Passenger Motor Vehicles (PMV) who transport people and their produce to and from markets and going to the urban towns for other transactions. The equivalent acoustic level (Leq) for (8.am - 8.pm) would be 40 – 50 dB (A) and 20 – 10 dB (A) as it reaches into the evenings.

Within PNG, houses are often built next to feeder roads although in some places, the house is situated about 10 metres away. No noise barrier is anticipated for the PPAP feeder roads and the noise levels will be within the stated Legal limits.

4.8.2 Noise from Gravel Sorting and Screening

The sorting of gravel and screening in a quarry produces noise when the crusher is in operation and crushes gravel into size fractions are loaded onto delivery trucks for the feeder roads. As is the case for the operational hours in section 4.6.2, quarry operators will be operating equivalent hours to the road works people. Hence, the noise within those activities will be increased during the operation of the crushers and it could be as high as 60 – 70db (A). Operators must have appropriate ear muffs or ear plugs to lessen the impact on their ear drums. The noise however, is confined within the quarry and as the noise travel outside of the quarry, it will fall back into 50 to 40dB and with corresponding distances, the noise will wane into 20 or 10dBs(A).
4.8.3 Noise from processing and marketing facilities

Noise levels from the wet coffee "pulpers" will be reduced as compared to coffee factories that have mechanized rotational driers for the coffee beans. Within the coffee factories, the equivalent acoustic level (Leq) for (8.am - 8.pm) would be 60 - 70 dB (A) right next to the driers and in other sections down to 50 dB (A). In comparison to the wet pulper, the Leq would be 30 - 40 dB (A) throughout the day.

Regarding safety, ear muffs must be made available to operators who could suffer hearing loss if subjected to consistently high noise levels.

Similarly in the warehouse, the moving of coffee or cocoa bags onto pallets on onto heaping arrangement requires forklifts who again will create noise levels within the 50 - 60dB (A) for the daily operations. Again, appropriate ear muffs are essential for operators. Trucks then load coffee or cocoa and proceed to their delivery onto wharfs for shipping. For coffee, trucks deliver them to Lae for loading onto onward ships to international ports. Often these are kept in warehouse or sheds until requested to load onto ships. Within the cocoa fermentories, the only noise is from the flames from the firewood and coconut husks providing heat to dry off the cocoa beans.

4.8.4 Summary of proposed mitigation measures

Impacts on fauna, flora, air quality and noise are varied however; overall, they do not represent any significant impact. As for the biodiversity, no primary forest will be impacted hence there is no potential for the diminishing of endemic species. Likewise, the air quality involves the emission of flue gases which are considered an impediment to good quality cocoa or coffee and as long as engineered methods by way of sealing potential leakage spots in the dryer is done, then good quality and production of coffee and cocoa will emerge. This is an important output from the PPAP.

Noise levels vary depending on the range of machinery that is available for road rehabilitation work. In addition, the quarries or borrow sites will involve the screening and preparation of road base and sub base materials. While the immediate surroundings will be noisy, the corresponding Leq from distance away from the operations will decrease to background levels.

4.9 Cultural & Archaeological Sites

Within coffee and cocoa plots, it is very unlikely to find cultural or archeological sites, although potential World War II sites may be present, especially in ENB. It will be only a matter of time for erosion or excavation of a particular site for a toilet pit or others sites that may expose cultural artefacts or graves. Should such a discovery of this sort be encountered, then the community should liaise with the DEC and the National Cultural Commission for an assessment.

If graves are excavated then elders within the communities can be called to verify who it belongs to so as to identify the next of kin to relocate the remains to another site. Similar situations for the rehabilitation of feeder road would apply and community consultation would be imperative to ensure that compensation issues are addressed through an open dialogue. The procedures for such contingencies are detailed in the Compensation Policy Framework. Within the PPAP provinces, ENB is the only province that has outlawed compensation and this is a useful tact for other provinces to explore.
4.10 Public Disruption and Safety
The risk of public disruption and safety is unlikely to arise from activities within the coffee and cocoa sub projects. Activities such as the distribution of coffee and hybrid cocoa seedlings to the communities will be more welcomed by the community. These would be greatly appreciated as the farmers will look forward to developing their blocks. While there is a possibility with feeder road or wharfs or jetty construction, the possibilities of disruption would be remote. During the PPAP field study, youth along feeder roads in the EHP expressed their disappointment about the lack of feeder road maintenance and because of that, sought to engage in criminal activities. However, this is unlikely to occur given the greater acceptance of road improvements that will lead to them and the community improving their livelihood.

