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# Constraints Facing Rural Poultry Production in PNG

## The Role of Input Suppliers

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## INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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**Abstract**

*Context*: The average consumption of protein foods in Papua New Guinea (PNG) remains insufficient to meet nutritious diet guidelines, especially in rural areas. While an expanding literature has demonstrated that poultry is a cost-efficient animal source food to increase protein intake, rural households in PNG face high prices at the market for poultry meat. Similarly, the high price of poultry production inputs constrains greater uptake of rural poultry production. PNG's heavy reliance on feed (and feed input) imports, as well as high transportation costs and insufficient rural manufacturing and processing infrastructure creates limited opportunities for rural subsistence and commercial poultry production growth.

*Objective*: There is a lack of value chain studies to understand the feasibility of expanding the local mini livestock feed mill model in PNG to increase poultry feed supply in underserved areas. This study builds from earlier work on rural livestock feed infrastructure programs, and aims to fill the knowledge gap on the opportunities and constraints for expanding domestic livestock feed production and distribution via rural mini feed mills.

*Method*: The International Food Policy Research Institute (IFPRI) and the National Agriculture Research Institute (NARI) conducted in-depth qualitative interviews with 8 mini mills and 13 poultry farmers across 4 highland provinces during October and November 2022. We synthesize the interview transcriptions of the qualitative interviews in tandem with quantitative analysis of food consumption and agri-food trade data, as well as the authors' own field observations in this paper.

*Results*:
The in-depth interviews showed that the poultry farmers who purchased from local mini feed mills substantially lowered their feed costs, resulting in greater gross profits compared to rural poultry farmers that only sourced feed from commercial feed suppliers. However, the mini feed mills that we interviewed outlined a series of challenges in sustaining rural feed mills in PNG. The main challenges of running a successful mill included feed mill equipment procurement, electricity reliability, reliable raw ingredient supply, mini mill retailing to secure a client base, and adequate information about feed formulation. We identified two potential approaches that have overcome many of the identified challenges, that could be replicated and adapted to expand mini feed mill operations in the Highlands. The first approach is a farmer cooperative model that incorporates credit and feed delivery services to cooperative farmers. In doing so, they are able to better estimate volume demand for processed feed and accommodate feed production accordingly. The second approach follows a lead firm model, whereby a local farm supply retail outlet is expanding its business to include livestock feed production and supply, overcoming equipment procurement constraints given their previously developed business model focused on farm implement supply. Our evaluation provides detailed costs and benefits of both approaches for potential expansion of these livestock feed producer and distributor models.

Keywords: Papua New Guinea, Poultry, Value chain, Feed.

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# 1. Introduction

Although Papua New Guinea has achieved lower-middle income status, recent analysis suggests that a large share of the rural population is not meeting minimum dietary nutrition targets (Schmidt et al., 2022). Recent survey data suggest that almost half of the surveyed households do not consume sufficient daily amounts of protein (Schmidt et al., 2020). Although poultry production has been touted as a low-cost, efficient means of increasing animal-source protein in low-income countries (Fang et al., 2021; Nordhagen and Klemm, 2018), domestic poultry production in PNG remains relatively low.

The growth in poultry imports in PNG suggests a shift in demand towards increased consumption of protein-rich foods. Poultry imports (primarily from Australia) increased, from a low base, more than 28 percent (Real 2021 USD) on average between 2005 and 2021, growing at 24 percent per capita per year. However, household consumption expenditure data suggest that rural households (which comprise over 80 percent of the population) consume substantially less poultry and other animal-sourced products compared to urban households. The per capita consumption of animal-sourced foods in urban areas of PNG is about three times that of the rural areas for both poor and non-poor households.

Comparing the cost of poultry meat per kilo in PNG with neighboring countries, we find that on average, poultry costs about 3 times in PNG than in Indonesia, and about 2 times than in the Solomon Islands. The low poultry consumption rate in rural areas of PNG is due, in part, to the high price that rural households face for poultry meat and/or poultry production inputs. The two large scale domestic poultry producers for the entire country are located in Lae city, which houses the only industrial sea port where producers can obtain poultry inputs (e.g., day-old-chicks, feed, and feed ingredients) at a lower cost, bypassing significant transaction costs of handling, loading, and transporting inputs on PNG's underdeveloped and poorly maintained on-land transportation network.

Both small scale domestic and commercial poultry production in PNG relies on imported livestock feed and / or concentrates (to supply the protein element of the feed formula). PNG's heavy reliance on feed (and feed input) imports, as well as high transportation costs and insufficient rural manufacturing and processing infrastructure (e.g., electricity, ICT, processing and storage facilities and

machinery, etc.) creates limited opportunities for rural commercial poultry production. Day-old-chick (DOC) and poultry feed become cost prohibitive as transaction costs are added to initial input costs, resulting in limited demand for (and supply of) poultry inputs in rural areas.

This study builds upon earlier work by the National Agricultural Research Institute (NARI) in collaboration with Australian Centre for International Agricultural Research (ACIAR) (de Koning and Kohun, 2019). Between 2012 and 2016, NARI and ACIAR developed a poultry feed formula that uses local ingredients such as sweet potato and cassava to produce livestock feed. They then supported a series of mini feed mills that use local ingredients and small-scale equipment to produce poultry feed with the goal of decreasing overall feed costs for rural poultry producers.[1] NARI piloted several mini-mill trials in different highland provinces (Glatz, 2017). However, after program implementation, results suggest that trials remain localized within the pilot project areas, sometimes discontinuing after project completion (Mehta and Galgal 2019). According to Glatz (2017) and Mehta and Galgal (2019), there is a lack of value chain studies to understand the feasibility of expanding the local mini feed mill model in PNG to increase poultry supply in underserved areas.

This study aims to fill the knowledge gap on the opportunities and constraints for expanding rural livestock feed production and distribution via rural mini feed mills. During October and November, 2022, IFPRI and NARI conducted qualitative interviews with the mini feed mills that participated in the NARI-ACIAR pilot study. In doing so, we used a snowball sampling approach where we first interviewed operating mini-feed mills from the earlier NARI / ACIAR program. We then asked the mini mills to provide contact information for the poultry farmers and input retailers that they work or partner with, whom we also interviewed (Appendix A1 provides the interview guides for mini feed mills). Given that the NARI mini mills program focused on the Highlands area of PNG, we sampled 8 mini mills and 13 poultry farmers across 4 highland provinces between October 16th and November 6th, 2022.[2] We

[1] It is also common in many other countries (e.g. Nigeria, Uganda, Indonesia) that rural poultry farmers produce feed using mini mills and source local ingredients (Apantaku et al., 2006; Lukuyu et al., 2013; Mege et al., 2015).

[2] The input retailer interviews are not discussed in this paper because mini mills have not linked to retail shops to sell feed, rather the mini mills interviewed in this study sell feed directly from the mill rather than via 3rd party input retailers. Similarly, the retailers reported that they did not sell mini mill feed in their retail shops.

synthesize the interview transcriptions of the qualitative interviews, as well as the authors' own field observations in this paper.

