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Claremont McKenna College

**Rural Development in Papua New Guinea:
Mining, Logging, Agriculture, and Alternatives**

Submitted to
William Ascher

By
TJ Askew

For
Senior Thesis in Environment, Economics, and Politics
Fall 2021 – Spring 2022
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Abstract

This thesis examines multiple approaches to providing rural, indigenous Papuans with improved social services and economic opportunities. Rural Papuans, who make up 80 percent of the population, face below average rates of nutrition, education, disease, crime, and other quality of life indicators. Due to location, land use rights, lack of infrastructure, and minimal access to economic markets, the PNG government has struggled to provide rural communities with basic social services. Historically, the development of resource extraction projects such as mining, logging, and agriculture have been the main strategies used to improve the livelihood of rural Papuans, with limited success. This thesis conducts an analysis of these resource extraction sectors, providing strategic and legislative recommendations to the PNG government on how to improve these projects. Additionally, this thesis outlines sustainable alternatives to resource extraction projects and potential pathways to their expansion.

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Chapter 1: Health, Education, & Safety

Papua New Guinea (PNG) has the third-highest proportion of rural citizens of any country, with over 80 percent of its citizens living in rural, forest communities, the vast majority of which of indigenous Papuans (World Bank 2020). When PNG became independent in 1975, 97 percent of the country's land was given to indigenous Papuans under customary ownership (Martin-Prevel 2013). Since this time, the PNG government has struggled to provide Papuans with quality education, health services, economic development, and protection of land use rights. This chapter will document some of the current problems facing indigenous Papuans today.

Health Services

The lack of access to health services such as medicine and clinics is one of the forefront problems facing New Guinean communities. Papuans face high rates of pneumonia, tuberculosis, gastrointestinal diseases, influenza, and malaria, which are among the leading causes of mortality, especially for small children (Britannica, 2019). A recent study estimated that 49 percent of male and 41 percent of female deaths in PNG are related to largely preventable diseases such as infection, malnutrition, neonatal mortality, and maternal mortality. In some provinces, preventable diseases account for over half the total deaths, serving as a barrier for these communities to improve economic and social structures (Kitur et al. 2019). PNG is also the country most affected by HIV in the Pacific Region, with five percent of its population possessing the virus (Riono and Challacombe 2020).

Many of the hospitals and clinics fighting to minimize these diseases are not government-run. Of the available health services, roughly half are provided by church

agencies, which may occasionally receive government funding. The availability of these services has declined in some rural areas since the 1980s, largely due to a lack of staff, equipment, and government aid (Kitur et al. 2019). Primary health care in rural communities remains inadequate, as the infant and maternal mortality rates are consistently above global and regional averages. On top of this, immunization rates are low, as distrust of government and outside aid sources often discourages communities from receiving vaccination when available (Jackson 2019).

As a percentage of rural/urban populations.	2000 Rural	2000 Urban	2015 Rural	2015 Urban
Drinking water estimates in PNG				
Basic	29	84	29	84
Limited >30 minute walk	1	4	1	4
Unimproved (not protected)	21	8	21	8
Surface	48	4	48	4
Improved water supplies (protected from contamination)				
Accessible on premises	16	43	16	43
Available when needed		80		80
Piped	13	71	13	71
Non piped	18	17	18	17
Sanitation estimates in PNG				
Basic	13	55	13	55
Limited (shared)	3	9	3	9
Unimproved (not protected)	70	32	70	32
Open defecation	14	4	14	4
Improved sanitation facilities excluding shared (protected from human contact)				
Wastewater treated	0	11	0	11
Latrines & other	11	14	11	14
Septic tanks	1	21	1	21
Sewer connections	1	20	1	20

Table 1: Access to water services and sanitation facilities. (WHO UNICEF 2017)

Access to clean water is another obstacle facing Papuans. In rural areas, under one-third of the population has dependable access to clean water (Table 1). In urban areas, this number rises to almost 90 percent, but with only 60 percent of these receiving

water pumped directly into their home (LandLinks, 2022). Improving these poor health conditions remains at the forefront of many Papuans' desires and needs.

Education

The development of PNG's education systems has been a long-standing challenge for government agencies, with recent administrations placing a priority on improving the broken system. Despite continual support from missionary and NGO organizations, who provide almost one-third of Papuan schools, PNG still has the lowest literacy rate in Oceania at 67 percent (Index Mundi 2022).

Before colonization, children were educated on important practical skills and cultural rituals by fellow clan members, often their parents. The first school was established in 1873 by the London Missionary Society to teach students to read and learn about Western ideas of morality and mortality. While the Universal Primary Education system established under British colonialism claimed to provide free primary school education for the youth, it struggled to deliver, providing only a select few with this education until 1981 (Borgen Project 2017). At this time, after PNG had gained independence, PNG's Tuition Fee Free (TFF) program was instituted, which promised free elementary, primary, and secondary schools for all students. While this seemed promising, the initiative has since failed three times, with the current administration attempting the program for the fourth time. Many see it as a political scheme rather than a serious commitment, as the lack of follow-through from government funds forces many schools to charge student fees. While the TFF program aims to cover school fees, it does nothing regarding classroom size, maintenance, and teaching support, meaning classrooms are often left under-resourced and understaffed. These factors heavily

contribute to the country maintaining the lowest net enrollment rate in the Asia-Pacific region at 63 percent.

In urban areas, primary schools provide six years of free education taught in English, the national language, until the age of 12. However, attendance is not mandatory, resulting in 36 percent of boys and 44 percent of girls leaving before completing primary school (World Vision 2022). Those who do complete must pass a national exam to continue to secondary school or seventh grade. Only around 35 percent of students who complete sixth grade will continue to seventh, largely due to the lack of exposure to affordable and accessible secondary schools for much of the population (State University 2022). While the Papuan government has emphasized improving its education systems, it still has large strides to take to ensure a quality education for its youth.

While the failure of the government to establish effective education systems has played a large role in the education struggle, some of the country's natural circumstances complexify the process of providing young Papuans with education. The outspread nature of many Papuans' living situations makes it difficult to establish schools that can cater to large groups. This forces some rural families to send their children to boarding schools, which are often more expensive.

Today, NGOs and religious institutions such as UNICEF are trying to change the outlook on education in PNG, providing many urban schools with relevant curricula and teacher training. On top of that, these organizations are pushing for better access to education for girls, who are ten percent less likely than boys to go to primary school, and 25 percent less likely for secondary school. While the education system in PNG has a

long way to go, these current initiatives show that progress is being made (State University, 2022).

Crime and Safety

The proliferation of both violent and non-violent crimes has led to PNG harboring one of the highest crime rates in the world. Crime is most potent in and around major cities (OSAC). While the scarcity and underreporting of national-level data on crime and safety statistics limits the quantifiable impact crime has on the average Papuan, it is widely believed to be one of the leading causes of the economic struggles PNG has faced.

The major cities of Port Moresby, Lae, and Mount Hagen are known for the presence of gangs involved in carjacking, theft, breaking, domestic violence, sexual assault, and murder (Safe Travel, 2022). The national victimization surveys estimated a murder rate of 323 murders per 100,000 (World Bank 2014). This starkly contrasts the government-reported murder rate of 33, showing either a lack of reporting or a lack of successful data collection on a national level. For example, the 2005 victimization survey conducted in the city of Lae estimated that only 2.3 percent of all crime documented by victimization surveys was reported to the police. While victimization surveys do tend to be overestimated when compared to reported murders, a true crime rate anywhere near the victimization survey data would solidify PNG, especially in urban areas, as one of the most dangerous countries on earth.

Additionally, violence against women is reported to be one of the highest in the world. Sixty-eight percent or more than 2.3 million women in PNG have experienced violence, with one-third, or 1.13 million women, being subjected to rape (UN-Women 2022).

Urbanization

One variable that may mutually reinforce these problems facing urban communities is the continual growth of the urban population. The 2011 census found that 40 percent of the urban population were not born there (Saverimuttu and Cochran 2018). Since then, the percentage of the population in urban areas has continually risen, with current levels estimated at 13.4 percent (Statista 2020). This, along with PNG's annual population growth rate of 2.7 percent, means more people are inhabiting urban areas than ever before (UN-Habitat 2020). With a lack of quality infrastructures such as roads, drainage, and sanitation systems, urban areas are characterized by poor living conditions. Most urban areas also suffer from complex housing crises. As most land is owned by traditional clans, open spaces on traditional land are rarely translated into infrastructure that could house the growing urban population.

With a lack of large-scale urban infrastructure projects, the urban job opportunities have not expanded to support the ongoing growth of the urban population. According to World Bank statistics in 2020, only 45 percent of Papuans engaged in any activity to produce goods or provide services for pay or profit (World Bank 2022). On top of this, some of these working individuals make their living through involvement in gangs, robbery, or illegal markets such as drugs. With little work, housing, or social infrastructure to support the growing urban population, conflict over property rights is common in urban areas, acting as an obstacle to social and economic growth.

Chapter 2: Economic Development & User Rights

Economy

With a GDP of \$2,600, falling below its neighboring countries of the Philippines (\$3,300) and Indonesia (\$3,900), PNG should classify as a middle-income country (World Bank 2020). However, this statistic is extremely misleading in terms of the incomes of the average Papuans, as it includes earnings from mining and other extractive industries, which the average Papuan rarely receives monetary benefits from. In reality, 40 percent of the population lives under the established United Nations poverty line of \$1.90 per day (United Nations 2022; World Report 2020). For those living in rural jungle areas, living conditions are often even poorer, making rural development a leading goal for the PNG government. About 50 percent of PNG citizens are economically active, with only about one-fifth of these holding wage-earning jobs (Thompson 1986). Because of this, much of the population is able to shift between economic activities.

Rural Living Conditions

As previously mentioned, access to health services in many regions of PNG is poor. Diseases such as pneumonia, tuberculosis, gastrointestinal diseases, influenza, and malaria are among the leading causes of mortality, especially for small children (Jackson, 2019). Almost 50 percent of all deaths in PNG are related to largely preventable causes such as infection, maternal mortality, and malnutrition.

For the average rural Papuan, conditions are even worse. PNG has the largest rural population share in the East Asia and Pacific region, with 80 percent (6.4 million) of the population living in rural jungle communities (Schmidt, Mueller, and Rosenbach 2020). Health infrastructure, immunization distrust, disease rates, and infant and maternal

mortality rates are all higher in rural communities than in urban ones. Sanitation services and clean drinking water are also a problem throughout rural areas, with only 33 percent of rural Papuans having access to consistent sanitation, compared to the 88 percent of the urban population. Similarly, while 56 percent of the urban population has access to safely managed drinking water services, only 19 percent of rural populations do. This disparity illuminates the stark difference between the access to basic health services in urban and rural areas (PNG Statistics Office 2019).

On top of health services, rural PNG citizens often face trouble accessing sustainable food and clean water. With 77 percent of rural households owning agricultural land, many families rely heavily on their agriculture to provide food. When environmental changes such as droughts hit, many of these families have no alternative source of food, as seen by the 58 percent of rural populations likely to experience moderate to severe food insecurities at least once in an average year (PNG Statistics Office 2019). In 2015, when a powerful El Niño hit the Pacific, no country was affected more than PNG. With below-average rain for over a year, over one-third of all Papuans suffered the critical effects of the drought. A projected 2.1 million people in the highlands region, where the majority of the rural population live, saw their food production critically decrease (Oxfam 2016). With many gardens and creeks dried up and not producing anymore, communities faced high rates of malnutrition, diarrhea, dysentery, and typhoid. Through government, foreign, and NGO aid, some of these communities had emergency resources such as rice, water purification tablets, and soap airlifted to them, saving further disaster.

Of the few available health services in rural areas, more than half are provided by religious agencies, which are often subsidized through annual Church Health Services Operational Grants from the National Department of Health (WHO 2018). To improve rural conditions, the PNG government is partnering with the United Nations to attempt to implement the UN Development Assistance Framework. In partnership with organizations such as WHO, UNICEF, and UNFPA, heavily funded by the Australian government's Department of Foreign Affairs and Trade, this program focuses on four main pillars: People, Prosperity, Planet, and Peace (UN PNG 2022). The "People" focus centers around providing marginalized communities with quality and equitable services, food security, and social protection. "Prosperity" focus includes growing the economy to where each citizen sees the benefits of economic growth. The "Planet" focus reiterates PNG's focus on sustainably managing environmental resources and the risks emanating from climate change. The "Peace" focus emphasizes an improvement in transparency and accountability in government and non-government institutions in PNG. Through all of this, the PNG government's main target is to provide PNG's large rural population with adequate health services to improve their quality of life.

Detriments to Rural Development

The main reason rural communities face these difficult living conditions is the complexity of providing aid and spurring economic development in these areas. Serving PNG's rural population has been a constant struggle for government administrations since PNG's independence in 1975.

The largest barrier to providing government aid to PNG's rural population is location. As most of PNG's rural population live in widespread communities located in

dense rainforest, the infrastructure required to develop social services is expensive. For example, building a road to a rural community in most areas of PNG requires the clearing of dense rainforest, the construction of bridges, and the approval of local clans to build on their land. The comparatively high costs of both infrastructure resources and transportation services further discourage the development of rural infrastructure. With urban communities facing their own challenges, which often have more feasible solutions, the services the government provides to rural Papuans are limited and often struggle to meet remote communities' demand for government services.

Additionally, even if services such as roads were developed, the profitability of many economic activities connected to urban centers is limited for rural communities. As urban Papuans do not have to pay as high of transportation costs as rural communities, they can often provide goods at lower prices, potentially limiting the benefits rural communities receive from selling their goods in urban areas (Anderson and Parker 2004).

Another barrier to rural development is criminal activity. The insecurity generated by criminal activity increases the risk rural communities face in selling their goods locally and in urban areas. With the most frequently reported crimes in PNG being robbery and assault, business owners are often at threat of robbery when traveling with their goods. This threat is apparent in both rural and urban areas, as police presence in rural areas is limited and crime in urban areas is so common that policemen have trouble responding to every report. When rural Papuans travel to cities to sell their goods (gold, agriculture products, carvings) it is common for them to be targets of robbery by locals. This is because rural villagers often are carrying all their valuable goods and do not have

the support network in urban areas to protect them against these attacks. This cycle is a further detriment to rural development in PNG.

User Rights

Despite these barriers, spurring economic development is necessary to improve the services rural communities receive. To bypass some of these barriers, some indigenous Papuans partner with outside firms to establish self-reliant projects within their rural community. To accomplish this, both the PNG government and the firm must navigate PNG's unique land-use rights.

