Towards a sustainable cocoa economy in PNG: Enhancing cocoa production through adoption of Integrated Pest and Disease Management (IPDM) with farmers participation

Introduction

As a member of the International Cocoa organization (ICCO) and a signatory to the 2001 International Cocoa Agreement, Papua New Guinea has an obligation to promote a sustainable cocoa economy. The Consultative Board on the World Cocoa Economy acknowledges that there are three pillars of sustainable development: environmental, economic and social and adopted the Brundlandt Commission’s definition which describes sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The Consultative Board resolved that ICCO member countries should work collectively towards a world cocoa economy that is “economically viable, ecologically sound and socially acceptable”.

The Cocoa Board of Papua New Guinea, as the central state agency that has overarching responsibility for the sub-sector is mandated to oversee the approach of the Papua New Guinea cocoa industry to promote a sustainable development in the cocoa industry in Papua New Guinea. The approach by the industry in Papua New Guinea needs to factor in the National Government objectives for environmental protection, social and economic development and the need to maintain a viable domestic cocoa industry. It is crystal clear that these, and the need to achieve the cocoa industry’s goal to increase cocoa production to 100,000 tonnes by 2012 will determine the approach and success by Papua New Guinea to move towards a sustainable cocoa economy environment.

Background to PNG Cocoa Industry

Cocoa, one of the four main cash crop in Papua New Guinea (PNG) contributes up to 17% of the nation’s agriculture sector’s revenue equivalent to about K250-K300 million annually. PNG contribution, though insignificant in volume (1-2% of the world’s cocoa production) represents up to 9% of the world’s fine flavour cocoa. Up to 80 % of this volume is produced by smallholders in 14 of the 20 provinces in PNG.
The average cocoa production per family in PNG (300kg/ha/year) is low, even though the planting material developed by the Cocoa & Coconut Institute of PNG and available commercially has a maximum potential yield of 2500kg/ha/yr. Cocoa production has remained stagnant since the early 1970’s to more recently when production increased from 40-50 thousand tones between 2004/2005 to 2005/2006. The major contributing factor to the low cocoa production were a lack of effective technology delivery system coupled with farmers inability to adopt sound cocoa management practice, particularly crop protection technology, knowledge and skills. Compounded on top of this is the lack of easy access to marketing, transport and a poor infrastructural set up. The increase experienced recently is not a result of improved management by farmers, but is due to the cocoa replanting program in Bougainville after the crisis and more new plantings using the high-yielding varieties. Up to 20 million hybrid seeds were distributed through out Bougainville in the early year 2000, but the exact numbers survived is unknown.

Currently about 60% of the cocoa exported out of PNG is produced in East New Britain, followed in order by Bougainville with 20%, Madang, East Sepik, New Ireland, Oro and Morobe. The rest of the other provinces contributed insignificant amounts. This scenario may change in the next 10-20 years as a result of changes in climate and environment, pest incursions, social and cultural change increase population. It is likely that cocoa production for some parts of the country may drop as cocoa is cut down to give way for housing and food gardens in highly populated areas. This is already happening in the Gazelle Peninsula of East New Britain.

The challenges, threats and problems and strength
In July of 2003, a National cocoa summit, convened by Cocoa Board of PNG and sponsored by the European Union was held at the Vunapope, East New Britain province. At that workshop, the Cocoa Industry set a target of wanting to achieve a national average yearly production of 100000t/year from its low average production of 40000t/year.

A number of key points highlighted at that meeting were:

1. The average low production nationwide of 300kg/HA/year with a negative yield gap of 2200kg/HA/year by almost 99% of the small holder cocoa growers who produce 80% of the national cocoa have not adopted any protection technology. The only technology few farmers adopted were the good planting materials developed and released by CCIPNG

2. Vascular Steak Dieback (*Oncobasidium theobromae*), Black pod (*Phytophthora palmivora*) of cocoa and pink disease (*Corticium salmonicor*) were still claiming up to over 40% of the crop loss. Associate with the crop loss are the crop loss due to Longicorn, pensepta and mirids. Also with age, cocoa suffers from yield decline, a phenomenon whose epidemiology is yet to be investigated in PNG and around the world.

