



THE NATIONAL
RESEARCH INSTITUTE
PAPUA NEW GUINEA

DISCUSSION PAPER

VALUE CHAIN ANALYSIS FOR THE
PNG COCOA INDUSTRY

Satish Chand
James Rooney
Ronald Sofo

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Abbreviations and Acronyms

CBPNG	Cocoa Board Papua New Guinea
CPB	Cocoa pod borer
DIS	Delivered-in-store
ENB	East New Britain
FOB	Free on board
GVC	Global Value Chain
NADP	National Agriculture Development Plan
PNGDSP	PNG Development Strategic Plan
PPAP	Productive Partners in Agriculture Program

Abstract

How much of the price paid for cocoa exported from Papua New Guinea (PNG) is captured by the grower? And how does this compare with international norms? This paper uses data collected from official sources to answer both of these questions. We place cocoa produced in PNG within the global cocoa supply chain to analyse the distribution of economic rents across economic agents, national borders, and processes. Our analysis extends beyond corporate and industry reporting to measure economic value generation and capture through the Global Value Chain (GVC) for cocoa produced by the smallholders in the East New Britain Province (ENB) of PNG. Our analysis shows that the grower received approximately 84 percent of the free-on-board (FOB) price for export-quality cocoa when this is delivered in store to the exporter. This outcome compares favourably with comparator nations such as Ghana where the equivalent proportion was 83 percent. Whilst no stakeholder in the PNG cocoa value chain is earning excessive profits, smallholders who produce the cocoa remain unable to substantially increase personal and household wealth. Hence, we argue for improved quality control in processing wet beans, better branding of PNG cocoa and consideration of opportunities to develop roasting and grinding operations within PNG to allow the smallholder growers to capture additional rents from the GVC.

Introduction

Cocoa beans are amongst the most highly traded tropical crop, valued at US\$7 billion in 2015 and expanding with total trade within the Global Value Chain (GVC) for chocolate products having doubled to US\$44 billion within the decade to 2015 (Hamrick & Fernandez-Stark, 2018). The International Institute for Sustainable Development (2019) estimated that the global market for cocoa beans alone will expand at an annual rate of 7.3 percent between 2019 and 2025, reaching US\$16 billion. It is as yet unclear, however, if and how the market for cocoa beans is being affected by the Covid-19 pandemic that began in December 2019.

The production and consumption of cocoa beans is mediated through the market. The spatially fragmented value chain for cocoa has spread the rents generated from cocoa across producers and intermediaries both within and between countries (Kaplinsky, 2000). The case of cocoa is stark given that the crop is largely grown by smallholders in developing countries while the processing and branding of cocoa is undertaken by multinational enterprises located in developed nations (Bhutada, 2020). The global cocoa industry is linked through the major global chocolate manufacturers who procure their supplies through largely global market-based intermediaries operating in developing nations. Consequently, the multinational manufacturing companies have had little direct interaction with growers. This study endeavours to investigate how much of the price paid for cocoa exported is captured by the farmers at the source, and comparatively how does this flare to international standards.

The global price of cocoa draws together the myriad of producers, processors, and consumers that make this market. Three main types of beans are internationally traded: Fine and Flavour Cocoa (FFC comprising mostly Criollo and Trinitario varieties of beans) used to produce high-end chocolates (ICCO, 2019); Fairtrade and Rain Forest Alliance certified beans; and bulk uncertified cocoa beans (Forastero). Amongst these, FFC is a premium product that commands roughly three times the price of bulk cocoa but it requires certification by a committee of the International Cocoa Organisation (ICCO). This certification can only be secured by governments for their exports (Hamrick & Fernandez-Stark, 2018). Bulk cocoa beans, in contrast, has a uniform price irrespective of source as it is considered to be a homogenous/undifferentiated product.

Globally, approximately four million tonnes of cocoa beans are produced annually. Most of this output is used to produce chocolates by large multinational corporations, an industry that has a turnover of US\$106 billion in 2017 (Voora et al., 2019). But the supply of cocoa beans over the future is far from being assured. The major global chocolate manufacturers have expressed concern regarding the reliability of supply and the quality of cocoa with several committing to procure sustainably produced beans (Hamrick & Fernandez-Stark, 2018). For example, factors such as climate change and the emigration of workers out of agriculture into the manufacturing and service sectors of developing economies have been detrimental to cocoa production. The focus on sustainability of the supply of cocoa beans has consequently shifted towards providing incentives for farmers and their progeny to remain engaged in cacao-growing. These incentives in the main are those of raising income of farmers through improved yield and quality of cocoa beans (Bolwig et al., 2010; Kaplinsky, 2004).

Some of the initiatives to secure supplies of beans over the future include (i) development of more disease and pest resistant hybrid trees; (ii) improved techniques for fermentation and drying; (iii) better farm management techniques; and, (iv) higher income and improved quality of life for the cacao farmer. The industry also introduced certification and fair-trade prices in response to allegations of the use of child labour and predatory pricing in some countries. Tracing the source of the beans is now possible through improvements in technology. Saltini et al. (2013) reviewed this literature, tracking the impact of individual processes through the entire cocoa value chain to the quality of chocolate produced.

The constraints to expansion of cocoa production is similar to those for the agro-food industry. Gereffi and

Fernandez-Stark (2016) identified four sets of constraints: (1) access to markets; (2) access to training; (3) collaboration and cooperation across stakeholders; and, (4) access to finance that smallholders face in high-value agro-food chains. We next summarise these within the context of cocoa in PNG.

1. Access to markets and the GVC by the smallholder is through local buyers who then on-sell to local exporters with prices paid being determined by the level prevailing in the international market.
2. Access to training is via local agents/extension officers employed through the Cocoa Board Papua New Guinea (CBPNG), a statutory body with the mandate to “foster a sustainable cocoa industry that enhance rural livelihoods and contribute to the wellbeing of our rural population [through] innovative farming practices that maximise farmer’s profitability and income” (PNG Cocoa Board).
3. Coordination amongst the growers is limited, with traditional kinship ties being the strongest form of collaboration. Such coordination is facilitated through the CBPNG across growers and by the local exporters as the intermediaries between the growers and the multinational processor of the beans. Lack of scale at the smallholder level and the high costs of self-organisation have been significant barriers to coordination amongst the stakeholders.
4. Liquidity and credit constraints are both prevalent within PNG cocoa value chain. Payments are made in season only, thus managing cash flow at the level of the farmer has been problematic. Access to finance from the formal sector is constrained by the lack of collateral to secure loans. Similarly, the capacity to invest into capital and equipment to raise productivity and the quality of the produce such as through improved drying facilities are constrained by the limited access to credit.

In PNG, cocoa is grown by smallholders and plantations with the former accounting for close to 98 percent of total production that in 2019 amounted to 42,464 tonnes of wet beans (Cocoa Board PNG, 2018). PNG’s current participation in the GVC is largely confined to cultivation and production of Trinitario cocoa beans for export through international intermediaries. A small chocolate-making factory was established in Port Moresby in 2011 but it largely serves the domestic market. Some dried cocoa beans from PNG is purchased by Bahen and Co of Australia for the manufacture of a single-origin chocolate that is marketed via Harrods in London and similar specialty stores in France, Holland, Hong Kong, Singapore, and the USA.¹ Similarly, Nestle Japan released a ‘volcanic edition of its Kitkat’ using cocoa beans from Papua New Guinea and Vanuatu in January 2019. These direct purchases by the manufacturers, while paying a price higher than that for bulk cocoa, account for less than 1 percent of total production. Farmer-led entrepreneurial initiatives such as the Kuapa Kokoo group and the Day Chocolate Company in Ghana are examples of the direction in which this approach can lead (Tiffen, 2002; Doherty & Tranchell, 2005). Similar forms of social enterprise in other cocoa-producing countries attest to the promise of this approach (Gallo et al., 2018).

Whilst considering these developments, the focus of this paper is on the proportion of export income that accrues to the smallholder grower, an issue that has not as yet been addressed in PNG. Our analysis based on the segmenting of proceeds along the local cocoa value chain reveals that approximately 84 percent of the total free-on-board (FOB) export price was paid for beans delivered in store to the local exporter. This proportion compares favourably internationally, thus an increase in income of the smallholders rests with raising yield and reducing costs of production.