Because PNG's constitution awarded 97 percent of the land to Papuan clans, neither the government nor foreign agencies can legally obtain land-use rights without consent from the clan. In principle, for governmental agencies or private corporations to use these lands, they need a contract agreed upon by key members of the applicable clan, called a Customary Land Deal (Filer 2019). For private companies, the land originally distributed to clans is only valid for leasing, and not buying. Once the land deal is agreed upon between the local community, the government, and the firm, the parties must file an Ownership Title through the Lands Department. In some areas, if the PNG government plans to be a key stakeholder in an extraction project, the government is legally allowed to buy land from clans, acting as a middleman, to lease the land to private companies directly. In addition, the system of land ownership forbids land swapping or sales by individuals, as the land is communally owned unless sold to the government. This structure gives clans in PNG much more legal power surrounding natural resource projects than in many other developing countries, where governments may force indigenous groups to migrate out of resource-rich areas for resource extraction projects.

By negotiating the working standards, environmental standards, monetary compensation, and community development projects, indigenous Papuans have some control over how their land is used. However, there are often large discrepancies between the rights indigenous Papuans receive on paper versus reality, as government corruption and lack of oversight often allow extraction companies to exploit indigenous Papuans for their land (Filer 2019).

Historically, individuals on both sides of the negotiation procedure have tried to bypass this process through unlawful measures. The most common way international companies have historically accomplished this is through incentivizing government officials through bribes. Corruption is relatively common within the PNG government, leading to Transparency International's 2021 Corruption Index ranking PNG 124th of 180 countries in their corruption perception index. By bribing government agencies to look the other way, these companies may be able to disregard aspects of their Customary Land Deals, expanding their user rights to areas not included in land deals or receiving government permits without community consent. On these occasions, rural communities often lack the resources geographically, monetarily, and educationally, to challenge these companies in court. One example of this was exposed in 2021 by undercover journalists for the British watchdog group Global Witness. In their conversation, executives from East New Britain Resources Groups (ENB), one of the largest oil palm and logging firms in PNG, described how the company bribes the minister, secretary, and chairman of the National Forest Board with payments between US \$14,000 and \$28,000 to provide illegal logging permits and to look the other way during operations (Mongabay 2021). On top of this, the executives described strategies for evading taxes within PNG, as well as ENB's

employment of a special police unit to beat up villagers who opposed their logging and agriculture operations.

While the vast majority of illegal business within PNG is conducted by foreign companies and government officials, clan members have also attempted to hijack the system to their benefit. Companies have been known to make deals with single clan members, paying them handsome sums of money in exchange for “land rights” to use their traditional land. These clan members, who have often left their tribes to live in coastal cities, claim to be singular owners of their clan land. These individuals sign contracts handing over land rights for the next 50 years. Meanwhile, when the companies arrive claiming ownership over the land, local communities do not know of the transaction. In one investigation, ExxonMobil claimed that just 47 people across multiple clans in the nation’s capital, Port Moresby, signed over land rights to part of an area used for a US \$19 billion natural gas plant (Barrett and Westbrook 2019). Through this manipulation, external companies attain illegal access to Papua New Guinea’s natural resources, destroying local communities’ way of life while the government often misses out on economic growth opportunities. While the rights outlined in PNG’s constitution afford indigenous Papuans powerful user rights, the government must improve its efforts to protect these rights.

WanTok Culture and Clan Relations

Understanding PNG’s social environment, established norms, and motivations of the average Papuan is vital if one hopes to improve rural development through social and economic levers. In much of PNG, the social structure is built around tribes and clans. Within PNG, there are over 300 different tribes with populations ranging from 300 to

300,000 (Paget 2020). Within these tribes, social and cultural relationships are based on the 'WanTok' system, through which family and clan members are seen as a unit and are expected to support each other with little question. This creates a safety net for families in times of crisis, minimizing the effects of natural disasters such as droughts. However, these mutual-benefit expectations are not just reserved for critical situations. In practice, this means that a person who owns a business often has the responsibility to provide extended family members with discounts and cash allowances, if requested.

In PNG, an individual's most important kin relational group is their patrilineal and matrilineal lineages and clans. However, clan members do not necessarily live on clan land, as women often marry outside of their clan and ambitious youth may move far from their ancestral territories to chase better employment in urban centers. All the members of a clan, however, are expected to participate in clan affairs, contributing to bride prices, and helping with initiation and mortuary ceremonies. While clans, or WanToks, are tight-knit groups, people can join other clans, allying themselves with their wives' clans or being adopted as youths. One's status in the clan, as well as one's share of resources, is largely based on the contribution one makes to the clan. For intra-clan relations, etiquette centers on reciprocity and being hospitable to guests and unexpected clan visitors (Jackson 2019). This allows clan connections and land access to act as social security for members living in towns, most of whom actively engage in kin group affairs to maintain the option of rural living.

Meanwhile, there is a rising generation of second or third-generation townspeople who may feel a growing sense of national loyalty rather than clan loyalty (Jackson 2019). This has led to intergenerational tension related to the stresses of economic and cultural

urbanization. One aspect of rural society that largely affects clan relations is the development of education systems and government projects in rural areas. One way these projects are initiated is by requests to government and non-profit agencies from rural communities. Once this happens, the government will often send in officials to fill out a community report, outlining population size, income sources, health and education services available, access to urban markets, and other information about the community. If the community is large and accessible enough, the government then sends in an official of education to assess the applicability of implementing a school in the area (Sam 2022).

These schools are normally highly coveted by rural communities hoping to gain access to education that can not only raise social class when traveling to other regions but can lead to better employment opportunities. Because rural clans and villages can be small, it can be beneficial for multiple clans to unite in their requests for aid, missionaries, and specifically education. This can either minimize or ignite inter-clan conflicts. On one hand, this increases the interactions between clans, increasing the potential for quarrels. If this is the case, government aid can be removed from the region due to the danger of violence and infrastructure loss in the area. If clans can put aside historical disputes and focus on the importance of additional resources to their communities, they can receive the benefits of education and other government aid such as income-generating partnerships with corporations.

One example of this is the collaboration of the Nakui and Iteri tribes in the East Sepik, where regional education officials recently conducted an exploratory trip to evaluate the applicability of a school in the area. Village leaders came together and conducted rituals presenting cultural aspects of the community while expressing the

clans' needs in a school using the trade language Tok Pisin. Following the presentation, the Minister of Education for the Sepik Region approved the implementation of a school in the area.

While inter-clan collaboration such as this may be historically frowned upon, this transformation of WanTok values and interactions shows these norms are not rigid but can be adapted to different situations to benefit indigenous communities.

Religion and Missions

Outside of tribal relations, religion is one aspect of PNG society that impacts Papuans' daily lives. Religion in PNG has been largely impacted by international missionary organizations. Outside of spiritual services, these organizations also provide access to health services, education, and manufactured goods for many rural Papuans. Today, 96 percent of Papuans identify as Christian. Within Christianity, 32 percent identify as Catholic, 12 percent identify as Anglican, and 11 percent identify with the Uniting Church in Australia (Jackson 2019). To understand the role religion and missions play in PNG today, it is important to look back at the history of missions in PNG.

The first Catholic missionaries landed in PNG in the 1860s, developing four main centers by the early 1900s. With Germany holding control of the Solomon Islands, German Catholic missionaries spread to PNG. There, they became the first missionaries to venture inland through PNG's difficult terrain (Licas News 2021). Over time, they built schools, churches, roads, and hospitals, learning the languages and customs of the people. While the majority of relations between these missionaries and local Papuans were peaceful, some opposed the missions and the change they brought. In 1904, ten

missionaries and seven local Christians in a mission near the Baining Mountains were killed by locals.

Missions were heavily affected by World War I, with many missionaries returning home due to military and social unrest in the area. After Australia was granted control over PNG in 1920, a wider variety of missions began within PNG, with Seventh Day Adventists, Catholics, Evangelicals, and Methodists sending missionaries across the island (Licas News 2021). Mission work continued to grow throughout the twentieth century, venturing into more remote villages, many of which requested missionaries, which may be due to the material and technological benefits that often accompanied them.

Despite this, differences between traditional and Christian beliefs have led to both intra-tribal conflicts and tension between tribal members and missionaries. One example of this is arranged marriages that include bride prices. Under this tradition, individuals within a clan may arrange for one of their female relatives to be wed to an individual within a neighboring tribe, receiving back a bride price that often includes money, livestock, and other goods, with the couple often not meeting before marriage (Cultural Atlas 2022). While this act encourages inter-tribal relations and minimizes intra-clan marriages risking genetic inbreeding, it also extremely limits women's ability to choose their husbands. While this process can be successful, women can begin to be seen as property, especially within clans where polygamy is practiced. Because many mission groups encourage female empowerment, more and more women attempt to sabotage this process if they feel unsafe around their new husbands. They may accomplish this by fleeing from their new village or threatening suicide to break their planned partnership

goods. These actions have created a divide between older and younger generations, with clan elders sometimes using verbal and physical assault to coerce compliance. Seeing local missionaries as partially responsible for this, missions and clan relationships can become damaged in the process (Cultural Atlas 2022). Today, most churches in urban churches are led by indigenous Papuans, reducing the influence missions have on the average Papuan.

Chapter 3: Natural Resource Extraction Projects

One way government officials have attempted to stimulate rural development and increase national earnings is through natural resource extraction projects. These projects, if done right, have the potential to spur economic growth where business opportunities are limited. This in turn creates the opportunity for local communities to gain greater access to income-generative avenues, as well as social services and new technologies that could improve their quality of life.

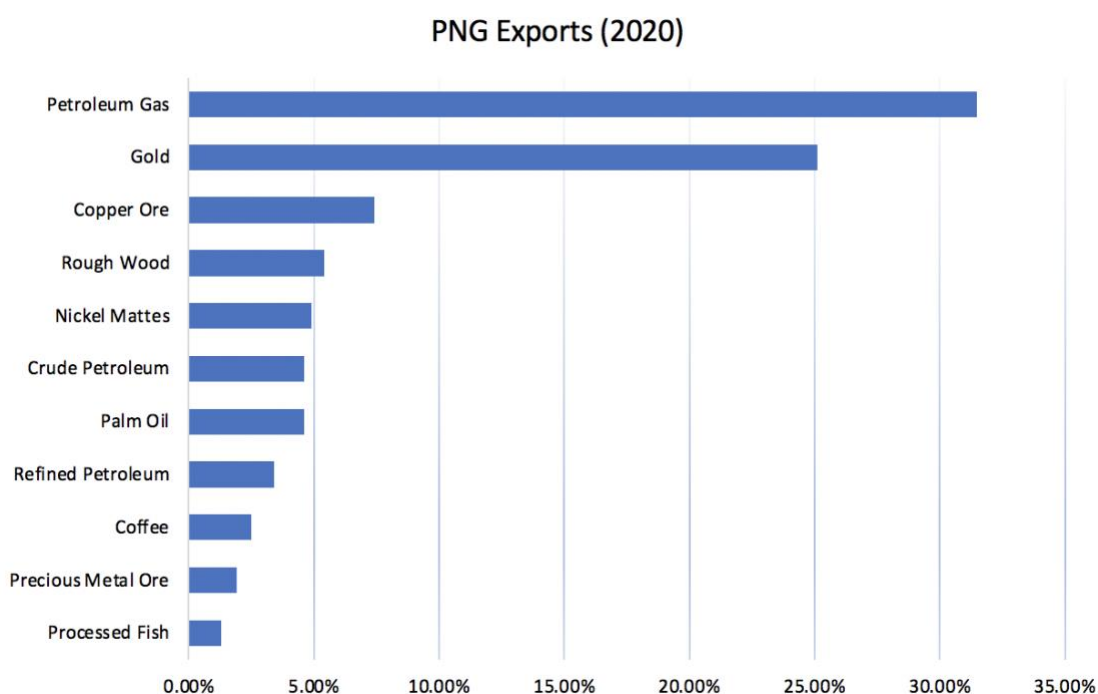


Figure 1: PNG's Exports by Percent for 2020 (OEC 2020)

PNG's economy is largely dominated by three sectors: agriculture, fishing, and natural resource extraction. Commercial agriculture and fishing employ the majority of the formal labor force in PNG and are largely concentrated near coastal regions. Despite this, the fishing industry accounted for just 2.5 percent of PNG's exports in 2020, totaling US \$232 million (OEC 2020). The natural resource extraction sector, which is focused on

both logging and the extraction of minerals such as copper, gold, and silver, accounts for the majority of exports and GDP. These projects include petroleum gas, crude petroleum, nickel, copper ore, and gold, and often take place in rural jungle regions where mineral concentrations are high but the established infrastructure is sparse. This section will focus on the benefits and risks of three main categories of projects that could be utilized to spur economic growth in rural PNG: logging, mining, and agriculture.

Logging

PNG has the 14th largest continuous area of tropical rainforest in the world. With 91 percent of its forest still considered a primary forest, it is considered one of the most intact forest ecosystems in the world (Forest Legality 2022; Conserve Energy Future 2022). Estimates of forest coverage range between 32 and 36 million hectares of forest, of which around 15 million are currently assessed as being accessible for log harvesting. Initial studies estimate this area contains approximately 500 million cubic meters of commercially valuable timber, valued at US \$100 billion (SGS 2021). The growing global demand for lumber makes logging one route the government and local communities can take to improve social structures and quality of life (Nepal, Johnston, and Ganguly 2021). However, these forests have environmental and cultural importance as well. On top of holding more than 2,000 tree species and 11,000 vascular plant species, with over 32 percent of PNG's total landmass being richly biodiverse tropical rainforest, local communities cherish these forests, using them for hunting, gathering, and spirituality.