The dreaded Asian cocoa pest, cocoa pod borer (CPB) incurred into East New Britain in March 2006. An extensive eradication exercise was mounted against this pest. After almost 10 months of the exercise, it was thought that the pest was eradicated. Leading experts commented of a very effective and meticulous eradication exercise ever undertaken against CPB in the world. After the eradication exercise was completed, the CPB monitoring and surveillance programs, using both pod sampling and pheromone trapping, identified CPB flare ups in areas within designated buffer zones. The present indications from the surveillance and trapping program indicate that the insect pest would be here for a bit longer than anticipated.
Management strategies aimed at living with CPB are needed to be transferred to the cocoa farming communities immediately, whilst research into breeding for resistance and tolerance and also control methods are can be developed quickly.

Following the July 2003 National cocoa summit, the Plant Pathology section of CCIPNG initiated a summit-follow-up workshop to develop a research program to address the crop loss due to pest and disease and identify a effective delivery system. The following points were noted:

1. Farmers still lack basic cocoa management skills and knowledge after almost 100 years of cocoa being in PNG
2. Crop losses due to *Phytophthora palmivora*, *Oncobasium theobromae* and *Corticium salmonicor* were still very phenomenal despite decades of control recommendations.
3. Nobody adopt pest and disease management technology and all the entomological and agronomical issues highlighted in the 2003 cocoa summit was still persistent.
4. That the delivery of appropriate cocoa technology was not effective thus a newer, more radical and effective delivery systems needs to be sought for the growers.
5. It was strongly recommended that efforts be put into addressing the low productivity in PNG and that the loss to pest and disease be addressed.
6. It was also highlighted that cocoa yield decline was a major issue in PNG and needed investigation.
7. The average cocoa growing families in PNG were living below the poverty line according to the UN standard and efforts must be made to address this through cocoa activities.

On a positive front, it the PNG Cocoa Industry realised that it has significant strength in its scientists based at the Research Institute with some of the most comprehensive and relevant research programs in the world to address PNG cocoa growers problems. The nation’s cocoa industry through its research Institute (CCIPNG) developed and released very high quality planting materials in terms of:

a. Yield of up to 2500kg/HA/year  
b. Relatively pest and disease resistant  
c. High fine flavour characteristics  
d. High precocity

Through its research programs at CCIPNG, the cocoa industry has a lot of very innovative technologies, skills and knowledge generated already and now available for adoption.

**Development of the Integrated Pest and Disease Management (IPDM)**

Following the July 2003 National Cocoa summit, the Integrated Pest and Disease Management (IPDM) was conceived at CCIPNG after careful considerations of the yield patterns, the cropping phenological cycle, the pest and disease epidemiology. IPDM aims to disrupts the cocoa pest and disease cycle at its weakest link a while at the same time making the environment discriminately favorable for the host than the pest and the pathogen. IPDM remove various stress factors on the plants, boosting its health both in time and space to withstand pest & disease pressure to enhance realization of maximum potential of the crop. The IPDM input is scheduled to break the pest and disease cycle in relation to the cropping cycle over the year (Table 1).
Table 1
The cocoa pest and disease cycle and general IPDM input periods in relation to the cropping cycle in PNG

<table>
<thead>
<tr>
<th>Input Application Months</th>
<th>Peak Flower &amp; Fruit Set</th>
<th>Peak Harvest</th>
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<tbody>
<tr>
<td>Jan, Feb &amp; March (Major peak)</td>
<td>April, May, June &amp; July</td>
<td>Oct, Nov, Dec &amp; Jan</td>
</tr>
<tr>
<td>Aug, Sept &amp; Oct (Minor peak)</td>
<td>Nov, Dec, Jan &amp; Feb</td>
<td>Apr, May, June &amp; July</td>
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The following four IPDM management options (the fifth option included to control Cocoa pod borer) are promising under pilot test and are available for recommendation when adequate data become available (Table 2). The management options should be presented as a complete package and trialled as where each farmer has a choice and depending on farmers economic status and appreciation of each option after testing can graduate from one management type to another.

The on-station testing of the technology has been very encouraging with yield increase of up to over 500% from 500g/tree to over 2.61kg/tree/year. Three provinces in PNG: East New Britain, Bougainville and Madang provinces were identified and the IPDM technology tested this sites since March 2007 has proven increased yield with significant pest and disease control.