The remainder of this paper is structured as follows: the next section provides the context for cocoa in PNG and also presents the value chain for PNG cocoa. The following section presents the analysis on the distribution of proceeds from sale of cocoa across the value chain. Then the last section explains means to raising income, followed by concluding remarks.

The study adopted desktop review approach and consultation with relevant stakeholders. Besides undertaking

¹ See <https://www.businessadvantagepng.com/artisan-chocolate-maker-chooses-papua-new-guinea-cacao/>

literature review on value chain analysis of cocoa in PNG and similar jurisdiction, the research team had an opportunity to consult the Cocoa Board PNG, Paradise Food Ltd (Queen Emma Chocolate), and New Guinea Island Product (NGIP) Agmark. In addition, the team also conducted semi-structured interview with cocoa traders and smallholder farmers in Rabaul, East New Britain (ENB). The province is one of the leading cocoa-producing provinces in the country. The team liaised closely with the Cocoa Board PNG to access official and updated set of data on production, export and price.

Context: Cocoa production in PNG

Cocoa has been grown in PNG for over a century now. It was first brought into New Guinea by German traders around 1900, who later established plantations in Bougainville, New Britain, and New Ireland under German colonial administration. The Australian administration took over following the First World War, and embarked upon the expansion of cocoa production that continued following Independence in 1976 (PNGETCS, 1987). Initially, cocoa was grown as a plantation crop with locally hired labour. Plantations flourished in the 1970s on the back of structured management and increasing global demand for cocoa (PNGETCS, 1987). The marked shift to smallholder production occurred in the aftermath of Independence as plantations were taken over by the smallholders, and as more land held under customary tenure was brought into production.

Cocoa makes a substantial contribution to the economy of PNG. It is grown in all of the coastal and island provinces of PNG, with one of every eight citizen being dependent on the crop for cash income (Nelson et al., 2011). It employs approximately 140,000 smallholders or 20 percent of the workforce with majority being women (World Bank, 2014). According to Cocoa Board PNG (2018), some 99 percent of total production is exported with remaining 1 percent used locally in manufacturing of chocolate and cocoa powder for domestic consumption. Cocoa is a leading agricultural export, only surpassed by coffee and oil palm. In 2019, cocoa generated K239 million in export earnings, contributing 99.7 percent of total cocoa earnings (see Table 1).

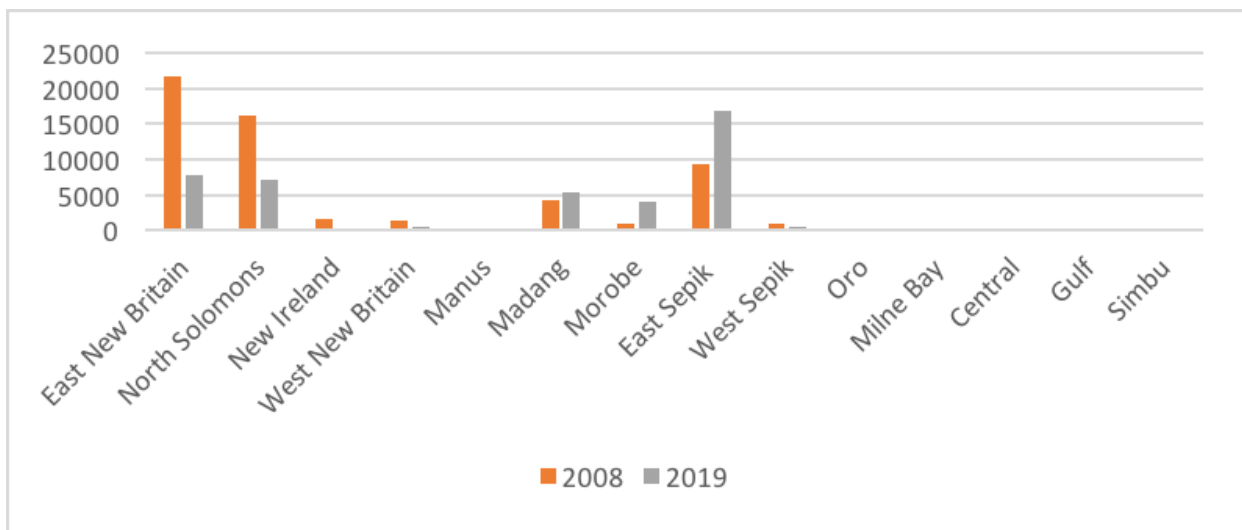
Table 1: Production and income from cocoa, 2010 to 2019

Year	Export		Non-Export		Residues		Total	Total
	Quality Beans		Quality Beans		Residues		Volume	Value
	Tonnes	K'000	Tonnes	K'000	Tonnes	K'000	Tonnes	K'000
2010	41,392	348,416	234	1,597	81	10	41,707	50,023
2011	47,445	320,306	75	530	132	251	47,652	321,087
2012	38,168	182,595	527	2,522	57	42	38,753	185,159
2013	38,774	206,008	178	842	43	26	38,995	206,876
2014	33,577	243,059	15	105	57	51	33,649	243,215
2015	33,090	271,897	15	114	45	108	33,150	272,119
2016	40,117	359,876	88	808	n.a	n.a	40,205	360,684
2017	42,003	269,075	250	1,596	46	58	42,299	270,729
2018	33,340	247,683	109	711	10	13	33,459	248,407
2019	28,995	238,259	99	694	37	48	29,131	239,001

Source: Cocoa Board of Papua New Guinea. Note: n.a. denotes data for the cell is not available.

Cocoa is mainly grown in coastal lowlands of PNG: predominantly in East New Britain (ENB), the Autonomous Region of Bougainville, Madang, Morobe, and East Sepik. These regions have a warm and humid climate with regular rainfall, thus, providing the climatic conditions for the crop. ENB and Bougainville outrank the remaining provinces in terms of total output of cocoa (see Chart 1). Bougainville was the leader in terms of total output until the eruption of war in 1989 that raged on for a decade leading to a collapse in cocoa production. Peace installed through an agreement signed between the parties in 2001 has seen a slow rebound in production from Bougainville.

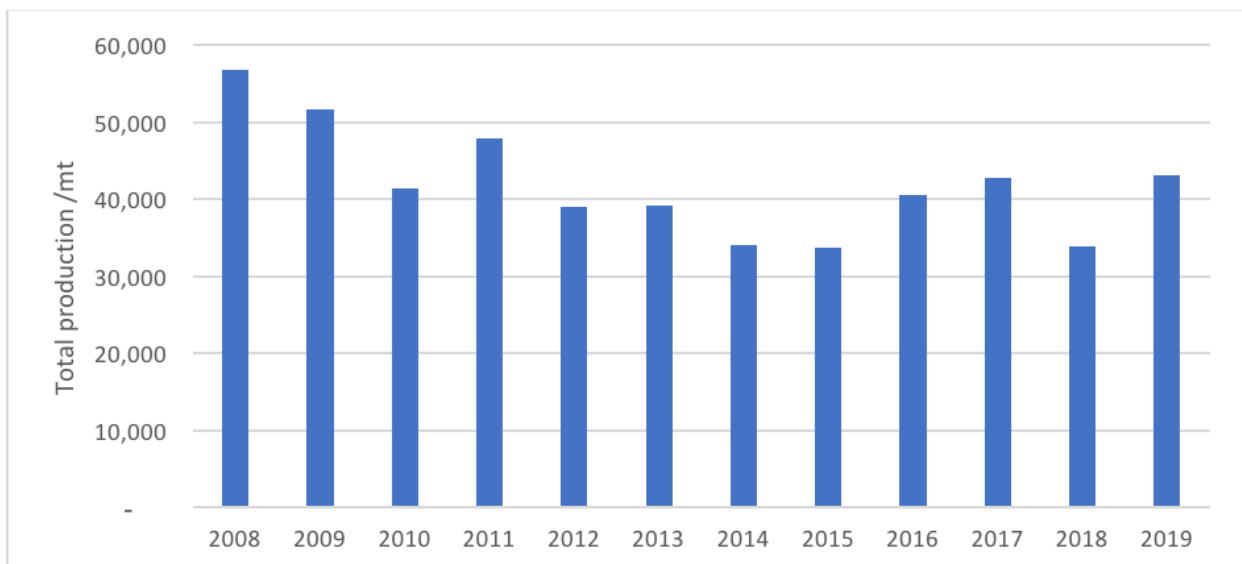
Figure 1: Cocoa production by province



Source: Cocoa Board PNG (2020)

For the decade to 2017, ENB has led in terms of total production of cocoa but output has been volatile due to a combination of unfavourable weather conditions (i.e. periods of prolonged drought), outbreak of a pest (i.e. the cocoa pod borer), and volatility in the price of exports that has ranged from K5,300 per tonne in 2013 to nearly K9,000 in 2016 (see Table 1).