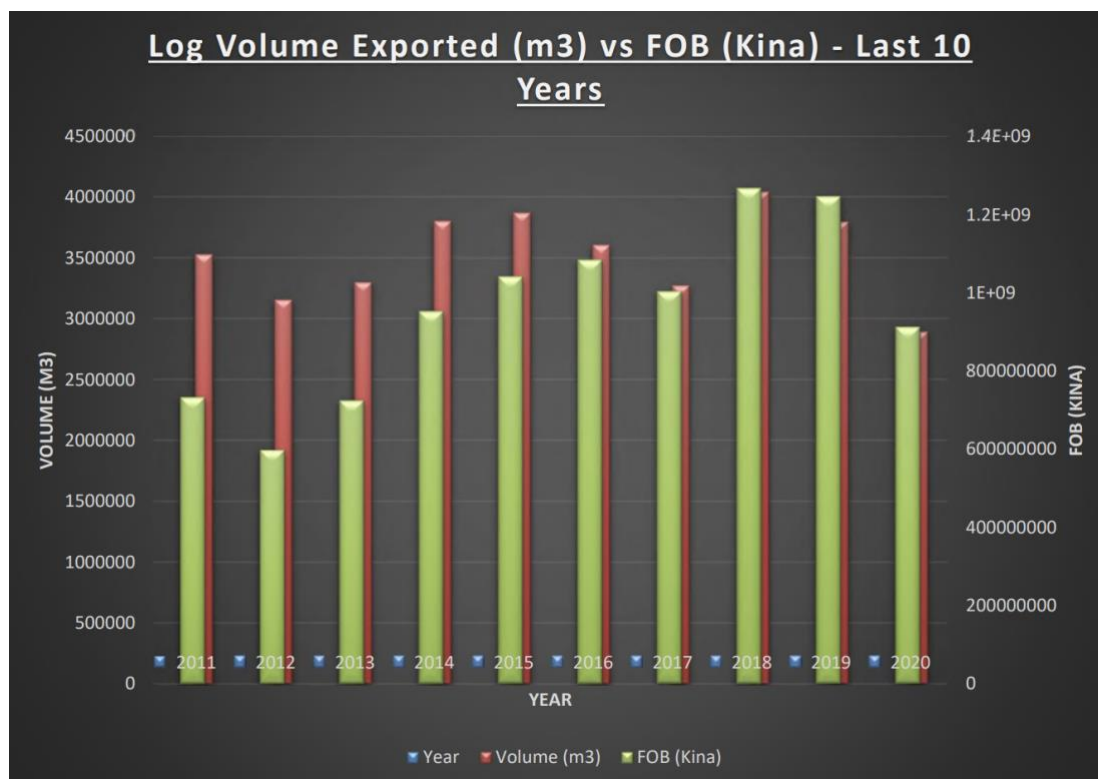


Figure 2: Volume and Revenue of Log Exports by Year (SGS 2021)

While deforestation may not be as widespread in PNG as in some other forest-heavy countries, it is continually growing. PNG has substantial timber exports, providing many South-East Asian countries with consistent non-coniferous logging imports since the 1980s. In 2020, over 2.8 million cubic meters of logs were exported from PNG, valued at over US \$156 million (SGS 2021 pg. 16, OEC 2020). This amount represents an estimated six percent of total non-coniferous log exports from all countries, making it the third-largest exporter of non-coniferous logs in 2020 and the largest exporter of tropical logs (Act Now! 2021). Between 2009 and 2019, PNG exported an estimated 21 percent of the world's non-coniferous logs. China was the largest importer of Papuan timber, taking an estimated 65 percent of exports in 2020 (SGS 2021, OEC 2020). Due to

the lack of infrastructure and high costs of treatment within PNG's border, 74 percent of logs are exported as roundwood and processed abroad by foreign firms (ITTO, 2015).

All legally exported timber is registered and inspected by the SGS, a Swiss-based independent log export auditor with more than 1,000 offices worldwide. SGS partners with the PNG Forestry Authority to monitor logging exports and publicly publish annual logging statistics.

**Log Exports Monthly Summary for 2020:
Volumes (m3), FOB Values (USD and Kina) and
Duty Payable (Kina)**

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Month	Volume (m3)	Value FOB (USD)	Value FOB (K)	Duty (K) Payable	Levy (K) Payable
January	264,374	23,567,007	78,318,324	34,705,011	2,051,723
February	241,947	23,296,577	77,420,058	35,870,448	1,912,983
March	250,512	23,649,975	78,811,446	35,863,442	2,001,617
April	210,640	17,083,427	57,292,284	25,041,866	1,676,381
May	233,143	23,673,744	79,555,493	37,042,635	1,865,145
June	289,566	23,807,721	80,282,516	32,267,512	2,140,164
July	210,922	23,113,119	78,203,108	36,448,642	1,687,374
August	196,475	16,164,431	54,778,091	21,576,025	1,469,985
September	139,533	13,719,535	46,746,704	20,064,885	1,051,727
October	310,781	30,495,280	103,920,185	46,082,239	2,473,815
November	332,400	26,900,219	91,797,691	37,571,057	2,600,561
December	210,841	24,682,016	84,460,429	38,366,642	1,633,011
Year to Date	2,891,135	270,153,051	911,586,330	400,900,404	22,564,486

Table 2: 2020 Monthly Summary of Logging Exports and Revenues (SGS 2021)

History of Logging

A number of critical policies have shaped the landscape of the timber industry in PNG. The first was the Private Dealings Act of 1971, which allowed foreign timber firms to bypass governmental regulation and deal directly with Forest Resource Owners (FROs) (Scudder, Baynes, and Herbohn 2019). This often forced less educated and inexperienced local landowners to bargain without assistance from government agents. This allowed foreign firms well versed in negotiation tactics to exploit FROs for inequitable prices, as well as minimized the regulation these firms faced regarding land boundaries, quotas, and taxes. These dangers led to Parliament passing the new Forest Policy and Forestry Act in 1991. This Act prioritized proper protection and management of PNG's forest resources while still encouraging economic development through the use of forest resources such as timber (Filer 1997). It also repealed the Private Dealing Act of 1971, requiring the Papua New Guinea Forest Authority to lease land use rights for logging from local FROs for periods of 40 years. The Forest Authority would then allocate the land to large logging companies via Timber Permits. Currently, FROs and foreign companies do not need Timber Permits for small-scale projects under one year or 5,000 cubic meters of timber, but timber from these projects must be sold domestically. Ideally, this allows the government to give local FROs equitable timber prices while minimizing illegal logging and exportation. However, corruption within the permit allocation process has protected illegal logging operations.

Large-Scale Forestry Industry

The vast majority of logging in Papua New Guinea is conducted by foreign firms. Roughly 43 logging companies are currently operating in PNG (SGS 2021; Act Now!

2021). Most of these companies come from Malaysia and fall under one large Malaysian conglomerate that is responsible for around 45 percent of all logging exports in PNG. Of all exported logs, 83 percent are rainforest veneer logs, while low-grade log exports and plantation account for 15 and two percent of market exports, respectively.



Figure 3: Papuans Timber being Transported via Riverway (The Interpreter, 2016)

When companies export logs, they must pay both export duties and taxes via a progressive tariff rate based on the market value of the logs (PNGC 2012; Lawson, 2014). The tariff rate for log exports varies but averages around US \$10 per cubic meter. On average, PNG earns around US \$176 million from taxes and levies each year, totaling about 42 percent of the log export revenues (Adam 2008). The PNG government uses this revenue to provide a variety of public services; infrastructure and business development for the provincial and local-level government (45 percent); reforestation and monitoring (17 percent); administrative expenses (16 percent); education (11 percent); home

construction (6 percent); and spiritual activities (6 percent) (PNGFA 2018; Scudder, Baynes, and Herbohn 2019).

FRO Royalties

Resource rents from timber harvest can be a vital source of income for rural communities in Papua New Guinea with little access to other income opportunities. This income can improve access to infrastructure, health services, education, and quality food sources. To receive this revenue, communities must sacrifice areas of forest that hold both practical and cultural importance. Opening up local forests to logging sacrifices land that is likely used for agriculture, hunting, and homes. For this decision to be beneficial, these communities must be sure these payments are large enough to at least counteract these losses and support basic living necessities. Therefore, FROs must receive equitable payment for the concessions they provide to the PNG government and foreign logging firms.

Historically, these communities receive small fractions of the logs' actual value, limiting their ability to improve their quality of life and develop sustainable services in their community. In PNG, timber royalties are paid to local communities using a fixed rate per cubic meter of timber that varies by species (Scudder, Baynes, and Herbohn 2019a). The government collects these levies and redistributes payments to FROs. Depending on the species, FROs receive between US \$3.89 and \$13.63 of revenue. Because the fixed rate is rarely changed (only once between 1991 and 2017), inflation decreases the value of payments FROs receive per cubic meter of timber. Between 1991 and 2017, the real value of royalties received by FROs decreased by between 32 and 66 percent due to the fixed-rate system, meaning FROs often receive under-market value

prices for their timber. From 2007 to 2017, PNG's indigenous FROs received an average of just 6 percent of the market value of the logs harvested on their land. By comparison, the PNG government received an average of 42.3 percent of market value from levies, while logging companies received 51.6 percent for their work. FROs received on average only \$6.03 in royalty payment per cubic meter of timber harvested on their land.

Comparing this to the \$41.78 and \$50.44 per cubic meter the PNG government and logging companies received, respectfully shows the large difference between the value FROs receive compared to what the PNG government and logging companies receive.

While FROs in other tropical developing countries have also received inequitable shares of lumber revenue, some Melanesian countries have taken legislative steps to ensure FROs receive their share. In Fiji, the Forestry Bill requires the review of timber royalty rates every five years, with new rates based on discussions between industry leaders, government officials, and outside consultants (Scudder, Baynes, and Herbohn 2019a). The Solomon Islands Forests Bill (SIFB) requires timber royalties for FROs to, "be the greater of either 10% of the determined timber value or the amount fixed by the Forest Commissioner" (The Forests Bill 2004). To ensure companies do not manipulate their timber's value, the timber value is estimated using world prices rather than the actual sale price of the timber.

By calculating royalty payments through a percentage of market value, rather than a fixed rate system, the real value of royalties FROs receive would not be affected by inflation. If from 2007 to 2017 royalty payments had been made in the form of 8 to 20 percent of the market value of lumber, FROs in PNG would have received between US \$2.6 and \$6.6 million annually (Scudder, Baynes, and Herbohn 2019a). Additionally, the

use of greater public participation in the allocation of timber revenues could lead to a more equitable distribution of resources, potentially providing FROs with enough income to not just get by but to invest in alternative revenue-generating activities.

One unintended consequence of FROs receiving low royalty payments and poor policy enforcement of logging permits by the PNG government is the growth of small-scale illegal logging operations. Because the PNG Forestry Department does not have the resources to investigate and regulate these operations, little is known about the extent of small-scale illegal logging in Papua New Guinea. Looking for alternative ways to make money, some Papuans attempt to harvest their logs or participate in small-scale forestry projects.

Small-Scale Forestry Projects

To avoid many of the risks that come with dealing with large-scale logging and partnering with foreign firms, many within PNG have championed the growth of small-scale forestry projects operated by indigenous Papuans. In theory, this would give local communities autonomy over lumber production, while still encouraging economic development in the area. Starting in the 1990s, six organizations attempted this strategy, utilizing an eco-forestry approach to logging focused on the use of selective logging and portable sawmills (Scudder, Baynes, and Herbohn 2019b). The lumber produced would be sold both locally and internationally as sustainable lumber certified by Forest Stewardship Council (FSC) principles. These projects received both government subsidies and donor funding to minimize risk and encourage participation for local communities.

Once production started, these projects struggled to make a profit. Each of the six organizations failed to develop self-reliant and financially viable models for small-scale indigenous logging production, with production ceasing once donor funding ended. On top of this, the projects struggled to produce lumber at the quality and quantity of other suppliers, which led to buyers ultimately refusing to purchase from these indigenous producers. Additionally, the indigenous-produced logs failed to uphold the FSC sustainability standards, ultimately losing their FSC certification, which reduced the prices indigenous Papuans receive for their timber (Scudder, Baynes, and Herbohn 2019b).

While these examples highlight some of the difficulties that accompany the expansion of logging projects focused on ecological sustainability and indigenous empowerment, it should not discourage the exploration of this sector. Instead, future projects attempting similar goals of indigenous sovereignty should adjust the methods of these projects to encourage better results. One way this is possible is by shifting the market focus of these projects from the global market to the less competitive domestic one. Within larger tribes, there is a sustainable market for lumber to support infrastructure growth.

Illegal Forestry

While SGS has claimed that there is little evidence of illegal logging or log smuggling, some independent reviews have found different results. One reason for this may be SGS's surveillance process. While SGS works to ensure all logging exports are declared and have a legal Export Permit and License, they do little to monitor the logging process before exportation (Timber Trade 2022). The SGS system only tracks logs back

to the project destination, not to individual stumps. This limits the government's ability to validate whether the log was harvested legally within permit boundaries. The system also does not involve a background check on the legality of the permits or licenses, as there is a history of falsified permits within PNG. This lack of surveillance opens the door for logging companies to expand beyond permitted areas into indigenous forests, risking the livelihood of indigenous Papuan communities and the ecosystems they interact with.

In 2006, the World Bank estimated that up to 70 percent of logs exported from PNG could be illegal (World Bank, 2006). Other reviews commissioned by the government and surveyors from private experts have also suggested that the majority of logging production in PNG has some illegal elements (Lawson 2014; Seneca Creek Associates and Wood Resources International 2004). However, recent reports from SGS seem to indicate a lower rate of illegal logging. Their most recent report, which highlights 27 regulatory inspections conducted in December of 2020, shows that serious discrepancies were detected and corrected for 3 shipments. The total volume of lumber inspected was 203,615 cubic meters, of which undeclared logs across these 3 shipments totaled just 307 cubic meters. For all of 2020, SGS found a total of just 36 discrepancies across 10 different shipments. Given that SGS conducted an estimated 600 inspections throughout 2020, this gives a discrepancy rate of 6 percent across all shipments. These discrepancies include both the mislabeling of logs and the inclusion of unregistered logs in shipments. Given that these illegal logging rates are accurate, this would put illegal logging in PNG far below the global average, which is estimated to be between 50 and 90 percent of all forestry activities in key tropical forests such as PNG (WWF 2020; Blarel 2019).

However, there is still heavy global skepticism about the legality of much of the logging processes within PNG. While it is difficult to get a clear picture of illegal logging in PNG, by emphasizing the regulation of timber exports, the PNG government can continue to minimize and de-incentivize the exportation of illegal logs in PNG. Because of the uncertainty surrounding much of PNG's lumber, some companies have stopped all purchases from the region. Home Depot, one of the industry giants, has ceased all shipments of PNG lumber, "due to the risks associated with sourcing from these countries" (Davidson 2021). On top of protecting the rights of indigenous Papuans and the primary forest they interact with, the improvement of its permitting and monitoring processes surrounding logging may be able to open PNG to new global markets that may pay more for PNG's veneer wood.

Permitting Process

While the vast majority of logging in Papua New Guinea has the required permits, there are frequent breaches of the law in the process of granting permits and logging companies conducting their operations (Strachan 2021). In response to funding requirements from the World Bank, the PNG government commissioned a series of investigations into the forest industry. The reviews found, "incompetence at almost every level of the Papua New Guinea Forest Authority". The report famously declared, "The overwhelming conclusion... is that the robber barons are now as active as they ever were. They are not only free to roam but are encouraged to do so by persons whose proper role is to exercise control over them" (Strachan 2021). The investigations discovered that proper permit procedures were not followed in both permit allocations and permit extensions. Those granted to logging companies sometimes lacked any formal application

or board approval. While this report was conducted in the early 2000s, multiple independent reports have recommended the restructuring of PNG's permitting process. Despite this, the PNG government has taken little action, declining to implement these recommendations.

It is believed that the most common way logging companies obtain illegal logging permits is through the Special Agricultural and Business Lease (SABL) program. In 1995, the PNG government launched the SABL program, which allowed the PNG government to directly sub-lease land for sustainable cash-crop projects. This program was an effort to create rural jobs while generating capital for the government. In 2011, in response to international pressure, PNG's government launched a Commission of Inquiry into SABLs, giving landowners the chance to testify. By 2016, over five million hectares of land had been leased through the SABL program, equal to 12 percent of the country's total land (Andrews 2016). In 2013, the PNG government launched a Commission of Inquiry into the SABL program, giving landowners the chance to testify. The commissioners concluded that SABLs were characterized by "widespread abuse, fraud, lack of coordination between agencies of government, failure and incompetence of government officials to ensure compliance, accountability and transparency within SABL process from application stage to registration, processing, approval and granting of the SABL" (Global Witness 2022). Out of 42 leases provided through SABL, only four had obtained the required landowner consent. Most of these areas were never translated into sustainable agriculture but were primarily used for logging. With little government oversight, logging companies were free to expand outside of permitted areas, negatively affecting the environment as well as hunting, farming, and cultural aspects of Papuan

communities that are connected to the forest. While the inquiry uncovered large-scale corruption, the program is still running, with many believing illegal permits are still regularly distributed to logging companies. The presence of corruption such as this has played a key role in the growth of deforestation in PNG (Andrews 2016).