The following section reviews poultry consumption trends in PNG during the last 2 decades, evaluating the importance of imports and the difference of consumption patterns between rural and urban areas. Section 3 describes the total costs and revenue of poultry production in PNG based on the farmer interviews we conducted in the Highlands. Farmer interviews uniformly identify comparatively high input costs as a primary obstacle to expanding poultry production, thus we extend our analysis to compare poultry input costs between PNG and neighboring countries. Section 4 investigates the opportunity for mini feed mills to fill some of the rural gap in feed input supply. In doing so, we outline the major constraints to supply sufficient (both in terms of quantity and quality) livestock feed to rural areas. Section 5 discusses two potential 'model' mini feed mill operations that innovated their business models to address some of the challenges that all of the poultry farmers and feed mills mentioned during interviews. If the mini feed mill model is to be expanded, learning from these businesses would be insightful to ongoing efforts to promote rural livestock feed production. Finally, Section 6 concludes.

## 2. Consumption of poultry in PNG

Rapid growth in the PNG economy and population has created higher demand for animal-sourced foods such as pork, poultry, and eggs. One reason for the rapid increase of poultry meat imports is the comparatively high price of domestically produced poultry meat in PNG (retail price in PNG in 2019 was about $8 per chicken; 4.2 $/kg for live weight; and 5.7 $/kg for dressed weight) (Kosec et al., 2022). In Indonesia, the retail price of live chicken was 1.5 $/kg in 2019, about one-third the price in PNG (USAID, 2013; Mehta and Galgal, 2019; Nugroho, 2020).

While animal-sourced food imports continue to increase, the average consumption of protein foods in PNG remains insufficient to meet nutritious diet guidelines, especially in rural areas. Data from the PNG Rural Survey on Food Systems (IFPRI, 2018) reveal that about half of the rural sample in Momase region consumed less than the recommended protein quantity (Schmidt et al., 2020).

Data from the 2009/10 HIES suggests that urban households consumed about half the poultry meat in PNG despite comprising only 15 percent of the total population (Table 1). Per capita consumption of poultry in urban areas is thus significantly higher for both the urban poor and non-poor (8.5 and 20.3 kgs/person/year) than for the rural poor and non-poor (0.2 and 4.2 kgs/person/year) (Table 1). More recent nationally representative data is not available, however the surge in poultry imports over the past decade, suggests that the concentration of poultry consumption in urban areas is even greater than in 2009/10.

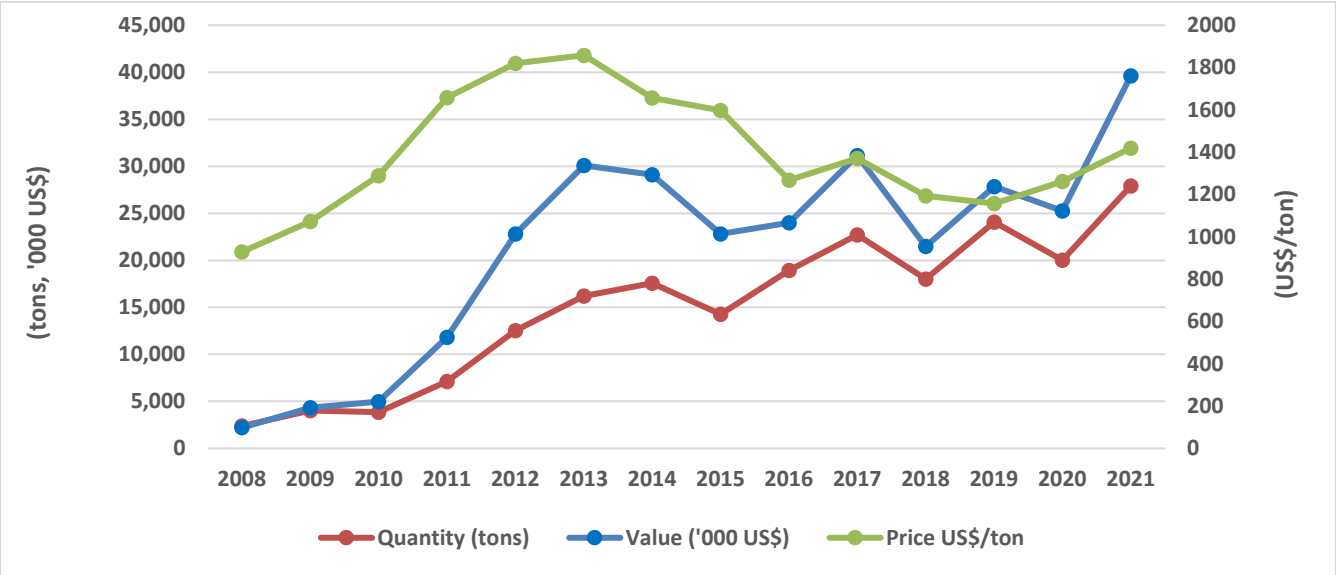
**Table 1: Poultry Consumption in PNG (2009/10)**

| | Urban | | Rural | | All PNG | | All PNG |
|---|---|---|---|---|---|---|---|
| | Poor | Non-poor | Poor | Non-poor | Poor | Non-poor | Total |
| **Consumption / person (kgs)** | 8.5 | 20.3 | 0.2 | 4.2 | 1.3 | 6.5 | 4.2 |
| **Consumption ('000 tons)** | 3.6 | 10.6 | 0.5 | 13.6 | 4.1 | 24.2 | 28.2 |
| **Consumption share (percent)** | 12.7 | 37.4 | 1.8 | 48.2 | 14.5 | 85.5 | 100.0 |
| | | | | | | | |
| **Consumption (mn kina)** | 3.58 | 10.55 | 0.51 | 13.60 | 4.09 | 24.15 | 28.24 |
| **Consumption / person (kina)** | 97.3 | 208.7 | 12.7 | 39.5 | 24.4 | 62.9 | 45.7 |
| **Food consumption (mn kina)** | 600 | 1,289 | 2,086 | 4,933 | 2,686 | 6,222 | 8,909 |
| **Poultry share of food expenditure (percent)** | 6.8 | 8.4 | 1.6 | 2.6 | 2.8 | 3.8 | 3.5 |

**Source:** Authors' calculations from HIES 2009/10.

The total volume of chicken meat imports has grown steadily over time (Figure 1). The quantity of chicken meat imports in 2021 was more than ten times that of 2008 (27.9 and 2.4 thousand tons, respectively). The average price of chicken imports has remained relatively stable in nominal terms in recent years, ranging from $1.16/kg to $1.42/kg, from 2016 to 2021. As a result, the value of poultry imports has risen steeply, along with the increase in quantities.