The Compensation Policy Framework will address issues along feeder roads and together with the Community Liaison Officer and the Provincial Lands Officer, issues can be amicably addressed. Care will be taken in the rehabilitation work overseen by the Road Engineer and Transport Specialist so that only the minimum width of clearing the existing Right Of Way (ROW) will be adhered to. The Eastern Highlands Development Authority Manager has been involved with community discussions in the ADB projects, which occur alongside the proposed feeder road. His experience will add to resolving any potential issue that will arise.

Some of the community awareness will be done prior to the start up of the feeder roads by the Community Liaison and Provincial Lands Officers. This will highlight the extent of the projects and an important message to inform the community is that, all road works will involve right of way so there should not be any alienation of land. In the case of fruit trees or assets currently established on the ROW, there may be an avenue for negotiations and appropriate settlement made.

The scope of work in the feeder roads do not entail the storage of volume of toxic material such as bitumen for sealing and as such, all will be contained within contractors premises along strategic locations. The safety of this equipment will be discussed between the contractors and the community. A similar arrangement to that of the current ADB trunk road projects will be adopted for the PPAP. In addition, the engagement of outside contractors and their interaction with the community may lead to the spread of HIV/AIDS if adequate mitigation measures are not taken. Construction supervisors will ensure that workers and villagers are made aware of the potential hazards and that condoms be made available to workers.

Within the coffee factories, all activities are contained within premises and no public disruption would arise. However, if there is a large volume of waste water with a high biological oxygen demand (BOD), and this was discharged and high incidents of sickness arise then, there may a potential for public disruption. The wet factories by the CIC encouraging central processing of coffee beans will also have to abide by this, by providing an appropriate settling pond for the dilution and anaerobic treatment of wastewater before they are discharged or used in the coffee gardens.

For the ENB and ARB, situations, there are very different from EHP or mainland PNG. Compensation claims for clearing of roads has been outlawed in ENB, while in the ARB, this is an unheard of term. Although, the community may learn about mainland PNG experience and may propose some compensation. This is however, an unlikely scenario.

4.11 Construction Activities and Camps
At the feeder roads, construction activities will be mainly limited to the preparation of road materials, drainage reconstruction, culvert insertion, concrete mixing and casting. Standard levels of care will need to be taken to ensure that these activities do not adversely impact on community drinking water supplies and food gardens. Road reconstruction contractors must ensure drainage runoff does not
impact into food or coffee gardens but are diverted to natural runoff following the lower gradient of the earthworks.

It is not expected to have camps with up to 15 men along the road works. This will greatly reduce the interaction between workers and local villagers. Interactions such as these vary widely from province to province and lesser period of absence along road camps will lessen potential social problems such as prostitution, HIV/AIDS, STD and tribal fights occurring. Nevertheless it is essential to include this aspect within this EA or through the EMP.
5.0 Staffing, Technical Assistance and Training Requirement

DAL has requested for a Technical Assistance for an Environmental Specialist to be engaged to provide additional training for the environmental measures within the coffee and cocoa industries, and for CIC and CB, and the indicators that would need to be observed to ensure environmental issues are thoroughly addressed within the project.

With the guidance from the Project Steering Committee (PSC), the implementation at the national level will be through a Project Coordination Unit at DAL having its primary functions on Monitoring and Evaluation and the liaison between the government agencies.

At the provincial level, the Project Management Units (PMU) within the CIC and the Cocoa Board will coordinate all activities within components 1 – 3. The positions within each of the PMU provide ample coverage for the PPAP to be thoroughly implemented in the pilot provinces. When these move into the other provinces, then coverage and project design would need to consider these. The engagement of Provincial Lands Officer together with a Community Liaison Officer is imperative as land is integral in the people’s life and only through a thorough understanding and consultations can potential issues be addressed amicably. The Compensation Policy Framework describes the procedures to be used under the PPAP.