Because the SGS only checks the presence of a permit, not the legality of that permit, logging companies can defend the legality of their operations while receiving illegal permits that allow them to log primary markets without landowner consent or government oversight. For these reasons, all of PNG's tropical hardwood exports should be considered at risk as possibly from illegal sources (Strachan 2021).

Mining

PNG has a rich endowment of mineral resources, hosting the most biodiverse ecosystems on the planet. The country has historically struggled to develop infrastructure stable enough to cleanly, effectively, and efficiently extract and capitalize on these resources (McKinnon 2002). In the 1980s, Papua experienced an explosion of mining projects, with foreign firms focused on attaining access to some of the richest gold, copper, oil, and natural gas reserves on Earth. Currently, eight mining projects are operating within PNG. These include the Ok Tedi Gold and Copper Mine, the Porgera Gold and Silver Mine, the Lihir Gold and Silver Mine, the Ramu Nickel and Copper Mine, the Hidden Valley Gold and Silver Mine, the Tolukuma Gold Mine, the Simberi Gold Mine, and the Sinivit Gold Mine, stretching from PNG's Western borders to the North-Eastern island province of New Ireland (PNG Facts 2022). These rich natural resources dominate a large part of PNG's economy, contributing to at least 10 percent of the government's revenue, 30 percent of the nation's total GDP, and 89 percent of its

exports in 2020 (Trading Economics 2022). To effectively operate these mines, normally located in extremely rural areas, foreign firms, the PNG government, and local indigenous communities must work together to ensure the mine's success and the shared benefits it can provide. Depending on the social, environmental, and economic standards of these mines, they have the potential to either benefit or harm the indigenous Papuans inhabiting local areas (Herman 1996). Because of the high input costs of infrastructure, transportation, and extraction, many of these resource extraction projects are initiated by foreign companies. To legally complete these projects, foreign companies must negotiate with both local communities and governmental agencies, navigating PNG's traditions and complex land use rights. Because of the large infrastructure and investment requirements for these mining projects, it is difficult for foreign companies to illegally receive mining permits or start mining production without local consent in similar ways as logging companies do. However, with limited government accountability in rural areas where operations are often located, mining companies have little incentive to follow environmental and working condition standards. While some believe mining can play an integral part in rural development, a study comparing communities surrounding the Porgera and OK Tedi mines to those without a nearby mine found that the presence of mining had minimal effects on poverty and welfare (Yamarak and Parton 2021). However, one way these local communities can receive more benefits is through negotiating for better community development projects during the development of the Customary Land Deal.

Community Development and Relations

PNG clans tend to use their strong land-use right to their benefit throughout negotiations with mining companies. In PNG, it is rare that a Customary Land Deal only includes a direct payment to the clan. Their demands typically include both large compensation packages and primary access to employment, encompassing both mining labor and spin-off contracting projects that provide the clan with sustainable income and status (Imbun 2007). By maintaining a larger influence over the daily operations of these mines and the economic benefits they produce, largely by acting as contractors for resource extraction companies. These contracting projects often fall under the mining company's "community development" initiative, showing their commitment to growing local economies.

When negotiating the leasing of their land for extraction projects, nothing may be as important to local Papuans as community development projects, or projects focused on developing highly demanded services within these rural communities. The growth of this area, and the business standards it represents, can improve historically hostile relations between international mining companies and local Papuan communities. This rise has also led to an increase in communication of expectations, grievances, and desires between multinational corporations (MNCs) and local Papuan communities. This shift can be closely compared to the rise of Corporate Social Responsibility (CSR), which can be defined as a company management principle through which companies integrate social and environmental concerns into their business operations with the goal of "building a better world" (Unido 2022). CSR has four main categories: environmental, philanthropic, ethical, and economic responsibility (Stobierski 2021). While mining MNCs may not be

the quickest to embrace CSR as their driving force, the global expansion of the principle, as well as other pressing factors they face, has led to the adoption of business ethics values mirroring those of CSR. The emphasis on business ethics is specifically relevant to the mining industry, where international mining companies must balance economic benefits with the social, political, and environmental damages their work may cause (Imbun 200).

The rise of CSR and the business ethics they accompany have led to organizations incorporating the social impact of their business practices into their decision-making processes. This lens can be used to anticipate, respond to, and manage areas of social responsibility, particularly in the vicinity of their operation. It has led to the increased focus on the financing services, infrastructure, and other community-related activities the mine provides for local communities, which are often isolated from existing services and urban environments (Imbun 2007).

The rise of business ethics in the mining industry globally, and PNG, has come from four main players. The first is multinational corporations (MNCs) themselves. Some of these companies, seeing the enormous economic power and political influence it has in the host countries, have embraced these business ethics to both gain more popularity in host countries and amplify their business' success. These companies see that while focusing on community impact may cost in the short term, it leads to better business performance and relations in the long run (Imbun 2007).

The next player that has led to the rise of business ethics are citizens of the parent countries of the MNCs. As global reporting and communication have increased, some citizens of the parent countries have found the actions of large companies' offshore

dealings to be immoral, which has consequently affected some MNCs' reputations and investors (Dembinski et al. 2003). Because of this, MNCs have been encouraged to improve their ethical standards to please stakeholders and customers (Jirasek 2003; Imbun 2007).

The set of actors pressing for the rise of business ethics is non-government organizations (NGOs). NGOs across the globe have worked to give voice to those affected by the unethical actions of these MNCs, championing ethical justice in resource-extraction projects and foreign government relations. In response to accusations of environmental degradation, poor working conditions, appalling wages, and corrupt government relations, many extractive MNCs have been obligated to improve their business practices to benefit the host country overall, as well as the communities around their resource-extraction projects (Imbun 2007).

Finally, the role local indigenous communities have played in the growth of ethical business practices has largely been underestimated. Through the debacle of both the Bougainville and Ok Tedi mines, indigenous communities have done their best to keep mining companies accountable for their actions, whether through resistance on the local level or legal actions at the national level. Local indigenous communities in the host regions of PNG have made their expectations of beneficial community projects known to MNCs, while insisting that these demands are met in return for cooperation. While mining negotiations often include payments in the form of royalties, occupation fees, and relocation fees, which are documented in contracts and government documents, they also come with the expectation of additional goods and services at the community level. These include roads, health centers, electricity, and schools. Having heard about the disasters of

the Ok Tedi and Bougainville mines, these communities see these benefits as a requirement to take the risk of inviting a mine into their community. By establishing this expectation, some forms of community development projects by MNCs are no longer seen as voluntary actions of “goodwill” business, but as a requirement of business, despite their details rarely being explicitly laid out in most local and governmental contracts. However, the extent to which mining companies accommodate these expectations, and go above and beyond to build trusting relationships within the community, varies (Imbun 2007).

One example of both the PNG Government and mining companies’ effort to accommodate these projects is the Infrastructure Tax Credit Scheme in the Porgera Mine in PNG. The agreement allowed, on an annual basis, the mining company to spend up to 0.75 percent of the value of gross sales of gold production on approved infrastructure projects in return for a tax credit from the government on company tax. After the success of this scheme at the Porgera Mine, this has now become standard practice for mines in PNG. As one of the mining executives in PNG said, “We (PJV) quickly came to sense that maintaining a viable mine was going to be offset (balanced) with how we responded to the expectations of not only the Porgerans but the entire Engan community” (Imbun, 2007). The difference between this mine, which has been successful both financially and socially, and those that have failed, is an emphasis on strong community relations and CSR projects as integral aspects of the mines, not optional facets. Mine executives went so far as to term CSR projects as, “the engine of the mine operation” (Imbun 2007). Both the Lihir and Progeria mines have CSR teams that exceed thirty individuals, many of

whom have extended experience working with indigenous Papuans and have a strong understanding of the cultural values of local communities.

Another example of the rise of business ethics and the improved relations between MNCs and local communities is Lihir Mine's Integrated Benefits Package (IBP). This IBP, signed in 1995, was a landmark agreement between the PNG Government, the Lihir customary landowners, and mining company Rio Tinto. It described what each actor needed to accomplish in the next five-year span. Specifically, it outlined the complete benefits local communities would receive in the form of housing, roads, electricity, health, education, and economic activities initiated by Rio Tinto. Many of these benefits were not only for landowners affected by the mine but for the entire Lihir islands community. To ensure these benefits were implemented, Rio Tinto created a Community Relations Department, which included government representatives, tasked with organizing and executing these projects. This IBP set the standard moving forward of including detailed outlines of community development projects during the negotiation process, rather than focusing on monetary implications and making promises of community development that may be left by the wayside once production starts. While these mines still experience community conflicts, improvements such as these help to improve future relations between local Papuans and mines (Imbun 2007).

This rise of business improvements that have been made both globally and in PNG has the potential to make mines more socially and economically beneficial for both local communities and the country overall. However, many within PNG still have valid suspicions when it comes to foreign resource extraction projects within its borders, having experienced hardship, loss, and conflict at the hands of these mines. Some see

these community development projects as bribes to manipulate local communities into giving access to their sacred land rather than as projects aimed at helping local communities. In addition, many believe the social and environmental effects of the mine have the potential to be so large that the benefits of community development projects do not outweigh the risks.

Environmental Effects of Mining

When deciding whether to allow mining within traditional land, local communities need to understand the wide array of risks that accompany these projects. Across the history of mining in PNG, there have been multiple mines that have failed to uphold the social and environmental standards necessary to avoid the dangers of mining. When environmental standards are not upheld, waste from process plants and sediment runoff from open-cut mines are often dumped directly into riverways. This often leads to heavy metal contamination, spreading to the soil and into the surrounding ecosystem.

Table 3 shows the effects of major PNG mines on the water quality of local waterways (Mudd et al 2020).

Table 3
Water quality regulation for PNG mines - key criteria, strengths and weaknesses.

	Water resources	Compliance location (s)	Water quality basis	Transparency ^a	Strengths	Weaknesses
Ok Tedi ^b	Fresh	Along entire river system	ANZECC 95% Values	High	<ul style="list-style-type: none"> • Extensive monitoring • Annual public reporting • Ecotoxicological basis • Clarity on compliance 	<ul style="list-style-type: none"> • Fails to address bioaccumulation of metals and long-term acid drainage risks • Still allows significant impacts along river system
Porgera	Fresh	~180 km downstream (SG3)	ANZECC 95% Values (mostly)	High	<ul style="list-style-type: none"> • Extensive monitoring • Annual public reporting • Ecotoxicological basis • Clarity on compliance 	<ul style="list-style-type: none"> • Fails to address bioaccumulation of metals and long-term acid drainage risks • Still allows significant impacts along river system
Hidden Valley	Fresh	~20 km downstream (Nauti)	Unclear	Medium	<ul style="list-style-type: none"> • Extensive monitoring • Some historic public reporting • Unclear scientific basis • Some clarity on compliance 	<ul style="list-style-type: none"> • Fails to address bioaccumulation of metals and long-term acid drainage risks
Lihir	Marine	Tailings discharge point	Unclear	Low	<ul style="list-style-type: none"> • None identified 	<ul style="list-style-type: none"> • No public transparency • Uncertain compliance • Unclear scientific basis
Simberi	Marine	Unclear	Unclear	Low	<ul style="list-style-type: none"> • None identified 	<ul style="list-style-type: none"> • No public transparency • Uncertain compliance • Unclear scientific basis
Ramu	Marine	Unclear	Unclear	Low	<ul style="list-style-type: none"> • None identified 	<ul style="list-style-type: none"> • No public transparency • Uncertain compliance • Unclear scientific basis

Notes: ^aBased on public reporting and scientific justification of compliance regime (Low = no public reporting or explanation; Medium = infrequent public reporting and explanation; High = frequent public reporting (e.g. annual), clear scientific explanation and regular review and improvement in regime criteria).

This was the case of the OK Tedi Mine, which caused severe environmental damage along 1,000 km of the OK Tedi River and Fly River in the Sepik region (Burton 2000). Deemed one of the worst environmental disasters caused by humans, the copper mine discharged over two billion tons of untreated mining waste into the riverways. Broken Hill Property (BHP), the operator and 52 percent stakeholder of the mine, admitted that the environmental impacts of the mine have affected the lives of over 100,000 Papuan in the immediate area, with more affected downstream (McKinnon 2002). The constant discharge of over 90 million tons of discharge annually since 1999 has decimated the ecosystem. Not only are the rivers almost completely barren of aquatic life, with an estimated 70 percent of fish populations wiped out, but the effects have expanded into the forest. About 2,000 square kilometers of the forest has completely died, with a thick, gray layer of sludge visible in the surrounding forest throughout the riverway. Gaining national attention, with organizations such as BBC, Asia Times, the World Bank, and the World Wildlife Fund reporting on the effects of the mine, pressure grew to close the mine.



Figure 4: Ok Tedi Mine (Metallurgist 2013)

With the PNG government holding a 30 percent stake in the mine (Imhof 1996) and the mine contributing to ten percent of the country's GDP and 20 percent of the country's export income at the time (Berne Declaration 1999), the government was caught between economic and social pressures (McKinnon 2002). Having become so reliant on the mine, and with much of the local environment already destroyed, the government chose to keep the mine open, continuing to run it to this day. The following are quotes from local communities surrounding the Ok Tedi mine describing the effects the mine has had on their lifestyle:

“We no longer use the river to fish or drink. We also do not plant food crops near the river bank. We believe the river is totally polluted and it may never be possible for the river to return to what it was like before. Life is harder now because we have to move inland to plant food crops and we no longer have fish to eat. The company is seeing these problems but they are not doing anything to help us.” (Kepore and Imbun 2011)

..

“The river is flooding more often these days. The mud from the river is washed into our gardens killing our taros, yams, and sago palms. We have petitioned the company so many times but they are not responding. The total Western province village petition is about 150 petitions, but we have not heard from the company.” (Kepore and Imbun 2011)

The government continues to prioritize expanding the mining industry within PNG. Currently, the government is proposing a new copper and gold mine called Frieda Mine, in a similar region of the Sepik. If the foreign firms and the PNG government hope to avoid the disasters of the past, they must ensure the protection of local Papuans and their environment.