Figure 2: Cocoa production, 2008-2019



Source: Cocoa Board PNG (2020)

On a national scale, the total production of cocoa peaked at 56,000 tonnes in 2008 and thereafter fluctuated between that level and 33,000 tonnes produced in 2015, as shown in Figure 2 above. The decline in production after 2008 is attributed largely to the devastation caused by the outbreak of cocoa pod borer in 2008, and its subsequent spread across the regions prompting many farmers in the cocoa-producing provinces to abandon their crop altogether (Curry et al., 2009).

Production of cocoa has been on a slow rebound since 2015 following concerted efforts to contain the spread of the cocoa pod borer. The interventions included introduction of new pest-resistant and higher yielding clones

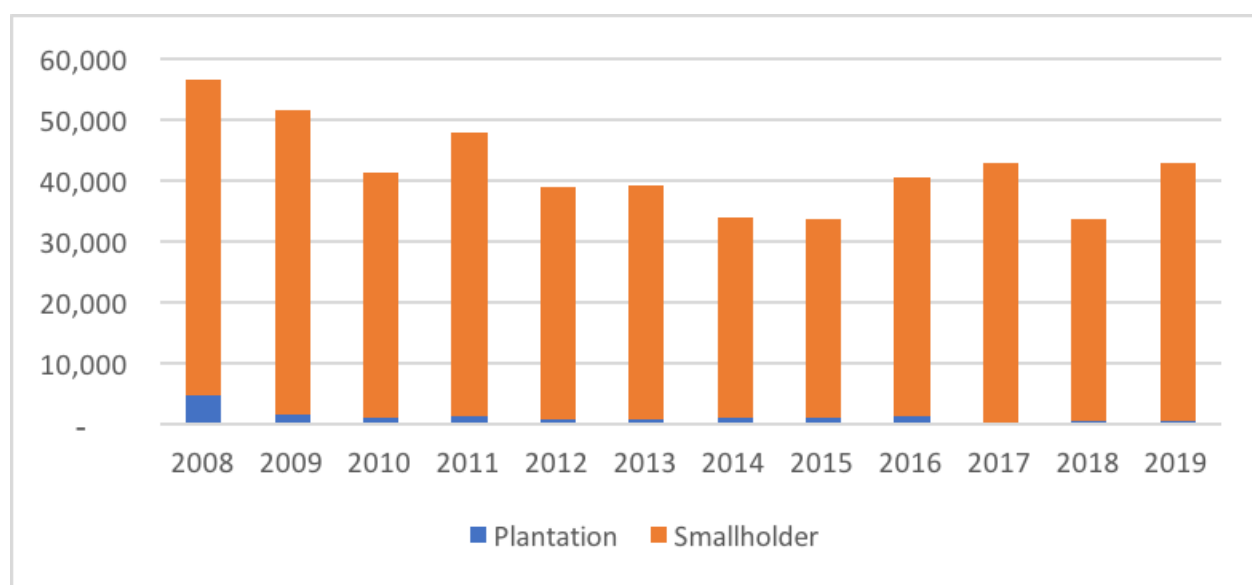
supported through a large-scale nursery, and aggressive replanting programs. This intervention was supported by donors and the two large, licensed exporters. Yields have since been recovering slowly while the quality of beans produced remains inconsistent, owing largely to poor processing including the smoke contamination of beans from defective and aging (often rusty) dryers.

Role of smallholder in cocoa production

Smallholder growers dominate production as old plantations are either abandoned or divided. As of 2019, for example, just one percent of the total output of 43,044 tonnes of green beans was produced by plantations. The share of production from the smallholders has risen over time, from around 87 percent a decade ago to around 99 percent by 2019 (see Figure 3). The demise of plantations commenced with problems of land tenure that began in the 1970s (Connell, 1997), which was then exacerbated by a collapse in international commodity prices (Curry et al., 2009).

Smallholders, unlike plantations, are family-run operations. The typical smallholder grows cocoa on two hectares of land that is held under customary title. The family provides all of the labour for the farm, and growers often pool their daily harvest for fermentation within their neighbourhood. Many of the smallholders belong to cooperatives who access information on prices and acquire inputs for growing and processing cocoa. These cooperatives also act as the vehicle to voice the concerns of their members affecting the industry.

Figure 3: Cocoa production by plantation and smallholder sectors, 2008 – 2019



Source: Cocoa Board PNG (2020)

Cocoa is the major source of cash for the growers, the majority of whom rely on subsistence agriculture to supplement their income. For the nation as a whole, and using data for the 140,000 smallholders who produced a total of 29,000 tonnes of cocoa beans in 2019 (World-Bank, 2014), the average output per grower is 208kg of dry beans. This output at the prevailing price of which the smallholder receives 86 percent equates to an income of K1,450 (i.e. approx. US\$405), or equal to roughly 11 percent of the national per capita income.

Income from cocoa has been stagnant, largely due to stagnant productivity since 1998. Curry et al. (2007) reported that smallholder from the main cocoa-producing provinces of East New Britain and Bougainville have an annual average yield of 300kg to 400kg of dry beans per hectare. In an earlier baseline survey conducted in late 1998 by the Cocoa and Coconut Research Institute (CCRI), the average yield of 401 kg per hectare was reported,² with a range between 284kg and 605kg per hectare (Omuru et al., 2001, p13-14). Productivity, as

² Although, as cited in the Omuru et al. (2001 p13) study, this is approximately 25% higher than that estimated for East New Britain by Yarbro & Noble (1989).

quantified by yield per hectare, has PNG above Ghana which has a corresponding figure of 360 kg per hectare but well below that of Malaysia which has a yield of 1800kg per hectare (UNFAO Statistics Division, 2006b).

Smallholders in PNG have considerable room to raise productivity. They may learn from plantations where modern management techniques are employed with intensive use of chemical fungicides and fertiliser. Smallholders in contrast use labour-intensive techniques instead of chemicals as pesticides or fertiliser (Curry et al., 2007). Consequently, cocoa produced by the smallholder farmers are largely organic in nature. This is consistent with the 1989 CCRI baseline survey which cited that just 3 percent of surveyed farmers had changed their practices to include use of fertilisers and chemicals within the past 10 years (Omuru et al., 2001, p.47)³. While the cocoa produced is largely free of chemicals, it is not classified as being organic, thus, misses out on the price premium. The decisions by smallholders to minimise use of chemicals is explained by the fact that they continue to draw many environmental services from their surroundings.

Key policies, interventions and institutions

The Government has aspirations to expand cocoa production. The PNG Development Strategic Plan 2010-2030 (PNGDSP) has espoused the goal of promoting the development of agriculture sector as a means to raising income and employment opportunities for the rural population. Specifically, it includes the target of increasing cocoa production to 310,000 tonnes by the year 2030. This is to be achieved through rehabilitation and replanting of new and high yielding varieties of cocoa (Department of National Planning and Monitoring, 2010, pp 90). This ten-fold increase in output from the level in 2019, all else equal, has the potential to lift many of the smallholders out of poverty. Similar to the PNGDSP, the PNG Vision 2050 envisages robust growth of agriculture sector with expanded production of cocoa.

Recognising agriculture as the backbone of PNG's economy with the potential to transform and sustain the livelihoods of the majority of population, the government had also formulated the National Agriculture Development Plan (NADP) 2007-2016. It was dubbed as the blue-print of agriculture sector to guide and drive its transformation. The NADP emphasised on improvement in production and increasing exports of primary commodities including cocoa. It is noted that through the NADP, a total of K246 million was earmarked for investment in the cocoa industry to lift production and encourage downstream processing (PNG Ministry of Agriculture and Livestock, 2007). Pointedly, the Cocoa Industry Strategic Plan for 2016-2025 (Cocoa-ISP) calls for a ramp up in investment to reach the 310,000 tonnes production-target.