5.1 Requirements within DAL and PPAP

The proposed Project Coordination Unit (PCU) within DAL will provide management of the PPAP at the national level. Discussions with the Deputy Secretary - Science and Technology and the PPAP Coordinator determined the need for technical assistance on environmental issues under the Project. This Technical Assistance will be required for three months annually for the duration of the project.

Upon engagement, the Environmental Consultant will be required to visit the project provinces to oversee the implementation of the EMSF and individual EMPs and provide training of key PPAP staff in CIC and CB. By providing quarterly reports to DEC, PPAP will be adhering to the requirements of the Environmental Act 2000.

The focus of the technical assistance would be that of building capacity for monitoring and evaluating against the indicators that are specified in the ESMF. PPAP staff involved in Monitoring and Evaluation will be able to collaborate to ensure that their work plans synchronize and are part of the overall project review during the project duration. The Environmental Specialist Terms of Reference can be found in Appendix 4 of the ESMF.

5.2 Cocoa Board

Within the Cocoa Board, there is a recognised need for legal assistance. The primary responsibility for this would be for the inclusion of environmental sustainability criteria in the Cocoa Industry licensing requirements. The medium term goal is to ensure international recognized certification of sustainability of the Cocoa Industry in PNG is met.
6.0 Community Consultations

This is a requirement of OP 4.01 Environmental Assessment under sub section 7, addressing the involvement of all stakeholders in the preparation process.

An updated study in 2007 noted the following factors affecting small holder production in ENB (Table 16) (Curry et al 2007).

Table 9: Factors affecting small holder production on the Gazelle Peninsula

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

These views were collected by extension officers from CCIL and the provincial Department of Primary Industry.

During the preparation of this EA, the consultant carried out discussions from the 22 – 23/10/09 with officials from the Cocoa Board (CB) and with seven individuals who represented farmer groups or cocoa cooperative societies. In total there are sixty two (62) cooperatives or farmer groups.

The overall message given by these farmers representing their cooperatives was that, cocoa is the lifeline for the ENB and this will still be cultivated regardless of the other alternative crops introduced.

Issues raised were in the following areas;
Training venues

- Training under PPAP could be better done within community halls as that will benefit both registered farmers to attend while the other farmers could be able to see the sessions and take a keen interest. Within dormitories, this will be more formal and more removed from the local setting. Farmers also have other household duties and the long absence would not be useful to them.

- Farmers still missing out as the IPM training by CCIL and AgMark only targeted certain districts. Maybe there was not enough awareness about them. Demonstration plots only in Balanataman and not in Kerevat.

Resources

- Water is scarce in certain areas and this will be a contributing factor to the purchase of pesticides and its dilution.

- Firewood is an issue in some communities while others with more land and resources do not see it as a problem.

- Flue gas contaminations is a concern and farmers would like assistance in getting a better replacement that can last, rather than the current ones which do not last for more than two years.

Organisation and IPM

- Cooperatives are better organized hence training and resources should be channeled through them rather than through established industry players, although some may need assistance in building up their management skills.

- Tools such as pole pruners, chain saw and others could be controlled through the cooperatives and not through DPI officers. DPI officers are seen as not performing their duties effectively. Incorrect information by these officers resulted in farmers clearing their cocoa trees when the correct information was to prune and apply corrective measures.

- Farmer to farmer training as promoted by the CB is the best option to deliver training after its delivery in the Morobe and Madang provinces.

- IPM adoption by farmers not taken seriously as coconut is there and copra can also be produced.

Rescue or Jump Start of farmers

- Farmers need Option 4 of the IPM promoted by CCIL where pesticides such as Karate must be given to them to apply to their cocoa trees for a 12 months period and after this, everything should be on line where the farmers will be able to sell his cocoa and repay the funds that was acquired to purchase the pesticides and assorted equipments (knapsacks, gloves, mixing containers). Funding for this could be arranged through the ENB Savings and Loans or PNG Micro Finance. The commercial banks have stringent rules to open an account and not user friendly to the local farmer.