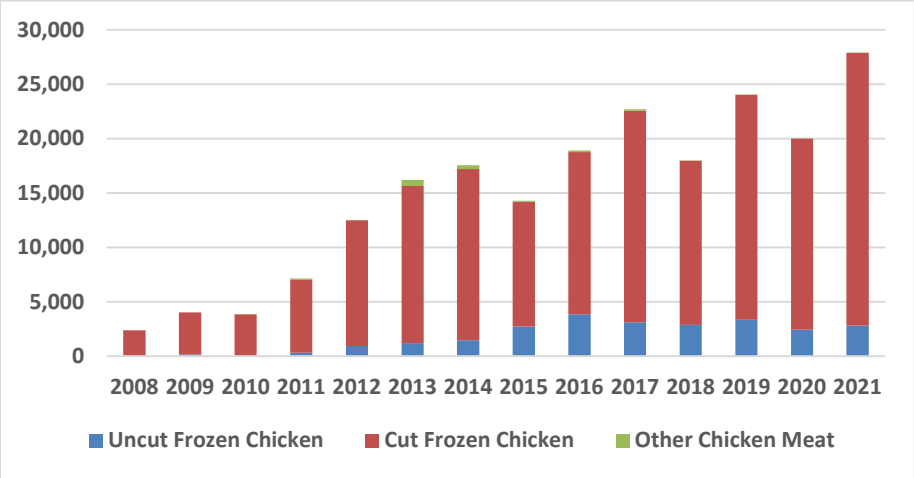
**Figure 1: PNG Poultry Imports, 2008-2021**




Source: Calculated from COMTRADE (2023) data.

Most of these imports of chicken meat are in the form of cut frozen chicken, which accounted for 85.6 percent of supply from 2016 to 2021. Uncut frozen chicken accounted for 14.0 percent of the trade; other forms of chicken meat imports were only 0.4 percent of the total value of the chicken meat imports in this period (Figure 2). In 2021, PNG was the largest importer of poultry meat, comprising 35.2 and 34.9 percent of frozen poultry meat exports, from Australia and New Zealand, respectively.

**Figure 2: PNG Imports of Chicken by Type, 2008-2021**

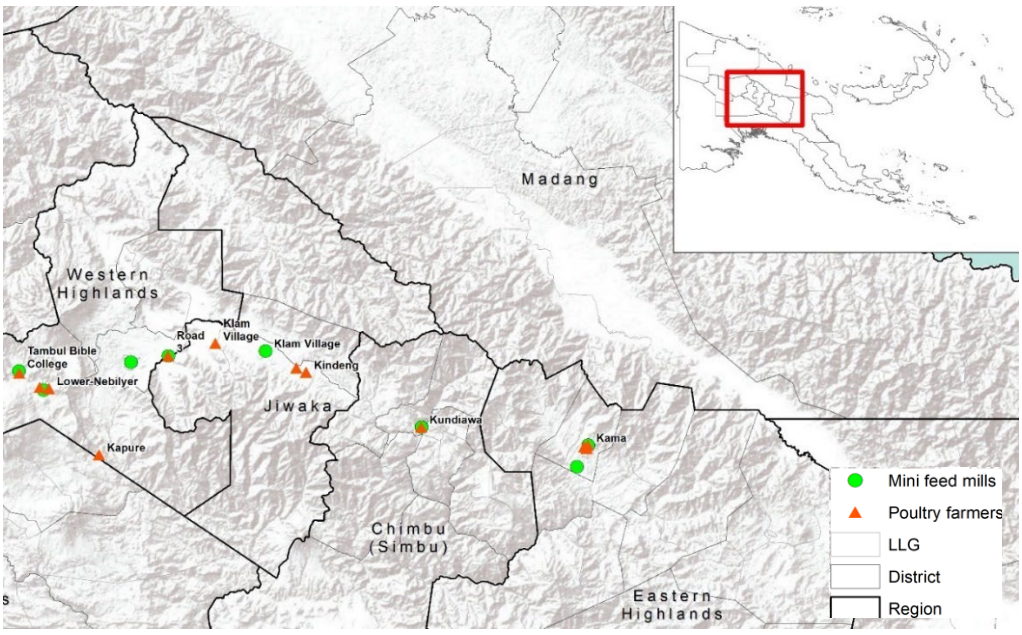



Source: COMTRADE (2023) data.

## 3. Rural Poultry Production and Farmer Input Prices

This study focuses on broiler chicken farmers, as broiler chickens are the main species sold at local markets. Building upon the NARI / ACIAR program that was implemented between 2012 and 2016, we tracked and interviewed 13 broiler chicken farmers that were previously involved in the program (Figure 3). The mini-mill program that NARI and ACIAR implemented focused on farming communities along the highlands highway. Most farmers in this area benefit from relatively more direct access to Lae city, however operate at small production capacity, rearing one box of day-old-chicks (52 DOCs) in each cycle (about 7 weeks per cycle). Three of the 13 broiler farmers raise up to three boxes of chicks (about 150 chickens) in a cycle, requiring greater infrastructure including chicken houses and equipment.[3] According to the broiler chicken producers, the high cost in conducting poultry farming and transporting live chicken to markets continues to stifle producers from expanding their business.

**Figure 3: Locations of mini feed mills and poultry farmers surveyed**




Source: Authors' compiled based on IFPRI-NARI mini feed mills and poultry farmers survey in the Highlands 2022.

We estimate the gross margin per cycle of the 13 poultry farmers we interviewed using reported revenue and cost items (Table 2). Estimating the stream of sales and purchases suggests that about 2/5 of

[3] Farmers reported rearing broiler chickens for about six to eight cycles per year, producing about 500 chickens per farm per year.

the interviewed farmers experience a gross profit rate lower than 10 percent. All of the poultry farmers we interviewed reported that the high cost of poultry feed is a primary constraint to maintaining profitability. Price increases during the last year (2021-2022) have left some farmers to consider quitting the poultry business. According to poultry farmers, the average price of commercial stock feed in the Highlands increased by more than 60 percent between 2018 and 2022, from about 90 PGK for a 40 kg bag (about 0.6 USD/kg) to 145 PGK for a 40 kg bag (about 1 USD/kg).[4] However, the average selling price of live chicken is not increasing at comparatively similar rates, growing by about 17 percent (from 30 PGK/live chicken to 40 PGK/live chicken) over the same period.

[4] Similarly, the price of day-old-chicks (DOCs) increased from about 270 PGK/box (52 DOCs per box) in 2018 to approximately 300 PGK/box in 2022.