While intentions behind these policies and plans are commendable, their implementation has been poor given the little change in the volume of output. Nevertheless, in recent years, the traditional development partners such as the World Bank, the European Union, and the New Zealand and Australian governments have assisted through a number of fresh initiatives. One prominent example is the World Bank's Productive Partners in Agriculture Program (PPAP) which aimed to lift smallholder cocoa productivity, and improve crop quality and cocoa farming systems. The PPAP, in response to rapid spread of the cocoa pod borer, had been instrumental in supplying pest resistant seedlings and in the rehabilitation of roads to improve market access.

One of the important institutions that coordinate and implement the government policies and interventions is CBPNG. As a statutory agency responsible for the industry, the CBPNG regulates licensing of fermentries and oversees both exports and marketing of PNG cocoa. One of its critical roles is ensuring that the quality of dry cocoa beans meets export standards, and that the farmers receive a fair price for their cocoa. Its regulatory functions and related operations are funded partly by levies, licensing and registration fees collected from the growers, cocoa processors, and exporters. The CBPNG has recently partnered with the PPAP to coordinate across local stakeholders to foster production of improved cocoa seedlings, in cocoa extension services, and in the efforts to eradicate the cocoa pod borer.

³ Compared to 25% indicating that they had used high-yielding varieties of cocoa plants in the same period.

Market

On the domestic front, most smallholders sell their harvested wet beans to buyers in the village or at the roadside. Usually, these farmers do not own or have access to facilities for fermentation and drying of the harvested beans. This is because many of the farms are small, thus, lack the scale to warrant the construction of their own drying facilities in the form of a kiln. Furthermore, an operator of a dryer has to secure a licence from the CBPNG which is an additional regulatory hurdle (Curry et al., 2007).

Farmers who engage in fermenting and drying of the wet beans then sell their dried beans to traders for export. Traders who buy dried beans as well as those who export the beans are required to register with the CBPNG before engaging in the market. According to a recent study on the cocoa specialty market, PNG mainly exports cocoa in bulk and largely to Malaysia, Singapore and Indonesia, followed by Belgium and the United States (Department of Foreign Affairs & Trade, 2017, p6).

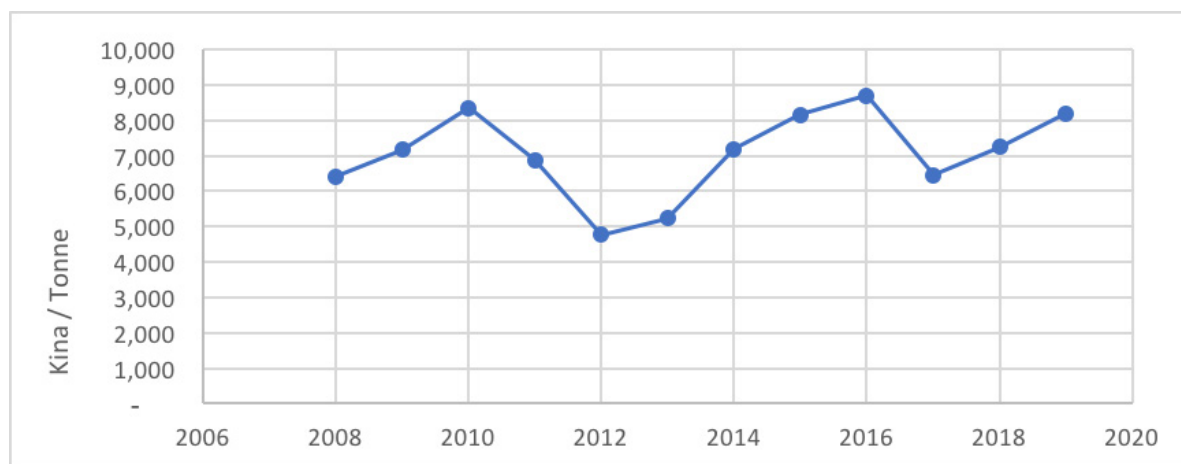
There are two large exporters of PNG cocoa. Agmark is the largest and it has had a long history of being involved in growing cocoa, sourcing and processing wet beans, buying dried beans from other processors, and exporting the beans. The company has buying and processing facilities in East New Britain (ENB) and Bougainville. Within ENB, Agmark maintains close connection with the farmers and is engaged in the provision of extension services to secure quality supplies.

Outspan, a relatively new entrant with growing presence in the cocoa-producing provinces, is the second major exporter of PNG cocoa. Operating as a subsidiary of Olam Group which is a multinational firm that specialise in trading cocoa, Outspan deals directly with farmers to source certified (i.e. Rainforest Alliance) cocoa beans for its clients.

On the local front, Paradise Food Limited buys cocoa beans for manufacturer of PNG chocolate that is sold via the retail outlets in the nation. The dry cocoa beans are sourced from farmer cooperatives from Morobe, Madang, East Sepik, Oro, Bougainville, and ENB. This company pays a 20 percent premium on the purchase price offered by the other traders on the day of purchase but requires that 17 percent is paid directly to the farmers whilst the remaining 3 percent held in trust for repair and maintenance of the fermentery, and other farming equipment. The manufacturer pays close attention to the source of its beans for traceability and quality assurance.

As with other commodities, the international price for cocoa beans fluctuates over time. Figure 4 below shows the average free-on-board price for cocoa exports for the years 2008 to 2017. Prices peaked at approximately K8353 per tonne in 2010, dropped to K4761 per tonne in 2012, rose steadily to K8697 by 2016 followed by another fall before recovering to K8199 in 2019.

Figure 4: Average free-on-board price of dry export-quality cocoa beans



Source: Cocoa Board PNG (2020)

Both the quantity and quality of dry beans produced is adversely affected by the cocoa pod borer (CPB). To provide an indication of the potential loss from CPB infestation, the economic impact is estimated to range from a loss in production of between 25 and 75 percent with a corresponding fall in the value of total income to the cocoa industry of between K28mil to K84mil (Curry et al., 2009, p.19). The corresponding potential reduction in employment is also significant with, for example, a 50 percent fall in production estimated to lead to a loss of the equivalent of 16,400 jobs (Curry et al., 2009).

The value of cocoa exports is a product of the volume of production and the international price of exports. Both the volume of exports and prices have been volatile, thus, compounding the impact on income. This is shown in Figure 5 where the volume of exports, prices, and total income are normalised to their levels in 2010. The values in 2011, for example, show that while production in the year had increased by 15 percentage points, export prices were lower by 20 percentage points implying that the value of exports was lower by 5 percentage points compared to the level in 2010.

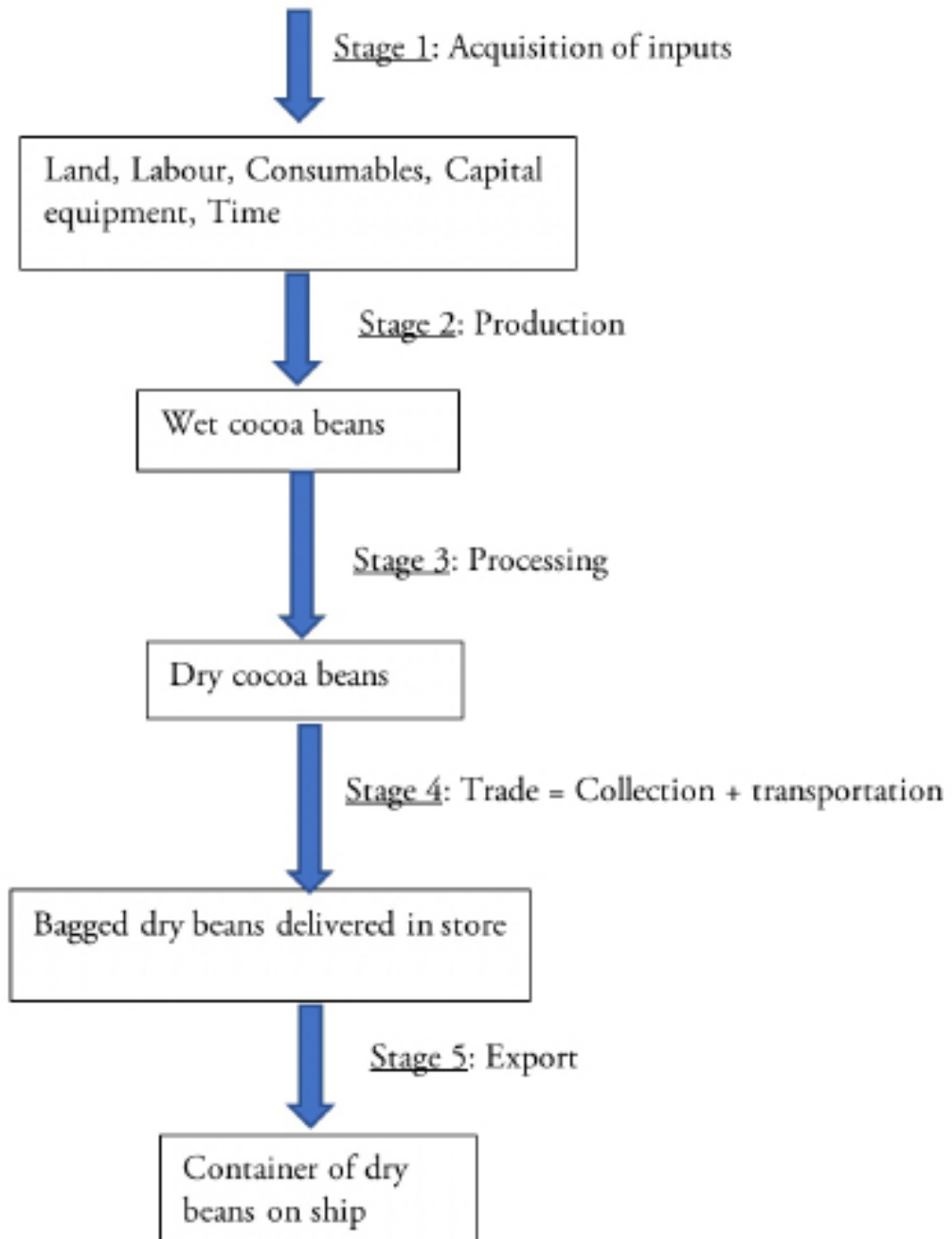
Figure 5: Volume, prices, and value of exports; 2010 = 100



