2013 Derek Tribe Award Address:

Working towards environmentally and socially sustainable oil palm production in Papua New Guinea

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Introduction

Oil palm is a tree crop grown in the tropical countries for oil. Commercially the crop has 20 – 25 years commercial life cycle and is replanted when it becomes too tall and not economical to harvest. The tree produces fresh fruit bunches (FFB) which are harvested when ripe and brought to the mill for oil extraction. There are two types of oil, crude palm oil which is extracted from the mesocarp and palm kernel oil which is extracted from the kernel. Other products are then derived from these two oil in refineries and then incorporated into other food and feed products. My aim with this presentation is to discuss the current oil palm industry in Papua New Guinea (PNG) and some of the agronomy research activities relating to environmental and social sustainability of the oil palm system.

The oil palm industry in PNG

The oil palm industry in PNG comprises two milling companies (New Britain Palm Oil and Hargy Oil Palms), smallholders with 2-6 ha each and independent estates. There are three types of smallholders. The first is the land settlement schemes (LSS) which are on state leased land. The farmers were brought in from highly populated provinces in PNG to settle on state alienated land to grow oil palms. The second group of smallholders are the village oil palm (VOP) who grow oil palm on their traditional land. The third group of farmers are the customary purchased rights blocks (CRPB) who are farmers from outside the oil palm growing areas who buy the rights to plant oil palm on traditionally owned land. In addition to the plantations and smallholders, there are also areas which are planted on traditional registered land and managed by local competent managers but sell their crop to the existing

mills, and are called independent estates. Oil Palm in PNG is grown in five provinces and the earliest planting was in 1967 in the Hoskins project while the latest is in Ramu Valley bordering Morobe and Madang Provinces in 2005. The two milling companies transport, enable credit facilities for tools and fertilisers and export extracted oil for overseas markets.

Production statistics and hacterage

In 2012, PNG had a total of 144,183 ha planted to oil palm, 58% owned by milling companies, 41 % by smallholders and 1.7% by independent estates (Table 1). In relation to production, milling companies produce 66% of the crop, smallholders produce 32 % and independent estates produce 1.6 %. It is clear that smallholders yields are low. The crop yield potential in PNG is 35 t/ha/year and the whole industry only produces 51% of the potential, which suggests there is still a lot to be done to narrow the gap by increasing productivity across the industry. I will discuss some of the agronomic approaches to reduce the gap sustainably.

Table1: Oil palm planted area in hectares and FFB yields in PNG in 2012

	Total	Milling companies	Smallholders	Independent Estates
Area (ha)	144,183	83,813	57,882	2,488
% of total area		58.1	40.1	1.7
Production (FFB t/ha/year)	2,584,748	1,702,393	839902	42452
% of total production		65.9	32.5	1.6
tonnes FFB t/ha/yr	17.9	20.3	14.5	17.1
Maximum potential yield in PNG (FFB t/ha/year)	35 t/ha/yr			
Proportion of maximum potential yield in %	51.2	58.0	41.5	48.8

Source: PNG Oil Palm Council, 2013.

Importance of oil palm industry to PNG

Oil palm is the highest export agricultural crop in PNG, in 2012 it earned approximately 1.1 billion Kina (1 PNG kina = Aus $0.47) for the country which was 59.4 % of all agricultural exports (PNG Oil Palm Council, 2013). Coffee and cocoa, the other two major export crops earned 28 % and 8 % of total exports respectively. Some 18,000 smallholder farmers (plus 250,000 dependents) depend directly on oil palm while some 28,000 people, both skilled and unskilled, are directly employed in the industry. The provincial economies of West New Britain and Northern Provinces depend highly on the existence of oil palm and have been for the last 30 or so years. The oil palm industry also builds and maintains roads and other infrastructure to many rural areas in the oil palm growing provinces which provides access to medical and education services for the people in these provinces.

Types of oil palm industry in PNG

There are two types of oil palm industry in PNG, the real and the virtual. The recent article by Nelson *et al.* (2013) discussed the industry in more detail. Basically the real industry is a genuine industry which invests in milling and other infrastructure and is serious in its business in the country. On the other hand, the virtual industry mostly is not genuine and uses the opportunity for logging and it is this group that has a negative impact on the image of oil palm in PNG.