**Table 2: Input costs, revenue, and profitability of the interviewed farmers per cycle**

| Poultry farmer No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DOC cost per cycle (Kina)** | **525** | **350** | **525** | **975** | **270** | **270** | **450** | **300** | **840** | **300** | **300** | **270** | **780** | **473** |
| No. of boxes of DOC per cycle | 1.5 | 1 | 1.5 | 3 | 1 | 1 | 1.5 | 1 | 3 | 1 | 1 | 1 | 3 | 1.6 |
| No. of cycles per year | 8 | 7.5 | 7.5 | 6.5 | 4.5 | 6 | 4.5 | 10 | 7 | 6.5 | 8 | 4.5 | 4 | 7 |
| Total no. of chickens in a year | 624 | 390 | 585 | 1014 | 234 | 312 | 351 | 520 | 1092 | 338 | 416 | 234 | 624 | 518 |
| DOC price per box (Kina/box) | 350 | 350 | 350 | 325 | 270 | 270 | 300 | 300 | 280 | 300 | 300 | 270 | 260 | 302 |
| **Feed cost per cycle (Kina)** | **1197** | **1216** | **1744** | **2604** | **1133** | **1314** | **1824** | **930** | **4195** | **1029** | **862** | **1015** | **3150** | **1751** |
| Commercial feed price (Kina/bag) | 150 | 150 | 144 | 144 | 148 | 143 | 150 | 150 | 139 | 142 | 150 | 140 | 135 | 145 |
| Bags of feed used per cycle | 5 | 8 | 8 | 6 | 7.5 | 9 | 8 | 6 | 10 | 7 | 5 | 7 | 7.5 | 7 |
| Local ingredient[1] total cost (Kina) | 62 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 62 | n/a | 92 | 72 |
| Total transportation cost for feed | 10 | 16 | 16 | 12 | 23 | 27 | 24 | 30 | 40 | 35 | 50 | 35 | 20 | 26 |
| **Labor[2] cost (Kina)** | **135** | **90** | **135** | **270** | **90** | **90** | **135** | **90** | **270** | **90** | **90** | **90** | **270** | **142** |
| **Total cost[3] per cycle (Kina)** | **1857** | **1656** | **2404** | **3849** | **1493** | **1674** | **2409** | **1320** | **5305** | **1419** | **1252** | **1375** | **4200** | **2324** |
| Chicken retail sale price (Kina/chicken) | 35 | 32.5 | 35 | 32.5 | 37.5 | 37.5 | 35 | 35 | 40 | 35 | 35 | 35 | 37.5 | 36 |
| **Chicken sales[4] revenue per cycle (Kina)** | **2484** | **1538** | **2484** | **4614** | **1775** | **1775** | **2484** | **1656** | **5678** | **1656** | **1656** | **1656** | **5324** | **2675** |
| Net income per cycle (Kina) | 628 | -118 | 80 | 765 | 282 | 101 | 75 | 336 | 373 | 237 | 405 | 281 | 1124 | 351 |
| Net income per box of DOC (Kina) | 418 | -118 | 54 | 255 | 282 | 101 | 50 | 336 | 124 | 237 | 405 | 281 | 375 | 215 |
| Net income per chicken (Kina) | 8.4 | -2.4 | 1.1 | 5.1 | 5.6 | 2.0 | 1.0 | 6.7 | 2.5 | 4.7 | 8.1 | 5.6 | 7.5 | 4.3 |
| **Gross profit rate** | **34%** | **-7%** | **3%** | **20%** | **19%** | **6%** | **3%** | **25%** | **7%** | **17%** | **32%** | **20%** | **27%** | **15%** |

Source: IFPRI-NARI mini feed mills and poultry farmers survey in the Highlands 2022.

Note: [1] Cassava flour was used by the three farmers. The unit price of cassava flour (0.77 Kina/kg) is from the mini mill study book (Glatz, 2017). [2] The labor cost is based on the mini mill study book (Glatz, 2017), with 1 hour spent on husbandry practices every day for a 50-day cycle. [3] The net income reported in Table 2 does not consider the initial input investment for poultry structures and other equipment. Thus, we assume net income (gross margin) would be lower than reported. [4] We assume a 9% mortality rate during chicken rearing and selling based on Mehta and Galgal (2019).

Given that poultry feed was the major constraint identified by poultry farmers during our interviews and the majority of feed is imported, we further evaluate the differences in import prices for the primary ingredients used in livestock feed using UN Comtrade data. Comparing PNG, Indonesia, Fiji and the Solomon Islands, data suggests that Indonesia imports a significantly larger volume of raw and processed inputs and benefits from comparatively lower import prices (Table 3). However, focusing on Pacific Island countries, PNG is a comparatively large importer of livestock inputs compared to Fiji and the Solomon Islands. Data suggest that PNG imports complete feed and the protein components of livestock feed for a comparatively lower price compared to neighboring countries, suggesting PNG has favorable terms of trade with Australia whom supplies the majority of complete feed and feed mix to PNG. (Australia comprises 92 percent of the value of PNG imports for these items).[5]

**Table 3: Total quantity imported and average unit price of stock feed and its ingredients (2017-2021)**

| | Wheat import | | Maize import | | Soya bean import | | Feed, concentrate, and premix import | |
|---|---|---|---|---|---|---|---|---|
| | Total quantity | Unit price | Total quantity | Unit price | Total quantity | Unit price | Total quantity | Unit price |
| Fiji | 867 | 0.26 | 0.3 | 0.96 | 0.1 | 0.51 | 82 | 0.50 |
| Indonesia | 53,600 | 0.22 | 3,965 | 0.19 | 12,800 | 0.40 | 2,358 | 0.91 |
| **PNG** | **1,200** | **0.25** | **1.5** | **1.77** | **3.0** | **0.46** | **296** | **0.27** |
| Solomon | 73 | 0.28 | 0.6 | 0.44 | 0.0 | 1.25 | 10 | 0.49 |

Source: UN Comtrade (2022)

Indonesia's greater demand for livestock inputs (the population of Indonesia is about 276 million people) benefits from economies of scale (of raw ingredients and final feed). These cost differences of imports are passed on to consumers whereby Indonesia sold feed at a retail price of 0.5 USD / kg in 2022, whereas PNG sold feed at 1.0 USD / kg. In addition to lower cost imports, Indonesia boasts more than 65 different feed suppliers in Indonesia, while there are only 2 major feed suppliers in PNG (Tablebirds and Flame) both located in Lae City. The main feed suppliers in Indonesia (which account for over 50 percent

[5] While feed, concentrate, and premix can be very different in prices, they are combined as one commodity (HS code 2309) in Comtrade data,.

of the market share) are Chareon Pokphand, which has 12 feed mills across Indonesia, and Japfa Comfeed Indonesia which operates 11 feed mills across the country. The branch operations of the major feed suppliers in Indonesia extend access to key inputs for poultry farmers in diverse locations of the country, facilitating supply and reducing transaction costs of rural farmers.

Finally, traders in PNG lamented the high wharf charges they face when importing goods. Not only are wharf fees relatively high for importing goods to PNG, but delays in clearance, high storage and handling costs may be affecting domestic retail prices. Recently, a new policy (Authorized Economic Operator model) was introduced to enable select imported commodities (including animal feed) to be cleared without delays.[6] Further research should evaluate the degree to which this policy eases supply chain bottlenecks. While more efficient wharf processes are needed to improve supply chains, significant and ongoing investment in land transportation to and from Lae is also needed. Several poultry farmers reported that the disruptions to the Highland highway continues to create uncertainty in feed supply, resulting in feed volume shortages and related price increases at local farm retail outlets in the Highlands.

## 4. Increasing Access to Livestock Feed in Rural Areas: The Mini-feed Mill Model

With the high cost of feed (and other transported inputs) in the Highlands, poultry farmers are likely to remain small scale and oriented towards own-consumption poultry production. The relative high price of live chicken in rural areas of PNG constrains consumer demand for poultry, which provides little incentive for poultry farmers to invest in greater volume production equipment (e.g., modernized feed mills, storage and other infrastructure) to bring costs down . This leads to a low-level equilibrium where limited demand constrains potential supply growth.

While mini feed mills may not be the panacea of addressing the high input costs currently stunting poultry and other rural livestock production, they may provide one avenue to reduce input costs and pass savings onto consumers, especially in more rural areas that are not easily serviced by motorized

[6]https://postcourier.com.pg/economic-model-to-assist-with-high-wharf-charges/

transport. Of the 8 mini feed mills that we interviewed in the Highlands, 2 mills focus on broiler chicken feed, while the remainder produce a mix of fish and pig feed (with interest to diversify to poultry feed), as well as milled products for human consumption. Among the 8 mini feed mills interviewed, only three produced feed for commercial purposes (1 poultry, 1 pig, and 1 fish feed supply operation), and 5 mills produced for own livestock operations and consumption. According to mill owners, running a mini feed mill requires start-up capital and other various inputs including: machinery equipment, raw ingredients, feed formulation training, reliable marketing channels and sufficient labor resources to maintain reliable supply and remain commercially competitive.