Source: Drawn by the authors using data from Cocoa Board of Papua New Guinea

PNG accounts for less than 1 percent of the global output of cocoa, thus has no influence on the international price for cocoa meaning that the volatility in prices is beyond local control. The volatility in production is at least partly the consequence of weather events, and droughts in particular. Farmers and exporters have influence over the quality of output, and this earns them a premium regardless of the price level. Thus, cocoa producers in PNG may have to learn to live with volatile income that gets transmitted through international prices and weather shocks. We next explore the transmission of the export price through the local value chain.

Figure 6: PNG Cocoa Value Chain



Source: Authors

PNG cocoa value chain

The cocoa value chain showing the primary processes and the key environmental factors impinging on the industry is presented schematically in Figure 6. The cocoa value chain, as it applies to PNG, extends over five distinct stages; namely, (i) acquisition of inputs; (ii) production of wet cocoa beans; (iii) processing of the beans; (iv) grading and packaging of the beans; and, (v) containerisation for export of the dried and graded cocoa beans in appropriately labelled bags. This relationship, however, is far from being linear as technical inputs are provided by both the downstream processors and the CBPNG. Each of the key processes are briefly explained next.

Export of the beans by one of the two licensed exporters is the final stage of the local value chain, with the lone exception of the local manufacturer of chocolates. Since some 99 percent of the cocoa produced in PNG is exported, the local manufacturing of chocolates is ignored from the subsequent discussion. The exporters buy dry beans from the traders and smallholders, and also acquire wet beans that they themselves process, sort, bag, and then containerise for export through international brokers.

The plantations, together with some of the relatively large smallholders, combine stages 2 to 4 in that they produce the wet beans, ferment and dry them before packing them into bags for transport to one of the two licenced exporters.

Acquisition of inputs

The first stage entails the acquisition of inputs in the form of land, labour, seedlings, and consumables in the form of fertiliser and pesticides, if used for the growing of cocoa. Land is often acquired either on lease from the State or through customary arrangements when the underlying title is customary. In the latter case, the growers are largely members of the clan that has rights to the land on which cocoa is grown. Capital equipment and consumables in the form of pruners, knives, spades, weedicides, and fertiliser are purchased from local retailers, and sometimes facilitated through the trader and/or the CBPNG. Larger capital equipment such as tractors and vehicles for the transportation of the beans are acquired from local suppliers by the bigger plantations and commercial holdings.

Production

The second stage of the local supply chain involves the production of wet beans. Cacao grows only in the tropics under specific temperature, soil, and humidity conditions; in PNG these conditions confine cacao farming to the coastal and island regions. Cocoa trees, depending on variety and environmental conditions, take between three to five years to mature before producing pods that are harvested and split to extract wet cocoa beans. The trees, if well maintained, have a productive life of up to 25 years. A farmer that takes up cocoa-growing for the first time, therefore, has to expand effort and wait until harvest to draw income from their investment; that is, the time to wait is a significant cost as the farmer has to rely on alternative sources of income until the trees are in production.

The wet beans are produced by both smallholders and plantations with the former accounting for some 99 percent of total output. The mix of inputs used between plantations and smallholders are different, as is their productivity. Plantations rely on hired labour, use more capital-intensive techniques, and make greater use of weedicides and fertiliser. The smallholders, in contrast, rely predominantly on their family members for planting of cocoa trees, weeding and fertilising the plants, harvesting and packaging (bagging) the wet beans, and selling to traders who normally collect the wet beans from the roadside. A typical smallholder has a cocoa plot of some 2 hectares with some 2,000 trees which on average, have yields of between 300 to 400kg of wet beans per hectare.

Processing

The third stage of the value chain involves the fermentation and drying of the harvested wet beans. For most smallholders, the extraction of wet beans takes place on the farm while the fermentation and drying of the beans is undertaken either at home or in dedicated facilities owned and operated by the traders. The typical drier uses a combination of solar energy and heat from burning of woods with the smoke generated being extracted

through a piped chimney. A leaky chimney such as that resulting from rust can contaminate the beans which then adversely affects the price received.

Trade

Grading and bagging of the beans takes place as the fourth stage of the value chain. This task is undertaken by the traders who collect dry beans from the processors, grade the beans including rejecting those that do not meet the minimal quality standards, bag and label the beans, and transport the bags of beans to the exporters where they then receive the delivered-in-store (DIS) price. Only beans deemed to be of export quality can be exported. The bags carry labels that identify the source of the beans so that any defects discovered subsequently can be traced back to origin. As for the processors, the traders are also required by regulation to hold a license and conform to approved standards for storage of dry cocoa beans. CBPNG has oversight over the design and operational standards of such storage facilities. Omuru and Fleming (2001, p37) identified that, even with significant increases in the preceding years, average transport costs from the farm to local processors for export averaged 6 percent of cocoa value in 1998. A subsequent econometric analysis of the relationship between market accessibility and cocoa production based on the same baseline data mentioned earlier identified that dimensions of economic distance other than physical distance were more important to cocoa farmers – these may include frequency and reliability of transportation (Omuru & Fleming, 2001 p20).

Export

The traders deliver their bagged dry beans to one of the two exporters, and receive a price depending on the quality of the product and the prevailing free-on-board price of cocoa. The exporters further sort the acquired beans, bag and label them, secure an export certificate authenticating the quality of the beans from the CBPNG, containerise the bags and load these at the port for sale through international brokers or directly to the importer. As an example, Outspan supplies dried cocoa beans from PNG to Olam International.

The price paid for dry beans delivered-in-store (DIS) is linked to the free-on-board price for cocoa. This, to the decade to 2019 has ranged from 71 percent in 2017 to 94 percent in 2014, with an average of 84 percent for the decade. A reason, as explained by one of the exporters during the stakeholder consultation of the study, for the large fluctuation in prices paid to the traders is the need for additional storage and at times for further sorting of the beans before export. The prices received by the producers and processors of the wet beans are linked to the free-on-board price received by the exporter. This illustrates the close association and trickle-down impact of international price of quality cocoa beans on the smallholder farmers.

The duopoly in export of cocoa beans from PNG is due to the high cost of acquiring and keeping permits. Businesses applying for an export licence are required to have a minimum financial capital of K300,000, and they must export a minimum of 1000 tonnes of dry cocoa beans per annum to retain their export licence (PNG Department of Foreign Affairs & Trade, 2017). The licencing of exporters and the monitoring of compliance with the regulations are the responsibilities of the CBPNG. The rationale for these restrictive conditions is to ensure that the exporters have the necessary capital to meet the cashflow needs of the business, that they have the requisite scale to minimise costs of export, and that the exporters retain an interest in the sustainability of the industry. This strategy has been effective in that the two major exporters have large investment throughout the supply chain, have provided technical support to the growers, and have remained vigilant on the quality of exports from PNG. They have taken charge of ensuring that every bag of cocoa beans exported from PNG carries a unique label to allow traceability of the contents to the producer in case of defects. However, the restrictive conditions for new entry into the PNG cocoa exports may be limiting competition in the market – an issue we investigate next.