Table 2
Components of Integrated Pest and Disease Management (IPDM) input Options

<table>
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<tr>
<th>Option</th>
<th>IPDM</th>
<th>Activity</th>
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<tr>
<td>1</td>
<td>Low</td>
<td>Current practice, start with good planting materials</td>
</tr>
<tr>
<td>2</td>
<td>Medium</td>
<td>Weekly harvest, sanitation, weed management, cocoa &amp; shade prune related to crop cycle. Cocoa height @ 3.5m-4m maximum</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td>Option 2 + Chemical inputs include: Glyphosate &amp; Gramoxone (Herbicide), NPK (Fertilizer)</td>
</tr>
<tr>
<td>4</td>
<td>Very High</td>
<td>Option 3 + Fungicide &amp; insecticide:</td>
</tr>
<tr>
<td>5</td>
<td>Maximum input including</td>
<td>Option 4 + CPB control,</td>
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The way forward for a sustainable cocoa economy in PNG

The overall objective of IPDM is to enable each cocoa plant perform to its full maximum potential leading. IPDM should lead to a transformation of the PNG cocoa industry from nil crop protection management input to at least 50% medium management input so that yields above 2.61kg /tree is finally realised. IPDM has the potential to transform the mindset of the farming families to approach cocoa farming as a family business activity.

For a sustainable cocoa economy in PNG, clear and well define production targets on a per trees basis must be set. This is what the Cocoa industry in PNG is moving towards by setting an objective minimum target of 2.6kg/tree/year from IPDM management option 2. The cocoa industry in PNG will need to make aware its farmers to invest into cocoa as a business. Currently from pilot test and available data, IPDM input cost is over-estimated at approximately K3/tree/year. This cost comes down as farmer maintains IPDM inputs according to cropping cycle. As more data becomes available, a confirm cost figure should be known. Such a cost level for a return of 2.61kg/tree is worthy. Not only is it profitable, but it is worth the investment for a sustainable cocoa economy and will address some of the pressuring issues such as rapid cocoa land depletion and shortage in PNG

For a sustainable cocoa economy in PNG, identifiable cocoa growing areas needs targeted and its farmers mobilized. A strong awareness on the potential of planting materials and other cocoa technology should be made and production target on individual trees basis be set as oppose to production per HA basis. The yield potential of the current planting materials is 4kg/tree at 4 x 4 m triangular spacing planting density. With IPDM a yield target of 2.61 kg/year is set as the objective target, an increase of almost 500%.

To enable an enhanced cocoa production in PNG, the current technology transfer approach is ineffective, costly and needs revamping. Newer, innovative and a more radical approaches are needed for the effective delivery of IPDM technology in PNG.

The major components (Research/Extension/farmer relationship) involved in deriving new information and technology, transfer of packaged innovative technologies, and adoption of factors of change and their effective relationship between these components must be looked at to determine the rate at which introduced technology is adopted.

The sole farmer focused extension approach needs to be replaced with a community of farmers who should develop their own community development plans with like minds with a bottom-up-planning characteristics a cooperative spirit.

Farmers participating through the PAR concept have embraced the technology and are now spreading the IPDM messages throughout their own areas and relatives at no cost to the state or any agencies. Farmers realised that the IPDM technology has the potential to turn ordinary village living standard above beyond expectation. With the IPDM the following method of delivery is promising:
1. Blocks demonstrating the IPDM options established on smallholder farms *near a public road*

2. These demonstration blocks become the classroom in which Extension staff and Farmers actively participate in management activities and recognise the differences between various management options themselves.

3. Model farmers selected from the villages by the villagers extend IPDM options through the participatory action research themselves.

4. Each model farmer signs an agreement to train 12 “disciples” whom he/she mentors so that knowledge available to freely is also given to their own peers freely more rapidly.

It is concluded that it is very highly feasible for a sustainable cocoa economy with the same area and existing trees in PNG. All involved with the cocoa industry in PNG needs to embraced and promote the adoption of IPDM technology across the country. The IPDM should be delivery through methods such as the PAR or similar concepts rather than the current conventional delivery system and method which is old fashioned and inefficient.

PNG has every cocoa technology, knowledge and the skills backed up with highly professional scientific personnel for the industry to go forward with high impact and also addressing the poverty in the country. There is no reason not too!

**Conclusions:**

A strategy to promote a sustainable cocoa economy would evolve around the following:

1. The need to reach the productivity gap of the current productivity gap of 2,200 kilograms per hectare; i.e the difference between 300 kilograms per hectare and research levels of 2,500 kilograms per hectare;
2. Focussing on current area under production rather than new developments;
3. Increasing the production intensity through programs to emphasising management practices;
4. Producing more organic methods of production under smallholder production
5. Providing up to date market and production information