- IPM training will be in line with the above assistance and maybe channeled through the cooperative to take charge of it.

Application of the 5 Golden Rules
• The five golden rules which include harvesting every week and burying of pods are impractical and are strenuous for the farmers. It may be possible for plantation applications but the leading plantation in ENB does not appear to be following IPM. There were instances of wrong concentrations and dilution of pesticides given to farmers.

• The ACIAR funded project of spraying every fortnight on the cherelle after the flowering of cocoa is imperative and is proving to be successful rather than blindly spraying mature pods which would already be infected by the CPB.

• Prices of cocoa seedlings are not equal, CCIL charges K0.07 per seedling while AgMark charges K1.40 per seedling.

Alternative Crops and Infrastructure

• Balsa will only be a viable crop for those that have a lot of land (and is subject to capacity of the processing mills and market demand). Definitely not for the majority and also the long wait for it to mature (5 years) is impractical for the small holder.

• Some feeder roads need to be maintained to deliver cocoa and during the wet session, many are impassable. One such road is the Bitanagalip road.

A more detailed listing of these interviews is in Appendix 3.

Coffee producing areas

• For the EHP, overall the communities within the Okapa and Gimi Loop Road have expressed their support for the project. They note the various cooperative groups that occur within their areas and are willing to produce more and the upgrading of roads provides other opportunities for further business and social transactions.

• The pooling of fresh coffee beans to a central wet processing area will be welcomed as long as the correct pricing for the beans are agreed between the farmers and CIC or whoever is operating the wet processing factory.

• Better arrangement of the delivery of finance to the farmers would also be an advantage where he or she can obtain other essential goods in town. For the intermediary transport, it will be improving their current mode of carting coffee beans to roads and this will make them more determined if they can sell all of what is produced.

A detailed summary of stakeholder consultations can be seen at Appendix 3 of this report.
7. References


PNGRIS Database, Department of Agriculture and Livestock, 2001 (now also available at UPNG & Unitech).


World Bank, 1999. Environmental Assessment Sourcebook, Volume I:

World Bank, 1999. Environmental Assessment Sourcebook, Volume II:


URS, 2009a, Productive Partnerships in Agriculture Project (PPAP) Draft Project Design Document for PNGDAL Rpt 42444072

______ 2009b, Working Paper No. 1 Institutional Assessment

______ 2009c, Working Paper No. 2 Cocoa Sub Sector

______ 2009d, Working Paper No. 3 Coffee Sub Sector

______ 2009e, Working Paper No. 4 Farming Systems

______ 2009f, Working Paper No. 5 Market Infrastructure Assessment

______ 2009g, Working Paper No. 6 Social Assessment

Appendix 1: Summary TOR for Environmental Assessment

Scope of work

To reach the above objective, the Environmental Assessment will involve the following:

i) Based on draft preparation designs of all project components, conduct an Environmental Assessment in accordance with World Bank Operational Policy (OP) 4.01, evaluating the project's potential environmental risks and impacts and if necessary identify ways of improving project selection, siting, planning, design, and implementation in order to prevent, minimize, mitigate or compensate for adverse environmental impacts and enhancing positive impacts, including the process of mitigating and managing adverse environmental impacts throughout project implementation.

ii) Specific attention should be given to potential environmental impacts from:

- the possible increase in the use of pesticides by smallholder farmers. The Consultant would provide recommendations for the mitigation of risks associated with pesticide use. The Consultant would prepare an appropriate Pest Management Plan in accordance with the requirements of World Bank OP 4.09;

- waste from coffee wet factories and other production processes;

- the possible intensification of farming systems, replanting of cocoa/coffee, and increased use of fertilizers;

- the rehabilitation of provincial roads; and

- the possible rehabilitation and construction of jetties and other such coastal infrastructure.