The mills that we interviewed described the main challenges of running a successful mill included feed mill equipment procurement, electricity reliability, reliable raw ingredient supply, and mini mill retailing to secure a client base (details are provided in Table 4). Given this all-encompassing list of challenges, it is not surprising that most of the mini mills in the NARI-ACIAR study either closed operations or remained localized after the project end date. However, ongoing efforts in PNG to promote domestic, rural-based feed mills suggest that a greater understanding of the constraints are needed to design a more cost-effective model, while also strengthening linkages between livestock feed suppliers and poultry producers.

**Table 4: Reported challenges of feed mill and poultry farmer enterprises**

| | |
|---|---|
| Procurement flexibility and cost support for machinery and equipment | 1. Of the 8 mills interviewed, 5 procured equipment through private suppliers that required full payment with no credit options<br>• 3 obtained equipment with help from the government (projects): DAL, NARI, NFA.[1]<br>• 2 purchased at international online vendors via partners of other business ventures<br>• 3 purchased equipment from local retailers<br>2. Only 2 of 8 mills own pelleting machines, which improves feed efficiency and livestock animal growth.[2]<br>• Interviews suggest minimal knowledge of the benefits of pelleting. |
| Reliable electricity | 1. Feed mills<br>• Delays in production due to electricity outage affect sustainability of consumer base; stunt production output; and increase wastage<br>• Some mill owners have purchased generators from international online sources, however must pay upfront the full price<br>2. Commercial and semi-commercial poultry farmers<br>• Electricity outage results in product loss due to disruptions in cold storage. Domestic poultry producers / processors have decreased production and processing to decrease losses. |
| Access to cost-efficient protein and micronutrient ingredients | 1. The most successful mills remain operational because they have lower-cost, domestic access to key protein and micronutrient ingredients, however this is a small scale solution.<br>• 3 feed mills reported planting their own soya bean to produce the protein ingredients needed in livestock feed.<br>• 5 feed mills reported accessing protein ingredients from fish meal purchased from the input retailers (e.g., Farmset) who domestically source from the fish canneries in Lae and Madang.<br>2. 7 of the 13 interviewed poultry farmers reported lack of knowledge in feed formulation as a major constraint to domestic milling. |
| Reliable supply and demand | 1. 2 of 3 commercial feed mills are farmer cooperatives that sell feed directly to farmers, reporting greater reliability of demand<br>• Reported easier to plan processing needs given electricity constraints for predictable (and consistent) demand<br>• Offered credit services for farmers in cooperative, which increased demand |

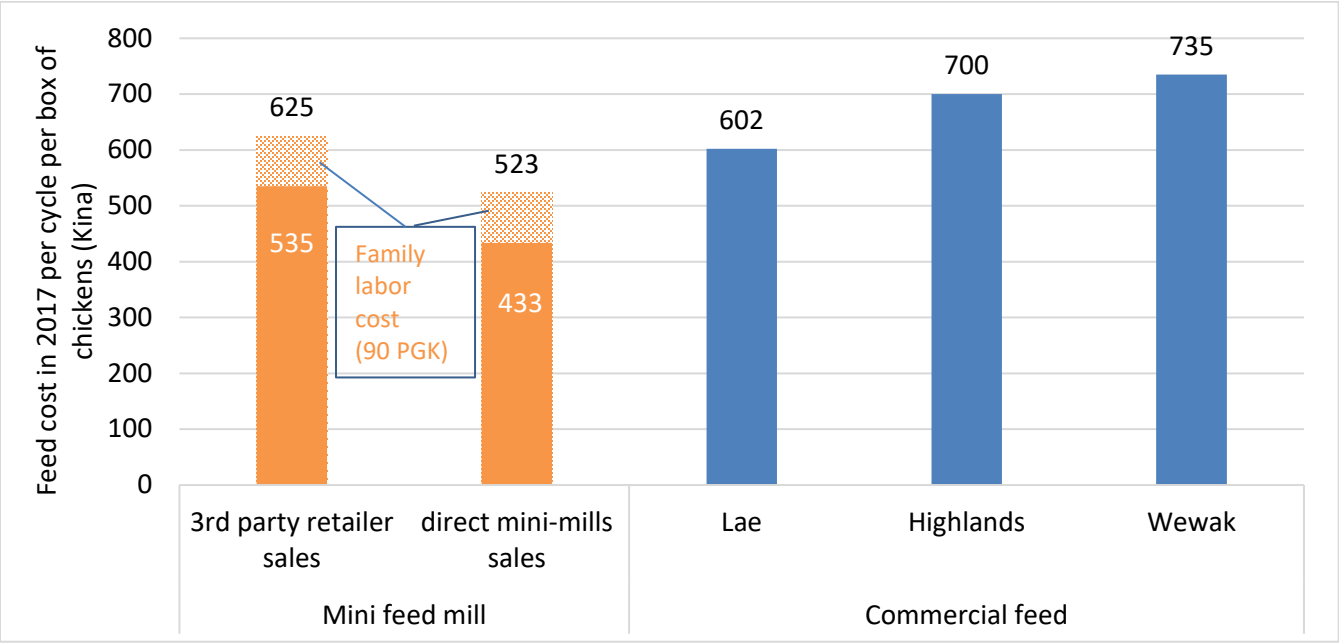
Notes: [1]Department of Agriculture and Livestock (DAL), National Agriculture Research Institute (NARI), National Fisheries Authority (NFA); [2] Kilburn and Edwards, 2010; Vukmirović et al., 2017; Zohair et al., 2012

Given current constraints to accessing milling machinery, reliable electricity and necessary training in feed formulation, it may not be cost-efficient or feasible for smallholder farmers to produce their own feed given the small volume of poultry output. We compare the retail feed cost of poultry farmers mixing their own feed using own-grown sweet potato flour with concentrate purchased from mini feed mills via a 3rd party retailer; and the retail feed cost of fully mixed commercial feed from retailers.

The feed cost per cycle per box of chicken using concentrate from mini mills amounts to approximately 625 PGK (including 90 Kina of family labor cost for mixing concentrate and own-grown sweet potato). Under this scenario, the mini feed mill mixture is more expensive than the retail cost of fully mixed commercial feed in Lae (602 PGK). Thus, farmers located closer to Lae should continue to buy commercial feed from large processors in Lae.

However, as distance from Lae increases, the average consumer price of commercial feed increases to approximately 700 and 735 PGK for raising one box of DOCs in the Highlands provinces and Wewak, respectively (Figure 4). Under this scenario, and assuming the mini feed mill model can overcome the aforementioned challenges to reliably fulfil demand at a competitive cost, mini mill concentrate mixture with own production of starch ingredients (e.g., sweet potato, cassava, etc.) in the Highlands and Wewak is 11 and 15 percent less expensive, respectively, than fully mixed commercial feed at retail outlets. Comparing the cost of feed (for feeding one box of chicken) sold directly from mini-mills (523 PGK) with feed produced by mini-mills sold through a 3$^{rd}$ party retailer (625 PGK), both producer (the mini mill) and consumer (poultry farmers) may benefit from direct sourcing of feed from the mini mill outlets rather than a third-party retail sales agreement (Figure 4).