PNG Oil Palm Research Association (PNGOPRA) and the Agronomy Program

PNGOPRA is the research arm of the oil palm industry in PNG and is funded by a levy collected from every tonne of FFB from the milling companies as well as from the smallholders' crop. The organisation also receives grants for special projects from funders such as ACIAR, EU and others. PNGOPRA has four sections, Agronomy, Pathology, Entomology and Socio-economics, which provide research into supporting the industry. I will be discussing mostly what the Agronomy section and to a certain what agronomy section does with Socio-economics section do. The Entomology and Pathology Sections also do a lot of important research in crop protection and beneficial micro-organisms, insects, and plants which are also very important for the long term sustainability of the industry.

The agronomy program focuses mostly on soil nutrition aspects but also investigates other agronomic factors such as planting density affecting production both in plantations and smallholder farms. The fertiliser trials concern fertiliser types, rates and placement field experiments. One of the important aspects of the program is providing technical services to the industry. The technical assistance is not only in the form of research results in publications and reports but also providing training and undertaking field days with local farmers. In a typical field day, the extension officers bring farmers to the trial sites and best management practices are discussed. Wise use and fair distribution of income are also discussed along with gender and HIV-AIDS issues. In addition to the field days with farmers a number of best management blocks have been set up in smallholder blocks across the country. The blocks were rehabilitated and are intended to be used as demonstration picture blocks for other farmers. Example data collected from a Demonstration block in New Ireland province is presented in Table 2. Yields increased three times from 7-9 tonnes in

2009 to 27 tonnes in 2012. Yields in the nil fertilised plots also increased with time because they probably had access to fertilisers from the neighbouring fertilised palms and or was due to improved pruning, harvesting and fruit collection. The results are discussed with farmers during field days to show the benefits of fertiliser and also other important BMP.

Table 2. Yield from smallholder demonstration block in New Ireland Province

Year	Treatment	Fresh fruit bunches (t/ha)
2009	- Fert	**7.7**
	+ Fert	**9.1**
2010	- Fert	7.6
	+ Fert	24.9
2011	- Fert	17.4
	+ Fert	25.1
2012	- Fert	**17.5**
	+ Fert	**27.1**

- Fert = 0 kg fertiliser/palm/year

+ Fert = 3.0 kg AMC and 2.0 kg MOP/palm/year

The trends in FFB yield productivity from both the plantations and smallholders have been generally increasing since 2002. Field days contributed to this increasing trend especially in the smallholder sector (Figure 1.0). From previous discussion where the potential yield is 35 t/ha/year (Table 1.0), suggests there is a big challenge to increase productivity even without increasing the area of planting. This could translate into millions of kina and could have a major impact on the national income. There is also the challenge of narrowing the gap between the smallholders and plantations and again this can translate to significant increases in income for smallholder farmers.

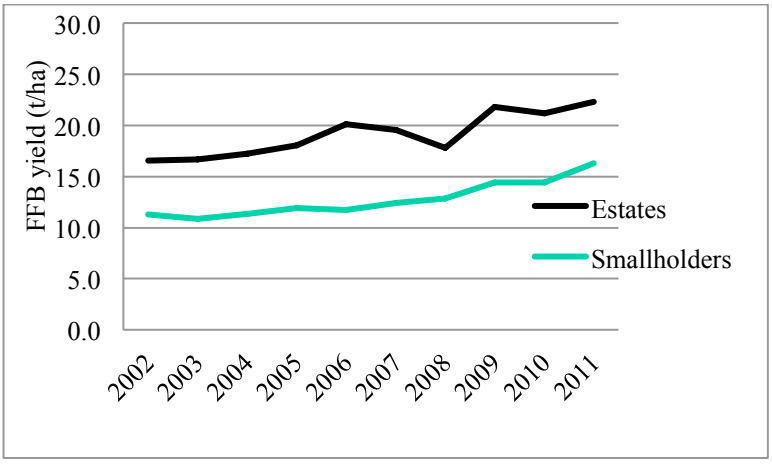

Figure 1: General FFB productivity from 2002 to 20011.

The large fertiliser trials and smallholder demonstration trials provided the required information for the industry to increase productivity, however they also raise questions of sustainability that need to be answered through in-depth studies. Three projects that were initiated to address such issues were a) European Union Stabex Project. 'Nitrogen loss pathways in oil palm growing agro-ecosystems on volcanic ash-derived soils in PNG' and b) ACIAR SMCN/2000/046 'Overcoming magnesium deficiency in oil palm crops on volcanic ash soils of Papua New Guinea' and c) SMCN-2009-013 'Sustainable management of soil and water resources for oil palm production systems in PNG'. I will discuss the N loss project because I was involved in this program and the sustainability project in the next section.