All of the above would include extensive consultations with PPAP stakeholders and partners in the provinces.
Appendix 2: Notification of Preparatory Work for Level 2

Productive Partnership in Agriculture Project (PPAP)

1. **Name of Proponent**
   
The Department of Agriculture and Livestock

2. **Name of Proponent’s Authorized Contact and Spokesperson**
   
Mr. Francis Daink – Deputy Secretary – Science and Technology

3. **Address of Principal Officer in PNG**
   
Department of Agriculture and Livestock
PO Box
KONEDOBU
NCD 121
Fax
Phone
Email: ppap@yahoo.com

4. **Company Registration Detail**
   
The proponent is a National Government Department who is accessing funding from the World Bank and IFAD.

5. **Site Address**
   
The PPAP will be coordinated by a Project Coordination Unit based from Port Moresby with links to the Coffee Industry Corporation in Goroka and Cocoa Board in Kokopo.

6. **Details of Site Ownership**
   
The PPAP is carried out in six provinces initially before it expands to other provinces. Feeder roads, coffee and cocoa production and processing are at rural areas and individual block holders.

7. **Has the Proponent negotiated and signed an Agreement with Government of Papua New Guinea in relation to this proposal?**
   
The PPAP is an agreement between the Government of Papua New Guinea and the World Bank and IFAD. It is be implemented by the Department of Agriculture and Livestock and through the Coffee Industry Corporation and the Cocoa Board. At this stage, the PPAP is undergoing a Project Design Phase.

8. **Other Government Department or Statutory Bodies Approached.**
   
The PPAP has its consultation with the National Agriculture Research Institute, National Agriculture Quarantine Inspection Agency, Cocoa Coconut Institute Limited, together with
the Coffee Industry Cooperation and the Cocoa Board. It also has linkages with private companies in the coffee and cocoa industry.

9.0 Other formal Government Approvals that are required to be obtained:

The PPAP has its focus with the Department of Agriculture and Livestock. It is approaching a Project Appraisal Document (PAD) stage where this is being appraised by the World Bank team to be considered for funding by the World Bank, and similarly for IFAD.

10. Status of Negotiations with Relevant Landowners/Resource Owner Group:

There has been considerable consultations undertaken with the relevant landowners and potential partners for PPAP, in terms of the Environment Assessment these consultations can be found in Appendix 3, further consultations can be found in the Social Assessment for the Project. There is broad community support for the project and a Compensation Policy Framework has been prepared that describes approaches for further communication with communities during project implementation. Note that at this stage the exact location of project activities are not specified (project funding will be demand driven).

11. Estimated Cost (In Kina) of Works:

The GoPNG through the Department of Agriculture and Livestock is seeking a loan of US$25 million from the World Bank and US$ 14 million from the International Fund for Agricultural Development and other sponsors and the remainder from the GOPNG and beneficiaries to a total of US$48,240 million (PNG129.6 million). This represents the total cost for PPAP implementation; individual sub projects will of course vary depending on the demand.

All costings for feeder roads, wharfs, jetties and paths involves the appropriate use of practices to minimise erosion and impact into side drained water ways. Within the coffee and cocoa small holders, new technology such as wet pulper or centralised fermenting are designed to minimise the impact on water quality or improve the processing of cocoa beans.

12. Shape and Description of the proposed Activity or Works:

The Project is focused on the cocoa and coffee industries and will include the following components:

i) Strengthen key sector agencies to support effective project implementation,

ii) Develop demand driven public private sector partnerships to improve the delivery of services to and increase the livelihoods of the stakeholder rural sector, and

iii) Address critical market infrastructure constraints facing the industry

Project preparation and design work was conducted between April and December 2009.

Development objectives of PPAP will be to increase smallholder agricultural productivity, quality and market access with a view to improving smallholders’ incomes and the sustainability of the sector. This will be achieved by building partnerships between the public and the private sector for the delivery of support services and infrastructure for smallholder agricultural development.
The project indicators could include: (a) the volumes and incremental value of additional produce reaching markets through the established partnerships compared to baseline; (b) number of farmers adopting improved technologies and meeting private standards; (c) changes in the ratio of farm gate to fob price; and (d) the numbers of successful public-private partnerships funded.

13. Description of Project Site:

PPAP will be implemented initially in five provinces, EHP, WHP, Simbu and ENB provinces and the ARB, with components consisting of:

1) Institutional Strengthening and Industry Coordination,
2) Productive partnerships, and
3) Market Access Infrastructure.