While each of the five stages of the value chain are distinct, they are not necessarily undertaken by different agents. The farmer and plantation holders particularly, for example, may undertake the production and processing of the beans on their farm. Some traders purchase wet beans on the roadside from the smallholders, transport these to their own facilities for processing, and then deliver the bagged dry beans to the exporter. Finally, both the major exporters have their own plantations, processing facilities, and thus work through all stages of the value chain shown in Figure 6.

Analysis

We next follow the payments and corroborate this with the quantity of beans produced through the value chain to gauge the division of proceeds through the five stages shown in Figure 6.

Table 2 provides data on price and quantity, including the extent of shrinkage and wastage, at each stage of the value chain. The second cell from the top of the second column shows that the importer receives 970kg of dried beans from every tonne exported free on board (i.e. FOB) from PNG with the balance of 3 percent by weight lost as waste and shrinkage during transit. Cascading to the next stage of the value chain, the exporter incurs losses of 2 percent as the beans are transferred from the trader, who in turn loses a percent when acquiring the beans from the processor. The last cell in Column 2 shows that green beans shed moisture totalling 55 percent by weight in the drying process. Column 3, when read from the bottom cell and upwards shows that the wet to dry conversion rate is 45 percent, and waste in transit through the value chain of 1 percent from the processor to the trader, a further 2 percent from the trader to the exporter, and another 3 percent from the exporter to the importer such that some 43 percent, by weight, of wet green beans reaches its ultimate overseas destination.

Table 2: Price margins and shrinkage plus wastage by weight for PNG cocoa, 2019

	Quality (kg)	Quantity after Shrinkage and waste (proportion of farm gate quantity)	Price (Kina/tonne)	Price share (%)
Importer (CIF)	970	0.43	8231	
Exporter (FOB)	1000	0.44	8199	16%
Trader (DIS, Dry beans)	1020	0.45	7072	54%
Processor (Dry beans)	1030	0.45	7001	
Farm gate buyer (Wet beans)	2266	0	3215	
Small holder farmer	2266		2493	30%

Notes: DIS is Delivered In Store; and, Price data for 2019 has been used. Assumptions regarding shrinkage and wastage are as follows: 2.2kg of wet beans are used to produce 1.0kg of dry beans implying a shrinkage of 45 percent by weight; waste in the transfer from the processor to the trader amounts of 1 percent; the transfer from the trader to the exporter results in an additional waste of 2 percent; and, the transfer to the import destination results in an additional waste of 3 percent (data on levels of waste and shrinkage drawn from Vadnjaj and Pelomo, 2014).

We next trace the flow of money through the value chain to calculate the share of total proceeds captured at each of the stages. The penultimate column of Table 2 shows prices received for the beans as of 2019. The topmost cell shows that importers pay K8,231 for 0.97 tonnes of dry beans, after shrinkage and wastage during transit of 3 percent by weight, inclusive of the costs of insurance and freight (i.e. CIF). The cell immediately below shows that the FOB price received at Lae Port in PNG is K8,199 while that paid to the trader is K7,072 per tonne after a price margin – gross of handling and delivery costs – to the exporter of 16 percent. Cascading the calculations down to the processor from this FOB price, assuming shrinkage and wastage of an additional 1 percent, implies the price of K7,001 for the 1,030kg of dry beans. Cascading the same calculations to the buyer of wet beans from the roadside implies a price of K3,215 per tonne. However, the processor and aggregator of wet beans is often the same entrepreneur who buys, processes, grades, and bags the beans. The actual price paid to farmers at the roadside for wet beans ranged between K1 and K1.20 per kilogram – the average of K1.10 is used here. Noting that some 2,266kg of wet beans are processed into a tonne of dry beans for export, the final column in Table 2 shows that the smallholder collects some 30 percent of the total proceeds, the exporter 16 percent, with the balance being captured by the processor and the intermediary who often is the same enterprise.

The financial distribution of the final price between the farmer, processor, and the exporter reflect a combination

of their value-add and any rents (i.e. excess profits) captured by them within the value-chain. There are minimal barriers to growing of cocoa – a farmer residing in the cocoa regions with land and labour is free to farm cocoa, thus smallholders have little opportunity to earn excess profits. Similarly, the many buyers and processors of cocoa beans suggests that there would be minimal rents to extract by the processors. Finally, the duopoly of exporters suggests the potential for rents but the margins reported compare favourably to those for other nations. In summary, the percentages shown in the right-most column of Table 2 broadly reflect the value created at each of the stages of the cocoa value chain in PNG.

Income earned by the smallholders is low however. This raises the challenge of how best to increase their income from cocoa. The evidence presented above points to raising yield and prices received as the only means to raising income for the smallholder growers of cacao. The next section explains how this may be achieved.

Inconsistency in smallholder production

Recent research has identified poor farm management, labour shortage, lack of access to land, and low cocoa price as key constraints to profitability of the smallholder sector (Curry et al., 2007). Addressing these challenges demands a holistic look at the entire value chain for cocoa, and the sources of livelihood for the farmers.

One of the challenges of the smallholder farmers has been their inability to maintain consistency in terms of quantity and quality of output over time. While this may be attributed to poor farming practices and failures in processing of cocoa beans, or the consequence of a lack of access to key inputs as highlighted earlier, infestation by the cocoa pod borer (CPB) has severely affected yield to the extent that many farms became unprofitable following infestation. This in turn has affected both the volume and quality of the beans produced.

Attempts are being made to raise yield of the smallholder cocoa sector. Support services in the form of technical assistance to raise yield and quality of beans produced are being extended by the exporters, the World Bank, and government agencies such as the Department of Agriculture and Livestock and the CBPNG. Donors, moreover, have been extending access to subsidised inputs including pruning equipment, new seedlings, pest control training, and financial assistance. The challenge is in maintaining this support until farms reach profitability.

Smallholders have historically grown a portfolio of crops, some for domestic consumption and others for sale. Cash crops have historically provided the income to purchase goods and services from the market, pay school fees of children, acquire capital equipment and consumer durables, and meet customary obligations such as contributions towards bride price and funerals. These crops have also supported families of growers taking up cacao farming for the first time while the trees mature. Harvesting of cocoa beans has varied depending on the need for cash and the price of alternative crops. Cash crops such as cocoa serve the role of deposits at a bank, meaning that these crops are harvested when in need of cash. But cash from the sale of cocoa is no different from alternate sources, thus alternate cash crops such as copra and fresh garden produce together with income generating activities like rearing of livestock and trade stores act as alternate sources of income for the smallholder farmer. Going forward, the prospect of cocoa could be enhanced with an objective analysis of the distribution of rents along the value chain.

Post-harvest quality control

The quality of dried beans rests on the wet beans being harvested when ripe, the fermentation and drying being done appropriately, and bagging and labelling being done correctly. Shortfalls at any and every stage of the value chain diminishes the quality of the finished product: the parlance used in the industry is that of 'subtraction', meaning that one can only reduce value as the product moves through the various stages of the value chain. The principal reasons for such subtraction are explained next.

A common complaint from both the traders and processors has been the supply of low-quality wet beans by farmers. The veracity of these complaints is difficult to establish, particularly when buyers of wet beans have an incentive to downplay the quality of the beans at the time of purchase. However, many traders operate in a single market, thus, the market is competitive to the extent that farmers have the choice regarding whom to sell to. Consequently, there must be some truth to the complaint regarding the inconsistency in the quality of beans

acquired from the smallholders. Smallholders, moreover, have acknowledged that the quality of their produce varies over time. They attribute this to several factors, but the principal reason given was the harvesting of unripe pods. On further enquiry, we were told during stakeholder consultation of the study that immature pods were harvested when there was an urgent need for cash. This problem could be addressed through better access to finance and secured through crop liens, thus obviating the need for premature harvests.