Social Effects of Mining

One risk of the expansion of mining projects into indigenous communities is the breaking down of social ties and customs in these communities through the growth of economic inequality. By giving a small portion of elite individuals the majority of contracting projects and their benefits, while the bulk of individuals work with poor on-site conditions, tension often rises within the clan. This economic growth strategy risks spreading the inequality already experienced in much of urban PNG, with 20 percent of the population holding 80 percent of the country’s wealth, to rural areas where economies are still in their developmental phases (Imbun 2007). While these spin-off companies do spur economic growth, albeit dependent on the mining projects, many believe this same economic growth could be produced through alternative sustainable projects such as agriculture development.

Economic Stagnation

Another risk to relying on mining production to spur economic growth in rural areas is the reliance of these communities on these resource extraction projects. When these rural projects are established, it opens up a wide variety of business opportunities for local communities, providing not only contracting work, but food, housing, and supplying goods to workers. However, the vast majority of these services are reliant on the mine and its production. When an extraction project is no longer profitable and is closed, many of the markets for these services go with it. Instead of building a sustainable economy, these rural projects can inhibit communities from creating sustainable, self-reliant economies.

Conflict and Resistance

This resource-based economy also creates fierce competition between local communities for management and business opportunities. With the mine offering limited high-paying employment opportunities, there is heavy competition to secure and hold these positions. These mines draw workers from neighboring regions who may travel for days in search of employment opportunities. They are willing to leave their community and work in difficult conditions to provide for their communities. Local communities, on the other hand, feel they have taken the burden, sacrificed areas of their land and risked environmental damages, and therefore should receive all the benefits, which includes employment. This clash of motivating factors, as well as traditional clan differences, can lead to social unrest and instability (Imbun 2007).

Additionally, when natural resource extraction projects do not receive the benefits promised to them in their customary land deals, and the government does not have the

resources to enforce these terms, communities may take physical action to ensure their voice is heard. By raiding working sites, and destroying equipment and other working necessities, these groups can heavily affect the profitability of these projects, as well as the safety of their workers.

This was the case at the Panguna mine in Bougainville, a small island off PNG that gained its semi-autonomous status in 2002. Known for its rich copper deposits, mine production exploded in the 1970s, becoming the main mine in PNG alongside Ok Tedi. However, the disposal of tailings and waste rock into local river systems has a “profound effect on the river system, the vegetation, and the people living within the tailings lease area” (Brown 1974 pg. 23). Despite many grievances from local communities that felt their ecosystem was being destroyed, they were not receiving the benefits that were promised, and they were being overcrowded by migrant workers, the mine’s operations did not change (Regan 1998). By 1989, tension over the mine led to violence, with a group of landowners using explosives to destroy the mine’s powerline, forcing the mine to be temporarily shut down. When the PNG government dispatched law enforcement, the uprising grew, with local communities fighting to regain their land. Throughout the uprising, mining infrastructure, communities, and villages were burned to the ground, eventually leading to the closing of the mine. After a year of fighting, the PNG government officials retreated to their homeland. Although Bougainville leaders declared independence, ultimately resulting in its semi-autonomous status, conflict continued for ten years (Regan 1998).



Figure 5: PNG clansmen rallying in protest against mine (Boyle 2016)

While their overall goal was met, thousands of Bougainville and Papuan citizens lost their lives in the process. Today, this revolution acts as a reminder of the possible effects of the use of indigenous communities' natural resources without cooperation from local communities. This incident provided an array of lessons for both mining companies and local communities. The majority of mining companies, trying to avoid repeating situations like this, have incorporated community liaisons tasked with attending to the concerns of local communities, into their business plan. Examples like Bougainville show the importance of government enforcement of Customary Land Agreements and the economic, political, and social costs that accrue when they are not.

Case Study of Lihir Mine

The Lihir Mine is an open-pit gold mine owned by Newcrest Mining and located off the coast of New Ireland Province in the Lihir Islands. These islands are inhabited by multiple clans, with approximately 40 villages spread along the coasts. Before the construction of the mine, the Lihir communities, with an estimated population of 10,000 individuals, primarily relied on subsistence farming for nourishment, with their only other economic activity coming from limited trading posts scattered throughout the islands. The Putput and Kapit villages were affected most by the creation of the mine, with their communities being relocated in 1995 to make way for the mine. Consequently, these groups received the largest monetary benefits, including both equity in the mine and cash payments for relocation costs. Included in the Customary Land Deal was the creation of locally owned companies to support the mine. The ownership of these companies was distributed to local tribes, with each specializing in one area. These companies included catering, cleaning and maintaining camps, earth-moving and construction companies, security and maintenance companies, labor hiring services, building contractors, a hotel, a post office, vehicle sales and services, and waste collection and disposal (Imbun 2007).



Figure 6: Lihir Mine in PNG (EJAtlas, 2017)

To encourage entrepreneurship, Newcrest Mining provided locals with interest-free loans for businesses such as these, holding classes to teach them the basics of running a business. However, these ownership positions went almost predominantly to the educated, meaning only the elite men gained access to these impactful positions. This increased the tension between the elite and the other Lihirans, as the WanTok values of good distribution and reciprocity were not upheld by the economic disparity seen throughout the community. While the elite still upheld the traditional act of hosting feasts for the entire community, this was not enough to appease those throughout the community struggling to provide for their families while seeing the businessmen enjoying luxuries others could not afford (Imbun 2007). However, there is no evidence of largescale conflicts, such as robbery or lawsuits, within WanTok communities due to these effects of mining.

Throughout the development and early production of the Lihir mine, local Papuans reacted to the mine in a variety of ways. Many of the older population, often thinking this project meant they would have a constant inflow of money to sustain themselves, missed the opportunity to take advantage of fruitful opportunities, like the

interest-free loans, that represented the early days of the mine. However, once the original relocation payments were used up and the monthly equity payments were not enough to provide for a family, most of the business opportunities had been filled. Many were then left in dire conditions, forced to return to subsistence farming without the established gardens they had before relocation (Imbun 2007).

The younger generation, on the other hand, largely encouraged the establishment of the mine for the opportunities it provided them rather than the direct payments they would receive. They understood that taking advantage of these economic opportunities to find management positions in these businesses could not only improve their standard of living but could improve their status and responsibilities. While they were focused on their well-being, they played an important role in the community. These men ensured the community had political influence over the mine, ensuring the company would uphold previous agreements and protect local businesses (Imbun 2007).

The large variance in response to the establishment of the mine in the Lihir community makes it hard to conclude whether the mine had a positive or negative impact on society as a whole. While the quality of life was improved through the importation of goods and medical services, these services are heavily reliant on the mine and are unlikely to meet the same standard of quality after the mine concludes. The mine has also split cultural ties, with some individuals sacrificing WanTok values of community unity for competitive economic behavior.

Agriculture

In PNG, the agriculture sector is the second largest contributor to GDP, employing a fourth of the total workforce in the formal work sector (IFAD, 2022). It

comprises three main groups: subsistence, semi-subsistence, and commercial farming. A subsistence farm only feeds the farm family, while semi-subsistence describes a farm that both provides for the farm's family and produces enough surplus to sell (Forum Synergies 2019). In 1980, 8.5 percent of the population was purely subsistence farming, while 87 percent were semi-subsistence, with the last 4.5 percent engaging in commercial farming. Today, subsistence and semi-subsistence farming is, and will remain for some time, the dominant economic activity in PNG, and the base upon which much of the population stands. Despite this, commercial farming has grown, occupying almost five percent of the country's total landmass for agriculture production (Piesse 2019). Within these groups, smallholder farmers are the most common, producing 96 percent of all agricultural produce, 75 percent of coffee, 65 percent of cocoa, 66 percent of copra, 35 percent of oil palm, and almost all food crops (IFAD 2022). In total, the agriculture sector contributes to nearly one-third of PNG's total GDP and 14 percent of foreign exchange earnings.

Subsistence Farming

Agriculture also directly sustains over 80 percent of the rural population, largely through sustenance or semi-sustenance farming. Traditionally, these substance farmers use natural propagation to grow and distribute their crops, rarely purchasing planting materials for their gardens. This strategy allows sustenance farmers to prepare a new garden for planting while their older garden is being harvested. While crops vary by region, the most population vegetation in gardens are bananas, taro, cassava, and sweet potato (Kambuou and Leipzig 1996).

Throughout PNG, rural communities have used swidden farming (also called “slash-and-burn agriculture”) to clear areas for subsistence agriculture. This method, which has been used by the indigenous population for over 5,000 years, involves burning small areas of forest to clear land for gardens, using the nutrients in the ash to help spur plant growth (Britannica 2022). After the garden soil has lost much of its nutrients due to cultivation, farmers move to a new area, leaving the previous garden to revert to a secondary forest. While this tradition has been historically sustainable, there are concerns that PNG’s growing population, which has doubled in the last thirty years, may increase the effects of slash-and-burn agriculture on the most biodiverse forests on Earth.

As a possible preview of the problems that PNG may face, Indonesia is more advanced in the consequences of swidden farming and agriculture expansion. While the potential effect of swidden has been seen in Indonesia for millennia, the growth of cash crops has increased the use of this agriculture practice. Here, the expansion of swidden to clear land for palm oil plantations and other crops has damaged forest ecosystems, as well as harmed air quality. In 2019 alone, these practices resulted in the burning of over 330,000 hectares of land (BBC 2019).

In PNG, it is extremely rare for an individual to own a piece of land outright in rural areas, as the land is recognized to be under the control of clans. Therefore, farmers in PNG often live in an agriculture system that is not easily defined. The clan will allow members to grow crops through sustenance farming on clan land and sell the excess yields at markets (Kambuou and Leipzig 1996). However, they rarely can expand this work to large-scale production entailing sales that span provincial or national boundaries. This is largely due to the clan’s relationship with the forest. Almost every member of

rural communities is connected with nature, not only relying on it for food, but also connecting with it spiritually, with local communities often attributing spiritual aspects to different areas of the forest. While this may result in lower crop yields per square kilometer than other agriculture strategies, it keeps individuals in touch with important spiritual aspects of WanTok culture.

Large-scale Commercial Farming

Commercial farms are usually located closer to urban areas, where labor and transportation are more available. Of these farms, coffee and cocoa are the main cash crops, employing over half of the total formal labor force (IFAD 2022). Despite this convenient location, the high cost and low availability of modern technologies, the lack of sound irrigation practices, and the inaccessibility of physical infrastructure often led to poor yield. The World Bank estimates that coffee yields could increase by 40 to 50 percent if better services and techniques were applied. These difficulties, on top of cultural aspects such as connectedness to nature and the WanTok system, often discourage small farmers from attempting to grow their farms.

While 70 percent of agriculture production within PNG is sweet potato, PNG's agriculture exports are almost entirely limited to coffee (US \$117 million), palm oil (US \$434 million), and coconut products (US \$77 million) (Piesse 2019). The revenue from these exports is often countered by the importation of rice and meat that are needed to supplement the staple crops. The cost of these imports continues to rise, with food imports rising above \$850 million annually, with rice alone accounting for US \$255 million annually. The rising prices of these goods limit much of the population's access to a diverse diet, leading to high rates of stunted youth and adult obesity.

As the PNG government hones in on areas vital to the growth of its economy, agriculture is one main focus. James Marape, the prime minister of PNG, believes the agro-industry is the most promising industry for investment and expansion in PNG and has urged small to medium enterprises (SMEs) to invest in agricultural processing, which could directly employ and provide for many rural communities (PM NEC 2021). By implementing strategies that improve small-scale farmers' access to improved production volumes and global markets, and provide farmers better access to modern technologies and strategies, the PNG government can improve the lives of small-scale rural farmers and their families.

Chapter 4: Discussion and Development Levers

This section discusses three aspects of development in PNG: first, the information policymakers and developers should consider when assessing rural development strategies; second, alternatives to rural development strategies to resource extraction projects; and third, policy recommendations and levers to improve rural development in PNG.

Indigenous Papuans and WanTok Flexibility

Throughout the history of PNG, indigenous communities have continually been misunderstood and misrepresented by outsiders. For much of PNG's development, outsiders have often blamed the development issues on rural Papuans on indigenous Papuans, claiming them to be simple, somewhat primitive individuals. However, when a household is struggling to consistently access clean water, diverse food, and education, it rarely has the excess money or knowledge necessary to invest in new business opportunities. As some rural communities gain access to better social services and economic opportunities, they often show strong entrepreneurial drive and consistent hard work to develop business enterprises. This was directly seen at the Lihir Mine, where indigenous Papuans started a variety of successful businesses after the mining organization provided them with interest-free loans and business training.

Additionally, outsiders have struggled to encapsulate the WanTok culture within PNG, likely due to the wide variety of communities and values across PNG. Besides their constantly high value of community and family ties, WanTok values have shown to be rather flexible, with younger generations adjusting values while still respecting traditions. This can be seen both through the implementation of Christian values into WanTok

culture and the increased cooperation and communication between historically conflicting clans hoping to gain access to better government services such as schooling. Moving forward, government officials and NGOs should focus on providing training and services around economic practices, education, and women empowerment to spur a shift in WanTok culture, allowing women to gain better access to leadership roles and individual households to rely less on their WanTok community as livelihood risks decrease.

Alternatives to Resource Extraction Projects

Small Business Development

While the vast majority of rural indigenous Papuans rely on subsistence farming and have relied on subsistence farming and hunting and gathering techniques for generations, this societal structure comes with difficulties that risk community health and limit development. First, largescale reliance on subsistence farming puts communities at risk of inconsistent food production caused by droughts, natural disasters, and environmental changes. When El Niño Southern Oscillation (ENSO) events hit, many rural households face serious food shortages due to crop failure. With almost 80 percent of rural households relying on some form of subsistence farming, providing aid to all rural communities during disasters is impossible. Additionally, a consistent rural population growth of two percent from 2008 to 2018, coupled with the growth of deforestation, means that rural communities may face increased food shortages in the coming years due to growing population density.

Because of these concerns, the development of alternative income pathways would likely improve rural resilience to these problems. The development of nonfarm

enterprises (NFEs) could provide these households with supplementary income to improve diet and living conditions while acting as a safety net when disaster strikes. This strategy of developing small-scale NFEs has led to the improvement of quality-of-life indicators across multiple countries, including Vietnam, India, and Bangladesh, where households with NFEs saw greater economic mobility and an increase in income level (Imai et al. 2015, Inchauste et al., 2012). This could aid in the transition from a largely agrarian rural economy, which limits economic growth and household flexibility, to a more urbanized economy that could benefit from improved labor productivity and access to modern services. While location, infrastructure, and technologies limit the diversity of NFEs indigenous Papuans can run, rural Papuans have shown the entrepreneurial drive to develop NFEs despite harsh conditions. In PNG, NFE activities typically include small-scale transportation, construction, and the trading or selling of manufactured goods from raw materials, such as traditional bilums (hand-woven bags)(Schmidt, Mueller, and Rosenbach 2020).