Nitrogen fertilisers are a major input in crop productions, they are expensive and have possible side effects on the environment. The N loss study was done with the following two objectives.

1. To identify and quantify major mechanisms involved in nitrogen losses from soil and fertiliser sources

2. To develop management practices that reduce N losses and improve the efficiency of applied nitrogenous fertilisers

The project identified that less than 1.5 % of added nitrogen fertiliser was lost in surface runoff water, while insignificant amounts are lost via the denitrification process. However, there was potential of significant losses through leaching if fertilisers practices are not managed properly. A residence time model was developed that used climate data and

measured soil parameters. A residence time model basically determines the number of days in which half of added N fertiliser would remain within the oil palm rooting depth before being leached out. Using this model a calendar was drawn up that shows when is the best time to add fertiliser (Table 3). For example if N fertilisers are applied in Nov-Dec, half of what is being added will remain within the rooting depth for only 55 days compared with when it is applied in May-June which will remain in the soil for 180 days. The longer the fertiliser remains at the rooting depth, the more opportunity the crop has to take up its requirements of N. The model uses climate records from the various sites to develop the calendar for fertiliser application and this information is relayed to plantation management and extension officers and even to the smallholder farmers to manage the timing of fertiliser application at the respective sites.

Table 3: N fertiliser application calendar– Northern Province

Month application	Days of available N
Jan – Feb	90
Mar – Apr	130
May – Jun	180
Jul – Aug	130
Sep – Oct	75
Nov – Dec	55

Another study looked at the possibility of nitrogen fixed biologically by legume cover crops under oil palm systems and suggests only 17 kg/ha/year of N is fixed (Pipai, 2013). Though this may not be sufficient to meet the N demand from oil palm, which requires about 100 kg N/ha/year, it may be useful for food crops which have a lower N demand in the smallholder oil palm system.

The N losses and N fixation studies provided information on how N fertilisers can be better managed not only to maximise yields but also to as much as possible minimise possible negative impacts on the environment.

Sustainability of oil palm systems

There are concerns worldwide regarding the quality of soil and water in all cropping systems including oil palm. The PNG oil palm industry is fully accredited to the Round Table Sustainable Palm Oil Production (RSPO). Prior to that the industry was accredited to ISO 14001 however this was mostly concerned with managing effects on the environment which are soil, water and air. RSPO covers the environment as well but also looks at the socio-cultural environment of communities around the production areas and involves the end users or the product consumers as well in implementation of the principles. Of the 8 RSPO principals, four are directly related to soil and water quality and require scientifically validated indicators to use for the industry. In response to environmental concerns, a scoping study was done with funding from ACIAR that looked at the quality of soil and water and asked if these issues effect management practices on the sustainability of the system (Nelson *et al*; 2010). In the next section, some of the work done in the project will be discussed. Here I will also make a point that though of global concern are the destruction of forests and effects on orang-utans, and cultivations of palms on peat soils, I will not discuss them. The reason here is that forests are not cleared for oil palm planting in PNG and there are no orang-utans in PNG and most oil palm in PNG is grown on well drained real soils and not on peat soils. However, I will also mention here that PNG Oil Palm Industry through NBPOL has joined the Palm Oil Innovations Group along with Green Peace, WWF Rainforest Action Network and the Forest People's Program to break the link between oil palm and deforestation.

Following the scoping study, a sustainability project "Sustainable management of soil and water resources for oil palm production systems in PNG SMCN-2009-013" was initiated with the aim to identify the main environmental risks and develop management strategies to sustainably manage the oil palm system. The project collaborators were PNG Oil Palm Research Association Inc, CSIRO, James Cook University, University of Adelaide, Curtin University of Technology, and funded by ACIAR. The project intends to develop indicators which are simple to do however scientifically valid and has to be able to detect trends over time, detect good vs bad areas, easily understood, useful for managers, useful for RSPO and useful for Life Cycle Assessments. To achieve the aims there were six objectives to: 1) improve soil health, 2) optimise nutrient balances, 3) maximise C sequestration, 4) improve aquatic ecosystem health, 5) develop a crop system model that enables prediction of

management effects on the environment, and 6) test and implement the monitoring packages.

The project is a very comprehensive project that included extension and involved plantation staff. The land based activities included measuring plant parts of oil palm, soil and other plant tissue sampling from plantations and smallholder blocks and in neighbouring forest and grassland areas, and discussing the work with selected farmers, while the aquatic component included studying the river and streams for aquatic life and looking at how best to monitor changes which will be useful to manage. An oil palm APSIM module is developed from the study, which will be used to model the parameters and extend the results to other oil palm growing areas.