**Figure 4: Compare feed cost of using mini feed mill with the commercial feed at 2017 price**




Source: Authors' compilation based on Glatz (2017).

Note: 1) Because the costs of producing concentrates is based on Glatz (2017), data are estimated for the year 2017 for consistency.2) We assume mini feed mills produce concentrate (rather than complete feed), so farmers need to mix concentrate with sweet potato/cassava flour. 3) We assume the feed made in mini mills is 50% sweet potato and 50% concentrate. 4) We followed the assumption by Glatz (2017) that the price margin of retailers (625 Kina) is 30% higher than the mini mill producers (523 Kina).

## 5. 'Model' Mini Feed Mill Operations

Based on our survey and the other value chain studies in PNG, we identified two potential approaches that could be replicated and adapted to expand mini feed mill operations in the Highlands. Both approaches have resolved several of the major constraints outlined in this study, namely reliably sourcing feed (protein) input ingredients and ensuring a predictable customer base to further grow milling operations.

### *The feed mill cooperative approach*

Two feed mill cooperatives have successfully produced and distributed feed to smallholder member farmers in the Highlands. The first mini feed mill is a poultry feed cooperative which has only recently reopened (management issues resulted in suspended operations during the last several years). The second successful cooperative model is operated by a fish farmer cooperative in the Highlands. The fish farmer cooperative produces feed using mini feed mills for own use and the cooperative member farmers. This cooperative model has also integrated flexible pay options, extending credit to cooperative members. In

addition, the cooperative provides feed delivery to smallholder farmers (who are no further than 4 hours from the mill) who lack transport and storage infrastructure. This cooperative has also integrated cooperative works projects (e.g., digging fishponds), as well as organized input purchases (e.g. fish meal) for farmers within the cooperative to reduce overall costs via bulk purchases (compared to individual farmer small input purchases).

### *The lead firm approach*

A similar business model to the larger Lae-based poultry feed and production supply operations (such as Tablebirds or Zenag chicken) is currently developing in the Highlands whereby a local machinery retail outlet expanded to also produce and sell livestock feed in its own retail store in town. While the retail owner is better able to procure machinery for feed processing, it is unclear whether the owner will be able to overcome the challenge of accessing sufficient amounts of raw (protein) ingredients. Currently, the firm grows its own soya bean on the owner's limited land. However, demand for feed exceeds the protein ingredients (soya bean) that the retail owner is able to produce. The firm aims to source raw ingredients from the local farmers in the future, however incentivizing farmers to modify their production patterns to satisfy protein crop demands for livestock feed has been limited. Further evaluation of this lead firm approach is needed to understand the constraints to securing farmer buy in for protein ingredients. A potential solution may be for the farmer and feed retailer to agree upon a floor price and volume of protein materials (soya bean) before planting, providing a sales insurance to area farmers to produce the specific crop.

## 6. Conclusion

The reliance on imported, protein-based ingredients and concentrates needed for complete poultry feed formula, coupled with inadequate transportation infrastructure and under-developed logistics operations perpetuates a cost prohibitive feed supply structure whereby only larger feed mills and poultry producers based in Lae can operate at a profit. Relatively high costs for live chicken in rural areas continues to stunt

consumer demand, leaving rural farmers with little incentive to expand poultry production and crowd-in rural-based service and input suppliers.

The PNG National Agriculture Research Institute (NARI) in collaboration with the Australia Center for International Agriculture Research (ACIAR) have supported a diverse network of rural mini feed mills throughout the Highlands of PNG. While most of these operations remain small and oriented towards own-use feed production, three mini mills have set up commercial operations to provide feed to area farmers. Poultry farmers that we interviewed who purchased from local mini feed mills substantially lowered their feed costs, resulting in greater gross profits compared to rural poultry farmers that only sourced feed from commercial feed suppliers (gross profit rates are 27%, 32% and 34%, respectively).

Given the sparse and small-scale poultry operations currently available in the Highlands, several mini mills have formed poultry farmer cooperatives, whereby farmers can: purchase feed on credit, form bulk orders to better inform mill production demand and decrease feed ingredient costs, and organize transport and delivery of feed to farm households in a cost-effective manner.

Given the demonstrated successful models of the few domestic medium and large-scale commercial feed mills, one potential solution to increase feed input supply would be for mills to also produce and sell protein concentrates or premix. In Indonesia, for example, an important business model of feed production businesses is also producing and selling feed concentrates that poultry farmers mix with their own starch crops (USAID, 2013). While the commercial feed mills in PNG have the capacity to produce concentrates, they are not produced (only Farmset produces on as-needed basis) because the demand for concentrates by poultry farmers or mini feed mills are currently low. Low broiler production capacity (limited by access to machinery, cold storage and reliable electricity) limits demand for poultry inputs, resulting in a vicious circle of insufficient input provision resulting in high costs throughout the value chain.

The bulk share of protein ingredients for livestock feed is still being imported in PNG. However, PNG export data (based on UN Comtrade 2022) suggests there may be opportunity to source greater volumes of protein ingredients domestically. Evaluating PNG's fish and copra meal exports over time

suggest that overall exports have remained (on average) constant since 2005 (Appendix A2). However, the average unit price in PNG received from fish and copra meal exports decreased from 1.1 and 0.6 USD/kg in 2011-15 to 0.7 and 0.3 USD/kg in 2016-20, respectively. These exporting unit prices are comparable to the price of domestic sales of fish meal (about 0.8 USD/kg recently) and other protein ingredients (e.g. soya bean) import by PNG.

Our interviews also showed that most poultry farmers did not have adequate information about feed formulation (e.g. were unknowledgeable about the importance of protein ingredients and proper ingredient mixing and pelleting). Interview results showed that 7 of the 13 poultry farmers reported lacking knowledge in feed formulation as a major constraint. Once protein input can be more reliably sourced from domestic producers, or more economically provided from imports (e.g., decrease transportation and handling costs, address port and wharf inefficiencies and delays, etc.), a targeted investment in agriculture extension for mini-mill owners and operators will be needed to ensure feed formula is properly and consistently mixed for optimum livestock growth and development.

While small scale solutions are being tested to increase livestock feed supply to rural areas, there is still a need for improved (and maintained) transportation infrastructure to incentivize greater expansion of rural input and service suppliers, across all agricultural value chains. Facilitating transport and market access along key rural economic corridors will not only improve livestock value chains (including input and processed output supply mechanisms) but will also strengthen other agriculture value chains and off-farm service sectors as well.

It may be necessary to incentivize 'first-entrant' businesses that are willing to set up feed production operations in rural areas, with low-cost loans, tax incentives or other financial instruments to reduce the risk of operating within an underdeveloped value (and logistics) chain. The Solomon Islands recently launched a program to incentivize nascent feed companies in the country.[7] The Ministry of Agriculture and Livestock selected and funded a private domestic company through a Public Private

[7]https://solomons.gov.sb/mal-and-foodworks-launches-govt-funded-poultry-project/

Partnership agreement to increase supply of DOCs and poultry feed. Before the partnership, the private company already formed a poultry growers association and provided important poultry processing services for local farmers. Further investigation should seek to understand the risks and opportunities to support a lead feed firm in the rural highlands.