In 2018, the PNG Household Survey on Food Systems conducted a randomized survey covering 996 rural households across 70 different communities of varying locations and levels of economic development. It collected holistic data encompassing the livelihood of rural households, including detailed diet data, agriculture practices, and NFE activity (IFPRI 2019). It found that one-third of the households reported engaging in NFE activity, with nine percent of the sample reportedly working waged work largely focused on fishing, agriculture, and forestry. The most common NFE activity was non-agricultural trade such as selling at trade stores or markets, making up 60 percent of overall activities, followed by agricultural trade (25 percent). The survey found no

significant difference in travel time to regional centers between households that owned NFEs and those that did not (Schmidt, Mueller, and Rosenbach 2020). One reason for this may be that the vast majority of NFE activities took place in local communities, with only ten percent of NFEs having operations in regional centers. Additionally, 18 percent of households that owned NFEs reported owning multiple NFEs, showing rural Papuans may engage in multiple businesses across different sectors. The median annual income from households owning an NFE was US \$305 per year.

Table 4: *Nonfarm enterprise Good and Services, by Province and Ownership (PNG Household Survey on Food Systems; Schmidt, Mueller, and Rosenbach 2020)*

	Male-owned	Female-owned	Jointly-owned	All NFEs
Garden produce, livestock, and inputs	3%	14%	13%	10%
Betel nut	9%	13%	6%	9%
Cash crops	4%	2%	10%	6%
Total agricultural trade	15%	28%	29%	25%
Trade stores/market vendor	44%	20%	39%	36%
Fuel/batteries/wood	11%	5%	10%	9%
Prepared food and alcohol	5%	36%	10%	15%
Total non-agricultural trade	60%	62%	59%	60%
Sewing and handicrafts	1%	9%	1%	3%
Transportation	11%	0%	7%	7%
Other services (including construction)	11%	1%	3%	5%
Share of NFEs	30%	25%	44%	100%
Total number of NFEs	142	118	206	466

Using nearest-neighbor matching to attempt to control for household differences, Schmidt, Mueller, and Rosenbach (2020) analyzed annual per capita expenditure, kilocalories per person consumed per day, grams of protein consumed per person per day, and a household dietary diversity score to compare households with and without NFEs. Their analysis found that households with NFEs had a US \$69 per capita (13 percent) greater expenditure per year than those without NFEs (Schmidt, Mueller, and Rosenbach

2020). Additionally, households with NFEs saw a 26 percent increase in daily protein per person from 39 grams to 49 grams, an 11 percent increase in daily kilocalories per person, and a ten percent increase in the household dietary diversity score. Individuals in households with NFE activity ate an estimated 2216 calories per day, which is just over the 2,000 to 2,200 calories per day recommended by the World Health Organization (WHO 2020). Additionally, the average individual in households with NFE activity consumed 52 grams of protein per day, which is just over the 50 grams of protein per day recommended for an average-sized Papuan (Schmidt, Mueller, and Rosenbach 2020).

Table 5: *Nearest Neighbor matching results at the household level, by nonfarm enterprise ownership (Schmidt, Mueller, and Rosenbach 2020)*

	No NFE Mean	All HHs with NFEs Unit effect	Effect (%)	Male-owned Unit effect	Effect (%)	Female-owned Unit effect	Effect (%)	Jointly-owned Unit effect	Effect (%)
Protein per person, daily grams	39	10*** (3.2)	26%	7.0 (4.6)	18%	4.1 (4.3)	10%	13*** (4.7)	33%
Kilocalories per person, daily	2005	211** (105)	11%	220 (165)	11%	58 (148)	3%	160 (140)	8%
Household dietary diversity score	4.8	0.5** (0.2)	10%	0.4 (0.3)	8%	-0.2 (0.3)	-4%	0.8*** (0.3)	16%
Total annual expenditure per capita, PGK '000 s	1.81	0.242** (0.11)	13%	0.377** (0.19)	21%	0.121 (0.17)	7%	0.225 (0.16)	12%
N (All treatment HHs)	609	387		127		107		153	
N (Treatment HHs in CS)	609	385		127		107		152	
N (Control HHs in CS)	609	479		277		321		289	
N (Total matched)	609	864		404		428		441	

Source: PNG Household Survey on Food Systems.

Note: HH = household; PGK = Papua New Guinean Kina; NFE = nonfarm enterprise; CS = common support. Standard errors are in parentheses. * $p < = 0.1$; ** $p < = 0.05$; *** $p < = 0.01$. We drop households that are not within the common support; all matching is executed without replacement. For sensitivity purposes, we implemented matching with and without ties, respectively, and found almost nil difference in the results.

While the average household with NFE activity did produce better, households with female-owned NFEs did not see the same benefits. As seen in Table 4, female-owned NFEs did not produce statistically significant results in protein consumption, kilocalories per day, dietary diversity score, or annual expenditure per capita. This result could be attributed to a variety of reasons. In qualitative interviews, female NFE owners were much more likely to express concern over physical and financial safety when conducting business. Additionally, they reported higher levels of pressure than male-run

NFEs to provide goods on credit or give clan members cash credit from their NFE earnings. Furthermore, women likely face higher barriers to entry into the higher-earning NFE markets, including the transportation and cash crop trade sectors. These factors probably play key roles in women-run NFEs performing worse than male-owned NFEs or jointly-owned NFEs, which performed best.

The growth of NFEs has the potential to benefit rural communities in a variety of ways. First, it creates an income safety net if agriculture yields that many rural Papuans rely on fail. On top of this, in normal times of agricultural production, additional income allows rural households to gain access to higher quality food, with NFE households eating more calories and protein on average. This analysis shows the importance of the development of alternative forms of income, however small, for rural communities.

The important question for those hoping to spur economic activity in rural PNG is how to promote the development of NFE businesses. One main lever that could improve the presence of NFE activities is the increased focus on policies and investments that promote female empowerment and presence in business activities. Given social customs, women often are not given leadership or management opportunities in business settings. With most men already spending much of their time engaging in farming or NFE activities, their scope for increased economic activities is limited. Therefore, women must get involved in leadership roles in NFEs businesses. Policies and investments to promote the success of female-owned NFEs, such as improved transportation infrastructure, market services, and productive technology, are lacking in Papua New Guinea (Pascual, Nordhagen, and Drucker 2021). Through increasing policies and investments into women empowerment and the breakdown of outdated stereotypes, women can feel more

confident running aspects of NFE businesses and helping to supplement their household income. Policies to decrease gender-based employment segmentation should be seriously considered when designing programs to enhance females' participation in nonfarm activities.

Micro Financing and Banking

Another lever that could minimize the initial barriers for rural Papuans to start an NFE business is greater access to microfinancing and banking. Microfinance is the provision of financial services to low-income households that traditionally lack access to banking and related services. For many, microfinance organizations provide saving accountings and small-scale loans to low-income communities to allow them to purchase technologies or goods that they usually would not be able to attain. For example, if a rural family wanted to start beekeeping but could not afford the required equipment (veil, smoker, and gloves) to start, they could apply for a microloan. Such loans would cover the upfront costs of starting a business and allow rural households to pay off these costs over time.

For much of PNG's history, the microfinancing sector remained untapped. Now, microfinancing is growing rapidly in much of rural PNG. Despite this, 75 percent of the adult population in PNG do not have access to formal financial services (CEFI 2019). The Center for Excellence in Financial Inclusion (CEFI) is assisting the PNG government to formulate and implement its National Financial Inclusion and Financial Literacy Strategy. The main initiatives of this strategy include investing in improvements in financial products and service delivery, establishing forums for information exchange on financial inclusion and personal finance, and promoting the economic empowerment of

women in financial inclusion initiatives. Since 2004, the Bank of PNG, PNG's central bank, has licensed five microbanks to provide financial services to a wider range of Papuans. In 2012, The Asian Development Bank (ADB) and the government of Australia announced the introduction of a PNG Microfinance Expansion Project (MEP) that would invest US \$25 million into expanding rural communities' access to financial services such as micro-loans (Asian Development Bank 2016). From 2013 to 2015, between the rollout of the MEP and the implementation of PNG's National Financial Inclusion Strategy, over 1.1 million new bank accounts were opened, with 125,000 people receiving financial education.

Traditionally, with nowhere to store their money, indigenous Papuans would rarely save their money to invest in businesses or other income-generating activities. By expanding financial services to rural areas, indigenous Papuans can not only receive valuable training on personal finance but have somewhere to store their savings to invest in NFEs and other economic activity. After a Financial Education Training, Mathew Simon, an indigenous Papuan who sells newspapers in the Southern Highlands of PNG, remarked the following on his experience in the training:

“Since I am uneducated, I never felt going to a bank was important but, after attending the training, I realized I was wasting my hard-earned money. I opened an account with Abumangre Microcredit Scheme (AMCS) soon after the training and every day I save some of my wages. “I make a point of saving every day. The trainers made me realize the importance of money and showed us easy ways of saving. I plan to start my own business when I have sufficient money. I am on the way.” (Asian Development Bank 2016)

While valuable work is being done by the Bank of PNG and the Asian Development Bank, the majority of indigenous Papuans still lack the knowledge and resources necessary to save and invest their money wisely. Because of this, the greater development of financial literacy programs and access to financial services is a vital aspect in increasing Papuans participation in NFEs.

Small-Scale Beekeeping

One non-forest enterprise that has the potential to supplement income generation for rural Papuans while imposing minimal effects on their environment is beekeeping. Globally, beekeeping has been considered an exemplary strategy to create sustainable rural development (Crane, 1999). Because of its low environmental impact, contribution to the improvement of nearby crop yield, the nonperishable nature of honey, and PNG's tropical climate, the development of beekeeping could improve the livelihood of rural Papuan households while giving them a valuable alternative to less sustainable income-generating activities. Additionally, pollination by bees can contribute to increased biodiversity and pollination in natural ecosystems, on which many Papuans rely for hunting and gathering. Finally, the demand for bee products such as honey, beeswax, nucleus colonies, and queen bees often exceeds demand, making apiculture an under-exploited business opportunity for many rural communities (Schouten et al, 2020).

However, the development of apiculture does not come without concerns. Beekeeping is a complex process, requiring technical knowledge of beekeeping skills such as managing swarms, multiplying colonies, and managing pests. On top of this, to start hives, keepers must have an in-depth knowledge of how surrounding flora and fauna interact with the hive, as well as access to an array of tools, many of which cannot be

built using natural materials. Because of these factors, apiculture is difficult to pick up without formal training or mentorship by experienced beekeepers (Schouten et al, 2020). While this creates additional barriers to entry for individuals within communities with no history of apiculture, an established beekeeping industry coupled with organizations such as Bees for Sustainable Living, that provide mentorship for households interested in developing hives minimizes this problem. Additionally, because of PNG's tight-knit WanTok culture, individuals are more likely to share their knowledge with extended family members interested in apiculture, rather than keep their knowledge within their primary family.

Beekeeping has been used to supplement portions of the rural population in many developing countries. This strategy has been especially successful in Ethiopia, a country that holds many similarities to Papua New Guinea. Eighty percent of Ethiopia's population lives in rural communities that are deeply rooted in traditional culture and agriculture practices. Over 95 percent of all agricultural goods are manufactured by rural households, with the industry employing 66 percent of the working population (Gratzer et al. 2021). Through the development of rural beekeeping, Ethiopia is now one of the top honey and beeswax producers in the world, with this production almost exclusively going to domestic markets. This development has given many rural Ethiopians who heavily rely on agriculture production for their livelihood a safety net in case of economic shocks and environmental disasters. With the successes and failures of Ethiopian apiculture as a guide, beehive production has the potential to develop into an important market within PNG.

In some areas of PNG, apiculture has already established itself as a dependable form of alternative income for many rural households. Schouten et al. (2020) analyzed a survey of 117 beekeepers in the Highlands Province of PNG to discover both the key drivers of beekeeper success and the influence beekeeping had on owners' livelihood. Of the beekeepers surveyed, 85 percent belonged to low-income or lower-middle-income households, showing beekeeping is an accessible form of income for the poorest families in PNG. This is likely due to small entry barriers and operation costs of beekeeping when compared to alternative enterprises. On top of this, 53 percent of survey beekeepers described subsistence farming as their main occupation, with the median proportion of total income generated from beekeeping being 45 percent. This shows that a majority of beekeepers rely on beekeeping as a supplementary form of income.

Table 6: *GNI per capita income brackets for beekeepers in the Eastern Highlands Province of PNG (Schouten et al, 2020)*

<i>GNI per capita income (USD)*</i>	<i>Respondents (%)</i>
Low income (\$1,025 or less)	12
Lower middle-income (\$1,025 - \$3,995)	73
Upper middle-income (\$3,995 - \$12,375)	13
High-income (\$12,376+)	2

*Gross National Income (GNI) classification of income is based on the 2020 fiscal year and is calculated using the World Bank Atlas method.

Their analysis found four key influenceable factors that were significant predictors of the five-year average number of hives owned by beekeepers, which is positively correlated with beehive health and net income. These predictors were owning protective equipment, the ability to make hive splits, owning more than one apiary, and reinvestment back into beekeeping operations (Schouten et al, 2020). The results from

this t-test can be seen in Table 3, showing that ownership of gloves and veils has the largest impact on the five-year number of hives owned.

Table 7: Results of *t*-tests and Descriptive Statistics for three response variables influencing five-year average number of hives owned (Schouten et al, 2020)

<i>Groups</i>	<i>M</i>	<i>SD</i>	<i>n</i>	95 % CI for Mean		<i>t</i>	<i>df</i>
				<i>Lower</i>	<i>Upper</i>		
Doesn't own gloves and veil	5.9	2.27	81	0.49	0.94	-2.33*	113
Owns gloves and veil	8.7	2.17	34				
Cannot make splits	1.5	0.90	27	0.45	0.93	-2.39**	113
Can make splits	2.0	0.77	88				
Has one apiary	1.7	0.83	82	0.43	0.84	-2.99**	111
Has more than one apiary	2.2	0.69	31				

* $p < 0.05$, ** $p < 0.01$ (two-tailed)

The average beekeeper owned 13 bee colonies and received US \$715 annually from their hives. Despite beekeepers who own more hives seeing decreased income per hive, they did receive significantly greater income overall. While beekeeping is a supplemental form of income for many beekeepers, this shows that growing beekeeping operations can improve the benefits beekeepers receive without significantly increasing the effort required by keepers. Data show there is a demand to support ongoing growth in the sector, as the beekeeping enterprises have increased their hive numbers by an average of 20 percent per year over the last five years without large changes in honey prices (Schouten et al, 2020).

While one may assume that receiving training would be a leading driver of beehive success that was not the case. While 84 percent of surveyed beekeepers had completed some form of basic beekeeping training, only six percent indicated they had completed formal training on how to breed queen bees. Despite this, 53 percent indicated

they know how to make queen bees and 80 percent reported being able to make colony splits, both of which are integral aspects of growing successful and healthy hives.

Analysis showed there was no significant difference in net income between beekeepers who received formal training and those who did not. While training is an integral part of learning to be a successful beekeeper, this lack of significant impact of training may be driven by two factors. First, beekeepers may be receiving informal training from family members, leading to their knowledge of intricate beekeeping skills without formal training. Additionally, the formal training some beekeepers receive may not be comprehensive enough to significantly impact beekeeper success. Because of these factors, beekeeping training should be centered around communities where beekeeping is not already prevalent and should focus on key skills such as bee splits, queen interaction, hive nutrition, and monitoring pests (Schouten et al. 2020).