The quality of the dried beans is also affected during the processing stage. The lack of quality equipment and storage facilities, together with poor knowledge of processing can once again subtract from the quality of wet beans used. Regulatory standards are in place with the CBPNG having oversight, but this is not a substitute for quality equipment and appropriate techniques in processing of wet beans. Drying the fermented beans has been problematic, and particularly for smallholders. PNG cocoa as a brand has been tainted by Polycyclic Aromatic Hydrocarbons (PAH) contamination (i.e. smoke) which is associated with poor equipment and the use of wood fires for drying that most farmers resort to during dull/overcast weather conditions. The presence of such contaminants endangers the reputation of PNG as a producer of premium fine flavour cocoa for the global market (PHAMA, 2017; Zyzelewicz et al., 2017).

Traders ensuring quality

Inconsistent quality of dry bean exports has a knock-on effect on prices down the value chain as it affects PNG's reputation as a supplier of fine flavour cocoa. The exporters have an incentive to protect this brand, thus, they spend time and resources in inspecting and sorting out the beans before bagging and containerising them for export. Similarly, traders are vigilant with checks at the point of pickup, rejecting and/or heavily discounting beans that they deem as being of poor quality. If and when acquired, they sort and repackage their acquisitions for on selling to the exporters.

Transportation and storage of beans is an impost on the traders too. Poor transportation infrastructure, including impassable roads during the wet season, hampers flow through the various stages of the value chain. This, in turn, taxes the quality of the final product. Besides, the CBPNG lacks the resources to ensure compliance with the regulatory standards to protect branding of PNG cocoa as being fine flavour.

Costly exercise to export

Finally, the cost to export dry beans from PNG are high. This is the result of two forces: first, the high costs of doing business in PNG; and second, regulatory imposts on exporters. On the former, PNG is located far from Europe which is the major destination for its fine-flavour cocoa meaning that shipping costs are high. And on the whole, PNG is ranked as a nation with high costs of doing business – the World Bank 2020 ranking for PNG is 120 out of 190 nations in terms of the ease of doing business. Compounding the above are regulatory hurdles in the form of licencing requirements for exporters that makes entry of new businesses for export prohibitive. Furthermore, the cost of exporting cocoa out of the country could rise as recent report indicates that the export licence fee will be increased by 60 percent as part of reform to the Cocoa Act 1981 and Cocoa Regulation 1982 (Gare, 2019). To date, the revised Cocoa Act and Regulation is yet to be approved by the National Parliament to effect the proposal. The stringent licencing requirements have prohibited farmer cooperatives from venturing into exporting of their own cocoa produce.

Conclusions

Cocoa has had a lasting presence in PNG, having first being introduced in the late nineteenth Century by German traders. The crop continues to make a significant contribution to the economy. Total exports of dry cocoa beans in 2019 amounted to 28,995 tonnes, earning an income of K239 million. Cocoa is also a significant source of cash income for many households with preliminary estimates suggesting that nearly one in every eight resident depends on the growing and sale of cocoa beans for their livelihood.

Cocoa is grown in warm humid regions with frequent rainfall. The producers of cocoa beans are generally smallholders located in poor countries of Africa, Asia, and Latin America. PNG is not an exception in this regard as it is a nation with a per capita Gross National Income (GNI) of US\$3,686 (in 2018 at 2011 PPP prices) and an average life expectancy of 64.3 years, ranking 155th of 189 countries listed on the United Nation's *Human Development Report* for 2019. Some 99 percent of cocoa in PNG is grown by smallholders, many of whom survive on subsistence agriculture with the cash income earned from sale of cocoa beans used to pay for school fees, medicines, and similar goods purchased from the formal market.

Cocoa, however, is largely consumed in rich nations. It is a critical ingredient in cocoa powder, chocolates, and some of the flavoured liqueur. Dried cocoa beans are often imported by large multinationals from developing nations such as PNG for processing, marketing, and sale in rich countries. A frequent complaint has been that the growers of cocoa who reside in poor regions of the world do not benefit sufficiently from their labour. The smallholders growing cocoa in PNG are poor, but this does not necessarily imply that they are being short-changed in the sale of their cocoa.

The value chain analysis reported in this paper shows that the smallholder captures some 30 percent of the final free-on-board price of cocoa, the exporters collect another 16 percent, while the balance of 54 percent accrues to the processors and intermediaries who often are the same enterprise. The potential for rents accruing to the smallholder growers and the processors are limited by competition where entry and exit into these segments of the value chain are minimal. Exporters, however, require licenses and must have substantial amounts in capital reserves together with a track record of exporting dry beans of a minimum of 1,000 tonnes annually. These regulatory hurdles confer market power to the two exporters, but their margins at 16 percent compare favourably to similar enterprises abroad. We take the above as evidence of the fact that the processors and exporters of PNG cocoa are not making abnormally high profits.

The Government of Papua New Guinea has placed priority on the agriculture sector as the driver for broad-based growth and employment generation. Cocoa, given its significance in the economy, has a prominent role in raising income for the growers. The smallholder cocoa sector in Papua New Guinea is a prime case of farmers producing cocoa having low incomes even when they receive the bulk (i.e., more than 80 percent) of the export price. Hence, a key challenge for policymakers, and the Cocoa Board of Papua New Guinea (CBPNG) in particular, is to improve yield and quality so as to raise income of the growers of cocoa. This may mean increased employment and/or wages of those engaged in smallholder agriculture (Weinberger & Lumpkin, 2007). Our preliminary analysis suggests that much ground remains to be covered on both fronts.

In terms of recommendation for future research, the next steps should be an investigation into the causes of the low yield and poor quality of cocoa produced by the smallholder sector in PNG. This should entail a survey of the smallholders, and the collection of qualitative data from the exporters and government agencies with a view to suggesting interventions to address the deficiencies.

References

- Afoakwa, E.O., Paterson, A., & Fowler, M. (2007). Factors influencing rheological and textural qualities in chocolate—a review. *Trends in Food Science & Technology*, 18(6), 290-298.
- Aipi, B., Irau, T. and Aba, L.A. (2012). Supply response of cocoa in Papua New. Working Paper BPNG2012/02, Bank of Papua New Guinea.
- Asiedu-Darko, E. (2013). Agricultural extension delivery in Ghana: A case study of factors affecting it in Ashanti, Eastern and Northern regions of Ghana. *Journal of Agricultural Extension and Rural Development*, 5(2), 37-41.
- Banson, K.E., Nguyen, N.C., Bosch, O. J., & Nguyen, T.V. (2015). A systems thinking approach to address the complexity of agribusiness for sustainable development in Africa: a case study in Ghana. *Systems Research and Behavioral Science*, 32(6), 672-688.
- Bitzer, V., Glasbergen, P., & Leroy, P. (2012). Partnerships of a feather flock together? An analysis of the emergence of networks of partnerships in the global cocoa sector. *Global Networks*, 12(3), 355-374.
- Bolwig, S., Ponte, S., Du Toit, A., Riisgaard, L., & Halberg, N. (2010). Integrating poverty and environmental concerns into value-chain analysis: a conceptual framework. *Development Policy Review*, 28(2), 173-194.
- Bourke, R.M., & Harwood, T. (Eds.). (2009). *Food and agriculture in Papua New Guinea*. Canberra: ANU E Press, Australian National University.
- Cidell, J.L., & Alberts, H.C. (2006). Constructing quality: the multinational histories of chocolate. *Geoforum*, 37(6), 999-1007.
- Cocoa Board PNG. (2018). PNG Cocoa Board Statistics, Kokopo.
- Connell, J. (1997). *Papua New Guinea: The struggle for development*. London: Routledge.
- Curry, G., Koczberski, G., Omuru, E., & Nailina, R. (2007). *Farming or foraging? Household labour and livelihood strategies amongst smallholder cocoa growers in Papua New Guinea*. Perth Black Swan Press.
- Curry, G., Lummani, J., & Omuru, E. (2009). *Social and economic impacts of cocoa pod borer in East New Britain Province, Papua New Guinea. Strategies for restoring livelihoods*. Perth: Curtin University of Technology.
- Department of Foreign Affairs and Trade. (2017). *Papua New Guinea specialty cocoa. Technical Report # 107, prepared by AECOM Service Pty Limited, Australia*.
- Department of National Planning and Monitoring. (2010). *Papua New Guinea Development Strategy Plan, Government of PNG: Port Moresby*.
- Doherty, B., & Tranchell, S. (2005). *New thinking in international trade? A case study of The Day Chocolate Company. Sustainable Development*, 13(3), 166-176.
- Effendy, H.N., Setiawan, B. & Muhaimin, A.W. (2013). Characteristics of farmers and technical efficiency in cocoa farming at Sigi Regency-Indonesia with approach stochastic frontier production function. *Journal of Economics and Sustainable Development*, 4(14), 154-160.
- English, A. (2008). "Determinants of Liberian Farmgate Cocoa Prices." Master's Thesis, University of Tennessee. [hBps://trace.tennessee.edu/utk_gradthes/3642](https://trace.tennessee.edu/utk_gradthes/3642)
- Fitter, R., & Kaplinksy, R. (2001). Who gains from product rents as the coffee market becomes more differentiated? A value-chain analysis. *IDS bulletin*, 32(3), 69-82.
- Fleming, E. & Lummani, J. (2001). *Analysis of the technical efficiency of cocoa smallholders in the Gazelle*