Given the current rates of low protein consumption among rural populations in PNG, there is a pressing need to continue exploring, piloting and evaluating options for increasing small livestock production in rural areas. This study has found that a diverse set of solutions have been tested among small livestock producers and mini feed mills in rural PNG to better service rural populations. These actors should be further evaluated and supported (where feasible and profitable) to expand greater small livestock production and services in rural areas. Ongoing investments to decrease feed input costs, improve cold storage and processing facilities and provide reliable electricity will be necessary to construct a strong value-chain of rural livestock provision.

# References


Apantaku, S.O., Oluwalana, E.O.A., Adepegba, O.A., 2006. Poultry farmers' preference and use of commercial and self-compounded feeds in Oyo area of Oyo State, Nigeria. Agric Human Values 23, 245–252. https://doi.org/10.1007/S10460-005-6110-9/METRICS

de Koning, C., Kohun, P., 2019. Enhancing role of small scale feed milling in the development of the monogastric industries in Papua New Guinea : final report.

Dowa, E., Omot, N., 2017. Using mini-mills for chicken feed manufacture in the Domil community of Papua New Guinea: farmers' attitudes, knowledge and constraints, in: Local Feed Resources for Pig, Poultry and Fish Production in Papua New Guinea.

Fang, P., Belton, B., Zhang, X., Ei Win, H., 2021. Impacts of COVID-19 on Myanmar's chicken and egg sector, with implications for the sustainable development goals. Agric Syst 190. https://doi.org/10.1016/J.AGSY.2021.103094

Glatz, P., 2017. Local feed resources for pig, poultry and fish production in Papua New Guinea.

Kilburn, J., Edwards, H.M., 2010. The response of broilers to the feeding of mash or pelleted diets containing maize of varying particle sizes. http://dx.doi.org/10.1080/00071660120070578 42, 484–492. https://doi.org/10.1080/00071660120070578

Kohun, P., Ayalew, W., Glatz, P., 2017. Agro-industrial by-products for livestock feed in Papua New Guinea: an overview.

Kosec, K., Schmidt, E., Carrillo, L., Fang, P., Ivekolia, M., Ovah, R., 2022. Improving agricultural value chain coordination and gender inclusiveness in PNG, Papua New Guinea food policy strengthening working papers. International Food Policy Research Institute (IFPRI).

Lukuyu, B., Baker, D., Baltenweck, I., Poole, E., Kabi, F., 2013. The concentrate feeds supply chain in Uganda: emerging trends and implications on quality and access to smallholder farmers and chain efficiency.

Market Development Facility, 2017. It's a pig's life in Papua New. https://mdf.exposure.co/its-a-pigs-life-in-papua-new-guinea (accessed 12.21.22).

Mege, R., Saerang, J., Manopo, J., Maramis, A., 2015. Facilitation of broiler chicken farming based on local resources for the community of Kabaruan Subdistrict, Talaud Islands, North Sulawesi.

Mehta, V., Galgal, K., 2019. Papua New Guinea small livestock value-chain study.

Nordhagen, S., Klemm, R., 2018. Implementing small-scale poultry-for-nutrition projects: Successes and lessons learned. https://doi.org/10.1111/mcn.12676

Nugroho, B.A. (2020) "Indonesia's Broilers Business Facing Oversupply Difficulties," IOP Conference Se-ries: Earth and Environmental Science, 478(1). doi:10.1088/1755-1315/478/1/012010.

Schmidt, E., Gilbert, R., Holtemeyer, B., Mahrt, K., 2020. Poverty analysis in the lowlands of Papua New Guinea underscores climate vulnerability and need for income flexibility*. https://doi.org/10.1111/1467-8489.12404

Sillitoe, P., 2021. Pigs in rites, rights in pigs: Porcine values in the Papua New Guinea Highlands. Anthropozoologica 56, 117–136. https://doi.org/10.5252/ANTHROPOZOOLOGICA2021V56A8

USAID, 2013. Indonesia's Poultry Value Chain Costs, Margins, Prices, and Other Issues.

Vukmirović, Čolović, R., Rakita, S., Brlek, T., Đuragić, O., Solà-Oriol, D., 2017. Importance of feed structure (particle size) and feed form (mash vs. pellets) in pig nutrition – A review. Anim Feed Sci Technol 233, 133–144. https://doi.org/10.1016/J.ANIFEEDSCI.2017.06.016

Zohair, G.A.M., Al-Maktari, G.A., Amer, M.M., 2012. A comparative effect of mash and pellet feed on broiler performance and ascites at high altitude (field study). Glob Vet 9, 154–159.

# Appendices

## Appendix 1A

### *Poultry Value Chain – feed mill interview guide*

***Target respondents: local mini mills***

1. Who is the most knowledgeable about the day-to-day operations (e.g., procuring inputs, milling inputs, packaging and processing feed, selling feed) of this feed mill?

[ENUMERATOR: *If available, please ask to talk to the person that is the most knowledgeable about the business*]

### *Introduction and consent form*

### *A. Interviewee information*

| | |
|---|---|
| Role of interviewee: owner, manager, worker | |
| Gender: | |
| Age: | |
| Date of interview: | |
| Location (District, LLG, Village): | |

### *B. Basic information about the business*

1. What is the ownership of this feed mill business? (HH/family business, Partnership, Farmer cooperative, Company)
2. Is the ownership of this mini-mill all male, all female, or mixed gender (men and women jointly)?
3. Is the manager of this mini-mill male, female, or mixed gender (men and women jointly)?
4. [If a HH business] When decisions are made regarding feed mill business, who in the household that normally takes the decision? (husband, wife, husband and wife jointly, family jointly, husband and male child, female child, etc…)

5. [If a HH business] Who decides what to do with the revenue (money earned) from the feed mill business?
6. How long has this business been operational?
7. What is the share of poultry feed in your total feed production?
8. Do you know any other poultry feed mills currently in operation near you?
    8a. How many other poultry feed mills are in operation near you?
    8b. Where are they located (village name)?
9. Do you have a brand name for your poultry feed? Is it printed on bags or visible for customers?
10. Have you done any quality tests or chemical analysis for the poultry feed you are producing?
11. If yes, which tests have you done?

### *C. Asset*

1. What equipment does this mill have? (hammer mill, roller mill, flake mills, hand grinder, mixing machines, pelleting machines…)
2. Do you have any problems in procuring this equipment? If so, what are the problems?
3. Do you have any problems in operating, maintaining, and repairing this equipment? If so, what are the problems?
4. Did you need to get any certification or routine maintenance checks for the mill equipment or operation?