Table 8: Results of *t*-tests and descriptive statistics for three response variables influencing five-year average annual honey production (Schouten et al, 2020)

<i>Groups</i>	<i>M</i>	<i>SD</i>	<i>n</i>	95 % CI for Mean Difference		<i>t</i>	<i>df</i>
				<i>Lower</i>	<i>Upper</i>		
Has one apiary	84.8	2.36	82	0.45	0.89	-2.63**	111
Has more than one apiary	133.0	1.97	31				
Doesn't own vehicle	91.4	2.28	104	0.31	0.88	-2.49**	113
Owens vehicle	174.5	2.10	11				
Dependant on public transport	87.7	2.27	84	0.48	0.96	-2.21*	113
Access to collection services	128.6	2.29	31				
Cannot supplementary feed	101.2	2.24	6	1.08	4.26	2.22*	113
Can supplementary feed	47.1	3.13	109				

* $p < 0.05$, ** $p < 0.01$ (two-tailed)

The increased development of beehives in rural communities diversifies household income, increasing rural communities' resilience to environmental and economic instability. One main lever that could improve both the number of beekeepers and the benefits beekeepers receive from their work is increased financial literacy such as saving and reinvesting. Individuals who reinvested at least US \$57 annually into their beekeeping business had on average significantly more hives and more income over five years than those who reinvested US \$15 or less annually. However, almost 90 percent of beekeepers reported having no ongoing operational costs, which is far below most beekeepers globally. While small-scale beekeeping can be developed around low-input systems, and some equipment can be made from available materials, there are essential aspects of Langstroth beekeeping practices that require ongoing input costs to optimize production and maintain bee health (Schouten et al. 2020). These ongoing input costs include minimizing pest presence, replacing old frames and combs annually, and

purchasing sugar for supplementary feeding during extended drought periods. Because these aspects of beekeeping can have large effects on the yields and hive health, increased financial education could lead to rural households saving more and reinvesting into their beehives, allowing them to receive greater long-term returns.

Carbon Credits

Another route indigenous Papuans can take to receive additional income is through certifying their land for carbon offset credits. A carbon offset credit is a transferable instrument certified by governments or independent certification bodies to represent an emission reduction equivalent to one metric ton of Carbon Dioxide (Carbon Offset Guide 2022). The purchaser, normally a company, can then use the credit to offset greenhouse gas emissions, normally to meet policy requirements or fulfill aggregate reduction goals. In 2021, PNG joined the Indo-Pacific Carbon Offsets Scheme, which allows private companies to purchase carbon offsets generated by Indo-Pacific countries, opening up the potential for large growth in the carbon credit sector (Yin 2021).

While most Papuans do not have the education or resources necessary to register their land for credits, there is a growing number of NGOs within PNG that aid the certification and ongoing maintenance process. One such organization is New Ireland Hardwood Timber Incorporated (NIHT). Its goal is to conserve PNG's biodiversity and tropical rainforests while generating economic growth and social transformation for its people (NIHT 2022). Through an Agriculture Forestry and Other Land Use (AFOLU) permit, NIHT partners with indigenous communities in the New Ireland and Sepik provinces of PNG to register their land as carbon credits under Climate, Community & Biodiversity (CCB) standards. Over the last three years, they have produced over 1.3

million carbon credits ranging across 6.1 million acres. This equates to roughly US \$6.1 million (Ecosystem Marketplace 2021). Host communities receive 56 percent of all profits from the transfer of these credits. Comparatively, indigenous communities get an estimated six percent of profits from logging activities conducted on their land. On top of this, NIHT works to provide partner communities with health, education, and sanitation services along with cash payments. Because carbon payments are given annually and are not large enough to provide for all a household's needs, NIHT also works to develop sustainable agriculture and NFE activities within partner communities to encourage alternative forms of income for indigenous Papuans. In the past three years, over 47,000 Papuans have benefited from NIHT's carbon credit projects in PNG.

While carbon credits can be a great form of supplemental income for indigenous Papuans, it does not come without risk. In other developing countries, some carbon credit programs have been infiltrated by corruption. In 2021, a US \$80 billion Nature Conservation Agreement (NCA) was signed between the Malaysian Chief Minister and Deputy Chief Minister and Hoch Standard, a Singaporean shell company with no history of carbon trading. The contract, which was formulated in secrecy, gives 30 percent of the revenue from carbon credit sales (US \$24 billion) to Hoch Standard. Accusations have come forward claiming that Jeffrey Kitingan, the deputy chief minister of Sabah, threatened to pull his party out of the ruling coalition to bring down the State Government if the NCA was not signed" (Cali Tzay 2022). In March of 2022, an appeal to the UN Special Rapporteur on the Right of Indigenous People was submitted by 19 civil society organizations. The appeal outlines the blatant disregard for indigenous Malaysians in the development and agreement of the NCA. As in any development

project, there is a risk of government officials and companies hijacking the carbon credit process for their benefit, trying to cut indigenous communities out of the picture and keep the benefits for themselves.

Efforts similar to this are already underway in PNG. Recently an Indian company, Kanaka Management Services, entered an agreement binding the company and local Papuans in the Oro Province for 100 years (Sarawak Report 2022). The area comprises 400,000 hectares of forest in a deal expected to generate 8.1 million credits per year. Within the contract, Kanaka Management Services would take over 65 percent of the profit for the first five years. Indigenous communities only receive 35 percent for carbon credits priced at six to eight dollars per credit, below-market rates. Only after 16 years would the company and indigenous groups split profits evenly. On top of that, the agreement also appoints a single representative to speak for the community, something contrary to PNG's user rights outlined in its constitution. With no guidelines for profit distribution to indigenous Papuans, only a small group of high-level individuals would likely see any benefits from this project.

The governor of the Oro Province, Gary Juffa, labeled the deal a "scam", stating that the agreement is void and will not be honored by the local government. While the carbon credits were verified by Verra Verified Carbon Standard (VCS), Carbon Market Watch, a carbon credit watchdog, raised multiple red flags around the formulation and negotiation process of this deal. Since the incident, the PNG government has banned all new voluntary carbon credit schemes until the government can create a regulatory framework for future and existing deals (Donald 2022). Going forward, all future carbon deals must be conducted through the PNG government in partnership with local

communities. While carbon credits have the potential to contain aspects of the corruption that has plagued the mining and logging industry, it also comes without many of the social and environmental effects that those projects contain. For carbon credits to be a credible source of emission reduction, processes within PNG and globally must be put in place to monitor companies dealing in carbon credits, keeping them accountable for protecting indigenous rights and producing ethically-producing carbon credits.

Recommendations for Resource Extraction Projects

Logging

While the legal framework surrounding logging is comparatively strong in PNG, illegality throughout the logging process in PNG is common. The types of illegality include licenses being issued or extended illegally, large-scale breaches of harvesting regulations by extraction companies, and the abuse of licenses for clear-felling forests for commercial agricultural plantations (Lawson 2014). However, there is relatively little completely illegal logging in PNG, and little or no smuggling of timber abroad. While all of these affect indigenous Papuans, the largest driver of illegal logging in PNG is illegality in the permitting process. This is largely due to the almost non-existent enforcement of the law, with penalties often being low, if they are enforced at all. Additionally, government agencies tasked with monitoring logging activities are woefully under-funded, under-resourced, and often unorganized, having no standardized practices for monitoring, opening up cracks for corruption.

However, some recent initiatives provide opportunities for making progress. These include diversifying the stakeholders involved in the permitting process, as well as improving the information management system regarding current permits and incoming

permit applications. The largest priority for the PNG government should be to finalize these information management systems and implement them across logging centers around the country (Lawson 2014).

Additionally, the PNG government needs to increase partnerships with NGOs and research centers inside of PNG attempting to track logging companies and represent indigenous Papuans who have been affected by illegal logging. One such organization is the Center for Environmental Law and Community Rights Inc. (CELOR) based in Port Moresby. CELOR focused on traveling to rural areas exposed to natural resource extraction projects and consulting indigenous Papuans on company relations and Free Prior and Informed Consent values. Anne Kajir, former Chief Executive Officer of the Environmental Law Center and Goldman Award winner in 2006, acted as lead attorney in a Supreme Court case on foreign timber companies' large-scale, illegal deforestation practices. She found evidence of government corruption in both the permitting process and indigenous relations (Roetzel 2021). After traveling to rural communities, she brought up evidence of logging companies forcing Papuans to sign logging deals at gunpoint, leading to the logging industry paying millions in damages to Indigenous landowners.

Mining

While copper, nickel, gold, and silver mines have made heavy contributions to PNG's GDP since 2000, many citizens question the claims that mining has overall benefitted PNG citizens. This is largely due to the struggle of the PNG government to turn revenue from mining projects into social, economic, and environmental progress in PNG. While there are a variety of dangers when developing mining projects in PNG, two

areas that could lead to direct improvement are limiting environmental damages through mandating proper management of tailings and ensuring local communities' voices are heard by creating best practices for community interactions and development projects (Connell 1997).

Currently, PNG is one of the few countries that allow large-scale mines to dispose of tailings and waste rock into rivers and oceans, with Indonesia and Turkey being the only others (Mudd et al. 2020). In almost all major mining countries such as Australia, Canada, and Chile, conventional approaches to minimize pollution are required by law. Because these mines are often dumping hundreds of millions of tons of waste rock and tailings into these rivers (Figure 4), local riverways and soil can see large changes, affecting plant, and animal life. Normally, tailing dams or waste rock dumps are constructed to minimize the waste dumped into the water systems. In PNG, the main arguments used to support the absence of these strategies are the high costs of constructing these dams or dumps in rural areas, as well as the risks these projects face from rainfall, flooding, difficult topography, and seismic activities. This effectively shifted the costs of these services to the environment and local communities. In some cases, these costs were not avoided, as future lawsuits over environmental damages, as seen at the Ok Tedi Mine, have cost mining companies millions in reparations (Mudd et al. 2020).

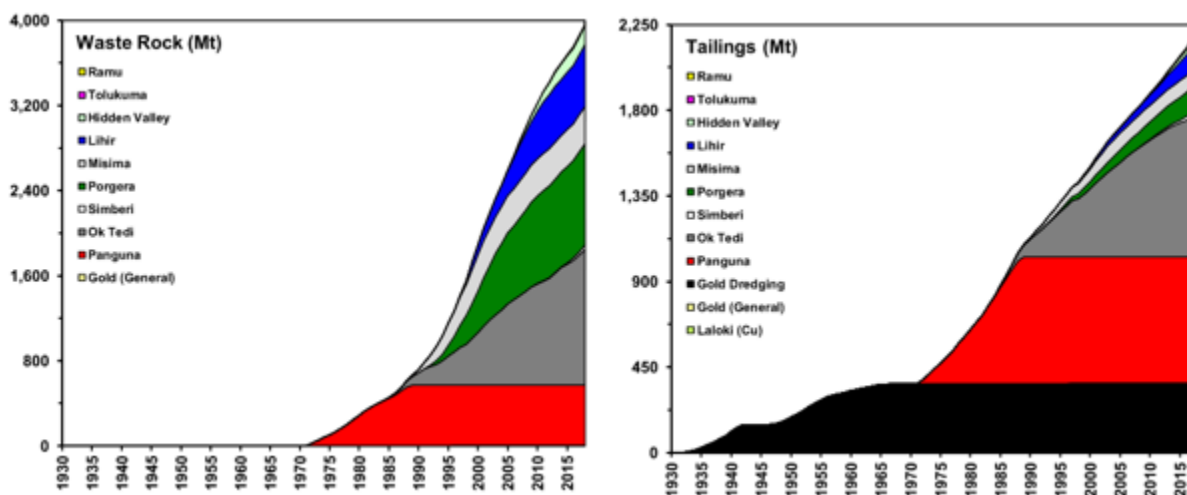


Figure 7: *Estimated cumulative waste rock (left) and tailings (right) for PNG from 1930 to 2018 (Mudd et al. 2020)*

To protect both local communities and the environment surrounding these mining projects, the PNG government should require mining companies to use industry-standard strategies to keep waste out of local riverways. While this will increase mining operation costs, it is no more expensive or risky than the development of the infrastructure required to operate these mines in remote and undeveloped areas of PNG, which mining companies are happy to pay in exchange for access to valuable minerals.

While the vast majority of mines within PNG dispose of tailings and waste rock into local water systems, there are examples of mines within PNG, such as the Hidden Valley gold and silver mine, that have engineered tailings dams (Mudd et al. 2020). Additionally, the proposed Frieda Mine plans to build a facility to house both waste rock and tailings in a dam. These efforts show that alternatives to dumping runoffs into local waterways are feasible for mining operations in remote areas of PNG.

These improvements, as well as the failures of the past, have led to significant legislative developments in recent years. In 2020, PNG's Constitutional and Law Reform

Commission, alongside Prime Minister James Marape, announced their reformation of mining laws regarding waste disposal. Specifically, the use of riverine mine waste disposal (RMWD) is banned in all future mining projects to protect the environment and the livelihood of local communities (Mudd et al. 2020). While existing mines do not need to renovate their disposal techniques, this policy pushed mining operations in PNG in the right direction.

While the banning of RMWD can help limit the effects of mining on local riverways and the environment, the government must be meticulous in the implementation of this policy. Foreign companies have been known to submit Environmental Impact Assessments (EIAs) with discrepancies around environmental impacts, standards, and plans. At the Hidden Valley mine project, a mine with an engineered tailings dam, an incorrect environmental impact assessment, and poor mine management led to the large-scale dumping of between 20 and 30 million tons of sediment into the river (Mudd et al. 2020). This likely doubled sediment rates within the Watut River, having long-term effects on local communities and the environment, changing water quality, oxygen levels, and biodiversity within the river. Similarly, there have been multiple reports of false assessments within the proposed Frieda Mine's EIA, with multiple communities and NGOs submitting Human Rights Complaints to the Australian government (Save the Sepik, 2021). To minimize the potential for local riverways to be polluted, the PNG government must ensure that foreign companies submit feasible EIAs and use consistent industry-standard strategies to account for waste rock and tailings. To do this, the government should intensify the EIA review process, partnering with independent consultants to review mining EIAs, as well as giving all

stakeholders involved an opportunity to voice their concerns before the implementation of the mine. Additionally, once the mine is constructed, the government should conduct annual reviews of tailing dams to ensure their operations are up to standards (Mudd et al. 2020).

While the banning of RMWD practices is a large step for environmental protection around mining projects, the PNG government should also ban the use of marine mine waste disposal (MMWD), or the disposal of mine waste into marine environments (Mudd et al. 2020). This method is currently used at the Lihir and Simberi mines and has recently been approved for the planned Wafi-Golpu and Woodlark Island mines. The major concerns with this process are the significant impacts it could have on marine health and biodiversity, the lack of transparency around the quantity of dumping, and the difficulty of monitoring and enforcement of government regulations (Vare et al., 2018; Mudd et al. 2020). In Basamuk Bay, the widespread use of RMWD at the Simberi mine has led to large-scale environmental degradation in the bay, as well as multiple litigations being lodged against the copper and nickel mine in 2020 (PNGMW, 2020).