Potential environmental impact may arise from component 2 & 3, although mitigation measures are proposed in the Environmental and Social Management Framework (ESMF), which also contains screening procedures for sub-projects and guidelines for Environment Management Plan preparation.

No site sensitive or critical areas close to the location of feeder reads in the EHP, WHP, Simbu, and ENB provinces and ARB. The Protected Areas in the PPAP provinces occur 50–100 km away from the project locations, hence there is no potential for the project to impact on these areas.

14. Applicant's Assessment of whether proposed activity is a Level 2 or Level 3 Activity:

PPAP will be implemented in existing areas of highly modified environments and where the natural vegetation has long ago been converted to agricultural development. The project has been designed to cause no lasting deleterious environmental effects, although some road and wharf reconstruction may cause temporary disruptions to the communities affected. Mitigation and monitoring measures are documented in the ESMF. DAL has prepared an EA, ESMF and IPMP, which comprise the Environment Impact Statement for PPAP.

It is therefore considered by the proponents that PPAP can be classified overall as a Level 2 Activity, with most subprojects being classified as Level 1. It is therefore requested that should DEC require that an Environment Permit is required for PPAP that it is issued for the whole Project.

15. Timetable or Schedule for the Planned Activity:

At this stage, the Production Partnership in Agriculture Project (PPAP) will commence in 2010. Depending the commencement date, and for the arrangement of logistics and funding to the provinces, the four components as stated is, will continue for a duration of five to six years and it should be completed by 2015 or later depending on project mobilisation phase and for it to promptly progress.
Appendix 3: Community Consultation undertaken for the EA
Appendix 4: List of persons consulted for the EA

Mr Francis Daink – Deputy Secretary – Science and Technology – NDAL
Mr. Harry Godfried – Coordinator – PPAP
Mr. Joe Katape – Manager – Environmental Impact Assessment – DEC
Mr Veari Kula – Manager – Industry Standards Branch – DEC
Ms Katrina Solien – Manager – Permitting and Compliance – DEC
Mr Robert Mckilllop – URS Team Leader
Mr Max Blacker – URS – Engineer
Mr Abel Philemon – Special Projects Officer – CIC
Mr. Robert Kakao – Manager – Eastern Highlands Development Authority
Mr. Henry T Ame – General Manager – Coffee Connections
Mr. John Leahy – Manager – Lahemanegu Coffee Factory
Mr. ? Selleys – Assistant Manager – Nowak Coffee Factory
Dr. Mark ? Plant Pathologist – CIC – Aiyura
Mr. Jim David – Trial Data Technician – CIC – Aiyura
Mr. Nosare Mika – Post Harvest Engineer – CIC – Aiyura
Mr. David Yinil – Senior Agronomist – CCI – Tavilo
Mr. Alfred Nongkas – Acting Executive Manager – Industry Services Division CCI – Tavilo
Dr. Josephine Saul – Chief Plant Pathologist CCI – Tavilo
Mr. Paul Kende – Research Officer – Entomology section – CCI – Tavilo
Mr. Hosea Turburat – Manager Kairak – Vudal Training Centre
Dr. Samson Laup – Executive Manager – Cocoa Research – CCI – Tavilo
Dr. Ereman Tade – Senior Agronomist – CCI – Tavilo
Mr. Anton Kamoso – Plant Pathologist – CCI – Tavilo
Mr. Isimel Pulpui – Graduate Economist – CB – Kokopo
Mr. Nathan Wartovo – Acting Export Quality Manager – CB – Kokopo
Mr. Charles Koel – Acting Regional Manager – ENB – CB – Kokopo
Mr. Francis Minbuna – Sub branch Manager CB – Kerevat
Mr. George Pamel – Financial Controller – CB – Kokopo
Mr. Paul Nelau – Manager – CCI – Buka
Mr. Chris Mutu – Accountant – CCI – Buka
Mr. Albert Nukuitu – Director – UPNG Open Campus – Buka.
Mr. Anton Warwaliu – Acting Regional Programme Manager – NGI- CCI
Mr. Peter Alexander Nomoreke – Provincial Forestry Officer - PNGFA – Buka
Mr. Simeon Itamai – Civil Engineer – ABG Technical Services
Mr. Stan Bassiou – Infrastructure Advisor – Coffey International – AGB
Mr. Bob Willis – Team Leader – Bougainville Project – TSSP
Mr. Otto Ngeri – CBB Entomologist – CIC - Aiyura
## Appendix 5: Protected Areas in Papua New Guinea with their location