- Peninsula, East New Britain Province. Occasional Paper 7, Understanding the Smallholder Cocoa and Coconut Sector in Papua New Guinea. PNG Cocoa and Coconut Research Institute/University of New England, Keravat and Armidale.
- Food and Agriculture Organisation of the United Nations Statistics Division. (2006a). Compendium of Food and Agriculture Indicators. Rome.
- Food and Agriculture Organisation of the United Nations Statistics Division (FAO). (2006b). Commodity Market Review 2007/8. Retrieved on 10th March 2020 from <http://www.fao.org/3/a1487e/a1487e00.htm>
- Gallo, P.J., Antolin-Lopez, R., & Montiel, I. (2018). Associative Sustainable Business Models: Cases in the bean-to-bar chocolate industry. *Journal of cleaner production*, 174, 905-916.
- Gare, C. (2019, April 4). Cocoa Board eyes rise in export licencing fee. *Post Courier*. Retrieved from <https://postcourier.com.pg/cocoa-board-eyes-rise-export-licencing-fee/>
- Gereffi, G., & Fernandez-Stark, K. (2016). Global value chain analysis: a primer.
- Govind, B. (2020). "Cocoa: A bittersweet supply chain". <https://www.visualcapitalist.com/cocoa-a-bittersweet-supply-chain/> ; accessed online on 29th October 2020.
- Hamrick, D., & Fernandez-Stark, K. (2018). *Belize in the cocoa-chocolate global value chain*. Retrieved from Duke Global Value Chains Center, U.S.A.
- International Cocoa Organisation (ICCO) (2012). *The World Cocoa Economy: Past and Present*. Retrieved on 10th March 2020 from: https://www.google.com/https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=10&cad=rja&uact=8&ved=2ahUKewiJpq_XmY_oAhXRzTgGHVsjADkQFjAJegQIAhAB&url=https%3A%2F%2Fwww.icco.org%2Fabout-us%2Finternational-cocoa-agreements%2Fdoc_download%2F442-the-world-cocoa-economy-past-and-present-26-july-2012.html&usg=AOvVaw2ZnO4KSOEUJq4mCgiOQX
- International Cocoa Organisation (ICCO) (2019). *What is Fine or Flavour Cocoa?* Retrieved on 16th September 2019 from: <https://www.icco.org/about-cocoa/fine-or-flavour-cocoa.html>
- International Institute of Sustainable Development. (2019). Global Market Report: Cocoa. Retrieved on 19 October 2021 from: <https://www.iisd.org/system/files/publications/ssi-global-market-report-cocoa.pdf>
- Kaplinsky, R. (2000). Globalisation and unequalisation: What can be learned from value chain analysis? *Journal of Development Studies*, 37(2), 117-146.
- Kaplinsky, R. (2004). Spreading the gains from globalization: what can be learned from value-chain analysis? *Problems of economic transition*, 47(2), 74-115.
- Kerua, W. (2017). Beyond the cocoa farm: A new look at farmers' livelihoods in Papua New Guinea (A thesis submitted to Charles Sturt University for the degree of Doctor of Philosophy)
- Lummani, J. and Nailina, R. (2001). A tri-annual survey results for cocoa and coconut smallholders in East New Britain Province, Occasional Paper 6, Understanding the Smallholder Cocoa and Coconut Sector in Papua New Guinea, PNG Cocoa and Coconut Research Institute/University of New England, Keravat and Armidale.
- McDougall, P. (2018). Boosting cocoa production through improved pest management. *Partners in Research for Development*, 14-15.
- Nelson, P., Michael, W., Berthelsen, S., Curry, G., Yinil, D., & Fidelis, C. (2011). *Nutritional status of cocoa in Papua New Guinea*. Canberra: Australian Centre for International Agricultural Research.
- Omuru, E. (2001). Estimates of Smallholder Cocoa and Copra Yield Profiles and Cost of Production in Papua New Guinea, Occasional Paper 3, PNG Cocoa and Coconut Research Institute/University of New

England, Keravat and Armidale.

- Omuru, E. and Fleming, E. (2001). Impact of location on the importance attached to accessibility and farm-gate prices by cocoa and copra producers, Occasional Paper 2, Understanding the Smallholder Cocoa and Coconut Sector in Papua New Guinea, PNG Cocoa and Coconut Research Institute/University of New England, Keravat and Armidale.
- Omuru, E., Nailina, R. and Fleming, E. (2001). A Socioeconomic Baseline Survey of Cocoa and Copra smallholders in East New Britain, Occasional Paper 1, Understanding the smallholder Cocoa and Coconut Sector in Papua New Guinea, PNG Cocoa and Coconut Research Institute/University of New England, Keravat and Armidale.
- Pacific Horticultural And Agricultural Market (PHAMA) (2017). Papua New Guinean Specialty Cocoa. Technical Report 107.
- Palinrungi, R. (2015). The institutional interests of upgrading agents in the Indonesian cocoa value chain, unpubl. PhD Thesis, University of Sydney .
- PNGETCS. (1987). Papua New Guinea export tree crop study: ACIAR/Queensland DPI/DAL/ Cocoa Board of PNG/ Copra Marketing Board of PNG.
- PNG Ministry of Agriculture and Livestock. (2007). *National Agricultural Development Plan 2007-2016*. Port Moresby: National Department of Agriculture and Livestock. Retrieved from <http://aciarc.gov.au/node/2406>.
- Saltini, R., Akkerman, R., & Frosch, S. (2013). Optimizing chocolate production through traceability: A review of the influence of farming practices on cocoa bean quality. *Food control*, 29(1), 167-187.
- Surentu, E. (2018). Factors affecting variation of total factor productivity in cocoa farming in the Central Sulawesi, Indonesia. *Australian Journal of Crop Science*, 12(4), 655.
- Tothmihaly, A., Ingram, V., & von Cramon-Taubadel, S. (2019). How can the environmental efficiency of Indonesian cocoa farms be increased?. *Ecological economics*, 158, 134-145.
- Tiffen, P. (2002). A chocolate-coated case for alternative international business models. *Development in practice*, 12(3-4), 383-397.
- Voice. (2020). Cocoa Barometer Consortium releases position paper on necessary farm gate prices for a living income in West African cocoa. Retrieved on 10th March 2020 from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjPmf-JqY_oAhV5wjgGHQ96DPIQFjAAegQIAxAB&url=https%3A%2F%2Fwww.voicenetwork.eu%2Fwp-content%2Fuploads%2F2020%2F01%2F200113-Necessary-Farm-Gate-Prices-for-a-Living-Income-Definitive.pdf&usq=AOvVaw0ocXMSgcR4JHw-35s_GHI9
- Voora, V., Bermudez, S., Larrea, C. (2019) Global Market Report: Cocoa. International Institute for Sustainable Development. Winnipeg.
- Weinberger, K., & Lumpkin, T.A. (2007). Diversification into horticulture and poverty reduction: a research agenda. *World Development*, 35(8), 1464-1480.
- World Bank Group (2014). Papua New Guinea: Restoring the Stream of Cocoa to Bougainville. Washington DC.
- World Bank Group. (2018). Household allocation and efficiency of time in Papua New Guinea. International Bank for Reconstruction and Development/The World Bank. Washington DC.
- Zyzelewicz, D., Oracz, J., Krysiak, W., Budryn, G., & Nebesny, E. (2017). Effects of various roasting conditions on acrylamide, acrolein, and polycyclic aromatic hydrocarbons content in cocoa bean and the derived chocolates. *Drying technology*, 35(3), 363-374.



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