Additionally, at the Lihir mine, MMWD was used due to the small nature of the island on which it is based (12 km). Mining tailings were disposed in the deep sea, while the waste rock was disposed of in the shallow bay. While it is difficult to calculate the total effect that MMWD has on the environment, research has shown that species abundance and taxon composition have been significantly affected by deep-sea disposal (Haywood et al. 2016). Effects were so significant that changes in sentiment levels could be measured 20 km offshore at depths of 2,000 meters. With many coastal communities relying on fish populations and reefs for their wellbeing, these environmental changes

have similar impacts as RMWD has on inland indigenous Papuans. Because of this, the Constitutional and Law Reform Commission should take steps to review the environmental effects of MMWD in the same manner they did RMWD, to ban MMWD throughout the country (Mudd et al. 2020).

Agriculture

The state of agriculture in Papua New Guinea is in a unique position. With a growing rural population and over 85 percent of Papuans relying on shifting agriculture to sustain them, there is a demand for agriculture growth (Schouten 2019). At the same time, much of PNG's forests, some of the most biodiverse on Earth, have been cut or are in danger of being cut due to logging and subsistence agriculture. Many government officials have targeted agriculture as the main focus for development in the coming decade. This is largely because, while its growth must be monitored, agriculture development can provide communities with supplementary income on top of other NFOs for rural development programs. For example, the payments Papuans receive from NIHT, which partners with rural Papuans to turn forests into carbon credits, are often not enough to sustain Papuans year-round (NIHT 2022). So, NIHT also provides guidance on the sustainable development of cash crops local communities can use to protect their environment and provide for their family. Even though this may impact the local environment, the overall impact on the environment is much smaller than if these communities sold their land to logging companies.

Additionally, when comparing agriculture to other rural development projects, small improvements in agriculture could have large-scale benefits across PNG. One main way the PNG government could spur these improvements is through educating Papuans

on certain agriculture practices that could improve their yield, therefore lowering the demand for new farms. Research conducted by Southern Cross University in Australia targeted five pillars for agricultural development in PNG. Their analysis concluded that small-scale agriculture enterprises could be improved by enhanced efforts to provide Papuans with additional education and resources surrounding agriculture extension, agriculture nutrition, pest and disease control, and genetics and technology (Schouten 2019).

The development of education and training programs focused on these areas could improve agriculture yield and sustainability across rural PNG. Because most Papuans are suspicious of outsiders, one strategy that has shown strong potential is for NGOs or government agencies to identify and train a small group of local individuals, who then will act as trainers for the rest of their community. These trainers, who have established relations within the community, could provide clear and practical training on farming extension and sustainable practices within their community. Research has shown that this increases unity across farmers within the community, encouraging participatory strategies to combat problems. Participatory approaches have been effective in developing lasting commitment to learned processes, as well as creating sustainable social capital within the community (Bradbear, 2009; ICIMOD, 2019). For example, in the Eastern Highlands Province of PNG, *Tropilaelaps* mites were decimating agriculture yields. In response, local farmers and outside researchers partnered to test a variety of techniques for managing the *Tropilaelaps* mites. Farmers, beekeepers, NGOs, and local governments worked together to find an effective solution, working with leaders within each community. Once a solution was found, these leaders shared these strategies throughout

their community, ultimately leading to the minimization of *Tropilaelaps* mites' impact on agriculture and beekeeping yields (Schouten 2019). To expand the potential for these trainings, local governments should both increase funding to relevant NGOs and government agencies such as the Fresh Produce and Development Agency, which aims at training communities on horticulture and providing rural communities with access to technologies and transportation to grow the fresh produce industry within PNG (FPDA 2022). Examples such as this show the benefits of outside researchers, NGOs, and the government partnering with local farmers to improve agriculture yields and develop sustainable practices (Schouten 2019).

While the majority of Papuan agriculture is sold domestically, one crop with the potential for growth that could lead to a strong global market share is coffee. Coffee is second only to crude oil as the most valuable internationally traded commodity (Stewart, 2021). This is because the vast majority of coffee produced is traded internationally, providing developing countries with large global markets that often provide higher returns. In PNG, coffee and cocoa are the main cash crops, employing half of the formal labor force within PNG (IFAD 2022). In 2020, PNG exported US \$117 million worth of coffee, with the United States (32 percent), Germany (24 percent), and Australia (15 percent) being the largest destinations for PNG coffee (OEC 2020). However, PNG is ranked 17th in coffee production, producing less than 0.5 percent of the US \$460 billion worth of coffee produced each year (Statista 2022; Perfect Daily Grind 2021). The World Bank estimates that a lack of efficient farming techniques and support reduce coffee yields by 30 to 50 percent (IFAD, 2022).

PNG's climate is naturally suited for coffee, with early planters in the 1960s describing it as "money which grows on trees" (Stewart, 2021). In these early days of coffee production, European planters established successful partnerships with indigenous Papuans to sell locally-grown coffee internationally (Sengere, Curry, and Koczberski 2019). This led to PNG developing a reputation for producing premium coffee for overseas markets. However, in the 1980s, the lack of foreign support and the closing of coffee plantations due to PNG's independence led to the decline of these partnerships, followed by a consistent decline in coffee quality and production (Allen et al., 2009).

Today, about 85 percent of coffee is produced by smallholder farmers. However, poor transportation networks, lack of efficient farming techniques, and deficient market information and organization are some of the main variables that led to the World Bank estimating that coffee yields are reduced by 30 to 50 percent within PNG. For example, most indigenous farmers do not use industry-standard replanting strategies, meaning most coffee trees are over 40 years old and produce less than younger trees (Bailey 2009). With the industry set to grow by more than 5 percent annually, one route the PNG government could take to improve market production would be the growth of partnerships between small-scale coffee growers and chain leaders (Statista 2022).

While mostly unsuccessful, there have been multiple efforts to improve smallholder coffee production and yields by providing rural producers with improved training and resources. Sengere's 2019 article found that these efforts have struggled to spur improvement due to weak institutional leadership and governance, poor program design, and minimal monitoring (Sengere, Curry, and Koczberski 2019). However, there is a plethora of evidence that partnership between foreign distributors and the growth of

collective action among farmers can benefit both parties (Kolk and Lenfant, 2015; Wollni and Fischer, 2015). These strategies often lead to better prices and greater support and market access for farmers (Sengere, Curry, and Koczberski 2019). For example, Rwandan cooperative farmers reported significantly higher productivity per hectare than independent farmers.

These distribution partnerships traditionally originate from either government agencies or private non-state actors. The government generally creates these partnerships to monitor sector production and create sustainable guidelines for how businesses should behave (Bitzer, 2012). In enhance their profits, private actors often engage in these partnerships to provide farmers with the resources, strategies, and infrastructure to improve their yields and sell their products globally. Due to the PNG government's historical struggle to provide strong institutional leadership and program design, the development of partnerships between private companies and indigenous Papuans would likely be more successful for both parties. However, because private parties may not be as concerned with sustainability standards and indigenous rights, these partnerships should be reviewed by the PNG government before initiation.

While these strategies can be successful, distribution partnerships and collective action organizations may not be beneficial for all farmers. For poor and remote farmers, the transportation of coffee to distributors, as well as the quality requirements of distributors, may make these services less beneficial than traditional selling methods (Sengere, Curry, and Koczberski 2019). However, in areas where coffee production is common, such as the Highland Province, both distribution partnerships and cooperative

organizations have the potential to improve the productivity and quality of coffee by providing rural farmers with improved agriculture services and resources.

For example, one cooperative in Morobe Province has successfully produced high-quality coffee since 2008. It has a total of 647 members, with over 200 hectares dedicated to coffee. The average annual income from coffee sales for each member was US \$225 from 2009 to 2014 (Sengere, Curry, and Koczberski 2019). Partnering with international distributors, farmers have received improved training, farm inputs, and credit, leading to production attaining almost double the average productivity of smallholder farmers per hectare (UniQuest Pty Ltd., 2013). They have even been verified as a Fair Trade certified operation (Sengere, Curry, and Koczberski 2019). Through partnerships, they have received funds for community development, creating a community water supply system and an elementary school. The steady growth of the cooperative has allowed members to diversify their income, creating a transport business that drives coffee and other products to the city of Lae, where partners ship coffee internationally. They have also expanded their production into other income-generating activities such as fishing and apiculture.

One of the leading drivers of the success of this cooperative is the high group cohesion and leadership standards within the group. Some of the leadership methods, such as electing local leaders, were requirements for Fair Trade certification, which has been shown to strengthen governance systems within organizations (Fairtrade Labeling Organizations Internals, 2005). While they may have been requirements to start, they have become integral to the success of the cooperative. The group meets regularly to discuss business decisions, community development projects, and collective marketing

(Sengere, Curry, and Koczberski 2019). These structures have led to high levels of trust within the cooperative. They also help the producers to clearly describe the wants and needs of community leaders, which can then be relayed to distributors. These organizational aspects of the cooperative have helped improve yield and social aspects of the community as a whole.

Because of low education rates and business experience, these rural communities will likely require assistance in the development of their cooperatives, as well as the application for certifications, such as the Free Trade certification. Therefore, to attain these higher levels of returns, yield, and market access, the PNG government and agriculture-based NGOs should make it a priority to provide rural communities with the training and resources necessary to organize local producers into cooperatives, as well as encourage partnerships between these cooperatives and international distributors. These cooperatives must be organized, with established management principles, before they sell their products. Once established, these organizations can partner with distributing organizations, which can provide additional services to producers. Government agencies should continue to monitor these partnerships from contract to production, ensuring that indigenous Papuans are receiving equitable rates and services. By developing these cooperatives and partnerships, Papuan producers can receive better training, resources, and prices that can not only improve their household income but provide their communities with better social services.

NGO and Faith-Based Organization (FBO) Partnerships

Historically, the PNG government's efforts to efficiently and effectively turn government funding into social services for rural Papuans have failed. One reason for this

is the government's focus on a top-down approach to rural development through national initiatives such as the Sustainable Development Goals (SDGs), which aim to improve rural conditions for all Papuans by 2030. While these top-down programs have had some success in peri-urban communities, they have largely failed to support growth within remote communities. This is due to a variety of reasons. First, each rural community hosts unique geographical and cultural characteristics, meaning there is no standardized solution that can be applied to rural communities, which has historically been the strategy used by the top-down approach. This is reflected by the lack of improvement in the standard of living indicators across rural PNG since the early 2000s. Additionally, government funding often is not distributed effectively and evenly, largely because of PNG's WanTok values and corruption within the government. If funds meant for rural development are even distributed to that cause, government officials often prioritize their clan or community above others, leaving many communities lacking the resources they need to strive for development (Saverimuttu and Cochran 2018).

If, alternatively, PNG's local and national government focus on a bottom-up approach to rural development by involving non-government and private partnerships can help create social value, entrepreneurship, and improved wellbeing for rural communities. Evidence shows that initiated development from the bottom-up approach works better in indigenous communities, likely due to its focus on community participation and ownership of developments at the village level (Fraser et al, 2005). Within PNG, implementation of this 'bottom-up' approach has been successful in both commercial and conservation initiatives (O'Brien and Ponting 2013; Benson 2012). This bottom-up approach involves investing in small-business development, expanding the

private sector's access to investment opportunities, and improving business and financial literacy (Saverimuttu and Cochran 2018).

One strategy to implement this bottom-up approach to rural development in PNG is through the increased partnership and funding of PNG-based non-government organizations (NGOs) and faith-based organizations (FBOs). Since PNG's independence, NGOs and FBOs have provided PNG's rural communities with services and products aimed at spurring social entrepreneurship and improving livelihood (Saverimuttu and Cochran 2018). Within PNG, there are a vast number of NGOs and FBOs aimed at solving many of the problems rural communities face, including agriculture development, women empowerment, carbon credits, medicine delivery, education, and small-business development. These organizations, who normally emphasize partnering with the indigenous Papuans, are better equipped to understand an individual communities' unique characteristics and needs and respond accordingly.

Large churches play an important role in social aspects of rural communities, hosting community gatherings and often providing medical services to the community. Because of poor prior experiences and rumors of outsiders' intentions, many rural Papuans are very critical of outside aid. It takes time for organizations to build a reputation and gain trust in communities, another reason top-down development initiatives, which can be impersonal and focus on output rather than relationship-focused, have struggled. Many rural churches have spent decades developing relationships alongside the goods and services, such as clinics and education, they provide. Because of this, FBOs have gained trust and respect within the community. For example, in one community, Buansing, community concerns about health, economic issues, and other

problems are often raised at meetings following church services (Saverimuttu and Cochran 2018). One impact this has had is the amplification of women's voices. Local Iwal government officials attend Lutheran district meetings to discuss social issues in the community. Here, Iwal women hold a place of power, representing their community in Buansing, even overruling men at times. Actions such as these help to break down barriers women face in attaining leadership roles in PNG (Saverimuttu and Cochran 2018).

Similarly, NGOs play an important role in providing rural communities with more specialized services to improve livelihood, as well as acting as a gatekeeper for the PNG government and private companies. Additionally, some uphold the unique position of acting as advisors for local communities during negotiations between rural communities and companies, ensuring rural Papuans get the money and services they deserve (ACFID, 2015, 19). This is because NGOs often have the resources, experience, and influence necessary to either provide services themselves or urge businesses to assume responsibility for marginalized communities and encourage investment into the creation of social value (ACFID, 2015; Seelos and Mair, 2005). To create alternative forms of income for these communities, it is crucial that NGOs and the private sector aid in the initiation of entrepreneurial opportunities and frugal innovation. Due to the lack of education and business experience, most individuals within these remote communities have, NGOs and FBOs often play an important advisory role in the development of entrepreneurial ideas and business strategies. Examples of this within Buansing include the processing and selling of cacao beans and the use of bamboo as a substitute for the more expensive PVC pipes (Saverimuttu and Cochran 2018).

Additionally, these organizations are often headquartered in nearby cities and have developed relationships with local or national government officials. Because of this, they are often equipped to lobby on the behalf of these remote communities, improving the likelihood of the development of infrastructure, education, or health services in those remote communities (Saverimuttu and Cochran 2018).

Providing social and economic services to a large number of remote communities within PNG is a complex process. Due to the lack of resources and organization, government agencies are often unable to provide these successfully. In these circumstances, NGOs and FBOs are often better equipped to engage with these communities and provide advice on economic and social improvement. However, as travel to these remote communities is often difficult and expensive, these organizations are often limited in their ability to meet the demand for their services around PNG. Because of this, it is important that the PNG government partners with credible NGOs and FBOs within PNG provide them with the resources, both monetary and infrastructural, to meet the needs of remote communities across PNG.

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