## *D. Procurement*

1. What ingredients do you use for producing poultry feed?

| **Ingredients:** | **yes / no** | **[if yes] Where does the business procure [ingredient]?** (e.g., local farmers, farmers in other areas, own production, inputs retailers, traders/wholesalers?) |
|---|---|---|
| Sweetpotato | | |
| Cassava | | |
| Purchased concentrate (ready-to-use for mixing with other ingredients) | | |
| Purchased premixes (ready-to-use for mixing with other ingredients) | | |
| Other ingredients, please specify (e.g. fishmeal, soybean meal, cassava leaves, milled corn, limestone, copra meal, cassava meal and kikuyu leaves, as well as table salt, methionine, palm oil and broiler pre-mix) | | |

2. Does the business have any problems in procuring raw ingredients? If so, what are the problems?

3. Is procuring ingredients for a local mill like this a job that is easier for women to do or men to do? Why?

4. [If using sweetpotato or cassava]: For the farmers that supplied sweet potato or cassava to you, could you provide us the names and contact information of these people so we can interview them as well? We are interested in interviewing both male and female farmers.

| | **Name of farmers** | **Male /female?** | **Location** | **Phone number** |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

## *E. Volume*

1. About how many bags or tons of feed did the business produce in the last month? Is this about the same amount that you produce each month? *If not*, on average what's the volume of your production?

2. Did you manage to sell all of the feed that you produced last month? Do you usually sell all of the feed that you produce?

3. Does the business have any problems in producing enough feed to supply customers? If so, what are the problems?
4. Do you ever need to store feed that you have produced before selling it?
5. [If yes] Does the business have any problems in storing the feed it produced to supply customers? If so, what are the problems?
6. Is producing feed for a local mill like this one a job that is easier for women to do or men to do? Why?

### *F. Sell*

1. Does the business experience any product losses (Storage losses, Theft, Spoilage) from producing to selling? Why, how much?
2. Are all of your customers from this village? Do you have any customers from other villages or districts or province?
3. What share of your feed was sold directly to farmers, and what share was sold to retailers?
4. Did the business ever sell any feed on credit?
5. Does the mill provide delivery of feed to farmers/retailers? Why / why not?
6. [If yes, the mill does deliver feed] How long does it take you to travel from your feed mill to the furthest customer that you deliver feed to?
7. Do you have any problems in selling feed? If so, what are the problems?
8. Is selling feed for a local mill like this one a job that is easier for women to do or men to do? Why?

### *G. Hired Labor use*

1 If there is family labor contributing to this business, how many women and how many men in your family work in this business?

2 In addition to your family labor, do you hire any labor?

3 How many people do you hire?

4 How many of your hired laborers are women?

## 5 *Training/information*

Are you able to know or inquire **on a weekly basis** the following information?

| | **Type of information** | **Yes / no** | **What is the source of information? (e.g., government, extension agents, other farmers, business association, NGO)** |
|---|---|---|---|
| 1 | Price of inputs to make feed (grains/roots, concentrates, etc. | | |
| 2 | Price of commercial feed | | |
| 3 | Opportunities for requesting credit, or loans for your business | | |
| 4 | Price and maintenance of milling equipment (hammer mill, roller mill, flake mills, hand grinder, mixing machines, pelleting machines…) | | |
| 5 | Other technical information | | |

1. Who in your household/business usually receives the information (man only, woman only, or both)?
2. What poultry feed information would be the most helpful for your business?
3. Has your mill ever received any training for this business? If so, on what subjects?

## 6 *Collaboration / collective action*

1. Are you a member of any poultry association or other association/cooperative that is related to your poultry farming?
2. What are the benefits of being in an association / cooperative for **men**?
3. What are the benefits of being in an association / cooperative for **women**?

## 7 *Perceptions*

1. Do you have any challenges in your business? If so, what are the challenges? What is the largest challenge?
2. What do you think would help you address these challenges? What kind of support do you need?
3. Any challenges specifically for women?
4. Is mini feed mill a business that is easier for women to do or men to do? Why?
5. What do women engaging in mini feed mill business do to support each other?

## 8 *Market integration/ upgrading*

1. Would you like to expand your work in the mini feed mill business? Why, and in what ways?

*If they say no, probe: by expand I mean do new tasks or earn more production or money; do you see any ways you would be interested in doing that?*

2. If they would like to expand, ask: What resources would you need to be involved in that work?

3. *If they* would like *to expand, ask*: Do you feel that this would be easier or harder for a woman compared to a man to obtain these additional resources? Why is that the case?

*Probe: for example,* what *barriers to women face that men do not, or what can men do that women cannot do, or vice versa?*

## 9 *Contacts of business partners and customers*

1. We would like to talk with some of your customers that buy your poultry feed to better understand the poultry business in this area. Can you provide us the names and contact information of 5-10 farmers that buy your feed? We are interested in interviewing both male and female poultry farmers.

| | Name | Male / female? | Location | Phone number |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

2. In addition to poultry farmers, do you ever sell your feed to the other customers (e.g. retail stores)? Again, we are interested in interviewing both male and female interviewees.

We would like to talk with some of them. Can you give us their contact information?

| | Name | Male / female? | Location | Phone number |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

## Appendix A2: Export value (real million USD at 2018 price) of fish and copra meal by PNG

| | Export value | | Unit price (USD/kg) | |
|---|---|---|---|---|
| | Fish meal | Copra meal | Fish meal | Copra meal |
| 2001-05 | 2.6 | 4.5 | 0.8 | 0.2 |
| 2006-10 | 4.0 | 3.5 | 1.0 | 0.3 |
| 2011-15 | 3.9 | 4.6 | 1.1 | 0.6 |
| 2016-20 | 4.5 | 3.6 | 0.7 | 0.3 |

Source: BACI trade data.

## Appendix A3: Compare poultry farmers' feed cost of using mini feed mill with the commercial feed

| | Quantity | Quantity unit | Unit price | Total cost per cycle per box DOC (kina) |
|---|---|---|---|---|
| *Feed cost per cycle per box DOC **if using mini feed mill*** | | | | |
| Mini mill concentrate **if selling through retailers** | 140 | kg | 3.14 | 440 |
| Mini mill concentrate **if selling by mills** | 140 | kg | 2.42 | 338 |
| Sweetpotato (fresh) | 140 | kg | 0.68 | 95 |
| Labor for mixing feed | 50 | hours | 1.8 | 90 |
| mini mill feed cost **if selling through other retailers** | | | | **625** |
| mini mill feed cost **if selling by mills** | | | | **523** |
| *Feed cost per cycle per box DOC **if using commercial feed*** | | | | |
| In Lae | 7 | bags | 86 | **602** |
| In Highlands | 7 | bags | 100 | **700** |
| In Wewak | 7 | bags | 105 | **735** |
| *Total cost saving if using mini feed mill* | **and sell through 3rd party retailers** | | **and sell through feed mill** | |
| In Lae | -4% | | 13% | |
| In Highlands | 11% | | 25% | |
| In Wewak | 15% | | 29% | |

Source: Authors' estimation based on the parameters reported by Glatz, 2017.

Note: 1) The costs of producing concentrates is based on Glatz (2017). All the other data/parameters are estimated for the year 2017 for consistency. 2) We assume mini feed mills produce concentrate (rather than complete feed), so farmers need to mix concentrate with sweet potato/cassava flour. Assume that 1 person hour per day is needed for farmers to mixing sweet potato/cassava with concentrates. 3) We assume the feed made in mini mills is 50% sweet potato and 50% concentrate.

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