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Marine/Terrestrial</th>
<th>Province</th>
<th>Area (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bagiai WMA</td>
<td>Marine/Terrestrial</td>
<td>Madang</td>
<td>13,760</td>
</tr>
<tr>
<td>2</td>
<td>Bayyer River Sanctuary</td>
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<td>Western Highlands</td>
<td>64</td>
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<tr>
<td>3</td>
<td>Balek Wildlife Sanctuary</td>
<td>Terrestrial</td>
<td>Madang</td>
<td>470</td>
</tr>
<tr>
<td>4</td>
<td>Banara Island WMA</td>
<td>Marine/Terrestrial</td>
<td>Milne Bay</td>
<td>37</td>
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<tr>
<td>5</td>
<td>Cape Worn Memorial Park</td>
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<td>East Sepik</td>
<td>105</td>
</tr>
<tr>
<td>6</td>
<td>Crater Mountain WMA</td>
<td>Terrestrial</td>
<td>Chimbu, Eastern Highlands, Gulf</td>
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</tr>
<tr>
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<td>Crown Island Wildlife Sanctuary</td>
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<td>Garu WMA</td>
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<td>Hombreeta WMA</td>
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<td>Oro</td>
<td>130</td>
</tr>
<tr>
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<td>Hunstein Range WMA</td>
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<td>Iomare WMA</td>
<td>Terrestrial</td>
<td>Central</td>
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<td>Jimi Valley National Park</td>
<td>Terrestrial</td>
<td>Western Highlands</td>
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<td>Kamaiali WMA</td>
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<td>Ndrolowa WMA</td>
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<td>Neiru (Aird Hills)WMA</td>
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<td>Nuraseng WMA</td>
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<td>Morobe</td>
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<td>Ol Mada Wara WMA</td>
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<td>Milne Bay</td>
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<td>36</td>
<td>Paga Hill Nat. Park Scenic R</td>
<td>Terrestrial</td>
<td>National Capital District</td>
<td>17</td>
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<td>37</td>
<td>Pirung WMA</td>
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<td>Siwi-Ulame WMA</td>
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<td>Talele Is. Nat. Park Reserve</td>
<td>Marine/Terrestrial</td>
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<td>Variarata Nat. Park</td>
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<td>Marine/Terrestrial</td>
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<td>Laugum WMA</td>
<td>Marine/Terrestrial</td>
<td>Madang 73</td>
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</table>

Figure showing distribution of Protected Areas in PNG as listed above.
## Appendix 6: Critical Habitat or Areas in Papua New Guinea

<table>
<thead>
<tr>
<th>PA Name</th>
<th>CNA Name</th>
<th>CNA Code</th>
<th>Description</th>
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<td>Crater Mountain</td>
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<td>Priority</td>
<td>Overlap between Very High and High</td>
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<td>Central Province</td>
<td>Wetlands W – 15</td>
<td>Wetlands Priority Area</td>
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<td>9 – VH Very High Priority</td>
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<td>Tonda WMA</td>
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<td>Good Enough</td>
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<td>High Priority</td>
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</table>
Figures showing densely populated areas of the EHP and Simbu

- Occupied land
- Uncropped land
- Major roads
- Minor roads/tracks
- District boundaries

Coffee growing areas cover the whole of the province with most production from Siapa, Kenapa, Lufa and Asaro Valley.

Coffee grows in all occupied areas with more concentration in the major Wapio valley and north and south-east of Kadavu.
Figures showing densely populated areas of WHP and ENB.
Figure showing densely populated areas in the ARB

All PPAP activities will be implemented within the densely populated areas well away from any natural environments and protected areas.