Smallholder sustainability – oil palm production and food security

PNGOPRA is involved in a number of smallholder studies some of which included socio-economic studies, agronomy fertiliser demonstrations, leaf tissue sampling and food security studies. From these studies a number of intervention measures have been developed with the oil palm industry to increase smallholder production and at the same time enhance the general standard of living of farmers. The measures include:

- Mama lus fruit scheme – with this scheme the husbands are paid separately from the wives and this ensures income is distributed between the different gender groups. The women tend to spend money on many household items which are useful for the families and have some control on how they spend their share of oil palm proceedings.
- Mobile card scheme – with the mobile card, surplus labour in certain parts of the oil palm community are utilised to work in those blocks that have labour shortages, this create work for many unemployed youths but also assists those families with labour problems. A portion of the crop proceedings is paid for hired labour through this mobile card.
- Clan land use agreement – this is a particular agreement between traditional land owners and a person who is purchasing the right to plant oil palm on the land. This provides a security to both parties and minimises any misunderstandings in the future which could affect production and livelihood of the persons involved.

- Food security trials (AIGS Funded) – This was a project that was started with smallholders as an option to minimise pressure on available land for gardening and also to diversify income for farmers. There are two approaches to this project; food cropping alternating with legumes in wider avenues in the oil palm system (Popondetta, Kimbe and Bialla) and food crop farming on land adjacent to existing oil palm systems (Poliamba – NIP). The different food crops trialled include staples such as sweet potato, taro, yam, banana and rice; tree crops such as mandarin oranges and pineapples; and fast growing trees/shrubs for wood and fuel wood. Field days were organised at various sites from the start of the project. Specific groups were targeted for the field days which included unemployed youths, students and women groups. The women group in New Ireland province were particularly targeted because they have a matrilineal society and by involving them it was hoped that they will be able to influence decisions on how land in their society can be best used.

Yield and yield components information were collected from the crops and samples were collected to determine nutrient export from the system. In Popondetta empty fruit bunches from the mill were used in the demonstration site to show its benefits as a fertiliser when growing taro (Table 4). The addition, of compost increased taro corm dry matter by about 4 times while the corm dry matter as a proportion of total dry matter increased from 26 % to 46%. This simple demonstration shows the importance of compost in this particular soil type and the major impact it could have on food production.

Table 4: Yield of taro corm in Popondetta with and without empty oil palm fruit bunch compost

Crop part	DM (kg/ha/crop)	% of Total
	No Compost	
Corm	499	25.6
Total DM	1949	
	With compost	
Corm	3646	45.7

Total DM	7980

The intervention measures discussed and particularly the food security project are important to ensure that available land are optimised for smallholder livelihoods and options are available for farmers to adapt to have sustainable oil palm farming systems which are both socially and environmentally acceptable.

In addition to research activities into smallholder affairs, the oil palm industry also involves directly with communities addressing social needs of the people. For example, NBPOL working together with VSO and Live and Learn (NGOs) to address social aspects for sustainable livelihoods of communities within and around oil palm growing areas.

Summary

Oil palm is a very important crop for PNG economically and providing employment, sustainable income source, infrastructure for the rural population within and around oil palm growing areas. With 100% accreditation to RSPO, oil palm is sustainably grown and measures are in place to improve further.

Oil palm has grown successfully in PNG however there is room for improvement in increasing productivity and narrowing the gap between plantations and the smallholders. The response in production and eventually will response positively and this can contribute improving the living standards of people. The increased productivity implies increased production without increase in land area. Effective smallholder field days and field demonstration sites are important to contribute to achieving high yields. Land can then be spared for other purposes such as food crop production which addresses food security issues within the communities and also diversify income sources for the farming families. In addition to industry involvement, there is a need for good governance, legislation and infrastructure support in key areas at a high government level to enhance production and sustainability in the industry. Oil palm can be grown sustainably into the future and enhance the general living standard of farmers and those involved.

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Finally, last but not the least, I come from a very rural and isolated village which takes 2-3 days walk to the nearest road and the village life is mostly farming. The area is rugged but people continue to live happily farming the rugged slopes. Coming from this background to receive this honor is a great achievement for me I am humbled by this recognition. I know this will be a real inspiration for my people and I am accepting this award whole heartedly and dedicating to my people.

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